# Attachment C: TRAFFIC MEMORANDA AND ANALYSES

# US 550 at US 160 Section 4(f) Evaluation ATTACHMENT C: TRAFFIC MEMORANDA AND ANALYSIS INDEX

Date	Correspondence
September 17, 2010	SEH Memorandum: US 160 FEIS Grandview Section—Year 2025 Traffic Analysis
September 17, 2010	SEH Memorandum: Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS
December 23, 2010	SEH Memorandum: Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f) Alternatives
January 5, 2011	SEH Memorandum: US 160 Section 4(f) Alternatives Considered in the Least Harm Analysis—The Degree to Which Each Alternative Meets the Purpose and Need for the Project
March 3, 2011	Final Safety Analysis for the US 550 at US 160 Section 4(f)

# SEH MEMORANDUM

# US 160 FEIS Grandview Section – Year 2025 Traffic Analysis

September 17, 2010



TO:	Mike McVaugh, PE - CE	OOT Region 5
FROM:	Philip T. Weisbach, PE Jon E. Larson, PE	Philoft. Weislach Son F. Lum
DATE:	September 17, 2010	0
RE:	US 160 FEIS Grandview SEH No. CODOT - 1051	Section – Year 2025 Traffic Analysis 81

## **Executive Summary**

Alternatives for the US 550 connection to the US 160 corridor were originally evaluated in the US Highway 160 from Durango to Bayfield Final Environmental Impact Statement (US 160 FEIS) dated May 2006. The US 160 Highway from Durango to Bayfield Record of Decision (US 160 ROD) documented selection of Grandview Alternative G Modified which included an interchange at US 160/US 550 approximately 0.6 miles east of the current intersection.

The technical traffic analysis data for this memo is included in the attached appendices at the end of this document.

The following traffic analysis was performed:

- A. Evaluate the interchanges along US 160 as shown in the Alternative G Modified to confirm that the original work performed in the FEIS is valid;
- B. Evaluate the option of an at-grade intersection at US 550 and US 160 Alternative G Modified connection in-lieu of an interchange.

The purpose and need for improvements to the US 160 corridor include increasing travel efficiency and capacity to meet current and future needs, while improving safety for the traveling public by reducing the number and severity of accidents, and controlling access.

## **Evaluation Criteria**

The interchange was evaluated to determine if it met operational level of service requirements as described in the Executive Summary of the FEIS, based on guidance in the AASHTO Policy on Geometric Design of Highways and Streets 2004 (AASHTO Green Book) and capacity analysis performed according to the methods described in the <u>Highway Capacity Manual</u><sup>1</sup> (HCS). This memorandum deals with the capacity analysis and not design. Traffic volumes used in the analysis are year 2025 volumes documented in <u>Appendix A, Traffic Report, Figure 8 of the US 160 FEIS</u>.

The following criteria were used to determine the capacity need in the US 160 FEIS:

1

<sup>&</sup>lt;u>Highway Capacity Manual - Special Report 209</u>. Transportation Research Board. National Research Council. 2000.

- A Level of Service (LOS) D or better for an urban signalized intersection, including signalized intersections at single point urban interchanges (SPUI), and its individual legs during the peak hour in year 2025; and
- A LOS D or better for urban interchange merge, diverge, weaving, auxiliary lanes and freeway sections in the Grandview Section during the peak hour in year 2025.

Anything worse than LOS D for any urban intersection, leg or section is considered "failing", and not meeting the purpose and need. These same criteria were applied to the evaluation of the US 160 FEIS in this memorandum.

For the purposes of this analysis, US 160 is assumed to be east/west and US 550 is assumed to be north/south.

## Alternative (G Modified) Analysis – Figure 1, Tables 1 & 2

This evaluation was performed to validate the analysis in the FEIS. The Alternative G Modified from US 160 FEIS was evaluated using year 2025 traffic volumes from Figure 8 of the FEIS. The G Modified alternative includes four through lanes throughout the Grandview Section with an eastbound and westbound auxiliary lanes extending from the US 160 / US 550 / Grandview interchange to the west end of the Grandview Section. Single point urban interchanges are assumed at CR 233 (Three Springs) and SH 172 / CR 234. A SPUI is similar to a diamond interchange. However, where there are two intersections that control the ramps of a diamond interchange, there is only one intersection that controls the ramps of a SPUI. The SPUI interchange allows US 160 to pass over an intersection maintaining a free-flow condition for traffic on US 160 while the approach roads have a single signalized intersection underneath the overpass to meter traffic on and off of US 160. The freeway segment and ramp merge/diverge analysis includes the same assumptions as the US 160 FEIS. The analysis worksheets are contained in Appendix A for reference.

#### **Alternative G Modified**

The results of the analysis (Figure 1) based on the Alternative G Modified interchange configuration show that the freeway segments and ramp merge/diverge operations are expected to operate at LOS D or better during the morning and evening peak periods. The results match the results from the US 160 FEIS.

#### **Conclusion**

Based on the analysis, the results support the finding that Alternative G Modified satisfies the purpose and need. The interchange geometry described in the FEIS is adequate to accommodate the projected volumes at LOS D or better.

# Alternative (G Modified) Analysis (At-Grade, Signalized Intersection) – Figure 2

The Alternative G Modified interchange location was evaluated as a signalized intersection using year 2025 traffic volumes from Figure 8 of the FEIS. The purpose of this analysis is to determine if an intersection at this location would meet the capacity LOS D requirements for the purpose and need in the FEIS.

The assumed lane configuration on US 160 at the intersection includes two left turn lanes, two through lanes, and one right turn lane in both directions. On the US 550 northbound approach, the lane configuration includes two left turn lanes, one through lane and one right turn lane. The US 550 southbound approach includes one lane each for the left turn, through and right turn movements.

The results of the analysis (Figure 2) show that the signalized intersection is expected to operate at LOS F in the morning and evening peak periods in the year 2025. Numerous individual movements are shown to exhibit LOS F during the morning and evening peak periods as well. This analysis supports the findings in the FEIS that an at-grade intersection as described will not meet the capacity requirements of the Purpose and need. The analysis worksheets are contained in Appendix B for reference.

In an attempt to improve the LOS to acceptable levels, additional lanes were added to particularly heavy movements and signal timing was optimized. Even with providing three lanes in each direction through the intersection on US 160 and analyzing triple left turn lanes, the LOS D evaluation criteria for signalized intersections and individual movements could not be achieved. Appendix B contains the LOS table to support these findings.

#### **Conclusion**

Based on the analysis, the results support the findings from the US 160 FEIS that an interchange is necessary for the Alternative G Modified to satisfy the capacity requirements of the purpose and need.

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### Preferred Alternative (G Modified) Analysis

#### Comparison between US 160 FEIS and SEH<sup>1</sup>

#### Table 1a Highway Segment

		East	oound		Westbound						
US 160 Highway Sagmont	US 16	0 FEIS	SI	EH	US 16	0 FEIS	SEH				
05 Too Fighway Segment	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak			
	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS			
West of US 550 (south)	В	D	В	D	С	D	С	D			
US 550 (south) to CR 233 (west)	С	D	С	D	С	D	С	D			
CR 233 (west) to SH 172/CR 234	В	С	В	С	В	С	В	С			

#### Table 1b Ramp Merge/Diverge and Weaving Area

		Merge/Div	verge Area		Weaving Area					
US 160 Highway Segment	US 16	0 FEIS	SI	EH	US 16	0 FEIS	SI	EH		
00 for highway beginent	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak		
	LOS	LOS	LOS	LOS	LOS	LOS	LOS	LOS		
Eastbound										
Off-Ramp to US 550 (south)	В	С	В	С						
On-Ramp from US 550 (south)	С	D	С	D						
Off-Ramp to CR 233 (west)	С	D	С	D						
On-Ramp from CR 233 (west)	В	С	В	С						
Off-Ramp to SH 172/CR 234	В	С	В	С						
On-Ramp from SH 172/CR 234	В	В	В	В						
Westbound										
Off-Ramp to SH 172/CR 234	В	В	В	В						
On-Ramp from SH 172/CR 234	В	С	В	С						
Off-Ramp to CR 233 (west)	В	С	В	С						
On-Ramp from CR 233 (west)	N/A	N/A	N/A	N/A						
Between CR 233 (west) On-Ramp and US 550 (south) Off Ramp					В	D	В	D		
On-Ramp from northbound US 550 (south) (Loop)	В	С	В	С						
On-Ramp from southbound US 550 (south)	В	С	В	С						

Note:

1) SEH used the same assumptions as the US 160 Final EIS for its analysis of the Preferred Modified G Alternative.

## Preferred Alternative (G Modified) Analysis Comparison between US 160 FEIS and SEH<sup>1</sup>

#### Table 2. US 160 Analysis - Intersection Operations at Single-Point Interchange

	Year 2025 Traffic Volumes												
Intersection and Approaches		AM Pea	ak Hour			PM Pea	ak Hour						
	US 160	FEIS	SE	Η	US 160	FEIS	SE	4					
	Delay <sup>(2)</sup>	LOS	Delay <sup>(2)</sup>	LOS	Delay <sup>(2)</sup>	LOS	Delay <sup>(2)</sup>	LOS					
SIGNAL CONTROL													
SH 172/CR 234 & US 160	24.7	С	27.9	С	28.8	С	25.0	С					
Eastbound Left	23.3	С	32.6	С	42.6	D	29.7	С					
Eastbound Right	33.4	С	27.2	С	34.2	С	32.4	С					
Westbound Left	22.3	С	34.1	С	35.6	D	29.6	С					
Westbound Right	23.3	С	24.4	С	9.0	Α	18.6	В					
Northbound Left	28.7	С	32.5	С	10.6	В	23.0	С					
Northbound Through	28.3	С	24.2	С	40.6	D	28.6	С					
Northbound Right	8.0	Α	14.6	В	22.4	С	10.7	В					
Southbound Left	22.8	С	24.9	С	9.3	Α	19.9	В					
Southbound Through	28.0	С	23.9	С	38.5	D	27.8	С					
Southbound Right	9.3	Α	17.3	В	39.8	D	13.5	В					
Three Springs Blvd/CR 233 & US 160	18.7	В	22.4	С	17.5	В	24.7	С					
Eastbound Left	22.3	С	30.2	С	34.8	С	53.7	D					
Eastbound Right	30.5	С	30.8	С	18.7	В	20.6	С					
Westbound Left	17.9	В	21.3	С	25.0	С	14.7	В					
Westbound Right	23.4	С	23.4	С	16.1	В	34.7	С					
Northbound Left	21.2	С	30.9	С	17.0	В	23.0	С					
Northbound Through	37.6	D	31.0	С	38.8	D	42.3	D					
Northbound Right	9.2	A	11.1	В	15.6	В	19.7	В					
Southbound Left	21.0	С	30.5	С	15.1	В	20.4	С					
Southbound Through	37.6	D	31.0	С	38.8	D	42.3	D					
Southbound Right	0.1	Α	0.8	Α	0.7	Α	2.4	Α					

Notes:

1) SEH used the same assumptions as the US 160 Final EIS for its analysis of the Preferred Modified G Alternative.

2) Delay measured as seconds per vehicle





US 160 FEIS Grandview Section - Year 2025 Traffic Analysis

# **Appendix A**

# **Alternative G Modified**

Interchange Evaluation Worksheets

AM Peak Period Single Point 2025 Traffic Volumes

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	٦ ۲		*	ሻሻ	•	*	7	<b>†</b>	1
Volume (vph)	260	0	325	65	0	70	630	55	60	50	40	255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	274	0	342	68	0	74	663	58	63	53	42	268
RTOR Reduction (vph)	0	0	250	0	0	54	0	0	35	0	0	19
Lane Group Flow (vph)	274	0	92	68	0	20	663	58	28	53	42	249
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			5			5			16			16
Actuated Green, G (s)	13.7		24.2	13.7		24.2	24.2	25.6	47.8	24.2	25.6	47.8
Effective Green, g (s)	13.7		24.2	13.7		24.2	24.2	25.6	39.3	24.2	25.6	39.3
Actuated g/C Ratio	0.15		0.27	0.15		0.27	0.27	0.28	0.44	0.27	0.28	0.44
Clearance Time (s)	9.0		9.0	9.0		9.0	9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	523		426	269		426	923	530	691	476	530	691
v/s Ratio Prot	c0.08			0.04			c0.19	0.03		0.03	0.02	
v/s Ratio Perm			0.06			0.01			0.02			c0.16
v/c Ratio	0.52		0.22	0.25		0.05	0.72	0.11	0.04	0.11	0.08	0.36
Uniform Delay, d1	35.1		25.5	33.6		24.4	29.8	23.8	14.5	24.8	23.6	17.0
Progression Factor	0.90		1.06	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0		0.3	0.5		0.0	2.7	0.4	0.0	0.1	0.3	0.3
Delay (s)	32.6		27.2	34.1		24.4	32.5	24.2	14.6	24.9	23.9	17.3
Level of Service	С		С	С		С	С	С	В	С	С	В
Approach Delay (s)		29.6			29.1			30.5			19.2	
Approach LOS		С			С			С			В	
Intersection Summary												
HCM Average Control Delay	,		27.9	Н	CM Leve	el of Servio	e		С			
HCM Volume to Capacity rat	io		0.54									
Actuated Cycle Length (s)			90.0	Si	um of los	st time (s)			27.0			
Intersection Capacity Utilizat	ion		50.0%	IC	U Level	of Service	;		А			
Analysis Period (min)			15									
c Critical Lane Group												

PM Peak Period Single Point 2025 Traffic Volumes

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	ľ		1	ኘኘ	•	1	ľ	<b>†</b>	1
Volume (vph)	385	0	795	115	0	90	640	105	105	135	80	405
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	405	0	837	121	0	95	674	111	111	142	84	426
RTOR Reduction (vph)	0	0	358	0	0	60	0	0	53	0	0	71
Lane Group Flow (vph)	405	0	479	121	0	35	674	111	58	142	84	355
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			5			5			16			16
Actuated Green, G (s)	20.1		32.9	20.1		32.9	32.9	22.0	47.1	32.9	22.0	47.1
Effective Green, g (s)	20.1		32.9	20.1		32.9	32.9	22.0	47.1	32.9	22.0	47.1
Actuated g/C Ratio	0.22		0.37	0.22		0.37	0.37	0.24	0.52	0.37	0.24	0.52
Clearance Time (s)	5.0		5.0	5.0		5.0	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	767		579	395		579	1255	455	828	647	455	828
v/s Ratio Prot	c0.12			0.07			0.20	0.06		0.08	0.05	
v/s Ratio Perm			c0.30			0.02			0.04			c0.22
v/c Ratio	0.53		0.83	0.31		0.06	0.54	0.24	0.07	0.22	0.18	0.43
Uniform Delay, d1	30.8		26.0	29.1		18.5	22.5	27.3	10.6	19.7	26.9	13.2
Progression Factor	0.94		0.88	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7		9.5	0.4		0.0	0.4	1.3	0.0	0.2	0.9	0.4
Delay (s)	29.7		32.4	29.6		18.6	23.0	28.6	10.7	19.9	27.8	13.5
Level of Service	С		С	С		В	С	С	В	В	С	В
Approach Delay (s)		31.5			24.7			22.1			16.8	
Approach LOS		С			С			С			В	
Intersection Summary												
HCM Average Control Dela	у		25.0	Н	CM Leve	el of Servic	e		С			
HCM Volume to Capacity ra	ntio		0.64									
Actuated Cycle Length (s)			90.0	S	um of los	st time (s)			15.0			
Intersection Capacity Utiliza	ition		75.6%	IC	CU Level	of Service	;		D			
Analysis Period (min)			15									
c Critical Lane Group												

AM Peak Period Single Point 2025 Traffic Volumes

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ		1	5		1	ካካ	•	1	ካካ	•	1
Volume (vph)	735	0	355	95	0	195	180	60	50	145	60	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	774	0	374	100	0	205	189	63	53	153	63	584
RTOR Reduction (vph)	0	0	300	0	0	85	0	0	26	0	0	0
Lane Group Flow (vph)	774	0	74	100	0	120	189	63	27	153	63	584
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			5			5			16			156
Actuated Green, G (s)	27.9		17.8	27.9		17.8	17.8	17.8	54.2	17.8	17.8	90.0
Effective Green, g (s)	27.9		17.8	27.9		17.8	17.8	17.8	45.7	17.8	17.8	81.5
Actuated g/C Ratio	0.31		0.20	0.31		0.20	0.20	0.20	0.51	0.20	0.20	0.91
Clearance Time (s)	9.0		9.0	9.0		9.0	9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1064		313	549		313	679	368	804	679	368	1433
v/s Ratio Prot	c0.23			0.06			0.06	0.03		0.04	0.03	
v/s Ratio Perm			0.05			0.08			0.02			c0.37
v/c Ratio	0.73		0.24	0.18		0.38	0.28	0.17	0.03	0.23	0.17	0.41
Uniform Delay, d1	27.7		30.4	22.7		31.3	30.6	30.0	11.1	30.3	30.0	0.6
Progression Factor	1.00		1.00	0.93		0.73	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.5		0.4	0.1		0.7	0.2	1.0	0.0	0.2	1.0	0.2
Delay (s)	30.2		30.8	21.3		23.4	30.9	31.0	11.1	30.5	31.0	0.8
Level of Service	С		С	С		С	С	С	В	С	С	A
Approach Delay (s)		30.4			22.7			27.5			8.9	
Approach LOS		С			С			С			A	
Intersection Summary												
HCM Average Control Dela	у		22.4	H	CM Leve	el of Servic	e		С			
HCM Volume to Capacity ra	atio		0.49									
Actuated Cycle Length (s)			90.0	Si	um of los	st time (s)			9.0			
Intersection Capacity Utiliza	tion		59.3%	IC	U Level	of Service	;		В			
Analysis Period (min)			15									
c Critical Lane Group												

PM Peak Period Single Point 2025 Traffic Volumes

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	5		1	ሻሻ	•	1	ሻሻ	•	1
Volume (vph)	720	0	345	90	0	190	570	85	150	250	85	930
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	758	0	363	95	0	200	600	89	158	263	89	979
RTOR Reduction (vph)	0	0	234	0	0	40	0	0	103	0	0	0
Lane Group Flow (vph)	758	0	129	95	0	160	600	89	55	263	89	979
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			5			5			16			156
Actuated Green, G (s)	21.0		31.9	21.0		31.9	31.9	10.6	40.1	31.9	10.6	90.0
Effective Green, g (s)	21.0		31.9	21.0		31.9	31.9	10.6	31.6	31.9	10.6	81.5
Actuated g/C Ratio	0.23		0.35	0.23		0.35	0.35	0.12	0.35	0.35	0.12	0.91
Clearance Time (s)	9.0		9.0	9.0		9.0	9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	801		561	413		561	1217	219	556	1217	219	1433
v/s Ratio Prot	c0.22			0.05			0.17	0.05		0.08	0.05	
v/s Ratio Perm			0.08			0.10			0.04			c0.62
v/c Ratio	0.95		0.23	0.23		0.29	0.49	0.41	0.10	0.22	0.41	0.68
Uniform Delay, d1	33.9		20.4	28.0		20.9	22.7	36.8	19.6	20.3	36.8	1.1
Progression Factor	1.00		1.00	0.52		1.65	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.7		0.2	0.3		0.3	0.3	5.5	0.1	0.1	5.5	1.4
Delay (s)	53.7		20.6	14.7		34.7	23.0	42.3	19.7	20.4	42.3	2.4
Level of Service	D		С	В		С	С	D	В	С	D	A
Approach Delay (s)		43.0			28.2			24.4			8.6	
Approach LOS		D			С			С			A	
Intersection Summary												
HCM Average Control Delay	/		24.7	H	CM Leve	el of Servio	ce		С			
HCM Volume to Capacity ra	tio		0.70									
Actuated Cycle Length (s)			90.0	Si	um of los	st time (s)			9.0			
Intersection Capacity Utiliza	tion		88.4%	IC	U Level	of Service	;		E			
Analysis Period (min)			15									
c Critical Lane Group												

RAMPS AND RAMP JUNCTIONS WORKSHEET													
General Info	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	50 Ea	stbound		
Agency or Co	mpany				Jur	nction			Grand	lview	<sup>v</sup> Ramp A	A	
Date Perform	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period				Ana	alysis Ye	ar		Year	2025			
Project Descr	iption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis					
Inputs		Torroin								1			
Upstream Adj	Ramp	Terrain									Downstre Ramp	am Adj	
Yes	On										Ves	🗖 On	
No 🔽	Off										🗖 No	Cff Off	
L <sub>up</sub> = ft				60.0 mph				40.0 -	~~h		- <sub>down</sub> =	ft	
	h /h	3	FF =	60.0 mpr			FR <sup>=</sup>	= 40.0 r	прп	,	VD =	veh/h	
vu = ve	en/n		5	sketch (s	how lan	ies, L <sub>A</sub> , L	<sub>D</sub> ,V	R,Vf)					
Conversion t	to pc/h Und	der Base (	Condit	ions	1	1	1	1		1			
(pc/h)	V (Veh/hr)	PHF	Te	errain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f	V=V/PHF <sub>HV</sub> f <sub>p</sub>		
Freeway	2700	0.95	Ro	lling	5	0	0	.930	1.00		3055		
Ramp	795	0.95	Ro	lling	2	0	0	.971	1.00	[	862		
UpStream													
DownStream													
	Me	rge Areas						[	Diverge /	Areas	6		
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	, = V <sub>R</sub> +	(V <sub>F</sub> -	V <sub>R</sub> )P <sub>FD</sub>		
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				$L_{EO} = $ (Equation 25-8 or 25-9)							
$P_{\rm EM} = u \sin \alpha E$	auation	,				$P_{rp} = 0 \theta$	544	usina l	Equation	, 5			
$V_{\rm e} = nc/h$	4.0					$V_{-} = 22$	71	nc/h	_quallor				
$v_{12} = p_0/n$	aka					$V_{12} - 22$	·/4	pc/ll					
		Movin			E2	Capacit	<u>у</u> С	Actuo		lovim		108 52	
	Actual	Ινιαλιτι	luin		1:	<u> </u>		2055				No.	
V <sub>FO</sub>		See Exh	ibit 25-		-	V <sub>FI</sub> =V <sub>F</sub>	:	2055		090		No	
		· ·				V 12		2274		4400.	All	INO	
V <sub>R12</sub>		4600	:All			$v_{FO} = v_{I}$ $V_{R}$	F	2193		6900	)	No	
						V <sub>R</sub>		862		2100	)	No	
Level of Serv	vice Detern	nination (i	f not F	7)		Level of	f Se	rvice De	etermina	ation	(if not F)		
D <sub>R</sub> = 5.475 -	⊦ 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		D	<sub>R</sub> = 4.252	2 + 0.008	86 V <sub>1</sub>	<sub>2</sub> - 0.009	L <sub>D</sub>	
D <sub>R</sub> = (po	c/ mi /ln)					D <sub>R</sub> =	14.	8 (pc/ m	i /ln)				
LOS = (E:	xhibit 25-4)					LOS=	<b>B</b> (	Exhibit 2	5-4)				
Speed Estim	ation					Speed Estimation							
M <sub>s</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.4	41 (Exhi	bit 25-19	9)			
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	52.	1 mph (	Exhibit 2	25-19	)		
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> =	65.	8 mph (	Exhibit 2	25-19	)		
S= mph	(Exhibit 25	-14)		S = 55.0 mph (Exhibit 25-15)									

RAMPS AND RAMP JUNCTIONS WORKSHEET													
General Infor	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of <sup>-</sup>	Travel	US 160	Eastboun	d		
Agency or Co	mpany				Jur	nction			Grandvi	iew Ramp	ЪА		
Date Performe	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 20	25			
Project Descri	iption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis					
Inputs		Terrein								1			
Upstream Adj	Ramp	rerrain								Downst Ramp	ream Adj		
Yes	On									F Yes	🗖 On		
No 🔽	Off									🔲 No	Cff		
$L_{up} = ft$ $S_{FF} = 60.0 \text{ mph}$ $S_{FR} = 40.0 \text{ mph}$													
	h/h	0	FF - V	kotob ( a			'FR -	- +0.0 m	ipii	VD =	veh/h		
vu – ve			0 		now lan	ies, L <sub>A</sub> , L	D, <sup>V</sup> F	<sup>χ, ν</sup> <sub>f</sub> )					
Conversion t	o pc/h Und	der Base C	;onditi	ons	1	1	1	1			E		
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>	Γ		
Freeway	4265	0.95	Rol	ling	5	0	0.	.930	1.00	4826	)		
Ramp	1540	0.95	Rol	ling	2	0	0.	.971	1.00	1670	)		
UpStream					<u> </u>								
DownStream													
	Me	erge Areas					-	D	iverge Ar	eas			
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$= V_R + (V_R)$	/ <sub>F</sub> - V <sub>R</sub> )P <sub>FC</sub>	)		
$L_{EQ} = (Equat)$	ion 25-2 or	25-3)				$L_{EQ} = (Equation 25-8 \text{ or } 25-9)$							
P <sub>FM</sub> = using E	quation					$P_{FD} = 0.5$	563	using E	quation	5			
$V_{12} = pc/h$	-					$V_{12} = 34$	45	pc/h	•				
Capacity Che	ecks						v Cl	hecks					
	Actual	Maxin	num	LOS	F?		1	Actual	Ma	ximum	LOS F?		
		Soo Evh	ihit 25			V <sub>EI</sub> =V <sub>E</sub>		4826	6	5900	No		
V <sub>FO</sub>		7	DIL 20-		-	V <sub>12</sub>		3445	44	00:All	No		
V <sub>B12</sub>		4600	:All			$V_{FO} = V_F$ $V_R$	-	3156	6	900	No		
						V <sub>R</sub>		1670	2	100	No		
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	terminati	on (if not	F)		
D <sub>R</sub> = 5.475 +	+ 0.00734 v	/ <sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		D <sub>R</sub>	s = 4.252	+ 0.0086	V <sub>12</sub> - 0.00	9 L <sub>D</sub>		
D <sub>R</sub> = (po	c/ mi /ln)					D <sub>R</sub> =	24.9	9 (pc/ mi	/ln)		-		
LOS = (Ex	xhibit 25-4)					LOS=	C (E	Exhibit 25	5-4)				
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.5	13 (Exhik	oit 25-19)				
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	50.8	8 mph (E	Exhibit 25	-19)			
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> =	64.3	3 mph (E	Exhibit 25	-19)			
S= mph	(Exhibit 25		S = 54.0 mph (Exhibit 25-15)										

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informat	ion				Site Information							
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L G	IS 160 Ea Granview	astbound Ramp B			
Analysis Tim	e Period	AM Peak			A	nalysis Year		Y	ear 2025				
Project Desc	ription US 1	60 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis							
inputs		Torrain Rolli	na							1			
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp		
F Yes	Cn On									No	On Off		
l No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft												
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	5 <sub>FR</sub> = 40.0 <sub>R'</sub> V <sub>f</sub> )	mph		Vd =	veh/h		
Convers	sion to pc	/h Under	Base	Condi	tions	1	1		1				
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>		
Freeway	1905	0.95	Roll	ing	5	0	0.930		1.00	2156			
Ramp UnStream	595	0.95	Roll	ing	2	0	0.971	_	1.00	645			
DownStream	 n												
		Merge Area	S		J		]	Dive	erge Area	S			
Estimat	ion of v <sub>12</sub>					Estima	tion of	v <sub>12</sub>					
	 \	$V_{12} = V_{F} (P_{FM})$	)					V <sub>12</sub> =	$V_{R} + (V_{F})$	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>FO</sub> = (Equ	uation 25-2 or 2	25-3)				$L_{EQ} = $ (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 1.000	using Equation	on O				$P_{FD} = using Equation$							
V <sub>12</sub> = 2156	pc/h					$V_{12} = pc/$	h						
Capacit	v Checks					Capaci	ity Cheo	ks					
	Actua	al Max	kimum	LOS	S F?		A	ctual	Ma	iximum	LOS F?		
						V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14			
V <sub>FO</sub>	2801	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44	100:All			
V <sub>R12</sub>	2801	460	DO:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ex	khibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servi	ce De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4	.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>			
D <sub>R</sub> =	23.3 (pc/ m/ln)	)				D <sub>R</sub> = (	(pc/ m/ln)						
LOS =	C (Exhibit 25-	4)				LOS= (	(Exhibit 25-	4)					
Speed E		Speed	Estima	tion									
M <sub>s</sub> = 0.3	337 (Exibit 25		D <sub>s</sub> = (Exhibit 25-19)										
S <sub>R</sub> = 53	.9 mph (Exhib	oit 25-19)				S <sub>R</sub> = r	mph (Exhit	it 25-19	))				
$S_0 = N/$	A mph (Exhib	it 25-19)				S <sub>0</sub> = mph (Exhibit 25-19)							
S= 53	.9 mph (Exhib	oit 25-14)				S = mph (Exhibit 25-15)							

		RAMP	S AND	RAM	P JUN	CTIONS	WORK	SHE	ET				
General	Informati	ion				Site Information							
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U G	S 160 Ea Grandview	astbound / Ramp B			
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2025				
Project Desc	ription US 16	60 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis							
mputs		Terrain Rolli	na										
Upstream Ac	j Ramp		''g							Downstrea	m Adj Ramp		
F Yes	Cn On									No	Off		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft			<u> </u>									
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V	5 <sub>FR</sub> = 40.0 r <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	1	1	1		1			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	<sub>HV</sub> f <sub>p</sub>		
Freeway	2725	0.95	Roll	ing	5	0	0.930		1.00	3084			
Ramp UnStream	Ramp 465 0.95 Rolling 2						0.971		1.00	504			
DownStream	 ז				 			1					
	1	Merge Areas	5					Dive	erge Area	S			
Estimati	on of v <sub>12</sub>					Estima	tion of v	12					
	V	′ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	$V_{R} + (V_{F})$	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Ec	uation 25-8	or 25-9	9)				
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = us	ing Equatior	I					
V <sub>12</sub> = 3084	pc/h					V <sub>12</sub> = pc/h							
Capacity	/ Checks					Capacity Checks							
	Actua	al Max	timum	LOS	S F?		Ac	ual	Ma	iximum	LOS F?		
V	2500		hihit DE 7		•	V <sub>FI</sub> =V <sub>F</sub>	:		See Ex	hibit 25-14			
V FO	3088	See Ex	111011 25-7		0	V <sub>12</sub>			44	100:All			
V <sub>R12</sub>	3588	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Ex	hibit 25-14			
				<u></u>		V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service L	Determin	ation (	if not	F)	Level c	of Servic	e De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			$D_R = 4$	252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>			
D <sub>R</sub> = 29.5 (pc/ m/ln)							(pc/ m/ln)						
LOS = D (Exhibit 25-4)							(Exhibit 25-4	)					
Speed Estimation							Estimat	ion					
M <sub>S</sub> = 0.4	14 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	19)					
S <sub>R</sub> = 52	.5 mph (Exhib	it 25-19)				S <sub>R</sub> = r	mph (Exhibi	t 25-19	)				
S <sub>0</sub> = N/	A mph (Exhibi	t 25-19)				S <sub>0</sub> = r	mph (Exhib	it 25-1	9)				
S= 52	.5 mph (Exhib	it 25-14)				S = r	mph (Exhibi	t 25-15	i)				

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET			
General	Informati	ion				Site Information						
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U G	S 160 We randview	stbound Ramp C		
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2025			
Project Desc	ription US 16	50 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis						
inputs		Torrain Dolli	na							1		
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp	
F Yes	Cn On									Yes	On	
No	Cff Off								L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft											
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 40.0 n <sub>R'</sub> V <sub>f</sub> )	nph		VD =	veh/h	
Convers	ion to pc	/h Under	Base	Condi	tions	4	4					
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>H</sub>	<sub>IV</sub> f <sub>p</sub>	
Freeway	1750	0.95	Roll	ing	5	0	0.930		1.00	1980		
Ramp UnStream	10 945 0.95 Rolling 2						0.971		1.00	1025		
DownStream	1 1											
	]	Merge Areas	5 5		J		J	Dive	rge Areas			
Estimati	on of v <sub>12</sub>					Estima	tion of v	12				
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					$V_{12} = V_{12}$	V <sub>R</sub> + (V <sub>F</sub> -	V <sub>R</sub> )P <sub>FD</sub>		
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{FO} = (Ec$	uation 25-8	or 25-9	))			
P <sub>FM</sub> = 1.000	using Equation	on O				$P_{FD} = us$	ing Equation					
V <sub>12</sub> = 1980	pc/h					$V_{12} = pc/$	h					
Capacity	/ Checks					Capaci	ity Chec	ks				
	Actua	al Max	imum	LOS	S F?	Actual Maximum LOS F?						
						V <sub>FI</sub> =V <sub>F</sub>	=		See Ext	nibit 25-14		
V <sub>FO</sub>	3005	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44(	DO:All		
V <sub>R12</sub>	3005	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ext	nibit 25-14		
						V <sub>R</sub>			See Ex	hibit 25-3		
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	etermin	nation (if	f not F)	
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.	252 + (	0.0086 V <sub>1</sub>	<sub>2</sub> - 0.009 L <sub>D</sub>		
D <sub>R</sub> =	16.5 (pc/ m/ln)	1				D <sub>R</sub> = (	(pc/ m/ln)					
LOS = B (Exhibit 25-4) LC							(Exhibit 25-4)	)				
Speed E	stimation		Speed	Estimat	ion							
$M_{\rm S} = 0.2$	248 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	19)				
S <sub>R</sub> = 55	.5 mph (Exhib	it 25-19)				S <sub>R</sub> = r	mph (Exhibit	25-19	)			
$S_0 = N/$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = 1	mph (Exhibi	t 25-19	9)			
S=55	.5 mph (Exhib	it 25-14)				S =1	mph (Exhibit	25-15	)			

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET			
General	Informati	ion				Site Information						
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U C	IS 160 W Grandviev	estbound / Ramp C		
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2025			
Project Desc	ription US 16	50 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis						
Inputs		Torrain Dolli	na									
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp	
F Yes	Cn On									Ves	Off	
No	Cff Off									L <sub>down</sub> =	ft	
L <sub>up</sub> =	ft											
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	o <sub>FR</sub> = 40.0 i <sub>R</sub> ,V <sub>f</sub> )	nph		Vd =	veh/h	
Convers	ion to pc	/h Under	Base	Condi	tions	1	1			1		
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>	
Freeway	3135	0.95	Roll	ng	5	0	0.930		1.00	3547		
Ramp UnStream	p 565 0.95 Rolling 2						0.971		1.00	613		
DownStream	 n											
	<u>]</u>	Merge Areas	S		J		J	Dive	erge Area	S		
Estimati	ion of v <sub>12</sub>					Estima	tion of	V <sub>12</sub>				
	V	$V_{12} = V_{F} (P_{FM})$	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>		
L <sub>EO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{EQ} = (Equation 25-8 \text{ or } 25-9)$						
P <sub>EM</sub> = 1.000	using Equation	on 0				$P_{FD} = us$	ing Equatior	า				
$V_{12} = 3547$	pc/h					$V_{12} = pc/h$						
	Checks					Capacity Checks						
	Actua	al Max	imum	LOS	S F?	Actual Maximum LOS F?						
						V <sub>r</sub> =V	-		See Ex	hibit 25-14		
V <sub>FO</sub>	4160	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44	100:All		
V <sub>R12</sub>	4160	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Ex	khibit 25-14		
						V <sub>R</sub>			See E	xhibit 25-3		
Level of	Service L	Determin	ation (	if not l	F)	Level c	of Servic	ce De	etermi	nation (i	f not F)	
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4	.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>		
D <sub>R</sub> = 25.7 (pc/ m/ln)							(pc/ m/ln)					
LOS = C (Exhibit 25-4)							(Exhibit 25-4	)				
Speed E	stimation		Speed	Estimat	tion							
$M_{\rm S} = 0.4$	419 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	-19)				
S <sub>R</sub> = 52	.5 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)						
$S_0 = N/$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = 1	mph (Exhib	it 25-1	9)			
S= 52	.5 mph (Exhib	it 25-14)				S =1	mph (Exhib	t 25-15	5)			

		RAMP	S AND	RAM	) JUN	CTIONS	WORKS	SHE	ET				
General	Informati	ion				Site Information							
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	19		Fr Ju Ju	eeway/Dir c Inction Irisdiction	f Travel	US Gr	S 160 Wes randview F	stbound Ramp e			
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Ye	ear 2025				
Project Desc	ription US 16	50 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis							
Inputs		Torroin Dolli								1			
Upstream Ac	lj Ramp	Terrain Rolli	ng							Downstream	m Adj Ramp		
🗹 Yes	M On									Yes	On		
No Off											ft		
L <sub>up</sub> =	1700 ft			<u> </u>									
Vu =	945 veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V <sub>F</sub>	o <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	iph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	1	(	1		1			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>H</sub>	IV <sup>f</sup> p		
Freeway	2695	0.95	Roll	ng	5	0	0.930	1	1.00	3050			
Ramp UnStream	9/5	0.95	Rolli	ng ng	2		0.971		1.00	417			
DownStream	1 <u>743</u>	0.75	- Roll	ng			0.771	'	1.00	1023			
		Merge Areas	5		,			Diver	rge Areas				
Estimati	on of v <sub>12</sub>					Estima	tion of v	12					
	V	7 <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> = V	$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$				
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Eq	uation 25-8 (	or 25-9)	)				
P <sub>FM</sub> = 0.594	using Equation	on 1				P <sub>FD</sub> = usi	ing Equation						
V <sub>12</sub> = 1813	pc/h					V <sub>12</sub> = pc/	h						
Capacity	/ Checks					Capaci	ty Checl	ks					
	Actua	al Max	imum	LOS	S F?		Act	ual	Maxi	imum	LOS F?		
V	24/7				•	V <sub>FI</sub> =V <sub>F</sub>			See Exh	ibit 25-14			
V FO	3407	See EX	IDIL 25-7		0	V <sub>12</sub>			440	0:All			
V <sub>R12</sub>	2230	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Exh	ibit 25-14			
						V <sub>R</sub>			See Ext	nibit 25-3			
Level of	Service I	Determin	ation (	if not l	F)	Level o	of Servic	e De	termin	ation (if	f not F)		
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	'8 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0	).0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>			
D <sub>R</sub> =	18.9 (pc/ m/ln)					D <sub>R</sub> = (	pc/ m/ln)						
LOS = B (Exhibit 25-4) LOS= (Exhibit 2													
Speed Estimation Speed Estimation													
$M_s = 0.309$ (Exibit 25-19) $D_s = $ (Exhibit 25-19)													
$S_{R}^{=}$ 54.4 mph (Exhibit 25-19) $S_{R}^{=}$ mph (Exhibit 25-19)													
S <sub>0</sub> = 57	.3 mph (Exhib	it 25-19)				S <sub>0</sub> = r	nph (Exhibi	t 25-19	)				
S= 55	.4 mph (Exhib	it 25-14)				S = r	nph (Exhibit	25-15)					

		RAMP	S AND	RAM	) JUN	CTIONS	WORKS	SHEE	ΞT			
General	Informat	ion				Site Information						
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	19		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	US Gr	S 160 Wes andview F	stbound Ramp E		
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Ye	ear 2025			
Project Desc	ription US 10	60 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis						
Inputs		Torrain Dolli	na							1		
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp	
🗹 Yes	M On									Yes	On	
l No	Cff Off					L <sub>down</sub> =	ft					
L <sub>up</sub> =	1700 ft									down		
Vu =	565 veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V	6 <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	nph		Vd =	veh/h	
Convers	sion to pc	/h Under	Base	Condi	tions	1	-			1		
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>ł</sub>	<sub>IV</sub> f <sub>p</sub>	
Freeway	3700	0.95	Roll	ing	5	0	0.930	1	1.00	4187		
Ramp UnStroam	590	0.95	Roll	ing	2	0	0.971		1.00	640		
DownStream	n <u> </u>	0.75	I	ing		0	0.771	! 	1.00	013		
2011101.001	<u> </u>	Merge Areas	<u>.                                    </u>		J			Diver	ge Areas	J		
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12				
		/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					$V_{12} = V_{12}$	/ <sub>R</sub> + (V <sub>F</sub> - '	V <sub>R</sub> )P <sub>FD</sub>		
L <sub>FO</sub> = (Equ	uation 25-2 or 2	25-3)				$L_{FO} = (Ec$	uation 25-8 (	or 25-9)	)	K TD		
P <sub>EM</sub> = 0.594	using Equation	on 1				$P_{FD} = us$	ing Equation					
$V_{12} = 2488$	pc/h					$V_{12} = pc/h$						
	v Checks					Capaci	tv Checl	ks				
	Actua	al Max	imum	LOS	S F?	Actual Maximum LOS F2						
						V <sub>r</sub> =V <sub>r</sub>	-		See Exh	ibit 25-14		
V <sub>FO</sub>	4827	See Ex	hibit 25-7	N	0	V <sub>12</sub>	·		440	0:All		
V <sub>R12</sub>	3128	460	)0:All	N	0	$V_{FO} = V_{F}$ $V_{R}$	-		See Exh	ibit 25-14		
						V <sub>R</sub>			See Exh	nibit 25-3		
Level of	Service I	Determin	ation (	if not i	F)	Level c	of Servic	e De	termin	ation (in	f not F)	
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0	.0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>		
$D_{\rm p} = 25.8 ({\rm pc/m/ln})$							pc/ m/ln)					
LOS =	C (Exhibit 25-		LOS= (	Exhibit 25-4)								
Speed E	stimatior	า		Speed	Estimati	ion						
$M_c = 0.3$	362 (Exibit 25	5-19)			$D_{\rm s} =$ (Exhibit 25-19)							
$S_{p} = 53$	.5 mph (Exhib	, pit 25-19)				S <sub>R</sub> = r	nph (Exhibit	25-19)				
$S_0 = 55$	.7 mph (Exhir	oit 25-19)				S <sub>0</sub> = r	mph (Exhibi	t 25-19	)			
S = 54	.2 mph (Exhib	pit 25-14)				S = r	mph_(Exhibit	25-15)				

	_Operational Analys	is	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: 2 Analysis Time Period: 2 Freeway/Direction: 1 From/To: 1	11/13/2009 AM Peak Eastbound		
Jurisdiction:	West of 05 550		
Analysis Year:	Year 2025		
Description: US 160 FEIS	5 Grandview Section	- Year 2025 An	alysis
	_Flow Inputs and Ad	justments	
Volume. V		2700	veh/h
Peak-hour factor, PHF		0.95	,
Peak 15-min volume, v15		711	v
Trucks and buses		5	00
Recreational vehicles		0	00
Terrain type:		Rolling	<u>.</u>
Grade Sogmont longth		0.00	ð mi
Trucks and buses DCF FT		2 5	
Recreational vehicle PCE	. ER	2.0	
Heavy vehicle adjustment	, fhV	0.930	
Driver population factor	, fp	1.00	
Flow rate, vp		1018	pc/h/ln
	_Speed Inputs and A	djustments	
Lane width		12 0	ft
Right-shoulder lateral cl	learance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		3	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment, il	LW	0.0	mi/h
Interchance density adjust	stment fID	0.0	mi/h
Number of lanes adjustmen	nt fN	3 0	mi/h
Free-flow speed, FFS		60.0	mi/h
		Urban Freeway	
	LOS and Performanc	e Measures	
		1010	
FILOW LALE, VP Free-flow speed FFS		F0 0 F0 0	pc/H/HH mi/h
Average passenger-car spe	ed. S	60.0	mi/h
Number of lanes, N		3	
Density, D		17.0	pc/mi/ln
Level of service, LOS		В	

Operational	l Analysis	
Analyst: SEH Inc. Agency or Company: Date Performed: 11/13/2009 Analysis Time Period: PM Peak Freeway/Direction: Eastbound From/To: West of US Jurisdiction: Analysis Year: Year 2025 Description: US 160 FEIS Grandview	550 Section - Year 2025 An	alvais
Flow Inputs	s and Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp	4265 0.95 1122 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1609	veh/h V % % mi pc/h/ln
Speed Input	ts and Adjustments	
Lane width Right-shoulder lateral clearance Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, fLW Lateral clearance adjustment, fLC Interchange density adjustment, fID Number of lanes adjustment, fN Free-flow speed, FFS	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
LOS and Per	rformance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car speed, S Number of lanes, N Density, D Level of service, LOS	1609 60.0 60.0 3 26.8 D	pc/h/ln mi/h mi/h pc/mi/ln

	_Operational Analys:	ls	
Analyst: A Agency or Company: Date Performed: A Analysis Time Period: A Freeway/Direction: A Jurisdiction: Analysis Year: A Description: US 160 FEIS	SEH Inc. L1/13/2009 AM Peak Vestbound Vest of US 550 Cear 2025 S Grandview Section	- Year 2025 Ana	alysis
	_Flow Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE Heavy vehicle adjustment Driver population factor Flow rate, vp	· ER , fHV , fp	3080 0.95 811 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1162	veh/h v % % mi pc/h/ln
	Speed Inputs and Ad	ljustments	
Lane width Right-shoulder lateral c: Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, fl Lateral clearance adjust Interchange density adjus Number of lanes adjustmen Free-flow speed, FFS	Learance LW ment, fLC stment, fID nt, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	LOS and Performance	Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car spe Number of lanes, N Density, D Level of service, LOS	eed, S	1162 60.0 60.0 3 19.4 C	pc/h/ln mi/h mi/h pc/mi/ln

0	Operational Analys	Ls	
Analyst: SE	EH Inc.		
Agency or Company: Date Performed: 11 Analysis Time Period: PM Freeway/Direction: We From/To: We	/13/2009 4 Peak estbound est of US 550		
Jurisdiction:	2025		
Description: US 160 FEIS	Grandview Section	- Year 2025 Ana	alysis
Е	flow Inputs and Ad	justments	
Volume, V		4290	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		1129	v
Trucks and buses		5	00
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	
Trucks and bugge DCE FT		0.00	
Pecreational vehicle DCF	ΨD	2.5	
Heavy vehicle adjustment.	fHV	0 930	
Driver population factor.	fp	1.00	
Flow rate, vp	-1	1618	pc/h/ln
S	Speed Inputs and Ad	ljustments	
Lane width		12.0	ft
Right-shoulder lateral cle	earance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		3	
Free-flow speed:		Measured	
FFS or BFFS	_	60.0	mi/h
Lane width adjustment, iLW		0.0	mi/h
Lateral clearance adjustme	ent, ILC	0.0	mi/h
Interchange density adjust	- fN	0.0	$m_{\perp}/m$
Free-flow speed FFS	-, LN	5.0	mi/h
File filow speed, FFS		Urban Freeway	
I	OS and Performance	Measures	
Flow rate vo		1618	pc/h/ln
Free-flow speed. FFS		60.0	mi/h
Average passenger-car spee	ed, S	60.0	mi/h
Number of lanes, N		3	
Density, D		27.0	pc/mi/ln
Level of service, LOS		D	

	RAMPS AND RAMP JUNCTIONS WORKSHEET											
General Infor	rmation			Sit	te Infori	rmation						
Analyst	Fre	eeway/Dir of Travel US 160				50 Ea	astbound					
Agency or Co	mpany				Jur	unction CR 233					ff Ramp	
Date Performe	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	AM Peak	<u> </u>		Ana	halysis Year Year 2025						
Project Descri	ption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		Torroin										
Upstream Adj	Ramp	rerrain									Downstre Ramp	am Adj
Yes	On										Ves	🗖 On
No 🔽	Off										No No	☐ Off
L <sub>up</sub> = ft				40.0 -	~~h		L <sub>down</sub> =	ft				
	1 1		FR <sup>=</sup>	= 40.01	прп		VD =	veh/h				
vu = ve	show lan	ies, L <sub>A</sub> , L	<sub>D</sub> ,V	R,Vf)								
Conversion t	o pc/h Und	der Base (	Condit	ions	1	1	1	1				
(pc/h)	V (Veh/hr)	PHF	Te	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>		V=V/PHF f <sub>HV</sub> f <sub>p</sub>	
Freeway	2500	0.95	Rol	lling	5	0	0	.930	1.00		2829	
Ramp	1090	2	0	0	.971	1.00		1182				
UpStream												
DownStream					<u> </u>	<u> </u>						
	Me	erge Areas							Diverge A	Area	S	
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} +$	(V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>	
$L_{FO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	ation 25-8	8 or 25-9	9)		
$P_{\text{EM}}$ = using E	quation					$P_{ED} = 1.0$	000	usina l	Equation	, 0 r		
$V_{in} = nc/h$						$V_{42} = 2829 \text{ pc/h}$						
Capacity Ch	ocks					$v_{12} = 2829 \text{ pc/n}$						
		Maxin	m		F2	Capach	<u>y C</u>	Actua		lavin		LOS E2
	710100					VV		2820		16(		No
V <sub>FO</sub>		See Exh	ibit 25-		-	V	:	2829		400	· Δ11	No
		4600	· A II			$V_{FO} = V_{I}$		1647		460	0	No
<sup>v</sup> R12		4000	.711		-	• <u>R</u> Vp		1182		210	0	No
Level of Serv	vico Dotorn	nination (i	f not F	<u> </u>			- Sa		tormina	ation	(if not F	
D = 5.475 +		+ 0.007	8 \/ _	/ 0.00627	· 1	Leveror		- 4 252	$2 \pm 0.00$	86 V	- 0 009	
$D_{\rm R} = 0.470$	⊾A	n _	25	q = 4.202	- + 0.000	00 v.	12 - 0.003	►D				
$D_{R} = (pc/mi/in)$ $D_{R} = (pc/mi/in)$								9 (pc/ m	i /in)			
LOS = (E)	LOS=	C (	Exhibit 2	5-4)								
Speed Estim		Speed E	Esti	mation								
$M_{\rm S} =$ (Exibit 25-19) $D_{\rm S} = 0.469$ (Ex								69 (Exhi	bit 25-19	9)		
S <sub>R</sub> = mph	$S_R = 51.6 \text{ mph}$ (Exhibit 25-19)											
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> = N/A mph (Exhibit 25-19)						
S= mph	(Exhibit 25	-14)				S = 51.6  mph (Exhibit 25-15)						

RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Infor	rmation			Si	te Infori	rmation						
Analyst		Fre	reeway/Dir of Travel US 160				50 Ea	stbound				
Agency or Co	mpany				Jur	nction			CR 23	33 Ot	ff Ramp	
Date Performe	ed	11/13/20	09		Jur							
Analysis Time	Period	PM Peak			Ana	halysis Year Year 2025						
Project Descri	iption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		<b>T</b>										
Upstream Adj	Ramp	lerrain									Downstre Ramp	am Adj
Yes	On										Tes 🗌	🗖 On
No 🔽	Off										🔲 No	Cff Off
L <sub>up</sub> = ft				40.0 -	mah		L <sub>down</sub> =	ft				
	h/h	3	FF =	ou.u mpr	1 	3	FR <sup>=</sup>	= 40.01	прп	,	VD =	veh/h
vu = ve	· · · · · · · · · · · · · · · · · · ·		5	Ketch (s	snow lan	ies, L <sub>A</sub> , L	<sub>D</sub> , V	R,V <sub>f</sub> )				
Conversion t	o pc/h Und	der Base (	Condit	ions	1	1	1	1		1		
(pc/h)	V (Veh/hr)	PHF	Te	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	İ	v=v/PHF f <sub>HV</sub> f <sub>p</sub>	
Freeway	3190	0.95	Rol	lling	5	0	0	.930	1.00		3610	
Ramp	1065	0.95	Ro	lling	2	0	0	.971	1.00		1155	
UpStream												
DownStream												
	Me	rge Areas							Diverge	Areas	8	
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} +$	(V <sub>F</sub> -	· V <sub>R</sub> )P <sub>FD</sub>	
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	ation 25-8	8 or 25-9	9)		
$P_{\text{EM}}$ = using E	quation	,				$P_{\rm FD} = 1.000$ using Equation 0						
$V_{i} = nc/h$	1					$V_{12} = 3610 \text{ pc/h}$						
Capacity Ch	ocks					$v_{12} = 3610 \text{ pc/h}$						
		Maxin			E2	Capach	<u>y Cl</u>	Actua		lovin		
	Actual				1:	Actual Maximum LC						No
V <sub>FO</sub>		See Exh	ibit 25-		-	V FI V F	:	3010		400		NO
						V <sub>12</sub>		3610	·	4400	:All	No
V <sub>R12</sub>		4600	:All			$V_{FO} = V_{F}$ $V_{R}$	-	2455		4600	0	No
						V <sub>R</sub>		1155		210	0	No
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	etermina	ation	(if not F)	
D <sub>R</sub> = 5.475 +	' L <sub>A</sub>		D <sub>F</sub>	<sub>R</sub> = 4.252	2 + 0.00	86 V <sub>1</sub>	<sub>2</sub> - 0.009	L <sub>D</sub>				
D <sub>R</sub> = (po		D <sub>R</sub> =	32.	6 (pc/ m	i /ln)			-				
LOS = (Ex	LOS = D (Exhibit 25-4)											
Speed Estim		Speed E	sti	mation								
M <sub>S</sub> = (Exib		$D_{\rm s} = 0.467$ (Exhibit 25-19)										
S <sub>R</sub> = mph (Exhibit 25-19)							S <sub>R</sub> = 51.6 mph (Exhibit 25-19)					
S <sub>0</sub> = mph	(Exhibit 25	-19)				$S_0 = N/A \text{ mph} (\text{Exhibit 25-19})$						
S= mph	(Exhibit 25	-14)				S = 51.6  mph (Exhibit 25-19)						
		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET			
--	-----------------	---------------------------	-------------------------	--	----------------	--	--	---------	-----------------------	-------------------------------------	------------------------------	
General	Informati	ion				Site Int	formatio	n				
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U C	S 160 Eas R 223 On	stbound Ramp		
Analysis Tim	e Period	AM Peak			A	nalysis Year		Y	ear 2025			
Project Desc	ription US 16	50 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis						
Inputs		Torrain Dolli	22							1		
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp	
F Yes	Cn On									Yes	On	
No	Cff Off									L <sub>down</sub> =	ft	
L <sub>up</sub> =	ft											
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 40.0 n <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h	
Convers	ion to pc	/h Under	Base	Condi	tions	4						
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>H</sub>	<sub>IV</sub> f <sub>p</sub>	
Freeway	1410	0.95	Roll	ing	5	0	0.930		1.00	1596		
Ramp UnStream	195	0.95	Roll	ing	2	0	0.971		1.00	211		
DownStream	1 1											
		Merge Areas	ŝ		,		1	Dive	rge Areas			
Estimation of v <sub>12</sub>					Estima	tion of v	12					
$V_{12} = V_{\rm E} \left( P_{\rm EM} \right)$				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$								
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{FO} = (Ec$	uation 25-8	or 25-9	))			
P <sub>FM</sub> = 1.000	using Equation	on O				$P_{FD} = us$	ing Equation					
V <sub>12</sub> = 1596	pc/h					$V_{12} = pc/h$						
Capacity	/ Checks					Capaci	ity Chec	ks				
	Actua	al Max	imum	LOS	S F?		Act	ual	Мах	kimum	LOS F?	
						V <sub>FI</sub> =V <sub>F</sub>	<u>.</u>		See Ext	nibit 25-14		
V <sub>FO</sub>	1807	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44(	DO:All		
V <sub>R12</sub>	1807	460	)0:All	N	0	$V_{FO} = V_{F}$ $V_{R}$	-		See Ext	nibit 25-14		
						V <sub>R</sub>			See Ex	hibit 25-3		
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	etermir	nation (it	f not F)	
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.	252 + (	0.0086 V <sub>1</sub>	<sub>2</sub> - 0.009 L <sub>D</sub>		
D <sub>R</sub> = 15.7 (pc/ m/ln)				D <sub>R</sub> = (	(pc/ m/ln)							
LOS =	B (Exhibit 25-4	1)				LOS= (	(Exhibit 25-4)	)				
Speed E	stimation	ı				Speed	Estimat	ion				
$M_{s} = 0.2$	297 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	19)				
S <sub>R</sub> = 54	.7 mph (Exhib	it 25-19)				S <sub>R</sub> = r	mph (Exhibi	25-19	)			
$S_0 = N/$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = 1	mph (Exhibi	t 25-19	9)			
S=54	.7 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)						

	RAMPS AND RAMP JUNCTIONS WORKSHEET										
General	Informati	ion				Site Inf	formatio	n			
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir o Inction Irisdiction	of Travel	U C	S 160 Ea R 223 O	astbound n Ramp	
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2025		
Project Desc	ription US 16	50 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis					
Inputs		Torrain Dolli	na							1	
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp
F Yes	Cn On									Ves	On
No No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft			<u> </u>							
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	5 <sub>FR</sub> = 40.0 r <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h
Convers	ion to pc	/h Under	Base	Condi	tions	1				4	
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	<sub>HV</sub> f <sub>p</sub>
Freeway	2125	0.95	Roll	ing	5	0	0.930	<u> </u>	1.00	2405	
Ramp UnStream	400	0.95	Roll	ing	2	0	0.971		1.00	434	
DownStream	<u>ן</u> ח							- <u> </u>			
	ļ	Merge Areas	5 5					Dive	rge Area	S	
Estimation of v <sub>12</sub>					Estima	tion of <b>v</b>	12				
	$V_{12} = V_{\Gamma} (P_{\Gamma M})$					$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$					
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{FO} = (Eq$	uation 25-8	or 25-9	) )		
P <sub>EM</sub> = 1.000	using Equation	on 0				$P_{FD} = usi$	ing Equation	l			
$V_{12} = 2405$	pc/h					$V_{12} = pc/h$					
	/ Checks					Capaci	tv Chec	ks			
	Actua	al Max	timum	LOS	S F?		Act	ual	Ma	aximum	LOS F?
						V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14	
V <sub>FO</sub>	2839	See Ex	hibit 25-7	N	0	V <sub>12</sub>	·		44	400:All	
V <sub>R12</sub>	2839	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Ex	khibit 25-14	
						V <sub>R</sub>			See E	xhibit 25-3	
Level of	Service I	Determin	ation (	if not	F)	Level o	of Servic	e De	etermi	ination (i	f not F)
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.	252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>	
D <sub>R</sub> =	23.7 (pc/ m/ln)					D <sub>R</sub> = (	pc/ m/ln)				
LOS = C (Exhibit 25-4)				LOS= (	Exhibit 25-4	)					
Speed E	stimation	1				Speed	Estimat	ion			
$M_{s} = 0.3$	340 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	19)			
S <sub>R</sub> = 53	.9 mph (Exhib	it 25-19)				S <sub>R</sub> = r	nph (Exhibi	t 25-19	)		
$S_0 = N/2$	A mph (Exhibi	, t 25-19)				S <sub>0</sub> = r	nph (Exhib	it 25-19	7)		
S=53	.9 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)					

	RAMPS AND RAMP JUNCTIONS WORKSHEET											
General Infor	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eway/Dir of Travel US 160			50 We	estbound	1	
Agency or Co	mpany				Jur	nction			CR 23	33 Of	f Ramp	
Date Performe	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	AM Peak	<u> </u>		Ana	alysis Yea	ar		Year 2	2025		
Project Descri	iption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		Tarrain								- 1		
Upstream Adj	Ramp	rerrain								F	Downstre Ramp	am Adj
Yes	On										Ves	🗖 On
No 🔽	Off										No No	☐ Off
L <sub>up</sub> = ft				60.0 mph				40.0 m	nnh	L	- <sub>down</sub> =	ft
	h/h	3	FF = '	oo.o mpi	1 		'FR =	= 40.01	прп	N	/D =	veh/h
vu = ve			5	Ketch (s	now lan	ies, L <sub>A</sub> , L	<sub>D</sub> , V	R,V <sub>f</sub> )				
Conversion t	to pc/h Und	der Base (	Condit	ions	1	1	1	1		1		
(pc/h)	V (Veh/hr)	PHF	Te	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	۷ f	/=V/PHF <sub>HV</sub> f <sub>p</sub>	
Freeway	1685	0.95	Rol	ling	5	0	0	.930	1.00		1907	
Ramp	290	0.95	Rol	ling	2	0	0	.971	1.00		314	
UpStream												
DownStream												
Merge Areas							Diverge A	Areas				
Estimation of v <sub>12</sub> Es				Estimat	ion	of v <sub>12</sub>						
$V_{12} = V_F (P_{FM})$						V <sub>12</sub>	$_{2} = V_{R} +$	(V <sub>F</sub> -	V <sub>R</sub> )P <sub>FD</sub>			
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	ation 25-8	- 8 or 25-9	9)		
$P_{rM} = using E$	quation	,				$P_{rp} = 1$ (	=1.000 using Equation 0					
$V_{\rm res} = nc/b$	1					$V_{40} = 1907$ pc/h						
$V_{12} = p_0/n$	ocke					$V_{12} = 19$		books				
		Maxin			E2	Capach	<u>y Cl</u>	Actua		lovim		
	Actual				1:	<u> </u>		1007		160		No
V <sub>FO</sub>		See Exh	ibit 25-		_	V <sub>FI</sub> =V <sub>F</sub>	:	1907		400	0	INO
		/				V <sub>12</sub>		1907		4400:	All	No
V <sub>B12</sub>		4600	:All			$V_{FO} = V_{F}$ $V_{R}$		1593		4600	)	No
					-	V <sub>R</sub>		314		2100	)	No
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	etermina	ation	(if not F)	
D <sub>R</sub> = 5.475 +	+ 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	LΔ		D	<sub>2</sub> = 4.252	2 + 0.008	86 V₁	, - 0.009	L <sub>D</sub>
D <sub>R</sub> = (po	c/ mi /ln)	IX.	12		X	D <sub>R</sub> =	18.	、 0 (pc/ mi	i /ln)	12	-	D
LOS = (Exhibit 25-4) $LOS = B (Exhibit 25-4)$												
Speed Estimation Speed Estimation												
M <sub>S</sub> = (Exib	it 25-19)					$D_{\rm s} = 0.391$ (Exhibit 25-19)						
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> = 53.0 mph (Exhibit 25-19)						
$S_0 = mph$	(Exhibit 25	-19)				$S_0 = N/A \text{ mph}$ (Exhibit 25-19)						
S = mph	(Exhibit 25	-14)				S = 53.0  mph (Exhibit 25-15)						

	RAMPS AND RAMP JUNCTIONS WORKSHEET											
General Infor	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eway/Dir of Travel US 160			60 W	/estboun	d	
Agency or Co	mpany				Jur	nction			CR 2.	33 O	off Ramp	
Date Performe	ed	11/13/20	09		Jur	isdiction					_	
Analysis Time	Period	PM Peak			Ana	alysis Ye	ar		Year	2025	5	
Project Descri	ption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		Torroin									1_	
Upstream Adj	Ramp	renam									Downstre Ramp	eam Adj
Yes	On										F Yes	🗖 On
No 🔽	Off										🔲 No	Contraction of the second seco
L <sub>up</sub> = ft		S		60 0 mpt	<u> </u>		_	- 40.07	mph		L <sub>down</sub> =	ft
	h/h	5	FF -	Voteb ( a	1 		FR <sup>-</sup>	- 40.01	прп		VD =	veh/h
vu = ve	· · · · ·		3		snow lan	ies, L <sub>A</sub> , L	<u></u> , v	R, V <sub>f</sub> )				
Conversion t	o pc/h Und	der Base C	Condit	ions	1	[	1	- 1				•
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>		v=v/PHF f <sub>HV</sub> f <sub>p</sub>	
Freeway	2290	0.95	Rol	lling	5	0	0	.930	1.00	)	2591	
Ramp	280	0.95	Rol	lling	2	0	0	.971	1.00	)	304	
UpStream												
DownStream												
Merge Areas							Diverge	Area	S			
Estimation of v <sub>12</sub> Estimation of v <sub>12</sub>												
$V_{12} = V_F (P_{FM})$							V <sub>12</sub>	2 = V <sub>R</sub> +	- (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>		
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	ation 25-	8 or 25-	9)		
$P_{\text{EM}}$ = using E	quation					$P_{FD} = 1.000$ using Equation 0						
$V_{\rm m} = nc/h$						$V_{ee} = 2591 \text{ pc/h}$						
Capacity Ch	ocks					$\mathbf{C}_{2}$		bocks				
	Actual	Maxin		201	F2	Capach	<u>y Cl</u>	Actua		Mavir		105 F2
	Actual				1:	V –V		2501	<u> </u>	161		No.
V <sub>FO</sub>		See Exh	bit 25-		-	V FI	:	2591		40		No
						v <sub>12</sub>		2391		4400	J.Ali	INO
V <sub>R12</sub>		4600	:All			$v_{FO} = v_{FO}$ $V_{R}$	= -	2287		460	00	No
						V <sub>R</sub>		304		210	0	No
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	etermin	atior	n (if not F	)
D <sub>R</sub> = 5.475 +	+ 0.00734 v	r <sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		DF	<sub>R</sub> = 4.252	2 + 0.00	86 V	<sub>12</sub> - 0.009	L <sub>D</sub>
$D_R = (pc/mi/ln)$					D <sub>R</sub> =	23.	8 (pc/ m	i /ln)				
LOS = (Exhibit 25-4) $LOS = C (Exhibit 25-4)$												
Speed Estimation Speed Estimation												
M <sub>S</sub> = (Exib	$M_{\rm S} =$ (Exibit 25-19)					D <sub>s</sub> = 0.390 (Exhibit 25-19)						
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> = 53.0 mph (Exhibit 25-19)						
S <sub>0</sub> = mph	(Exhibit 25	-19)				$S_0 = N/A \text{ mph}$ (Exhibit 25-19)						
S= mph	(Exhibit 25	-14)				S = 53.0  mph (Exhibit 25-15)						

	Operational Analys	is	
Analyst:	SEH Inc.		
Date Performed:	11/13/2009		
Analysis Time Period:	AM Peak		
Freeway/Direction:	Eastbound		
From/To:	US 550 to CR 233		
Jurisdiction:			
Analysis Year:	Year 2025		
Description: US 160 FE	IS Grandview Section	- Year 2025 An	alysis
	Flow Inputs and Ad	justments	
Volume, V		2500	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		658	v
Trucks and buses		5	8
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	90
Segment length		0.00	mi
Trucks and buses PCE, E	Г	2.5	
Recreational vehicle PCI	E, ER	2.0	
Heavy vehicle adjustment	z, fHV	0.930	
Driver population factor	r, ip	1.00	() ()
Flow rate, vp		1414	pc/n/ln
	Speed Inputs and A	djustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS	<b>C-</b>	60.0	mi/h
Lane width adjustment, :	ELW	0.0	mi/h
Lateral clearance adjust	iment, ILC	0.0	mi/n
Number of lange density adjust	astment, IID	0.0	mi/h
Free flow greed FEC	ent, IN	4.5	mi/h
Fiee-filow speed, FFS		Urban Freeway	
	IOS and Darformans		
	LOS and Periormanc	e Measures	
Flow rate, vp		1414	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car sp	peed, S	60.0	mi/h
Number of lanes, N		2	
Density, D		23.6	pc/mi/ln
Level of service, LOS		C	

	Operational Analys	is	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: US 160 FE:	SEH Inc. 11/13/2009 PM Peak Eastbound US 550 to CR 233 Year 2025 IS Grandview Section	- Year 2025 And	alysis
	Flow Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCD Heavy vehicle adjustment Driver population factor Flow rate, vp	r 5, ER 5, fHV 5, fp	3190 0.95 839 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1805	veh/h v % % mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW tment, fLC stment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	LOS and Performanc	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1805 60.0 59.6 2 30.3 D	pc/h/ln mi/h mi/h pc/mi/ln

	Operational	Analysis	
Applyst:	CELL TRA		
Analyst. Agency or Company:	SEH INC.		
Date Performed:	11/13/2009		
Analysis Time Period:	AM Peak		
Freeway/Direction:	Westbound		
From/To:	CR 233 to US	550	
Jurisdiction:			
Analysis Year:	Year 2025		
Description:			
	Flow Inputs	and Adjustments	
		0100	
Volume, V		2130	veh/h
Peak-nour lactor, PHF		0.95	
Trucks and buses		567	V 9-
Pogroational wobiglog		0	50 9-
Terrain type:		Bolling	°0
Grade		0 00	ş
Segment length		0.00	mi
Trucks and buses PCE. E	г	2.5	
Recreational vehicle PC	- E. ER	2.0	
Heavy vehicle adjustment	t, fHV	0.930	
Driver population factor	r, fp	1.00	
Flow rate, vp	· •	1205	pc/h/ln
	Speed Inputs	s and Adiustments	
Lane width		12.0	ft
Right-shoulder lateral (	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS	C	60.0	mi/h
Lane width adjustment, :	ELW	0.0	mi/n
Lateral clearance adjus	unterne, ILC	0.0	III1/II mi/h
Interchange density adjust	ustment, IID	0.0	III1/II mi/h
Rumber of fames adjustme	ent, in	4.5	$\lim_{n \to \infty} / \ln n$
Fiee-liow speed, FFS		Urban Freeway	
		orban Freeway	
	LOS and Peri	formance Measures	
Flow rate, vp		1205	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	peed, S	60.0	mi/h
Number of lanes, N		2	
Density, D		20.1	pc/mi/ln
Level of service, LOS		C	

	Operational Analys	is	
Analyst:	SEH Inc.		
Date Performed:	11/13/2009		
Analysis Time Period:	PM Peak		
Freeway/Direction:	Westbound		
From/To:	CR 233 to US 550		
Jurisdiction:			
Analysis Year:	Year 2025		
Description: US 160 FE	IS Grandview Section	- Year 2025 An	alysis
	Flow Inputs and Ad	justments	
Volume, V		3510	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		924	v
Trucks and buses		5	00
Recreational vehicles		0	00
Terrain type:		Rolling	<u>^</u>
Grade		0.00	olo .
Segment length		0.00	ml
Pogroational wobigle DCL		2.5	
Heavy vehicle adjustment	- fhv	2.0	
Driver population factor	r, fp	1.00	
Flow rate, vp		1986	pc/h/ln
	Chood Inputs and A	diuatmonta	
	Speed inputs and A	a justments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-Ilow speed:		Measured	mi /b
I and width adjustment	FT W	0.0	mi/h
Lateral clearance adjust	ment flC	0.0	mi/h
Interchange density adju	istment, fTD	0.0	mi/h
Number of lanes adjustme	ent, fN	4.5	mi/h
Free-flow speed, FFS		60.0	mi/h
- ·		Urban Freeway	
	_LOS and Performanc	e Measures	
Flow rate, vp		1986	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car si	peed, S	58.1	mi/h
Number of lanes, N	-	2	
Density, D		34.2	pc/mi/ln
Level of service, LOS		D	

\_Operational Analysis\_\_\_\_\_ Analyst: SEH Inc. Agency/Co.: Date Performed: 11/13/2009 Analysis Time Period: AM Peak Freeway/Dir of Travel: US 160 Westbound CR 233 On US 550 Off Weaving Location: Jurisdiction: Analysis Year: Year 2025 Description: US 160 FEIS Grandview Section - Year 2025 Analysis Inputs Freeway free-flow speed, SFF 60 mph Weaving number of lanes, N 3 Weaving segment length, L 2070 ft Terrain type Rolling Grade 8 Length mi Weaving type Multilane or C-D А 0.49 Volume ratio, VR Weaving ratio, R 0.33 \_\_\_Conversion to pc/h Under Base Conditions\_\_\_ Non-Weaving Weaving V V V V A-C B-D A-D B-C 697 0.95 342 Volume, V 1053 38 veh/h Peak-hour factor, PHF Peak 15-min volume, v15 v Trucks and buses % Recreational vehicles % Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, fP 1.00 1.00 1.00 1.00 Flow rate, v 1191 42 386 788 pc/h \_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_ Weaving Non-Weaving a (Exhibit 24-6) 0.15 0.00 b (Exhibit 24-6) 2.20 4.00 c (Exhibit 24-6) 0.97 1.30 d (Exhibit 24-6) 0.80 0.75 Weaving intensity factor, Wi 1.22 0.19 Weaving and non-weaving speeds, Si 37.47 57.00 Number of lanes required for unconstrained operation, Nw (Exhibit 24-7) Maximum number of lanes, Nw (max) (Exhibit 24-7) 1.62 1.40 Type of operation is Constrained \_\_\_\_\_Weaving Segment Speed, Density, Level of Service and Capacity\_\_\_\_\_ Weaving segment speed, S 45.45 mph Weaving segment density, D 17.65 pc/mi/ln В Level of service, LOS Capacity of base condition, cb 4948 Capacity as a 15-minute flow rate, c 4603 Capacity as a full-hour volume, ch 4373 pc/h pc/h pc/h

		If Max Exce	eded See Note
	Analyzed	Maximum	Note
Weaving flow rate, Vw	1174	2800	a
Average flow rate (pcphpl)	802	2300	b
Volume ratio, VR	0.49	0.45	С
Weaving ratio, R	0.33	N/A	d
Weaving length (ft)	2070	2500	е
Notes:			

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

- b. Capacity constrained by basic freeway capacity.
- c. Capacity occurs under constrained operating conditions.
- d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
- e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
- f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
- g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
- h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
- i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

\_Operational Analysis\_\_\_\_\_ Analyst: SEH Inc. Agency/Co.: Date Performed: 11/13/2009 Analysis Time Period: PM Peak Freeway/Dir of Travel: US 160 Westbound CR 233 On US 550 Off Weaving Location: Jurisdiction: Analysis Year: Year 2025 Description: US 160 FEIS Grandview Section - Year 2025 Analysis Inputs Freeway free-flow speed, SFF 60 mph Weaving number of lanes, N 3 Weaving segment length, L 2070 ft Terrain type Rolling Grade 8 Length mi Weaving type Multilane or C-D А 0.51 Volume ratio, VR Weaving ratio, R 0.19 \_\_\_Conversion to pc/h Under Base Conditions\_\_\_ Non-Weaving Weaving V V V V Volume, V veh/h Peak-hour factor, PHF Peak 15-min volume, v15 v Trucks and buses % Recreational vehicles % Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, fP 1.00 1.00 1.00 1.00 Flow rate, v 1893 42 381 1654 pc/h \_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_ Weaving Non-Weaving a (Exhibit 24-6) 0.15 0.00 b (Exhibit 24-6) 2.20 4.00 c (Exhibit 24-6) 0.97 1.30 d (Exhibit 24-6) 0.80 0.75 Weaving intensity factor, Wi 2.06 0.39 Weaving and non-weaving speeds, Si 31.32 50.97 Number of lanes required for unconstrained operation, Nw (Exhibit 24-7) Maximum number of lanes, Nw (max) (Exhibit 24-7) 1.77 1.40 Type of operation is Constrained \_\_\_\_\_Weaving Segment Speed, Density, Level of Service and Capacity\_\_\_\_\_ Weaving segment speed, S 38.57 mph Weaving segment density, D 34.31 pc/mi/ln D Level of service, LOS Capacity of base condition, cb 4948 Capacity as a 15-minute flow rate, c 4603 Capacity as a full-hour volume, ch 4373 pc/h pc/h pc/h

#### Page 1

		If Max Exce	eded See Note
	Analyzed	Maximum	Note
Weaving flow rate, Vw	2035	2800	a
Average flow rate (pcphpl)	1323	2300	b
Volume ratio, VR	0.51	0.45	С
Weaving ratio, R	0.19	N/A	d
Weaving length (ft)	2070	2500	е
Notes:			

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

- b. Capacity constrained by basic freeway capacity.
- c. Capacity occurs under constrained operating conditions.
- d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
- e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
- f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
- g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
- h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
- i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

	Operational Analys	is	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	SEH Inc. 11/13/2009 AM Peak Eastbound CR 233 to SH 172		
Analysis Year: Description: US 160 FE	Year 2025 IS Grandview Section	- Year 2025 An	alvsis
	Flow Inputs and Ad	justments	-
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCD Heavy vehicle adjustment Driver population factor Flow rate, vp	r E, ER t, fhV r, fp	1605 0.95 422 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 908	veh/h v % % mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjust Interchange density adjust Number of lanes adjustme Free-flow speed, FFS	fLW fLW tment, fLC ustment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h mi/h
	_LOS and Performanc	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	908 60.0 60.0 2 15.1 B	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Analys	is	
Analyst:	SEH Inc.		
Date Performed:	11/13/2009		
Analysis Time Period:	PM Peak		
Freeway/Direction:	Eastbound		
From/To:	CR 233 to SH 172		
Jurisdiction:			
Analysis Year: Description: US 160 FE	Year 2025 IS Grandview Section	- Year 2025 An	alysis
	Flow Inputs and Ad	justments	
17.2 June 17		2525	
Volume, V Dock-hour factor DHE		2525 0 95	ven/n
Peak 15-min volume v15		664	24
Trucks and buses		5	\$ \$
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	8
Segment length		0.00	mi
Trucks and buses PCE, E'	Г	2.5	
Recreational vehicle PC	E, ER	2.0	
Heavy vehicle adjustmen	t, ihv	0.930	
Driver population facto:	r, Ip	1420	ng/h/ln
FIOW TALE, VP		1429	pe/11/111
	Speed Inputs and A	djustments	
Lane width		12.0	ft
Right-shoulder lateral	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	mi /h
FFS OF BFFS	Ет М	60.0	$m \perp / n$
Lateral clearance adjust	tment fl.C	0.0	mi/h
Interchange density adju	ustment, fTD	0.0	mi/h
Number of lanes adjustme	ent, fN	4.5	mi/h
Free-flow speed, FFS	,	60.0	mi/h
_		Urban Freeway	
	LOS and Performanc	e Measures	
Flow rate, vp		1429	pc/h/ln
Free-flow speed. FFS		60.0	mi/h
Average passenger-car si	peed, S	60.0	mi/h
Number of lanes, N		2	
Density, D		23.8	pc/mi/ln
Level of service, LOS		С	

0	perational Analys:	is	
Analyst: SE Agency or Company: Date Performed: 11 Analysis Time Period: AM Freeway/Direction: We From/To: SH	H Inc. /13/2009 Peak stbound 172 to CP 233		
Jurisdiction: Analysis Year: Yea Description: US 160 FEIS	ar 2025 Grandview Section	- Year 2025 Ana	alysis
F	low Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, Heavy vehicle adjustment, Driver population factor,	ER fHV fp	1685 0.95 443 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00	veh/h v % % mi
Flow rate, vp	L	953	pc/h/ln
S	peed Inputs and Ad	djustments	
Lane width Right-shoulder lateral clea Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, fLW Lateral clearance adjustment Interchange density adjust Number of lanes adjustment Free-flow speed, FFS	arance nt, fLC ment, fID , fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
L	OS and Performance	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car speed Number of lanes, N Density, D Level of service, LOS	d, S	953 60.0 60.0 2 15.9 B	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Analys	is	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	SEH Inc. 11/13/2009 PM Peak Westbound SH 172 to CR 233		
Description: US 160 FE	IS Grandview Section	- Year 2025 Ana	alysis
	Flow Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population factos Flow rate, vp	T E, ER t, fHV r, fp	2290 0.95 603 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1296	veh/h v % % mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjust Interchange density adjust Number of lanes adjust Free-flow speed, FFS	clearance fLW tment, fLC ustment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	LOS and Performanc	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1296 60.0 60.0 2 21.6 C	pc/h/ln mi/h mi/h pc/mi/ln

		RAM	PS AN		, JNNC.	TIONS W	OR	KSHEE	Г			
General Info	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	0 Eastbou	nd	
Agency or Co	mpany				Jur	nction			SH 17	2 Off Ran	np	
Date Perform	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	AM Peak			Ana	alysis Yea	ar		Year 2	2025		
Project Descr	iption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		Tarrain								1		
Upstream Adj	Ramp	Terrain								Downs Ramp	tream Adj	
Yes	On									Tes Yes	s 🔽 On	
No 🔽	Off									🔲 No	C Off	
L <sub>up</sub> = ft		S		60.0 mpt				- 400 r	nnh	L <sub>down</sub> =	= ft	
	h/h	0	FF - '	lkotob ( a	ı boyulor		FR <sup>-</sup>	- +0.01	VD =	veh/h		
vu = ve			3		snow lan	ies, L <sub>A</sub> , L	<u></u> , v	R, V <sub>f</sub> )				
Conversion t	o pc/h Und	der Base C	Condit	ions	1	1	1	1				
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>		
Freeway	1605	0.95	Rol	ling	5	0	0	.930	1.00	181	6	
Ramp	585	0.95	ling	2	0 0.971 1.00				634	1		
UpStream												
DownStream												
	Me	rge Areas				Diverge Areas						
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} + $	(V <sub>F</sub> - V <sub>R</sub> )P <sub>F</sub>	Đ	
$L_{FQ} = (Equat)$	ion 25-2 or	25-3)				L <sub>FO</sub> = (E	qua	ation 25-8	3 or 25-9	)		
$P_{EM}$ = using E	quation					$P_{EQ} = 1.000$ using Equation 0						
$V_{40} = pc/h$	•					$V_{40} = 18$	16	nc/h				
Capacity Che	ocks					Canacit		hecks				
	Actual	Maxim	mum		F?	Oupuon	<u>y 01</u>	Actual		aximum	LOS E?	
						V=V_		1816		4600	No	
V <sub>FO</sub>		See Exh	DIT 25-		-		·	1010			No	
						$V_{FO} = V_F$	= -	1010	4	400.All	No	
V <sub>R12</sub>		4600	:All		_	V <sub>R</sub>				4000		
						V <sub>R</sub>		634		2100	No	
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	termina	tion (if not	t F)	
D <sub>R</sub> = 5.475 +	⊦ 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		DF	<sub>R</sub> = 4.252	2 + 0.008	86 V <sub>12</sub> - 0.0	09 L <sub>D</sub>	
D <sub>R</sub> = (po	c/ mi /ln)					D <sub>R</sub> =	17.	2 (pc/ mi	/ln)			
LOS = (E:		LOS=	B (I	Exhibit 2	5-4)							
Speed Estim		Speed E	sti	mation								
M <sub>S</sub> = (Exib		D <sub>s</sub> =	0.4	20 (Exhi	bit 25-19	))						
S <sub>R</sub> = mph		S <sub>R</sub> =	52.	4 mph (I	Exhibit 2	5-19)						
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> =	N/A	A mph (I	Exhibit 2	5-19)		
S= mph	(Exhibit 25	-14)				S = 52.4 mph (Exhibit 25-15)						

	RAMPS AND RAMP JUNCTIONS WORKSHEET General Information Site Information												
General Infor	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	50 Ea	astbound	l	
Agency or Co	mpany				Jur	nction			SH 17	20	ff Ramp		
Date Performe	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 2	2025	5		
Project Descri	iption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis					
Inputs		Torroin									[		
Upstream Adj	Ramp	rerrain									Downstre Ramp	eam Adj	
Yes	On										Tes 🗐	🗖 On	
No 🔽	Off										🔲 No	Contraction of the other sectors of the other secto	
L <sub>up</sub> = ft		S		30.0 mph		S = 40.0  mph					L <sub>down</sub> =	ft	
	h/h	0	FF - V	kotob ( o			FR -	- +0.01	прп		VD =	veh/h	
vu – ve			0 		now lan	anes, $L_A$ , $L_D$ , $V_R$ , $V_f$ )							
Conversion t	o pc/h Und	der Base C	;onditi	ons	1	1	1			_		-	
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>		f <sub>HV</sub> f <sub>p</sub>		
Freeway	2525	0.95	Rol	ling	5	0	0	.930	1.00		2857		
Ramp	1180	0.95	ling	2	0 0.971 1.00				1279				
UpStream				<u> </u>	<u> </u>								
DownStream													
	Me	erge Areas					-		Diverge /	Area	S		
Estimation of	f v <sub>12</sub>					Estimati	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} +$	$(V_F$	- V <sub>R</sub> )P <sub>FD</sub>		
L <sub>EQ</sub> = (Equat	ion 25-2 or	25-3)				L <sub>EQ</sub> = (E	qua	ation 25-8	3 or 25-9	9)			
P <sub>FM</sub> = using E	quation					$P_{FD} = 1.0$	000	using E	Equatior	n 0			
$V_{12} = pc/h$	-					$V_{12} = 28$	57	pc/h					
Capacity Che	ecks						v Cl	hecks					
<b>_</b>	Actual	Maxin	num	LOS	F?			Actua		/laxir	num	LOS F?	
		Soo Evh	ihit 25			V <sub>EI</sub> =V <sub>E</sub>		2857		460	)()	No	
V <sub>FO</sub>		7	DIL 25-		-	V <sub>12</sub>		2857		4400	):All	No	
V <sub>R12</sub>		4600	:All			$V_{FO} = V_F$ $V_R$		1578		460	0	No	
						V <sub>R</sub>		1279		210	0	No	
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	etermina	ation	i (if not F	7)	
D <sub>R</sub> = 5.475 +	⊦ 0.00734 v	r <sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		D <sub>F</sub>	<sub>R</sub> = 4.252	2 + 0.008	86 V	<sub>12</sub> - 0.009	L <sub>D</sub>	
D <sub>R</sub> = (po	c/ mi /ln)					D <sub>R</sub> =	26.	1 (pc/ mi	/ln)				
LOS = (Ex		LOS=	C (I	Exhibit 2	5-4)								
Speed Estimation						Speed E	stii	mation					
M <sub>S</sub> = (Exibit 25-19)						D <sub>s</sub> =	0.4	78 (Exhi	bit 25-19	9)			
S <sub>R</sub> = mph (Exhibit 25-19)						S <sub>R</sub> =	51.4	4 mph (I	Exhibit 2	25-19	9)		
S <sub>0</sub> = mph	$S_0 = mph$ (Exhibit 25-19)						$S_0 = N/A \text{ mph} (Exhibit 25-19)$						
S= mph	(Exhibit 25	-14)				S = 51.4 mph (Exhibit 25-15)							

		RAMP	S AND	RAM	P JUN	CTIONS	WORK	SHEI	ET		
General	Informati	on				Site Information					
Analyst2 Agency or Co Date Perform	ompany	SEH Inc.	19		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U: SI	S 160 Eas H 172 On	stbound Ramp	
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Ye	ear 2025		
Project Desc	ription US 16	0 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis					
Inputs		T . D								1	
Upstream Ac	lj Ramp	Terrain Rolli	ng							Downstrea	m Adj Ramp
F Yes	Cn On									Ves	On Off
No No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft			0			10.0				
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	$S_{FR} = 40.0 \text{ mpm}$					veh/h
Convers	ion to pc	/h Under	Base	Condi	tions	1	1	1		1	
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		fp	v=V/PHF f <sub>H</sub>	<sub>IV</sub> f <sub>p</sub>
Freeway	1020	0.95	Rolli	ng	5	0	0.930		1.00	1154	
UnStream	110	0.95	Ruii	ng	2	0	0.971		1.00	119	
DownStream	 ח				 			1			
		Merge Areas	5					Dive	rge Areas		
Estimati	on of v <sub>12</sub>					Estima	tion of v	12			
	V	<sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> = \	/ <sub>R</sub> + (V <sub>F</sub> -	V <sub>R</sub> )P <sub>FD</sub>	
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Ec	uation 25-8	or 25-9	)		
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = us	ing Equation				
V <sub>12</sub> = 1154	pc/h					V <sub>12</sub> = pc/	h				
Capacity	/ Checks					Capaci	ity Chec	ks			
	Actua	I Max	imum	LOS	S F?		Act	ual	Мах	kimum	LOS F?
	1070					V <sub>FI</sub> =V <sub>F</sub>	-		See Ext	nibit 25-14	
V <sub>FO</sub>	12/3	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44(	DO:All	
V <sub>R12</sub>	1273	460	0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ext	nibit 25-14	
						V <sub>R</sub>			See Ex	hibit 25-3	
Level of	Service L	Determin	ation (	if not	F)	Level c	of Servic	e De	etermir	nation (if	f not F)
D <sub>R</sub> =	5.475 + 0.0073	84 v <sub>R</sub> + 0.007	'8 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.	252 + (	0.0086 V <sub>1</sub>	<sub>2</sub> - 0.009 L <sub>D</sub>	
D <sub>R</sub> =	11.6 (pc/ m/ln)					D <sub>R</sub> = (	(pc/ m/ln)				
LOS =	B (Exhibit 25-4	)				LOS= (	(Exhibit 25-4)				
Speed Estimation						Speed	Estimat	ion			
$M_{\rm s} = 0.287$ (Exibit 25-19)						D <sub>s</sub> =	(Exhibit 25-	19)			
$S_{p} = 54.8 \text{ mph} \text{ (Exhibit 25-19)}$						S <sub>R</sub> = r	mph (Exhibit	25-19)	)		
$S_0 = N/2$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = 1	mph (Exhibi	t 25-19	))		
S= 54	.8 mph (Exhib	it 25-14)				S =1	mph (Exhibit	25-15)	)		

		RAMP	S AND	RAM	P JUN	CTIONS	S WOR	RKSHE	ET		
General	Informat	ion				Site Information Ereeway/Dir of Travel US 160 Easthound					
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L	IS 160 Ea 6H 172 Or	istbound n Ramp	
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	'ear 2025		
Project Desc	ription US 1	60 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis					
Inputs		Torrain Dolli	na							1	
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp
F Yes	Cn On									Ves	On
No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft										
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 4( <sub>R</sub> ,V <sub>f</sub> )	0.0 mph		VD =	veh/h
Convers	sion to pc	/h Under	Base	Condi	tions	1	1	4		- 1	
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>H\</sub>	V	f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>
Freeway	1345	0.95	Roll	ng	5	0	0.93	0	1.00	1522	
Ramp UnStream	240	0.95	Roll	ing	2	0	0.97		1.00	260	
DownStream	 n				 						
		Merge Areas	5 5		J		]	Dive	erge Area	S	
Estimat	ion of v <sub>12</sub>					Estima	tion o	of v <sub>12</sub>			
	 \	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>	
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Eq	uation 2	25-8 or 25-9	9)		
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = us	ing Equa	ation			
V <sub>12</sub> = 1522	pc/h					V <sub>12</sub> = pc/	h				
Capacit	y Checks					Capaci	ity Ch	ecks			
	Actua	al Max	timum	LOS	S F?			Actual	Ма	ximum	LOS F?
V	1700					V <sub>FI</sub> =V <sub>F</sub>	-		See Ex	hibit 25-14	
v <sub>FO</sub>	1/82	See Ex	nidit 25-7	N	0	V <sub>12</sub>			44	00:All	
V <sub>R12</sub>	1782	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ex	hibit 25-14	
						V <sub>R</sub>			See E	xhibit 25-3	
Level of	Service I	Determin	ation (	if not	F)	Level c	of Ser	vice De	etermi	nation (i	f not F)
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub>	= 4.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>	
D <sub>R</sub> =	15.5 (pc/ m/ln)	)				D <sub>R</sub> = (	(pc/ m/ln	)			
LOS =	B (Exhibit 25-	4)				LOS= (	(Exhibit 2	25-4)			
Speed Estimation						Speed	Estin	nation			
M <sub>S</sub> = 0.296 (Exibit 25-19)						D <sub>s</sub> =	(Exhibit	t 25-19)			
S <sub>R</sub> = 54.7 mph (Exhibit 25-19)						S <sub>R</sub> = r	mph (E>	hibit 25-19	9)		
S <sub>0</sub> = N/	A mph (Exhib	it 25-19)				S <sub>0</sub> = r	mph (E	xhibit 25-1	9)		
S= 54	.7 mph (Exhib	oit 25-14)				S = mph (Exhibit 25-15)					

		RAM	PS AN		, JNNC.	TIONS W	'OR	KSHEE	Г			
General Infor	rmation			Sit	Site Information Freeway/Dir of Travel US 160 W							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	0 Westbo	und	
Agency or Co	mpany				Jur	nction			SH 17	2 Off Ran	np	
Date Performe	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	AM Peak			Ana	alysis Yea	ar		Year 2	.025		
Project Descri	ption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		Tarrain								1		
Upstream Adj	Ramp	rerrain								Downs Ramp	stream Adj	
Yes	On									Te:	s 🗖 On	
No 🔽	Off									🔲 No	C Off	
L <sub>up</sub> = ft				60.0 mph				40.0 m	nnh	L_down =	= ft	
	h/h	3	FF = '	bu.u mpi	l have lan		FR <sup>-</sup>	= 40.01	VD =	veh/h		
vu = ve	rn/m		5	Ketch (s	now lan	ies, L <sub>A</sub> , L	D, V	R,V <sub>f</sub> )				
Conversion t	o pc/h Und	der Base C	Condit	ions	1	1	1	1				
(pc/h)	V (Veh/hr)	PHF	Te	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	v=V/P f <sub>HV</sub> f <sub>p</sub>	HF	
Freeway	935	0.95	Rol	ling	5	0	0	.930	1.00	105	8	
Ramp	135	0.95	ling	2	0 0.971 1.00			14	6			
UpStream												
DownStream												
	Me	erge Areas							Diverge A	reas		
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} +$	(V <sub>F</sub> - V <sub>R</sub> )P <sub>I</sub>	FD	
$L_{FQ} = (Equat)$	ion 25-2 or	25-3)				L <sub>FO</sub> = (E	qua	ation 25-8	3 or 25-9	)		
$P_{EM}$ = using E	quation					$P_{FD} = 1.000$ using Equation 0						
$V_{40} = pc/h$	•					$V_{40} = 10$	58	pc/h	•			
Capacity Che	ecks						v C	hecks				
	Actual	Maxim	านฑ	LOS	F?	Actual Maximum LOSE						
		See Eve				V <sub>EI</sub> =V <sub>E</sub>		1058		4600	No	
V <sub>FO</sub>			DIL 20-		_			1050			No	
			A.II.			$V_{FO} = V_F$	= -	912		4600	No	
V <sub>R12</sub>		4600	:All		-	V_ 		1/6		2100	No	
Loval of Sam	viaa Datarr	ninotion (i	f nat E	<u> </u>		<sup>r</sup> R			tormino	2100	4 <b>F</b> )	
Level of Serv			0 \/	0.00627	· 1	Leveror	Se					
$D_{\rm R} = 5.4754$	F 0.00734 V	R + 0.007	o v <sub>12</sub> -	0.00627	LA			<sub>ع</sub> = 4.252 _	2 + 0.000	0.0 v <sub>12</sub> - 0.0		
$D_R = (pc$	:/ mi /ln)					D <sub>R</sub> =	10.	7 (pc/ mi	/ln)			
LOS = (E)		LOS=	B (I	Exhibit 2	5-4)							
Speed Estim		Speed E	sti	mation								
M <sub>S</sub> = (Exib		D <sub>s</sub> =	0.3	76 (Exhi	bit 25-19	))						
S <sub>R</sub> = mph		S <sub>R</sub> =	53.	2 mph (	Exhibit 2	5-19)						
S <sub>0</sub> = mph	(Exhibit 25	-19)				$S_0 = N/A mph$ (Exhibit 25-19)						
S= mph	(Exhibit 25	-14)				S = 53.2 mph (Exhibit 25-15)						

		RAM	PS AN		, JNNC.	TIONS W	'OR	KSHEE	Г			
General Infor	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	0 Westbo	und	
Agency or Co	mpany				Jur	nction			SH 172	2 Off Ran	np	
Date Performe	ed	11/13/20	)9		Jur	isdiction						
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 2	.025		
Project Descri	ption US	160 FEIS	Grand	view Sec	tion - Ye	ear 2025	Ana	alysis				
Inputs		Terrein								1		
Upstream Adj	Ramp	rerrain								Downs Ramp	tream Adj	
Yes	On									Te:	s 🔽 On	
No 🔽	Off									No 🗐	C Off	
L <sub>up</sub> = ft				60.0 mph				- 40.0 m	nnh	LL	= ft	
	h/h	3	FF = '	oo.o mpi	1 		FR <sup>=</sup>	= 40.01	VD =	veh/h		
vu = ve	rn/m		5	Ketch (s	now lan	ies, L <sub>A</sub> , L	<sub>D</sub> , V <sub>I</sub>	R, V <sub>f</sub> )				
Conversion t	o pc/h Und	der Base C	Condit	ions	1	1	1	1			<u>.</u>	
(pc/h)	V (Veh/hr)	PHF	Te	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>	1F	
Freeway	1450	0.95	Rol	ling	5	0	0	.930	1.00	164	1	
Ramp	205	0.95	ling	2	0 0.971 1.00			222	2			
UpStream												
DownStream												
	Me	erge Areas						C	Diverge A	reas		
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} + 0$	(V <sub>F</sub> - V <sub>R</sub> )P <sub>f</sub>	Đ	
$L_{FQ} = (Equat)$	ion 25-2 or	25-3)				L <sub>FO</sub> = (E	qua	ation 25-8	3 or 25-9	)		
$P_{EM}$ = using E	quation					$P_{FD} = 1.000$ using Equation 0						
$V_{40} = pc/h$	•					$V_{40} = 16$	41	nc/h				
Capacity Che	ocks					Canacit		hecks				
	Actual	Maxim	num		F?	Oupuon	<u>, Ci</u>	Actual		aximum	LOS E?	
			L:4 OF			V=V_		16/11		4600	No	
V <sub>FO</sub>		See Exh	DIT 25-		-			1641	1	400.41	No	
						$V_{FO} = V_F$		1/10	4	400.All	No	
V <sub>R12</sub>		4600	All		_	V <sub>R</sub>		1717		+000		
						V <sub>R</sub>		222		2100	No	
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	termina	tion (if no	t F)	
D <sub>R</sub> = 5.475 +	⊦ 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		DF	<sub>R</sub> = 4.252	2 + 0.008	6 V <sub>12</sub> - 0.0	09 L <sub>D</sub>	
D <sub>R</sub> = (po	:/ mi /ln)					D <sub>R</sub> =	15.	7 (pc/ mi	/ln)			
LOS = (Ex		LOS=	B (I	Exhibit 2	5-4)							
Speed Estim		Speed E	sti	mation	·							
M <sub>S</sub> = (Exibi	it 25-19)					D <sub>s</sub> =	0.3	83 (Exhi	bit 25-19	)		
S <sub>R</sub> = mph		S <sub>R</sub> =	53.	1 mph (I	Exhibit 2	5-19)						
$ S_0 = mph$	$S_0 = mph$ (Exhibit 25-19)							A mph (I	Exhibit 2	5-19)		
S= mph	(Exhibit 25	-14)				S = 53.1  mph (Exhibit 25-15)						

		RAMP	S AND	RAM	P JUN	CTIONS	WOR	KSHE	ET		
General	Informat	ion				Site Information           Freeway/Dir of Travel         US 160 Westbound					
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L S	S 160 W H 172 O	estbound n Ramp	
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2025	)	
Project Desc	ription US 1	60 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis					
inputs		Torrain Rolli	na							1	
Upstream Ac	lj Ramp		iig							Downstrea	m Adj Ramp
F Yes	Cn On									No	Off
No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft			<u> </u>							
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 40.0 <sub>R'</sub> V <sub>f</sub> )	) mph		VD =	veh/h
Convers	sion to po	/h Under	Base	Condi	tions	1	1				
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	<sub>HV</sub> f <sub>p</sub>
Freeway	800	0.95	Roll	ing	5	0	0.930		1.00	905	
UnStream	885	0.95	ROII	ing	2	0	0.971		1.00	960	
DownStream	n				 						
-	•	Merge Areas	8					Dive	erge Area	IS	
Estimat	ion of v <sub>12</sub>					Estima	tion of	<sup>r</sup> v <sub>12</sub>			
	١	$I_{12} = V_{F} (P_{FM})$	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>	
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Ec	uation 25-	-8 or 25-9	9)		
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = us	ing Equati	on			
V <sub>12</sub> = 905	pc/h					V <sub>12</sub> = pc/	h				
Capacit	y Checks					Capaci	ity Che	cks			
	Actua	al Max	timum	LOS	S F?		A	Actual	Ma	aximum	LOS F?
V	1965	Soo Ex	hihit 25.7	N	0	V <sub>FI</sub> =V <sub>F</sub>	-		See E	xhibit 25-14	
* FO	1005	Jee LA			0	V <sub>12</sub>			4	400:All	
V <sub>R12</sub>	1865	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See E	xhibit 25-14	
						V <sub>R</sub>			See E	xhibit 25-3	
Level of	Service	Determin	ation (	if not	F)	Level c	of Serv	ice De	etermi	ination (i	f not F)
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> =	4.252 +	0.0086 V	′ <sub>12</sub> - 0.009 L <sub>D</sub>	
D <sub>R</sub> =	15.8 (pc/ m/ln	)				D <sub>R</sub> = (	(pc/ m/ln)				
LOS =	B (Exhibit 25-	4)				LOS= (	(Exhibit 25	-4)			
Speed Estimation						Speed	Estima	ation			
$M_{\rm s} = 0.298$ (Exibit 25-19)						D <sub>s</sub> =	(Exhibit 2	5-19)			
$S_{R} = 54.6 \text{ mph} \text{ (Exhibit 25-19)}$						S <sub>R</sub> = r	mph (Exhi	bit 25-19	)		
$S_0 = N/$	A mph (Exhib	it 25-19)				S <sub>0</sub> = r	mph (Exh	ibit 25-1	9)		
S=54	.6 mph (Exhib	oit 25-14)				S = r	mph (Exhi	bit 25-15	i)		

		RAMP	S AND	RAM	) JUN	CTIONS	WORKS	SHEE	T			
General	Informati	ion				Site Int	formatio	n				
Analyst2 Agency or Co Date Perform	ompany	SEH Inc.	19		Fr Ju	eeway/Dir o Inction Irisdiction	of Travel	US SH	5 160 Wes I 172 On	stbound Ramp		
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Ye	ar 2025			
Project Desc	ription US 16	60 FEIS Gran	dview Sec	tion - Yea	ar 2025 Ai	nalysis						
Inputs										1		
Upstream Ac	lj Ramp	Terrain Rolli	ng							Downstream	m Adj Ramp	
F Yes	Cn On									Ves	On Off	
No	Cff Off									L <sub>down</sub> =	ft	
L <sub>up</sub> =	ft			0 1			40.0					
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V	o <sub>FR</sub> = 40.0 m <sub>R'</sub> V <sub>f</sub> )	iph		VD =	veh/h	
Convers	sion to pc	/h Under	Base	Condi	tions	1	1	1		1		
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>H</sub>	<sub>IV</sub> f <sub>p</sub>	
Freeway	1245	0.95	Rolli	ng	5	0	0.930	1	.00	1409		
UnStream	1045	0.95	RUII	ing			0.971		.00	1133		
DownStream	n											
	•	Merge Areas	ŝ		,		1	Diver	ge Areas			
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12				
	V	7 <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					$V_{12} = V$	r <sub>R</sub> + (V <sub>F</sub> - '	V <sub>R</sub> )P <sub>FD</sub>		
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Ec	uation 25-8 (	or 25-9)				
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = us	ing Equation					
V <sub>12</sub> = 1409	pc/h					V <sub>12</sub> = pc/	h					
Capacity	y Checks					Capacity Checks						
	Actua	al Max	imum	LOS	S F?		Act	ual	Maxi	imum	LOS F?	
	05.40					V <sub>FI</sub> =V <sub>F</sub>	-		See Exh	ibit 25-14		
v <sub>FO</sub>	2542	See Ex	hibit 25-7	N	0	V <sub>12</sub>			440	0:All		
V <sub>R12</sub>	2542	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Exh	ibit 25-14		
						V <sub>R</sub>			See Ext	nibit 25-3		
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	termin	ation (if	f not F)	
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0	.0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>		
D <sub>R</sub> =	21.0 (pc/ m/ln)	1				D <sub>R</sub> = (	(pc/ m/ln)					
LOS =	C (Exhibit 25-4	4)				LOS= (	(Exhibit 25-4)					
Speed Estimation						Speed	Estimati	on				
$M_{\rm s} = 0.323$ (Exibit 25-19)						D <sub>s</sub> =	(Exhibit 25-7	19)				
$S_{R}^{=}$ 54.2 mph (Exhibit 25-19)						S <sub>R</sub> = r	mph (Exhibit	25-19)				
$S_0 = N/$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = 1	mph (Exhibi	t 25-19)	)			
S=54	.2 mph (Exhib	it 25-14)				S =1	mph (Exhibit	25-15)				

US 160 FEIS Grandview Section – Year 2025 Traffic Analysis

## **Appendix B**

### **Alternative G Modified**

At-Grade Intersection Evaluation Worksheets

#### Preferred Alternative (G Modified) Analysis

(At-Grade, Signalized Intersections)

#### Apendix B - US 160 Analysis - Peak Hour LOS Results (Signalized Intersections)

Intersection and Approaches	2025 Tra	ffic Volume	es with C	Current Lan	eage	Year 2025 Traffic Volumes with 3 Lanes					
	Number of	AM Peak	k Hour	PM Peal	k Hour	Number of	AM Peal	(Hour	PM Peak	(Hour	
	Lanes	Delay <sup>(a)</sup>	LOS	Delay <sup>(a)</sup>	LOS	Lanes	Delay <sup>(a)</sup>	LOS	Delay <sup>(a)</sup>	LOS	
SIGNAL CONTROL											
US 550 & US 160	-	142.2	F	241.3	F	-	72.3	E	116.9	F	
Eastbound Left	2	223.3	F	295.3	F	2	137.9	F	218.5	F	
Eastbound Through	2	158.8	F	241.3	F	3	61.4	Ε	67.3	Ε	
Eastbound Right	1	0.3	Α	2.7	Α	1	0.3	Α	2.7	Α	
Westbound Left	2	164.4	F	110.5	F	2	127.2	F	123.2	F	
Westbound Through	2	175.5	F	403.7	F	3	91.0	F	205.6	F	
Westbound Right	1	28.5	С	39.7	D	1	34.3	С	55.3	E	
Northbound Left	2	215.2	F	317.5	F	2	111.4	F	214.9	F	
Northbound Through	1	46.0	D	62.4	E	1	40.3	D	65.2	E	
Northbound Right	1	0.5	Α	0.3	Α	1	0.5	Α	0.3	Α	
Southbound Left	1	72.6	Ε	88.7	F	1	72.0	Ε	69.2	Ε	
Southbound Through	1	59.2	Ε	61.1	E	1	59.2	Е	61.1	Ε	
Southbound Right	1	0.4	Α	0.7	Α	1	0.4	Α	0.7	Α	

Notes:

a) Delay measured as seconds per vehicle

AM Peak Period Year 2025 Traffic Volumes Current Laneage

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ	<b>^</b>	1	ሻሻ	<b>^</b>	1	ሻሻ	<b>†</b>	1	ሻ	<b>†</b>	1
Volume (vph)	480	1905	315	240	1750	140	945	70	485	110	55	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	4.0	4.0	5.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	505	2005	332	253	1842	147	995	74	511	116	58	405
RTOR Reduction (vph)	0	0	0	0	0	62	0	0	0	0	0	0
Lane Group Flow (vph)	505	2005	332	253	1842	85	995	74	511	116	58	405
Turn Type	Prot		Free	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			Free			Free
Actuated Green, G (s)	17.0	68.5	151.0	10.0	61.5	61.5	33.0	36.5	151.0	18.0	21.5	151.0
Effective Green, g (s)	17.0	68.5	151.0	10.0	61.5	61.5	33.0	36.5	151.0	18.0	21.5	151.0
Actuated g/C Ratio	0.11	0.45	1.00	0.07	0.41	0.41	0.22	0.24	1.00	0.12	0.14	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	
Lane Grp Cap (vph)	386	1605	1583	227	1441	645	750	450	1583	211	265	1583
v/s Ratio Prot	c0.15	c0.57		0.07	0.52		c0.29	0.04		0.07	0.03	
v/s Ratio Perm			0.21			0.05			c0.32			0.26
v/c Ratio	1.31	1.25	0.21	1.11	1.28	0.13	1.33	0.16	0.32	0.55	0.22	0.26
Uniform Delay, d1	67.0	41.2	0.0	70.5	44.8	28.0	59.0	45.2	0.0	62.7	57.3	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	156.3	117.5	0.3	93.9	130.7	0.4	156.2	0.8	0.5	9.9	1.9	0.4
Delay (s)	223.3	158.8	0.3	164.4	175.5	28.5	215.2	46.0	0.5	72.6	59.2	0.4
Level of Service	F	F	А	F	F	С	F	D	А	E	E	A
Approach Delay (s)		151.7			164.6			137.8			20.8	
Approach LOS		F			F			F			С	
Intersection Summary												
HCM Average Control Delay	/		142.2	Н	CM Level	l of Servic	e		F			
HCM Volume to Capacity ra	tio		1.08									
Actuated Cycle Length (s)			151.0	S	um of los	t time (s)			8.0			
Intersection Capacity Utilizat	tion		107.4%	IC	CU Level	of Service	;		G			
Analysis Period (min)			15									

c Critical Lane Group

PM Peak Period Year 2025 Traffic Volumes Current Laneage

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ	<b>†</b> †	1	ሻሻ	<b>†</b> †	1	ሻሻ	<b>†</b>	1	۲.	1	1
Volume (vph)	480	2725	1060	240	3135	135	565	70	295	170	85	590
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	4.0	4.0	5.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	505	2868	1116	253	3300	142	595	74	311	179	89	621
RTOR Reduction (vph)	0	0	0	0	0	33	0	0	0	0	0	0
Lane Group Flow (vph)	505	2868	1116	253	3300	109	595	74	311	179	89	621
Turn Type	Prot		Free	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			Free			Free
Actuated Green, G (s)	15.0	83.5	150.0	10.0	78.5	78.5	17.0	19.5	150.0	19.0	21.5	150.0
Effective Green, g (s)	15.0	83.5	150.0	10.0	78.5	78.5	17.0	19.5	150.0	19.0	21.5	150.0
Actuated g/C Ratio	0.10	0.56	1.00	0.07	0.52	0.52	0.11	0.13	1.00	0.13	0.14	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	
Lane Grp Cap (vph)	343	1970	1583	229	1852	828	389	242	1583	224	267	1583
v/s Ratio Prot	c0.15	0.81		0.07	c0.93		c0.17	0.04		0.10	0.05	
v/s Ratio Perm			c0.70			0.07			0.20			0.39
v/c Ratio	1.47	1.46	0.70	1.10	1.78	0.13	1.53	0.31	0.20	0.80	0.33	0.39
Uniform Delay, d1	67.5	33.2	0.0	70.0	35.8	18.3	66.5	59.1	0.0	63.6	57.8	0.0
Progression Factor	1.00	1.00	1.00	0.81	1.45	2.17	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	227.8	208.0	2.7	53.7	352.0	0.0	251.0	3.2	0.3	25.0	3.3	0.7
Delay (s)	295.3	241.3	2.7	110.5	403.7	39.7	317.5	62.4	0.3	88.7	61.1	0.7
Level of Service	F	F	А	F	F	D	F	E	А	F	E	А
Approach Delay (s)		188.0			369.7			197.6			24.5	
Approach LOS		F			F			F			С	
Intersection Summary												
HCM Average Control Delay	1		241.3	Н	CM Level	l of Servic	ce		F			
HCM Volume to Capacity ra	tio		1.51									
Actuated Cycle Length (s)			150.0	S	um of los	t time (s)			13.0			
Intersection Capacity Utilization	tion		134.8%	IC	CU Level	of Service	;		Н			
Analysis Period (min)			15									

c Critical Lane Group

## SEH MEMORANDUM

# Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS

September 17, 2010



TO:	Mike McVaugh, PE - CDOT Region 5				
FROM:	Phil Weisbach, PE Jon E. Larson, PE Jon F. Larson, PE				
DATE:	September 17, 2010				
RE:	Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS SEH No. CODOT – 105181				

#### **Executive Summary**

Alternatives for the US 550 connection to the US 160 corridor were originally evaluated in the US Highway 160 from Durango to Bayfield Final Environmental Impact Statement (FEIS) dated May 2006. The US 160 Highway from Durango to Bayfield Record of Decision (US 160 ROD) documented selection of Grandview Alternative G Modified as the Preferred Alternative which included an interchange of US 160 with US 550 approximately 0.6 miles east of the current intersection.

This analysis updates the traffic operations analysis from the FEIS to the year 2030 for several alternatives listed below and for at-grade intersections. An additional memo will analyze options for the US 160 Section 4(f) which includes some of the alternatives from the US 160 FEIS. This analysis looks at projected traffic in the year 2030 to evaluate if the roadway will meet the capacity requirements for the purpose and need 20 years into the future. The technical documentation of this analysis is included in the appendices of this memo.

This analysis addresses several questions:

- A. Does the US 160 Alternative G Modified continue to meet the capacity requirements of the purpose and need in the design year 2030?
- B. Do the future connections at Alternative G Modified, Three Springs/CR 233, and SH 172/CR 234 in the design year 2030 need to be interchanges?
- C. In the year 2030, does Alternative F Modified from the US 160 FEIS meet the capacity requirements of the purpose and need?

The purpose for improvements to the US 160 corridor include increasing travel efficiency and capacity to meet current and future needs, while improving safety for the traveling public by reducing the number and severity of accidents, and controlling access. The design year of the US 160 FEIS was 2025. The analysis performed in this memorandum will be the same as the FEIS except the design year is changed to 2030.

YEAR 2030 Analysis	Purpose and Need for Capacity					
	Met	Not Met				
Alternative (G Modified)	$\checkmark$					
Alternative (F Modified)		$\checkmark$				
At-Grade Signalized Intersections						
US 160 @ 172/CR 234		$\checkmark$				
US 160 @ CR 233 (Three Springs)		$\checkmark$				
US 160 @ Grandview		$\checkmark$				

**<u>Summary of Results:</u>** The results of the analysis performed are summarized below:

#### **Analysis Performed**

#### **Evaluation Criteria**

The interchange alternatives were evaluated to determine if each alternative met operational level of service requirements as described in the Executive Summary of the FEIS, based on guidance in the AASHTO Policy on Geometric Design of Highways and Streets 2004 (AASHTO Green Book) and capacity analysis performed according to the methods described in the <u>Highway Capacity Manual</u><sup>1</sup> (HCS). This memorandum deals with the capacity analysis and not design. Traffic volumes used in the analysis are year 2030 peak hour volumes that were projected from the year 2025 volumes documented in <u>Appendix A, Traffic Report, Figure 8 of the US 160 FEIS</u>. The 2025 background traffic volumes were projected based on the background annual growth rates in the accepted methodology in the FEIS to calculate the year 2030 background scenario. For this scenario it is assumed the approved development of the 2004 Grandview Area Plan by the City of Durango and La Plata County is fully built out in the year 2030. The trips generated by the Grandview development were combined with the year 2030 background volumes to generate the year 2030 total peak hour volumes used in the analysis.

The capacity requirement for the purpose and need of the Grandview Section is as follows:

- A Level of Service (LOS) D or better for an urban signalized intersection, including signalized intersections at single point urban interchanges (SPUI), and its individual legs or movements during the peak hour in year 2030; and
- A LOS D or better for urban interchange merge, diverge, weaving area, auxiliary lanes, and/or freeway sections during the peak hour in year 2030.

Anything worse than LOS D for any intersection, leg, movement, ramp or freeway section is considered "failing," and not meeting the purpose and need. These criteria were applied to the alternatives analyzed in this memorandum.

<sup>1</sup> 

<sup>&</sup>lt;u>Highway Capacity Manual - Special Report 209</u>. Transportation Research Board. National Research Council. 2000.

Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS September 17, 2010 Page 3

For the purposes of this analysis, US 160 is assumed to be east/west and US 550 is assumed to be north/south. Each analysis verifies the capacity requirements of each interchange that is a part of the Grandview Section as described in the FEIS.

#### **US 160 Continuous Through Lanes**

#### US 160 FEIS

Using year 2025 projected traffic volumes, the Alternative G Modified in the US 160 FEIS included a four-lane typical section, two continuous lanes in each direction, throughout the corridor with a westbound auxiliary lane and eastbound climbing lane from the Grandview Section limit at MP 88 to the future connection of US 160 and US 550. Auxiliary lanes were added to maintain an operational level of service of D by improving the merge, diverge and weave movements, thus helping to make safer lane transitions to and from the future location US 160/US 550 interchange.

#### Year 2030 Traffic Operations Analysis

In the analysis, the projected traffic volumes were extended to the year 2030. The background traffic on US 160 was increased from the year 2025 to 2030, and the trip generation from a fully developed Grandview Area Plan increased traffic on the US 160 mainline as well as the entering and exiting traffic volumes to US 160. Due to the increased entering/exiting volumes, auxiliary lanes will need to be extended, from those assumed in the US 160 FEIS. The auxiliary lanes in the year 2030 need to be extended to the future CR 233 (Three Springs) interchange to maintain a LOS D for the traffic operations of the merge, diverge and weaving movements along US 160.

Since the number of continuous through lanes remains constant throughout the US 160 corridor and auxiliary lanes are not carried through any of the interchanges, auxiliary lanes are not considered capacity-adding improvement measures. However, they can be utilized to improve the traffic operations between two successive interchanges and to assist in accommodating high entering/exiting traffic volumes. Without auxiliary lanes at high volume locations, bottleneck areas can result due to poor levels of service for the merging, diverging, and weaving movements. Areas of congestion such as bottleneck locations typically coincide with areas that exhibit poor accident ratings.

#### Special Case: Alternative F Modified

Though Alternative F modified does not include a Grandview interchange, the auxiliary lane assumptions for this alternative do not change. From the west project limit to the Alternative F Modified Interchange (Three Springs interchange) there would be two through lanes in each direction with an eastbound climbing lane and a westbound auxiliary lane. This is true for the US 160 FEIS as well in the year 2030 analysis.

#### **US 160 Interchanges and Signalized Intersections**

- Highway Segments, Ramp Merge/Diverge, Weaving Sections. The capacity of each of these features was evaluated based on HCS criteria with a minimum LOS D or better as the operational goal. The Year 2025 projected traffic volumes from the FEIS were adjusted to reflect projected Year 2030 volumes, and were used to evaluate LOS for each alternative.
- **Signalized Intersections.** The capacities of signalized intersections were evaluated using HCS criteria with a minimum LOS D or better for the intersection and the individual legs of the intersection. An individual leg having an LOS of E or F is also a failing criteria for the intersection.

#### Alternative G Modified (FEIS) Analysis (Year 2030) – Figure 1

This evaluation was performed to determine whether the Alternative G Modified (FEIS) meets the capacity requirements of the purpose and need for the design year 2030. The analysis assumes two

Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS September 17, 2010 Page 4

through lanes in each direction through the Grandview Section with a westbound auxiliary lane and eastbound climbing lane from the Grandview Section limit at MP 88 to the future connection of US 160 and US 550, similar to the US 160 FEIS, but with additional eastbound and westbound auxiliary lanes between the US 160/US 550 interchange and CR 233 (Three Springs) interchange. A trumpet interchange is assumed at the US 550 Grandview Interchange and Single Point Urban Interchange (SPUI) is assumed at both the CR 233 (Three Springs) and SH 172 / CR 234 interchanges.

The results of the analysis (Figure 1) show that the freeway segments and ramp merge/diverge operations for all of the interchanges are expected to operate at LOS D or better during the morning and evening peak periods. The analysis worksheets are contained in Appendix A for reference.

#### **Conclusion**

Based on the analysis, the results show that this alternative satisfies the capacity requirements of the purpose and need in the year 2030. This alternative accommodates the projected year 2030 volumes at LOS D or better.

#### At-Grade, Signalized Intersection Analysis – Figure 2

For this scenario, it is assumed that US 550 connects to US 160 at the existing connection or west of that location. The traffic volumes on US 550 were routed as through volumes on US 160 based on historic directional splits at the existing US 550 / US 160 intersection.

The connections evaluated in the US 160 FEIS Alternative G Modified were analyzed as at-grade, signalized intersections using year 2025 peak hour traffic volumes. This analysis is to determine if these connections could operate as at-grade intersections in the year 2030. Figure 2 illustrates the intersection laneage configurations, traffic volumes and the traffic operations analysis results. The analysis worksheets are contained in Appendix B for reference.

#### SH 172 / CR 234 – Signalized Intersection

The assumed lane configuration on US 160 includes two left turn lanes (eastbound), one left turn lane (westbound), two through lanes and one right turn lane in each direction. On CR 234 (southbound), the lane configuration includes one lane each for the left turn, through and right turn movements. On SH 172 (northbound), the lane configuration includes two left turn lanes, one through lane and one right turn lane.

The signalized intersection is expected to operate at LOS D in the morning peak period and LOS E in the evening peak period. Numerous individual movements are shown to exhibit LOS E during the morning peak period and LOS F during the evening peak period as well. A triple left turn lane on northbound SH 172 is a critical improvement in that this intersection could not meet the LOS D capacity requirements in the year 2030 without it. However, there is a local cemetery on the southwest corner of the intersection and on the east side of the intersection approximately 1500 feet south there is a local elementary school. These two features constrain the intersection and its ability to carry more lanes of traffic. To avoid impacts to the cemetery and the school, the FEIS selected a SPUI to address the traffic volumes at this intersection. The limits of the proposed interchange in the FEIS do not encroach on either of these properties. An at-grade signalized intersection would encroach on one or both properties if additional lanes were added to SH 172 to accommodate the traffic volumes at the intersection.

#### CR 233 (Three Springs) – Signalized Intersection

The assumed lane configuration on US 160 includes two left turn lanes (eastbound), one left turn lane (westbound), two through lanes and one right turn lane in each direction. On Three Springs Blvd., the lane configuration includes two left turn lanes, one through lane and one right turn lane southbound and one through lane, left turn lane, and right turn lane northbound.
Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS September 17, 2010 Page 5

The signalized intersection is expected to operate at LOS D in the morning peak period and LOS F in the evening peak period. Numerous individual movements are shown to exhibit LOS F during the morning and evening peak periods as well.

In an attempt to improve the LOS to acceptable levels, additional lanes were added to particularly heavy movements and signal timing was optimized. Even with providing three lanes in each direction through the intersection on US 160 and analyzing triple left turn lanes, the LOS D evaluation criteria for signalized intersections and individual movements could not be achieved.

#### **Grandview – Signalized Intersection**

The assumed lane configuration on US 160 includes two left turn lanes, two through lanes, and one right turn lane in each direction. On the Grandview approach, the lane configuration includes two left turn lanes, one through lane and one right turn lane in each direction.

The signalized intersection is expected to operate at LOS C in the morning peak period and LOS F during the evening peak period. Numerous individual movements are shown to exhibit LOS F during the morning and evening peak periods as well.

In an attempt to improve the LOS to acceptable levels, additional lanes were added to particularly heavy movements and signal timing was optimized. Even with providing three lanes in each direction through the intersection on US 160 and analyzing triple left turn lanes, the LOS D evaluation criteria for signalized intersections and individual movements could not be achieved.

#### **Conclusion**

Based on the analysis of the three intersections, the results show that interchanges are necessary for the three connections to satisfy the capacity requirements for the purpose and need.

### Alternative F Modified (FEIS) Analysis (Year 2030) - Figure 3

This evaluation was performed to determine whether Alternative F Modified (Figure 3) meets the capacity requirements of the purpose and need in the year 2030, while utilizing the same evaluation criteria as in the FEIS. Though Alternative F modified (Three Springs Interchange) does not include a Grandview interchange, the auxiliary lane assumptions for this alternative do not change. From the west project limit to the Three Springs interchange would be two through lanes in each direction with an eastbound climbing lane and a westbound auxiliary lane. This is true for the US 160 FEIS as well as the year 2030 analysis. Interchanges evaluated where the SPUI interchanges at SH 172/CR 234 and CR 233 (Three Springs) with US 550 connecting at CR 233 (Three Springs). The Three Springs development traffic was distributed equally (50/50) to the CR 233 (Three Springs) and SH 172/CR 234 interchanges. The analysis worksheets are contained in Appendix C for reference.

#### SH 172 / CR 234 Interchange

The interchange will have single lane ramps with merge and diverge movements that will continue to operate acceptably at LOS B during the morning peak period and LOS C or better during the evening peak period. The signalized intersection in the center of the interchange will continue to operate acceptably at LOS C during the morning and evening peak periods with individual movements operating at LOS D or better during both peak periods.

#### CR 233 (Three Springs) Interchange

The merge, diverge, and weave movements will continue to operate acceptably at LOS C or better during the morning and evening peak periods except for the westbound on-ramp which is expected to operate at LOS F. The signalized intersection in the center of the interchange will continue to operate acceptably at LOS C during the morning peak period and LOS D during the evening peak period. However, the

Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS September 17, 2010 Page 6

eastbound right turn, northbound left turn, northbound through and southbound through movements will degrade to an unacceptable LOS E during the evening peak period.

#### **Conclusion**

With the additional traffic at the CR 233 (Three Springs) interchange for the Alternative F Modified configuration, the operational capacity does not satisfy the capacity requirements for the purpose and need due to the failing LOS for the US 160 westbound on-ramp merge to southbound US 550 at the CR 233 (Three Springs) interchange and the failing LOS southbound from CR 233 (Three Springs) to US 160 westbound right turn movement. This alternative does not meet the capacity requirement for the purpose and need in the year 2030.

#### **Conclusions**

The following conclusions answer three questions fundamental to the purpose of the traffic operations analysis in this memorandum:

Does the US 160 Alternative G Modified continue to meet the capacity requirements of the purpose and need in the design year 2030?

- Alternative G Modified (FEIS) Analysis (Year 2030). With year 2030 traffic volumes, this alternative meets the LOS criteria for the purpose and need.
- Do the future connections at Alternative G Modified, Three Springs/CR 233, and SH 172/CR 234 in the design year 2030 need to be interchanges?
- At-Grade, Signalized Intersections Analysis. The signalized intersections are expected to operate at a failing LOS at the Grandview and CR 233 (Three Springs) intersections even with the absence of a northbound US 550 connection. The SH 172 / CR 234 intersection has environmental and other constraints that do not allow SH 172 to be widened to accommodate the 2030 traffic volumes. The results show that interchanges are necessary for the three connections to US 160 to satisfy the capacity requirements of the purpose and need.

In the year 2030, does Alternative F Modified from the US 160 FEIS meet the capacity requirements of the purpose and need?

Alternative F Modified (FEIS) Analysis (Year 2030). The CR 233 (Three Springs) interchange exceeds the LOS D threshold, therefore this alternative fails to meet the capacity requirements for the purpose and need.

jel

Attachments

p:\ae\c\codot\105181\to #3 - us 160 interchange analysis\project\\_\_\_final memos\_september 2010\2\_2030 traffic ops analysis for alternatives from the us 160 feis\_09-17-2010\_final.docx



Year 2030 Traffic Volumes



2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS US 160 FEIS Alternative G (Modified) - Interchange Analysis

Drawn by NV	/S Job #	105181	Figure	1



Year 2030 Traffic Volumes



Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS US 160 FEIS Alternative G (Modified) - At-Grade, Signalized Intersection Analysis

Drawn by NWS	Job #	105181	Figure	2	
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SEH

Scale

1"=1500'

Date

4/28/10

Year 2030 Traffic Volumes

2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS US 160 FEIS Alternative F (Modified) - Interchange Analysis

	Drawn by NWS	Job #	105181	Figure	3	
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Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS

# **Appendix A**

## **Alternative G Modified**

Interchange Evaluation Worksheets

PM Peak Period Year 2030 Traffic Volumes Alternative G (Modified)

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ		1	5		1	ካካ	•	1	5	•	1
Volume (vph)	385	0	855	125	0	90	685	105	115	135	80	405
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	10.0		10.0	10.0		10.0	10.0	9.5	10.0	10.0	9.5	10.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	405	0	900	132	0	95	721	111	121	142	84	426
RTOR Reduction (vph)	0	0	211	0	0	39	0	0	82	0	0	63
Lane Group Flow (vph)	405	0	689	132	0	56	721	111	39	142	84	363
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			16
Actuated Green, G (s)	17.8		52.7	17.8		52.7	31.5	11.2	38.5	31.5	11.2	38.5
Effective Green, g (s)	17.8		52.7	17.8		52.7	31.5	11.2	29.0	31.5	11.2	29.0
Actuated g/C Ratio	0.20		0.59	0.20		0.59	0.35	0.12	0.32	0.35	0.12	0.32
Clearance Time (s)	10.0			10.0			10.0	9.5		10.0	9.5	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	679		927	350		927	1202	232	510	620	232	510
v/s Ratio Prot	0.12			0.07			0.21	0.06		0.08	0.05	
v/s Ratio Perm			c0.44			0.04			0.02			c0.23
v/c Ratio	0.60		0.74	0.38		0.06	0.60	0.48	0.08	0.23	0.36	0.71
Uniform Delay, d1	32.8		13.7	31.3		8.0	24.1	36.7	21.2	20.7	36.1	26.8
Progression Factor	0.95		1.27	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.4		3.3	0.7		0.0	0.8	6.9	0.1	0.2	4.3	4.7
Delay (s)	32.5		20.7	32.0		8.0	24.9	43.6	21.3	20.9	40.5	31.5
Level of Service	С		С	С		A	С	D	С	С	D	С
Approach Delay (s)		24.3			22.0			26.6			30.3	
Approach LOS		С			С			С			С	
Intersection Summary												
HCM Average Control Delay			26.1	Н	CM Leve	l of Servic	e		С			
HCM Volume to Capacity rat	io		0.74									
Actuated Cycle Length (s)			90.0	S	um of los	t time (s)			20.0			
Intersection Capacity Utilizat	ion		87.8%	IC	U Level	of Service	:		E			
Analysis Period (min)			15									
c Critical Lane Group												

AM Peak Period Year 2030 Traffic Volumes Alternative G Modified

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	۲		1	ሻሻ	•	1	5	•	1
Volume (vph)	260	0	350	70	0	70	685	55	65	50	40	255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	274	0	368	74	0	74	721	58	68	53	42	268
RTOR Reduction (vph)	0	0	123	0	0	25	0	0	41	0	0	91
Lane Group Flow (vph)	274	0	245	74	0	49	721	58	27	53	42	178
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			16
Actuated Green, G (s)	12.5		60.0	12.5		60.0	27.8	23.2	44.2	27.8	23.2	44.2
Effective Green, g (s)	12.5		60.0	12.5		60.0	27.8	23.2	35.7	27.8	23.2	35.7
Actuated g/C Ratio	0.14		0.67	0.14		0.67	0.31	0.26	0.40	0.31	0.26	0.40
Clearance Time (s)	9.0			9.0			9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	477		1055	246		1055	1060	480	628	547	480	628
v/s Ratio Prot	c0.08			0.04			c0.21	0.03		0.03	0.02	
v/s Ratio Perm			0.15			0.03			0.02			c0.11
v/c Ratio	0.57		0.23	0.30		0.05	0.68	0.12	0.04	0.10	0.09	0.28
Uniform Delay, d1	36.3		5.9	34.8		5.2	27.2	25.6	16.7	22.2	25.4	18.4
Progression Factor	1.25		1.91	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.7		0.1	0.7		0.0	1.8	0.5	0.0	0.1	0.4	0.2
Delay (s)	46.9		11.4	35.5		5.2	29.0	26.1	16.7	22.2	25.7	18.7
Level of Service	D		В	D		А	С	С	В	С	С	В
Approach Delay (s)		26.6			20.3			27.8			20.0	
Approach LOS		С			С			С			С	
Intersection Summary												
HCM Average Control Delay			25.5	H	CM Leve	l of Servic	ce		С			
HCM Volume to Capacity rat	io		0.52									
Actuated Cycle Length (s)			90.0	Si	um of los	st time (s)			27.0			
Intersection Capacity Utilizati	ion		51.8%	IC	U Level	of Service	;		А			
Analysis Period (min)			15									
c Critical Lane Group												

PM Peak Period Year 2030 Traffic Volumes Alternative G (Modified)

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	5		1	ሻሻ	•	1	5	•	1
Volume (vph)	385	0	855	125	0	90	685	105	115	135	80	405
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	10.0		10.0	10.0		10.0	10.0	9.5	10.0	10.0	9.5	10.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	405	0	900	132	0	95	721	111	121	142	84	426
RTOR Reduction (vph)	0	0	209	0	0	39	0	0	84	0	0	65
Lane Group Flow (vph)	405	0	691	132	0	56	721	111	37	142	84	361
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			16
Actuated Green, G (s)	17.5		53.0	17.5		53.0	33.3	9.7	36.7	33.3	9.7	36.7
Effective Green, g (s)	17.5		53.0	17.5		53.0	33.3	9.7	27.2	33.3	9.7	27.2
Actuated g/C Ratio	0.19		0.59	0.19		0.59	0.37	0.11	0.30	0.37	0.11	0.30
Clearance Time (s)	10.0			10.0			10.0	9.5		10.0	9.5	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	668		932	344		932	1270	201	478	655	201	478
v/s Ratio Prot	0.12			0.07			0.21	0.06		0.08	0.05	
v/s Ratio Perm			c0.44			0.04			0.02			c0.23
v/c Ratio	0.61		0.74	0.38		0.06	0.57	0.55	0.08	0.22	0.42	0.76
Uniform Delay, d1	33.1		13.5	31.6		7.9	22.6	38.1	22.4	19.4	37.5	28.4
Progression Factor	0.96		1.27	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.6		3.2	0.7		0.0	0.6	10.5	0.1	0.2	6.3	6.7
Delay (s)	33.3		20.3	32.3		7.9	23.2	48.6	22.5	19.6	43.8	35.1
Level of Service	С		С	С		А	С	D	С	В	D	D
Approach Delay (s)		24.4			22.1			26.1			32.8	
Approach LOS		С			С			С			С	
Intersection Summary												
HCM Average Control Delay			26.5	Н	CM Leve	el of Servic	e		С			
HCM Volume to Capacity ratio	0		0.75									
Actuated Cycle Length (s)			90.0	S	um of los	st time (s)			20.0			
Intersection Capacity Utilization	on		87.8%	IC	U Level	of Service	;		E			
Analysis Period (min)			15									
c Critical Lane Group												

AM Peak Period Year 2030 Traffic Volumes Alternative G Modified

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	5		1	ሻሻ	•	1	ሻሻ	•	1
Volume (vph)	735	0	355	95	0	195	180	60	50	145	60	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	774	0	374	100	0	205	189	63	53	153	63	584
RTOR Reduction (vph)	0	0	294	0	0	72	0	0	27	0	0	0
Lane Group Flow (vph)	774	0	80	100	0	133	189	63	26	153	63	584
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			5			5			16			156
Actuated Green, G (s)	23.5		19.3	23.5		19.3	19.3	20.7	52.7	19.3	20.7	90.0
Effective Green, g (s)	23.5		19.3	23.5		19.3	19.3	20.7	44.2	19.3	20.7	81.5
Actuated g/C Ratio	0.26		0.21	0.26		0.21	0.21	0.23	0.49	0.21	0.23	0.91
Clearance Time (s)	9.0		9.0	9.0		9.0	9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	896		339	462		339	736	428	777	736	428	1433
v/s Ratio Prot	c0.23			0.06			0.06	0.03		0.04	0.03	
v/s Ratio Perm			0.05			0.08			0.02			c0.37
v/c Ratio	0.86		0.24	0.22		0.39	0.26	0.15	0.03	0.21	0.15	0.41
Uniform Delay, d1	31.7		29.3	26.0		30.3	29.4	27.6	11.8	29.1	27.6	0.6
Progression Factor	1.00		1.00	0.57		0.94	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.7		0.4	0.2		0.7	0.2	0.7	0.0	0.1	0.7	0.2
Delay (s)	40.4		29.6	15.0		29.2	29.6	28.3	11.9	29.2	28.3	0.8
Level of Service	D		С	В		С	С	С	В	С	С	A
Approach Delay (s)		36.9			24.5			26.2			8.4	
Approach LOS		D			С			С			А	
Intersection Summary												
HCM Average Control Delay	y		25.2	Н	CM Leve	el of Servic	e		С			
HCM Volume to Capacity ra	itio		0.51									
Actuated Cycle Length (s)			90.0	Si	um of los	st time (s)			9.0			
Intersection Capacity Utiliza	tion		59.3%	IC	U Level	of Service	<u>;</u>		В			
Analysis Period (min)			15									
c Critical Lane Group												

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET		
General	Informati	ion				Site Inf	ormatic	n			
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir o Inction Irisdiction	f Travel	U C	S 160 Ea R 223 O	astbound n Ramp	
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2030	)	
Project Desc	ription Year 2	2030 Traffic C	)perations	Analysis	of the US	160 FEIS					
inputs		Torrain Polli	na								
Upstream Ad	j Ramp		ny							Downstrea	m Adj Ramp
F Yes	Cn On									Ves	On
No No	C Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft										
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	v <sub>FR</sub> = 40.0 r <sub>R'</sub> V <sub>f</sub> )	nph		VD =	veh/h
Convers	ion to pc	/h Under	Base	Condi	tions	4					
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	HV <sup>f</sup> p
Freeway	1560	0.95	Roll	ing	5	0	0.930		1.00	1765	
Ramp UnStroam	195	0.95	ing	2	0	0.971		1.00	211		
DownStream	] 1										
	<u> </u>	Merge Areas	5 5		J			Dive	rge Area	IS	
Estimati	on of v <sub>12</sub>					Estima	tion of v	12			
	 V	′ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>	
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>EO</sub> = (Eq	uation 25-8	or 25-9	<i>)</i> )		
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = usi	ing Equatior	I			
V <sub>12</sub> = 1765	pc/h					$V_{12} = pc/l$	h				
	/ Checks					Capaci	ty Chec	ks			
	Actua	al Max	imum	LOS	S F?		Ac	tual	Ma	aximum	LOS F?
						V <sub>FI</sub> =V <sub>F</sub>			See Ex	xhibit 25-14	
V <sub>FO</sub>	1976	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44	400:All	
V <sub>R12</sub>	1976	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See E	xhibit 25-14	
						V <sub>R</sub>			See E	xhibit 25-3	
Level of	Service I	F)	Level o	of Servic	e De	etermi	ination (i	f not F)			
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4	252 +	0.0086 V	′ <sub>12</sub> - 0.009 L <sub>D</sub>				
D <sub>R</sub> =	11.6 (pc/ m/ln)					D <sub>R</sub> = (	pc/ m/ln)				
LOS =	B (Exhibit 25-4	1)				LOS= (	Exhibit 25-4	)			
Speed E	stimation	ı				Speed	Estimat	ion			
$M_{s} = 0.2$	232 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	19)			
S <sub>R</sub> = 55	.8 mph (Exhib	it 25-19)				S <sub>R</sub> = r	mph (Exhibi	t 25-19	)		
$S_0 = N/2$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = r	mph (Exhib	it 25-19	9)		
S= 55	.8 mph (Exhib	it 25-14)				S = r	nph (Exhibi	t 25-15	)		

		RAM	PS AN		, JNNC.	TIONS W	OR	KSHEE <sup>-</sup>	Г			
General Info	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eway/Dir	of <sup>-</sup>	Travel	US 16	0 Eas	stbound	
Agency or Co	mpany				Jur	nction			CR 23	3 Of	f Ramp	
Date Perform	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 2	2030		
Project Descr	iption Yea	ar 2030 Tra	affic Op	perations	Analysi	is of the l	JS 1	60 FEIS	3			
Inputs		<b>T</b> '.										
Upstream Adj	Ramp	Terrain								C F	Downstrea Ramp	am Adj
Yes	On										Yes	🔲 On
No 🔽	Off										🗌 No	Off
L <sub>up</sub> = ft	-	\$	_	60.0 mpt	<u> </u>	$L_{down} = ft$						
	h/h	0	FF - c	kotch ( c	how lon		FR <sup>-</sup>		прп	V	/D =	veh/h
vu – ve					now lan	ies, L <sub>A</sub> , L	D, <sup>V</sup> F	<sup>, ν</sup> f)				
Conversion t	o pc/h Und	ier Base C	ondit	ions	1	1	1	1		h		
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>l</sub>	HV fp	
Freeway	3460	0.95	Rol	ling	5	0	0.	.930	1.00		3915	
Ramp	1065	2	0	0.	.971	1.00		1155				
UpStream												
DownStream												
	Me	rge Areas							Diverge A	Areas		
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	· V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$_{2} = V_{R} +$	(V <sub>F</sub> -	V <sub>R</sub> )P <sub>FD</sub>	
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	tion 25-8	3 or 25-9	)		
$P_{rM} = using E$	quation	,				$P_{FD} = 0.6$	509	usina F	- auation	5		
$V_{\rm res} = nc/h$	1					$V_{} = 28$	36	nc/h	-94441011	Ŭ		
$V_{12}^{-} p_{0/11}$	ocks					$r_{12} - 20$		books				
		Maxim			E2	Capach		Actua		lavim		
	Actual				1:	\/ _\/		2015		6000		No.
V <sub>FO</sub>		See Exhi	bit 25-		-	V FI V F		3913		4400		No No
						$\frac{v_{12}}{v_{12}}$		2830		+400./		INO
V <sub>R12</sub>		4600	:All			V <sub>FO</sub> – V <sub>R</sub>	-	2760		6900	)	No
						V <sub>R</sub>		1155		2100		No
Level of Serv		Level of	Se	rvice De	etermina	ntion (	(if not F)					
D <sub>R</sub> = 5.475 -	⊦ 0.00734 v	L <sub>A</sub>	$D_{R} = 4.252 + 0.0086 V_{12} - 0.009 L_{D}$									
D <sub>R</sub> = (po		D <sub>R</sub> = 19.6 (pc/ mi /ln)										
LOS = (E:	xhibit 25-4)					LOS=	B (E	Exhibit 2	5-4)			
Speed Estim	ation					Speed Estimation						
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.40	67 (Exhi	bit 25-19	9)		
S <sub>R</sub> = mph	(Exhibit 25-	-19)				S <sub>R</sub> =	51.0	6 mph (	Exhibit 2	25-19)	1	
S <sub>0</sub> = mph		S <sub>0</sub> =	65.:	5 mph (	Exhibit 2	25-19)	1					
S= mph	(Exhibit 25-	-14)				S =	54.8	8 mph (	Exhibit 2	25-15)		

		RAM	PS AN		, JNNC.	TIONS W	OR	KSHEE	Γ		
General Info	rmation			Site Information           Freeway/Dir of Travel         US 160 Eastbound           Importion         CP 233 Off Pamp							
Analyst		SEH Inc.			Fre	eway/Dir	of <sup>-</sup>	Travel	US 160	) Eastbour	nd
Agency or Co	mpany				Jur	nction			CR 233	3 Off Ram	р
Date Perform	ed	11/13/20	09		Jur	isdiction					
Analysis Time	Period	AM Peak	-		Ana	alysis Yea	ar		Year 2	030	
Project Descr	iption Yea	ar 2030 Tra	affic Op	perations	Analysi	is of the l	JS 1	60 FEIS	5		
Inputs		<del>.</del>								1	
Upstream Adj	Ramp	lerrain								Downst Ramp	ream Adj
Yes	On									Tes Yes	🗖 On
No 🔽	Off									🔲 No	Cff Off
L <sub>up</sub> = ft	-	\$	_	60.0 mpt	$L_{down} = ft$						
	h/h	0	FF -	wotob ( a	ı bowlor		'FR -	- +0.01	прп	VD =	veh/h
vu – ve			3		snow lan	ies, L <sub>A</sub> , L	D, <sup>V</sup> F	<sup>, ν</sup> f)			
Conversion t	o pc/h Und	ler Base C	ondit	ions	1	1	1				IC
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>H∨</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>	IF
Freeway	2650	0.95	Rol	ling	5	0	0.	.930	1.00	2999	)
Ramp	1090	ling	2	0	0.	.971	1.00	1182	2		
UpStream											
DownStream											
	Me	rge Areas					_	C	Diverge A	reas	
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>			
	V <sub>12</sub> =	$V_{F} (P_{FM})$						V <sub>12</sub>	$ = V_{R} + ($	V <sub>F</sub> - V <sub>R</sub> )P <sub>F</sub>	D
$L_{FO} = (Equat)$	ion 25-2 or	25-3)				L <sub>FO</sub> = (E	qua	tion 25-8	3 or 25-9)	)	
$P_{EM}$ = using E	quation					$P_{ED} = 0.6$	531	usina E	Equation	5	
$V_{40} = pc/h$	•					$V_{10} = 23$	28	nc/h	- 1	-	
Canacity Che	ocks							hocks			
	Actual	Maxim	m		F2	Capacity	<u>y Ci</u>	Actual	M	avimum	LOS F2
	710100					VV		2000		6000	No
V <sub>FO</sub>		See Exh	bit 25-		-	V		2338	4	400·All	No
Vpto		4600	All			$V_{FO} = V_F$ $V_P$	= -	1817	6	5900	No
R12			.,		-	V <sub>R</sub>		1182	2	2100	No
Level of Serv	vice Detern	nination (i	f not F	·)		Level of	Se	rvice De	terminat	tion (if not	<b>F</b> )
$D_{\rm p} = 5.475 +$	+ 0.00734 v	0.00627	Ĺ		D	, = 4.252	2 + 0.008	6 V <sub>12</sub> - 0.00	)9 L <sub>D</sub>		
$D_R = (pc$		A	$D_{R} = 15.3 \text{ (pc/ mi /ln)}$								
LOS = (E)	xhibit 25-4)					LOS = B (Exhibit 25-4)					
Speed Estim	ation					Speed Estimation					
$M_{\rm S} = (Exib)$	it 25-19)					D <sub>s</sub> =	0.40	69 (Exhil	bit 25-19)	)	
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	51.0	6 mph (B	Exhibit 25	5-19)	
$S_0 = mnh$			S <sub>0</sub> =	65.8	8 mph (B	Exhibit 25	5-19)				
S= mph	(Exhibit 25	-14)				S =	54.Ű	2 mph (I	Exhibit 25	, 5-15)	
p.i	(=/:::::==	• •)				-	<u> </u>	- mpn (.		, 10,	

		RAMP	S AND	RAM	P JUN	CTIONS		SHE	ET		
General	Informat	ion				Site Inf	formati	on			
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L S	IS 160 W H 172 Or	estbound n Ramp	
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	'ear 2030		
Project Desc	ription Year	2030 Traffic C	Operations	Analysis	of the US	5 160 FEIS					
Inputs		Torroin Dolli	20							1	
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp
F Yes	Cn On									Ves	On Off
l No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft			<u> </u>							
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	5 <sub>FR</sub> = 40.0 <sub>R</sub> ,V <sub>f</sub> )	mph		VD =	veh/h
Convers	sion to pc	/h Under	Base	Condi	tions	1	1			1	
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>
Freeway	1505	0.95	Roll	ing	5	0	0.930		1.00	1703	
Ramp UnStream	1090	0.95	ROIL	ing	<u> </u>	0	0.971		1.00	1182	
DownStream					 						
-	•	Merge Areas	5				1	Dive	erge Area	S	
Estimat	ion of v <sub>12</sub>					Estima	tion of	v <sub>12</sub>			
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>	
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Eq	uation 25-8	8 or 25-9	9)		
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = us	ing Equatio	n			
V <sub>12</sub> = 1703	pc/h					V <sub>12</sub> = pc/	h				
Capacit	y Checks					Capaci	ity Chee	cks			
	Actua	al Max	timum	LOS	S F?		A	ctual	Ма	ximum	LOS F?
V	2005					V <sub>FI</sub> =V <sub>F</sub>	-		See Ex	hibit 25-14	
v <sub>FO</sub>	2885	See Ex	nidit 25-7		0	V <sub>12</sub>			44	00:All	
V <sub>R12</sub>	2885	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ex	hibit 25-14	
						V <sub>R</sub>			See E	xhibit 25-3	
Level of	Service I	F)	Level c	of Servi	ce De	etermi	nation (i	f not F)			
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4	1.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>	
D <sub>R</sub> =	18.2 (pc/ m/ln)	)				D <sub>R</sub> = (	(pc/ m/ln)				
LOS =	B (Exhibit 25-4	4)				LOS= (	(Exhibit 25-	4)			
Speed E	stimatior	า				Speed	Estima	tion			
$M_{\rm S} = 0.2$	273 (Exibit 25	5-19)				D <sub>s</sub> =	(Exhibit 25	-19)			
S <sub>R</sub> = 55	.1 mph (Exhib	oit 25-19)				S <sub>R</sub> = r	mph (Exhil	oit 25-19	))		
$S_0 = N/$	A mph (Exhibi	it 25-19)				S <sub>0</sub> = r	mph (Exhi	oit 25-1	9)		
S= 55	.1 mph (Exhib	oit 25-14)				S = r	mph (Exhit	oit 25-15	5)		

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET		
General	Informat	ion				Site Inf	formatio	n			
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U S	S 160 W H 172 O	estbound n Ramp	
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2030		
Project Desc	ription Year	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS					
Inputs		Torrain Dolli	20								
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp
F Yes	Cn On									Ves	On
No No	Cff Off									L <sub>dowp</sub> =	ft
L <sub>up</sub> =	ft										
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	9 <sub>FR</sub> = 40.0 n <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h
Convers	ion to pc	/h Under	Base	Condi	tions	1					
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	<sub>HV</sub> f <sub>p</sub>
Freeway	935	0.95	Roll	ing	5	0	0.930		1.00	1058	
Ramp UnStream	940	2	0	0.971		1.00	1019				
DownStream	1										
	ļ	Merge Areas	5 5					Dive	rge Area	S	
Estimati	on of v <sub>12</sub>					Estima	tion of v	12			
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> = '	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>	
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Eq	uation 25-8	or 25-9	9)		
P <sub>FM</sub> = 1.000	using Equation	on O				$P_{FD} = us$	ing Equation				
V <sub>12</sub> = 1058	pc/h					$V_{12} = pc/$	h				
Capacity	/ Checks					Capaci	ty Chec	ks			
	Actua	al Max	timum	LOS	S F?		Act	ual	Ma	iximum	LOS F?
V	2077	Soo Ev	hihit 25.7	N	0	V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14	
¥ FO	2011				0	V <sub>12</sub>			44	100:All	
V <sub>R12</sub>	2077	460	)0:All	N	0	$V_{FO} = V_{F}$ $V_{R}$	-		See Ex	khibit 25-14	
						V <sub>R</sub>			See E	xhibit 25-3	
Level of	Service I	F)	Level c	of Servic	e De	etermi	nation (i	f not F)			
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4.	252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>				
D <sub>R</sub> =	12.0 (pc/ m/ln)					D <sub>R</sub> = (	pc/ m/ln)				
LOS =	B (Exhibit 25-4	4)				LOS= (	Exhibit 25-4	)			
Speed E	stimation	1				Speed	Estimat	ion			
M <sub>S</sub> = 0.2	235 (Exibit 25	-19)				D <sub>s</sub> =	(Exhibit 25-	19)			
S <sub>R</sub> = 55	.8 mph (Exhib	it 25-19)				S <sub>R</sub> = r	mph (Exhibi	t 25-19	)		
$S_0 = N/2$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = r	mph (Exhib	it 25-19	9)		
S= 55	.8 mph (Exhib	it 25-14)				S = r	mph (Exhibi	25-15	)		

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Info	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of 7	Fravel	US 160 Y	Westbour	nd		
Agency or Co	mpany				Jur	nction			SH 172	Off Ram	)		
Date Perform	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 203	30			
Project Descr	iption Yea	ar 2030 Tra	affic Op	perations	Analys	is of the l	JS 1	60 FEIS					
Inputs	1	<b>-</b> .											
Upstream Adj	Ramp	lerrain								Downsti Ramp	ream Adj		
Yes 🗖	On									Tes Yes	🗖 On		
No 🔽	Off									🗖 No	Cff Off		
L <sub>up</sub> = ft		<u> </u>	_	60 0 mpt	<u> </u>			- 100 m	nh	_L <sub>down</sub> =	ft		
	h/h	0	FF -	Wetch ( a			'FR -	· +0.0 II	ipii	VD =	veh/h		
vu – ve			3		snow lar	ies, L <sub>A</sub> , L	D, V F	<sub>R</sub> , ν <sub>f</sub> )					
Conversion t	to pc/h Und	der Base C	Condit	ions	1	1	1	1			E		
(pc/h)	V (Veh/hr)	PHF	Те	errain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>	F		
Freeway	1720	0.95	Rol	lling	5	0	0.	930	1.00	1946			
Ramp	215	0.95	Rol	lling	2	0	0.	971	1.00	233			
UpStream													
DownStream					<u> </u>	<u> </u>							
	Me	rge Areas						D	iverge Are	as			
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	= V <sub>R</sub> + (V	<sub>F</sub> - V <sub>R</sub> )P <sub>FC</sub>	)		
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
$P_{rM} = using E$	auation	,				$P_{rp} = 1$ (		usina F	auation (	ו			
V = nc/h	quation					$V_{12} = 1946$ pc/h							
$V_{12}$ - pc/fi	aka					$V_{12} = 1946 \text{ pc/h}$							
		Maxin			E2	Capacity	<u>y Cr</u>	Actual	Max	imum			
	Actual	Ινιαλιτί	luin		1:	<u> </u>					No		
V <sub>FO</sub>		See Exh	ibit 25-		-	V <sub>FI</sub> =V <sub>F</sub>		1940	4		NO		
		·				V <sub>12</sub>		1946	44(	JU:All	INO		
V <sub>R12</sub>		4600	:All			$V_{FO} = V_{F}$ $V_{R}$	-	1713	46	00	No		
						V <sub>R</sub>		233	21	00	No		
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Ser	rvice De	terminatio	on (if not i	F)		
D <sub>R</sub> = 5.475 -	+ 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	' L <sub>A</sub>		$D_R$	= 4.252	+ 0.0086	V <sub>12</sub> - 0.00	9 L <sub>D</sub>		
D <sub>R</sub> = (po	c/ mi /ln)					D <sub>R</sub> = 12.0 (pc/ mi /ln)							
LOS = (E:	xhibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.38	34 (Exhib	oit 25-19)				
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	53.1	l mph (E	xhibit 25-	19)			
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> =	N/A	mph (E	xhibit 25-	19)			
S= mph	(Exhibit 25	-14)				S = 53.1  mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET Deral Information Site Information												
General Info	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 160	Westbou	nd		
Agency or Co	mpany				Jur	nction			SH 172	Off Ram	р		
Date Perform	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period	AM Peak	<u>.</u>		An	alysis Yea	ar		Year 20	30			
Project Descr	iption Yea	ar 2030 Tra	affic Op	perations	Analys	is of the l	JS <sup>,</sup>	160 FEIS					
Inputs		Tarrain								1			
Upstream Adj	Ramp	rerrain								Downst Ramp	ream Adj		
Yes	On									Tes Yes	🗖 On		
No 🗆	Off									No No	Cff		
L <sub>up</sub> = ft		S		30.0 mpt				- 40.0 m	nh	L <sub>down</sub> =	ft		
	h/h	0	FF - V	kotob ( a	how lon		'FR -	- +0.0 m	ipn	VD =	veh/h		
vu – ve			0 		now lar	ies, L <sub>A</sub> , L	D, V I	R <sup>, v</sup> f)					
Conversion t	o pc/h Und	der Base C	conditi	ons	1	1	1	1			F		
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	$\frac{1}{2} \frac{1}{2} \frac{1}$			F				
Freeway	1075	0.95	Rol	ling	5	0	0	.930	1.00	1216	5		
Ramp	140	0.95	Rol	ling	2	0	0	.971	1.00	152			
UpStream													
DownStream													
	Me	erge Areas						D	iverge Are	eas			
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
$L_{FO} = (Equat)$	ion 25-2 or	25-3)				L <sub>FO</sub> = (E	qua	ation 25-8	or 25-9)				
$P_{EM}$ = using E	quation					$P_{ED} = 1.0$	000	usina E	quation	0			
$V_{40} = pc/h$	•					$V_{12} = 1216 \text{ pc/h}$							
	ocks					Capacit		hecks					
	Actual	Maxim	num	1.05	F?	Oupuon	<u>y 01</u>	Actual	Ma	ximum	LOS F?		
					• •	V=V_		1216		600	No		
V <sub>FO</sub>		See Exh	DIT 25-		-	V	·	1210	44	000 00·All	No		
		4600	· A II			$V_{FO} = V_F$	= -	1064	4	500	No		
* R12		4000	.711		-	V <sub>P</sub>		152	2	100	No		
Level of Serv	vice Detern	nination (i	f not F			Level of	Se	rvice Def	terminati	on (if not			
$D_{\rm p} = 5.475$	+ 0.00734 v	$r_{\rm p} + 0.007$	, 0.00627	L.		D	= 4.252	+ 0.0086	V 0.00	9 Lp			
$D_{-} = (nc)$	/ mi /ln)	0.000_	-A	$D_{\rm R} = 5.7 (\rm mc/mi/m)$									
IOS = (F)			IOS = A (Exhibit 25-4)										
ECC = (E	ation												
Speed Estim						D –	<u>.su</u> 0.2'	77 (Evbih	it 25 10)				
$I_{S} = (EXID)$	n 25-19)					S –	0.3 52	//(⊏XIIIC 2.mmb./⊑		10)			
S <sub>R</sub> = mph	(Exhibit 25	-19)				$G_R^=$	33. N	∠ mpn (E	xnidit 25-	19)			
$S_0 = mph$	(Exhibit 25	-19)				5 <sub>0</sub> =	N/A	A mph (E	xhibit 25-	19)			
S= mph	(Exhibit 25	-14)				S = 53.2 mph (Exhibit 25-15)							

		RAMP	S AND	RAM	) JUN	CTIONS	WORKS	SHEE	Т			
General	Informat	ion				Site Inf	ormatio	n				
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir o Inction Irisdiction	f Travel	US SH	160 Eastl 172 On R	bound Camp		
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Yea	ır 2030			
Project Desc	ription Year	2030 Traffic (	Operations	Analysis	of the US	5 160 FEIS						
Inputs		Tamala Dall							1			
Upstream Ac	lj Ramp	Terrain Roll	ng							Downstrea	m Adj Ramp	
F Yes	Cn On									Ves	On Off	
No No	Cff Off									L <sub>down</sub> =	ft	
L <sub>up</sub> =	ft			0 1			10.0					
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V <sub>F</sub>	<sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	ph		VD =	veh/h	
Convers	sion to pc	/h Under	Base	Condi	tions	1		1	(			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>H</sub>	IV <sup>f</sup> p	
Freeway	1555	1555         0.95         Rolling         5           250         0.95         Rolling         2					0.930	1.0	00	1760		
Ramp UnStream	250	0.95	2		0.971	1.0	00	271				
DownStream	n											
		Merge Areas	S		,			Diverg	e Areas			
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12				
	 \	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FN</sub>	)				,	V <sub>12</sub> = V <sub>R</sub>	2 + (V <sub>F</sub> - V	/ <sub>R</sub> )P <sub>FD</sub>		
L <sub>EO</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EO</sub> = (Eq	uation 25-8 c	or 25-9)				
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = usi	ing Equation					
V <sub>12</sub> = 1760	pc/h					$V_{12} = pc/h$						
Capacity	v Checks					Capacity Checks						
	Actua	al Max	kimum	LOS	S F?		Actu	lal	Maxir	num	LOS F?	
						V <sub>FI</sub> =V <sub>F</sub>			See Exhil	oit 25-14		
V <sub>FO</sub>	2031	See Ex	hibit 25-7	N	0	V <sub>12</sub>			4400	):All		
V <sub>R12</sub>	2031	460	DO:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Exhil	oit 25-14		
						V <sub>R</sub>			See Exhi	bit 25-3		
Level of	Service I	Determin	ation (	if not	F)	Level o	of Servic	e Det	ermina	ation (if	not F)	
D <sub>R</sub> =	5.475 + 0.007			D <sub>R</sub> = 4.2	252 + 0.0	0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>					
D <sub>R</sub> =	12.0 (pc/ m/ln)		D <sub>R</sub> = (	pc/ m/ln)								
LOS =	B (Exhibit 25-		LOS= (Exhibit 25-4)									
Speed E	stimatior	า				Speed	Estimati	on				
M <sub>S</sub> = 0.2	233 (Exibit 25	5-19)		D <sub>s</sub> = (Exhibit 25-19)								
S <sub>R</sub> = 55	.8 mph (Exhib	oit 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)						
$S_0 = N/$	N/A mph (Exhibit 25-19)						S <sub>0</sub> = mph (Exhibit 25-19)					
S= 55	.8 mph (Exhib	bit 25-14)				S = mph (Exhibit 25-15)						

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET			
General	Informati	ion				Site Inf	formatio	n				
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U S	S 160 Ea H 172 O	astbound n Ramp		
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2030	)		
Project Desc	ription Year 2	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS						
Inputs		Torrain Dolli	na							1		
Upstream Ac	j Ramp	Tellalli Kulli	ny							Downstrea	m Adj Ramp	
F Yes	Cn On									Ves	On Off	
No No	Cff Off									L <sub>down</sub> =	ft	
L <sub>up</sub> =	ft			<u> </u>								
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V	<sub>FR</sub> = 40.0 ι <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h	
Convers	ion to pc	/h Under	Base	Condi	tions	1		- 1		-		
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	<sub>HV</sub> f <sub>p</sub>	
Freeway	Freeway         1145         0.95         Rolling           Ramp         115         0.95         Rolling						0.930		1.00	1296		
Ramp 115 0.95 Rolling UpStream						0	0.971		1.00	125		
DownStream	 ו							_				
	1.	Merge Areas	5 5					Dive	rge Area	IS		
Estimati	on of v <sub>12</sub>					Estima	tion of	/12				
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>		
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>FO</sub> = (Ed	uation 25-8	or 25-9	9)			
P <sub>EM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation						
V <sub>12</sub> = 1296	pc/h					$V_{12} = pc/h$						
	/ Checks					Capaci	ty Chec	ks				
	Actua	al Max	imum	LOS	S F?		Ac	tual	Ma	aximum	LOS F?	
						V <sub>FI</sub> =V <sub>F</sub>			See E	xhibit 25-14		
V <sub>FO</sub>	1421	See Ex	hibit 25-7	N	0	V <sub>12</sub>			4	400:All		
V <sub>R12</sub>	1421	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See E	xhibit 25-14		
						V <sub>R</sub>			See E	xhibit 25-3		
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	etermi	ination (i	f not F)	
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4	.252 +	0.0086 V	′ <sub>12</sub> - 0.009 L <sub>D</sub>					
D <sub>R</sub> =	7.3 (pc/ m/ln)		D <sub>R</sub> = (	pc/ m/ln)								
LOS =	A (Exhibit 25-4		LOS= (Exhibit 25-4)									
Speed E	stimation	ı				Speed	Estimat	ion				
$M_{s} = 0.2$	220 (Exibit 25		D <sub>s</sub> = (Exhibit 25-19)									
S <sub>R</sub> = 56	<sub>2</sub> = 56.0 mph (Exhibit 25-19)						S <sub>R</sub> = mph (Exhibit 25-19)					
$S_0 = N/2$	N/A mph (Exhibit 25-19)						S <sub>0</sub> = mph (Exhibit 25-19)					
S=56	.0 mph (Exhib	it 25-14)			S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Infor	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	0 Eas	tbound		
Agency or Co	mpany				Jur	nction			SH 17	2 Off	Ramp		
Date Performe	ed	11/13/20	)9		Jur	isdiction							
Analysis Time	Period	PM Peak			Ana	alysis Ye	ar		Year 2	2030			
Project Descri	iption Yea	ar 2030 Tra	offic Op	perations	Analysi	is of the l	JS <sup>,</sup>	160 FEIS	6				
Inputs		<b>T</b> '.											
Upstream Adj	Ramp	Terrain								D R	ownstrea amp	ım Adj	
Yes	On									Г	Yes	🔲 On	
No 🔽	Off									Γ	No	C Off	
L <sub>up</sub> = ft		S	_	60 0 mpt	<u> </u>			- 40.0 r	mph	L	down =	ft	
	h/h	0	FF -	Wetch ( a	ı boyulor		FR <sup>-</sup>	- +0.01	прп	V	D =	veh/h	
vu – ve			3 		snow lan	ies, L <sub>A</sub> , L	D, V	$R^{,V_{f}}$					
Conversion t	o pc/h Und	der Base C	;ondit	ions	1	1	1	1					
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	$\begin{array}{c c c c c c c c c c c c c c c c c c c $							
Freeway	2795	5	0	0	.930	1.00		3163					
Ramp	1240	2	0	0	.971	1.00		1344					
UpStream													
DownStream					<u> </u>								
	Me	rge Areas							Diverge A	Areas			
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
$P_{\text{EM}}$ = using E	quation	·				$P_{ED} = 1.0$	000	usina I	Equation	0			
$V_{\rm m} = nc/h$	1					$V_{12} = 3163 \text{ pc/h}$							
Capacity Ch	ocks					$r_{12} = 31$		bocks					
		Maxim		201	F2	Capach	<u>y Cl</u>	Actua		lavimi	im		
	Actual				1:	<u>\/_\/</u>		2162		4600		No No	
V <sub>FO</sub>		See Exhi	bit 25-		-	V FI V F	:	2162		4000	<u> </u>	NO	
	<u> </u>					V <sub>12</sub>		3163		4400:7		NO	
V <sub>R12</sub>		4600	All			$V_{FO} = V_{F}$ $V_{R}$		1819		4600		No	
						V <sub>R</sub>		1344		2100		No	
Level of Serv	vice Detern	nination (i	f not F	)		Level of	<sup>-</sup> Se	rvice De	etermina	ation (	if not F)		
D <sub>R</sub> = 5.475 +	+ 0.00734 v	L <sub>A</sub>		D	<sub>R</sub> = 4.252	2 + 0.008	36 V <sub>12</sub>	- 0.009 L	-D				
D <sub>R</sub> = (po	c/ mi /ln)		$D_{\rm R} = 22.5 ({\rm pc/\ mi\ /ln})$						-				
LOS = (Ex	khibit 25-4)					LOS= C (Exhibit 25-4)							
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.4	84 (Exhi	bit 25-19	9)			
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	51.	3 mph (	Exhibit 2	25-19)			
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> =	N/A	A mph (	Exhibit 2	25-19)			
S= mph	(Exhibit 25	-14)				S = 51.3  mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Infor	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of <sup>-</sup>	Travel	US 160	) Eastboun	d		
Agency or Co	mpany				Jur	nction			SH 172	2 Off Ram	р		
Date Performe	ed	11/13/20	)9		Jur	isdiction							
Analysis Time	Period	AM Peak			Ana	alysis Yea	ar		Year 2	030			
Project Descri	ption Yea	ar 2030 Tra	iffic Op	perations	Analysi	is of the l	JS 1	160 FEIS					
Inputs		Terrein											
Upstream Adj	Ramp	rerrain								Downst Ramp	ream Adj		
Yes	On									Tes Yes	🗖 On		
No 🔽	Off									No No	Cff		
L <sub>up</sub> = ft		S		60.0 mpt				- 40.0 n	anh	L <sub>down</sub> =	ft		
	h/h	0	FF - '	lkotob ( a	ı boyulor		FR <sup>-</sup>	- 40.011	ipii	VD =	veh/h		
vu = ve			3		snow lan	ies, L <sub>A</sub> , L	D, V F	<sub>₹</sub> , ν <sub>f</sub> )					
Conversion t	o pc/h Und	der Base C	Condit	ions	1	1	1	1			F		
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	k %Rv $f_{HV}$ $f_p$ $f_{HV}$ $f_p$			F				
Freeway	1755	Rol	ling	5	0	0.	.930	1.00	1986	5			
Ramp	610	ling	2	0	0.	.971	1.00	661					
UpStream													
DownStream													
	Me	rge Areas						D	iverge A	reas			
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
$L_{FQ} = (Equat)$	ion 25-2 or	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
$P_{EM}$ = using E	quation					$P_{ED} = 1.0$	000	usina E	auation	0			
$V_{40} = pc/h$	•					$V_{12} = 1986 \text{ pc/h}$							
Canacity Che	ocks					Canacit		hecks					
	Actual	Maxim	num		F?	Oupuon	<u>y 01</u>	Actual	M	aximum	LOS F?		
	, lotaan		L:4 OF			V=V_		1986		4600	No		
V <sub>FO</sub>		See Exh	DIT 25-		_			1006	1	4000	No		
						$V_{FO} = V_F$		1325	4	1600	No		
V <sub>R12</sub>		4600	All		_	V <sub>R</sub>		1525		+000			
						V <sub>R</sub>		661	2	2100	No		
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	terminat	tion (if not	F)		
D <sub>R</sub> = 5.475 +	⊦ 0.00734 v	0.00627	L <sub>A</sub>		D <sub>R</sub>	<sub>2</sub> = 4.252	+ 0.008	6 V <sub>12</sub> - 0.00	9 L <sub>D</sub>				
D <sub>R</sub> = (po	:/ mi /ln)				D <sub>R</sub> = 12.3 (pc/ mi /ln)								
LOS = (Ex	khibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.42	22 (Exhil	oit 25-19)	)			
S <sub>R</sub> = mph	(Exhibit 25-	-19)				S <sub>R</sub> =	52.4	4 mph (E	Exhibit 25	5-19)			
S <sub>0</sub> = mph	(Exhibit 25-	-19)				S <sub>0</sub> =	N/A	A mph (E	Exhibit 25	5-19)			
S= mph	(Exhibit 25	-14)				S = 52.4  mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informat	ion				Site Inf	formatio	n					
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	US Gra	160 Wes andview F	tbound Ramp E			
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Yea	ar 2030				
Project Desc	ription Year	2030 Traffic C	Operations	Analysis	of the US	160 FEIS							
Inputs		Torroin Dalli								[			
Upstream Ac	lj Ramp		ng							Downstream	m Adj Ramp		
🗹 Yes	M On									Yes	On		
🗖 No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	1700 ft									down			
Vu =	565 veh/h		S <sub>FF</sub> = 60	S s, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	ph		VD =	veh/h				
Convers	sion to pc	/h Under	Base	Condi	tions	1	1	1		1			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>⊦</sub>	<sub>IV</sub> f <sub>p</sub>		
Freeway	4030	0.95	5	0	0.930	1.	00	4560					
Ramp UnStroam	590	0.95	2	0	0.971	1.   1	00	640					
DownStream	n <u> </u>	0.75	I I I I I I I I I I I I I I I I I I I	ing		0	0.771	I. 	00	013			
2011104.004	<u> </u>	Merge Areas	5 5		J		<u></u>	Diverg	je Areas				
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12					
		/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					$V_{12} = V_{F}$	<sub>R</sub> + (V <sub>F</sub> - '	√ <sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 0.619	using Equation	on 1				$P_{FD} = us^2$	ing Equation						
V <sub>12</sub> = 2821	pc/h					$V_{12} = pc/h$							
Capacity	y Checks					Capaci	ity Check	ks					
	Actua	al Max	timum	LOS	S F?	; <u> </u>	Actu	Jal	Maxi	mum	LOS F?		
	5000					V <sub>FI</sub> =V <sub>F</sub>			See Exhi	ibit 25-14			
V <sub>FO</sub>	5200	See Ex	hibit 25-7	N	0	V <sub>12</sub>			440	0:All			
V <sub>R12</sub>	3461	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Exhi	ibit 25-14			
						V <sub>R</sub>			See Exh	nibit 25-3			
Level of	Service I	Determin	ation (	if not i	F)	Level c	of Servic	e Det	ermin	ation (if	f not F)		
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0.	0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>			
D <sub>R</sub> =	23.0 (pc/ m/ln)	)				D <sub>R</sub> = (	(pc/ m/ln)						
LOS =	C (Exhibit 25-	4)			LOS= (Exhibit 25-4)								
Speed E	stimatior	ו				Speed Estimation							
$M_{s} = 0.3$	328 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 54	.1 mph (Exhib	bit 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
$S_0 = 55$	.5 mph (Exhib	, bit 25-19)				S <sub>0</sub> = mph (Exhibit 25-19)							
S= 54	.6 mph (Exhib	, bit 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informat	ion				Site Inf	formatio	n					
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	US Gra	160 Wes ndview F	tbound Ramp e			
Analysis Tim	e Period	AM Peak			A	nalysis Year		Yea	ır 2030				
Project Desc	ription Year	2030 Traffic C	Operations	Analysis	of the US	5 160 FEIS							
Inputs		Torroin Dolli	20										
Upstream Ac	lj Ramp		ng							Downstream	m Adj Ramp		
🗹 Yes	M On									Ves	On		
No	Cff									L <sub>down</sub> =	ft		
L <sub>up</sub> =	1700 ft			<u> </u>									
Vu =	945 veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V	o <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	ph		VD =	veh/h		
Convers	sion to pc	/h Under	Base	Condi	tions	1	1	1					
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>⊦</sub>	<sub>IV</sub> f <sub>p</sub>		
Freeway	2940	0.95	5	0	0.930	1.(	00	3327					
Ramp UnStream	<u> </u>	0.95	2		0.971	1.0	00	1025					
DownStream	n 743	0.75	- Ron	ing			0.771	<u> </u>	00	1025			
	J.	Merge Areas	5		,		1	Diverg	e Areas				
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12					
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)			$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				$L_{EQ} = (Equation 25-8 \text{ or } 25-9)$							
P <sub>FM</sub> = 0.619	using Equation	on 1				$P_{FD} = us^2$	ing Equation						
V <sub>12</sub> = 2058	pc/h					$V_{12} = pc/h$							
Capacity	y Checks					Capaci	ity Check	ks					
	Actua	al Max	timum	LOS	S F?		Actı	Jal	Maxi	mum	LOS F?		
V	2744	See Ev	hihit DE 7		<u>_</u>	V <sub>FI</sub> =V <sub>F</sub>	:		See Exhi	bit 25-14			
V FO	3744	See Ex			0	V <sub>12</sub>			440	D:All			
V <sub>R12</sub>	2475	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Exhi	bit 25-14			
						V <sub>R</sub>			See Exh	ibit 25-3			
Level of	Service I	Determin	ation (	if not l	F)	Level c	of Servic	e Dete	ermin	ation (if	f not F)		
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0.0	0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>			
D <sub>R</sub> =	15.4 (pc/ m/ln)	)				D <sub>R</sub> = (	(pc/ m/ln)						
LOS =	B (Exhibit 25-4	4)		LOS= (Exhibit 25-4)									
Speed E	stimation	ו			Speed Estimation								
$M_{s} = 0.2$	250 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 55	.5 mph (Exhib	oit 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = 57	.2 mph (Exhib	oit 25-19)				S <sub>0</sub> = mph (Exhibit 25-19)							
S=56	.1 mph (Exhib	oit 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informat	ion				Site Inf	formatio	n					
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U G	S 160 We randview	estbound Ramp C			
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2030				
Project Desc	ription Year	2030 Traffic C	perations	Analysis	of the US	160 FEIS							
Inputs		Torrain Dolli	22							1			
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No	Cff									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft												
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	o <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	npn		Vd =	veh/h		
Convers	sion to pc	/h Under	Base	Condi	tions	1	1	1		-			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>ł</sub>	HV <sup>f</sup> p		
Freeway	3440	0.95	5	0	0.930		1.00	3893					
Ramp UnStream	590	0.95	2	0	0.971	<u> </u>	1.00	640					
DownStream								1					
	J.	Merge Areas	ŝ		,		1	Dive	rge Areas	5			
Estimat	ion of v <sub>12</sub>					Estima	tion of v	12					
	V	$V_{12} = V_{F} (P_{FM})$	)					V <sub>12</sub> = V	V <sub>R</sub> + (V <sub>F</sub> -	V <sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 0.631	using Equation	on 1				P <sub>FD</sub> = us	ing Equation						
V <sub>12</sub> = 2455	pc/h					$V_{12} = pc/h$							
Capacit	y Checks					Capaci	ity Chec	ks					
	Actua	al Max	imum	LOS	S F?		Act	ual	Max	kimum	LOS F?		
N/	4500					V <sub>FI</sub> =V <sub>F</sub>	=		See Ex	hibit 25-14			
v <sub>FO</sub>	4533	See Ex	nidit 25-7	N	0	V <sub>12</sub>			44	00:All			
V <sub>R12</sub>	3095	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ex	hibit 25-14			
						V <sub>R</sub>			See Ex	hibit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	etermi	nation (in	f not F)		
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.	252 + (	0.0086 V <sub>1</sub>	<sub>2</sub> - 0.009 L <sub>D</sub>			
D <sub>R</sub> =	17.4 (pc/ m/ln)		D <sub>R</sub> = (	(pc/ m/ln)									
LOS =		LOS= (Exhibit 25-4)											
Speed E	stimation	ו				Speed Estimation							
$M_{\rm S} = 0.2$	255 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 55	.4 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = 56	.6 mph (Exhib	it 25-19)			S <sub>0</sub> = mph (Exhibit 25-19)								
S= 55	.8 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informati	ion				Site Inf	formatio	n					
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L C	IS 160 W Grandview	estbound / Ramp C			
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	'ear 2030				
Project Desc	ription Year	2030 Traffic C	Operations	Analysis	of the US	160 FEIS							
Inputs		Torroin Dolli	22										
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft												
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V	e <sub>FR</sub> = 40.0⊺ <sub>R'</sub> V <sub>f</sub> )	mph		Vd =	veh/h		
Convers	sion to pc	/h Under	Base	Condi	tions	1		1					
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>		
Freeway	1940	0.95	Roll	ing	5	0	0.930		1.00	2195			
Ramp UnStream	1000	0.95	ing	2	0	0.971		1.00	1084				
DownStream	n				 			1					
	•	Merge Areas	5					Dive	erge Area	S			
Estimati	ion of v <sub>12</sub>					Estima	tion of	V <sub>12</sub>					
	V	7 <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 0.631	using Equation	on 1				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 1384	pc/h					V <sub>12</sub> = pc/h							
Capacity	<b>Checks</b>					Capacity Checks							
	Actua	al Max	imum	LOS	S F?		Ac	tual	Ma	iximum	LOS F?		
V	0700	Coo Eu			_	V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14			
v <sub>FO</sub>	3279	See Ex	nidit 25-7	N	0	V <sub>12</sub>			44	100:All			
V <sub>R12</sub>	2468	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See E>	hibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	ce De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4	.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>			
D <sub>R</sub> =	12.3 (pc/ m/ln)		D <sub>R</sub> = (	pc/ m/ln)									
LOS =		LOS= (Exhibit 25-4)											
Speed E	stimation	ו				Speed	Estimat	tion					
M <sub>S</sub> = 0.2	215 (Exibit 25		D <sub>s</sub> = (Exhibit 25-19)										
S <sub>R</sub> = 56	.1 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = 58	.9 mph (Exhib	it 25-19)		S <sub>0</sub> = mph (Exhibit 25-19)									
S= 56	.8 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informat	ion				Site Inf	formatio	n					
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U C	IS 160 Ea Grandview	astbound / Ramp B			
Analysis Tim	e Period	PM Peak			A	nalysis Year		Y	ear 2030				
Project Desc	ription Year	2030 Traffic C	perations	Analysis	of the US	160 FEIS							
Inputs		Torroin Dolli	22							1			
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft												
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 40.0   <sub>R'</sub> V <sub>f</sub> )	nph		VD =	veh/h		
Convers	sion to pc	/h Under	Base	Condi	tions	1	1						
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>		
Freeway	2980	0.95	Roll	ing	5	0	0.930		1.00	3372			
Ramp UnStream	480	0.95	2	0	0.971		1.00	520					
DownStream	 n												
		Merge Areas	5 5		J		]	Dive	erge Area	S			
Estimat	ion of v <sub>12</sub>					Estima	tion of	V <sub>12</sub>					
	V	$V_{12} = V_{F} (P_{FM})$	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>FO</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EO</sub> = (Eo	uation 25-8	or 25-0	9)				
P <sub>FM</sub> = 0.619	using Equation	on 1				$P_{FD} = us^2$	ing Equation	า					
V <sub>12</sub> = 2086	pc/h					$V_{12} = pc/h$							
Capacit	y Checks					Capaci	ity Chec	ks					
	Actua	al Max	imum	LOS	S F?		Ac	tual	Ma	iximum	LOS F?		
						V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14			
V <sub>FO</sub>	3892	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44	100:All			
V <sub>R12</sub>	2606	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ex	khibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4	.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	16.3 (pc/ m/ln)		D <sub>R</sub> = (	(pc/ m/ln)									
LOS =		LOS= (Exhibit 25-4)											
Speed E	stimation	ו				Speed Estimation							
$M_{\rm S} = 0.2$	256 (Exibit 25		D <sub>s</sub> = (Exhibit 25-19)										
S <sub>R</sub> = 55	.4 mph (Exhib	oit 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = 57	.2 mph (Exhib	oit 25-19)			S <sub>0</sub> = mph (Exhibit 25-19)								
S= 56	0.0 mph (Exhib	oit 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET												
General	Informat	ion				Site Inf	formatio	on					
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L C	IS 160 Ea Grandview	astbound / Ramp B			
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	'ear 2030				
Project Desc	ription Year	2030 Traffic C	Operations	Analysis	of the US	5 160 FEIS							
Inputs		Torroin Dolli	22										
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp		
F Yes	On									Ves	On Off		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft			0			40.0						
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V	o <sub>FR</sub> = 40.0 <sub>R</sub> ,V <sub>f</sub> )	mpn		VD =	veh/h		
Convers	sion to pc	/h Under	Base	Condi	tions	1							
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	HV <sup>f</sup> p		
Freeway	2030	5	0	0.930		1.00	2297						
Ramp UnStream	620	2	0	0.971		1.00	672						
DownStream	n				 								
		Merge Areas	5					Dive	erge Area	S			
Estimati	ion of v <sub>12</sub>					Estima	tion of	v <sub>12</sub>					
	 V	V <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 0.619	using Equation	on 1				P <sub>FD</sub> = us	ing Equation	n					
V <sub>12</sub> = 1421	pc/h					V <sub>12</sub> = pc/h							
Capacity	y Checks					Capacity Checks							
	Actua	al Max	imum	LOS	S F?		Ac	tual	Ма	iximum	LOS F?		
V	20/0				_	V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14			
v <sub>FO</sub>	2969	See Ex	nidit 25-7	N	0	V <sub>12</sub>			44	ioo:All			
V <sub>R12</sub>	2093	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See E>	hibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servie	ce De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.007			D <sub>R</sub> = 4	.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	12.3 (pc/ m/ln)		D <sub>R</sub> = (pc/ m/ln)										
LOS =		LOS= (Exhibit 25-4)											
Speed E	stimatior	1				Speed	Estima	tion					
M <sub>S</sub> = 0.2	235 (Exibit 25		D <sub>s</sub> = (Exhibit 25-19)										
S <sub>R</sub> = 55	.8 mph (Exhib	oit 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = 58	.6 mph (Exhib	oit 25-19)			S <sub>0</sub> = mph (Exhibit 25-19)								
S= 56	.6 mph (Exhib	oit 25-14)				S = mph (Exhibit 25-15)							

RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Information Site Information												
Analyst SEH Inc. Fro					eeway/Dir of Travel US 160				0 Eastbou	Eastbound		
Agency or Company Ju				Jur	nction Grandview Ramp A							
Date Performed 11/13/2009				Jur	risdiction							
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 2	2030		
Project Descri	iption Yea	ar 2030 Tra	iffic Op	perations	Analysi	is of the l	JS <sup>·</sup>	160 FEIS	6			
Inputs		<b>T</b> '.										
Upstream Adj Ramp									Down Ramp	strear	n Adj	
Yes On										Te Ye	es	Cn 🗐
No 🔽	Off									No No	)	Off
L <sub>up</sub> = ft		s	=	60 0 mph	n	S		= 400 r	nph	L_down	=	ft
Vu = ve	h/h	•	FF	sketch ( s	how lan		TR V	V)		VD =		veh/h
	to no/h Un	dar Basa (	`ondit	ione		юз, с <sub>А</sub> , с	D, • I	R, <sup>v</sup> f/				
Conversion		der base C	onan	IONS	1	1	1	1		//F	PHF	
(pc/h)	v (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>		
Freeway	4525	0.95	Rol	lling	5	0	0	.930	1.00	512	20	
Ramp	1545	0.95 Rolling 2		2	0	0	.971	1.00	16	75		
UpStream					<u> </u>	<u> </u>						
DownStream												
	Me	erge Areas							Diverge A	Areas		
Estimation of v <sub>12</sub> Estimat					Estimat	ion	of v <sub>12</sub>					
$V_{12} = V_{F} (P_{FM})$							V <sub>12</sub>	$_{2} = V_{R} +$	(V <sub>F</sub> - V <sub>R</sub> )P	FD		
$L_{EO} = (Equation 25-2 \text{ or } 25-3)$					L <sub>FO</sub> = (E	qua	ation 25-8	8 or 25-9	)			
P <sub>EM</sub> = using E	quation					$P_{ED} = 0.4$	555	usina I	Equation	5		
$V_{40} = pc/h$	•					$V_{10} = 35$	87	nc/h	- 1	-		
Canacity Che	ocks					Canacit	v C	hecks				
	Actual	Maxim	nim		F2	Oapach	<u>y 01</u>	Actua		aximum	11	OS E2
	/ totaai				• •	VV		5120		6000		No
V <sub>FO</sub>		See Exhi	bit 25-		-	$\frac{  F - F }{  F } = \frac{3120}{2507}$		3587		4400·AII		No
					$V_{12} = 3387$ $V_{FO} = V_F - 3445$		3445		6900		No	
V <sub>R12</sub> 4600:All		All			V <sub>R</sub>		1675		2100		No	
l evel of Serv	vice Detern	nination (it	f not F	;)		I evel of	Se	rvice De	etermina	tion (if no	of F)	
$D_{-} = 5.475 \pm 0.00734 \text{ y}_{-} \pm 0.0078 \text{ y}_{-} = 0.00627 \text{ J}_{-}$					$D_{p} = 4.252 \pm 0.0086 V_{12} = 0.0091 =$							
$D_{R} = 0.410 + 0.0010 + V_{R} + 0.0010 + V_{12} = 0.00027 L_{A}$					⊢A	$B_{\rm R} = -26.1 (\rm{rg}(r$						
$P_{R} = (p_{G} m_{T} m_{T})$					$\nu_{\rm R} = 26.1 (\text{pc/mi/ln})$							
LOS = (Exhibit 25-4)				LOS= C (Exhibit 25-4)								
Speed Estimation					Speed Estimation							
$M_{S} = (Exibit 25-19)$						D <sub>s</sub> =	0.5	14 (Exhi	bit 25-19	))		
S <sub>R</sub> = mph (Exhibit 25-19)						S <sub>R</sub> = 50.8 mph (Exhibit 25-19)						
$S_0 = mph$ (Exhibit 25-19)						S <sub>0</sub> = 63.7 mph (Exhibit 25-19)						
S= mph (Exhibit 25-14)						S = 54.1 mph (Exhibit 25-15)						

RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Information Site Information												
Analyst SEH Inc.				Fre	reeway/Dir of Travel US				S 160 Eastbound			
Agency or Company				Jur	nction			ew Ramp	Α			
Date Performed 11/13/2009					Jur	risdiction						
Analysis Time	Period	AM Peak			Ana	alysis Yea	ar		Year 203	30		
Project Descri	ption Yea	ar 2030 Tra	offic Op	perations	Analysi	is of the l	JS <sup>-</sup>	160 FEIS				
Inputs		Tarrain								1		
Upstream Adj Ramp									Downst Ramp	ream Adj		
Yes On									Tes 🗐	🗖 On		
No 🔽	Off									No I	Cff Off	
L <sub>up</sub> = ft		S	= (	60 0 mpł	<u>่</u> า	S		= 40.0 m	noh	_L <sub>down</sub> =	ft	
Vu = ve	h/h	•	FF S	sketch ( s	how lan		FR V	V)		VD =	veh/h	
Conversion	o no/h Ung	har Basa (	`ondit	ions		юз, с <sub>А</sub> , с	D, <sup>v</sup> I	₹ <sup>, •</sup> f/				
Conversion			Jonun	0115	1	1	1			v=V/PH	F	
(pc/h)	v (Veh/hr)	PHF	PHF Terrain True		Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>		
Freeway	2830	0.95	Rol	ling	5	0	0	.930	1.00	3202		
Ramp	800	0.95 Rolling 2		2	0	0	.971	1.00	867			
UpStream												
DownStream												
	Me	rge Areas						D	iverge Are	as		
Estimation of v <sub>12</sub>					Estimat	ion	of V <sub>12</sub>					
$V_{12} = V_F (P_{FM})$							V <sub>12</sub>	= V <sub>R</sub> + (V	<sub>F</sub> - V <sub>R</sub> )P <sub>FI</sub>	)		
L <sub>EQ</sub> = (Equation 25-2 or 25-3)					L <sub>EQ</sub> = (E	qua	tion 25-8	or 25-9)				
P <sub>FM</sub> = using E	quation					$P_{FD} = 0.6$	540	using E	quation	5		
$V_{12} = pc/h$						$V_{12} = 23$	62	pc/h				
Capacity Che	ecks					Capacit	y Cl	hecks				
	Actual	Maxim	num	LOS	F?			Actual	Max	timum	LOS F?	
		See Exhi	hit 25-			$V_{EI} = V_{E}$ 3202		3202	6	900	No	
V <sub>FO</sub>		7	7			V <sub>12</sub> 2362		2362	44(	00:All	No	
V <sub>R12</sub>	V <sub>R12</sub> 4600:All				$\begin{array}{c c} V_{FO} = V_{F} - \\ V_{R} \end{array} 2335$		2335	6900		No		
						V <sub>R</sub> 867		867	2100		No	
Level of Serv	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 <sub>R</sub> = 4.252 + 0.0086 V <sub>12</sub> - 0.009 L <sub>D</sub>								
D <sub>R</sub> = (pc/ mi /ln)				D <sub>R</sub> = 15.6 (pc/ mi /ln)								
LOS = (Exhibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estimation				Speed Estimation								
$M_{S} = (Exibit 25-19)$					$D_{s} = 0.441$ (Exhibit 25-19)							
$S_{R}$ = mph (Exhibit 25-19)						$S_{R}$ = 52.1 mph (Exhibit 25-19)						
$S_0 = mph$ (Exhibit 25-19)						$S_0 = 65.8 \text{ mph} (\text{Exhibit 25-19})$						
S= mph (Exhibit 25-14)					S = 55.1 mph (Exhibit 25-15)							

	Operatic	onal Ana	lysis_			
Analyst: Agency/Co.: Date Performed: Analysis Time Period: Freeway/Dir of Travel: Weaving Location: Jurisdiction: Analysis Year: Description: Year 2030	und 550 Off ions An	alysis	of the	US 160 FE	IS	
	Inp	outs				
Freeway free-flow speed Weaving number of lanes Weaving segment length, Terrain type Grade Length Weaving type Volume ratio, VR Weaving ratio, R	, SFF , N L	6 4 2 R A 0 0	0 070 olling .47 .19		mph ft % mi Multilane	e or C-D
Conv	ersion to pc/h	Under B	ase Co	nditions	5	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population adjus Flow rate, v	T E, ER t, fHV tment, fP Weaving and Nor	Non-We V A-C 1975 0.95 520 5 0 2.5 2.0 0.930 1.00 2234 n-Weavin	aving V B-D 40 0.95 11 5 0 2.5 2.0 0.93 1.00 45	Weav V 340 0.95 89 5 0 2.5 2.0 0 0.93 1.00 384 ds	ving V D B-C 1460 5 0.95 384 5 0 2.5 2.0 30 0.930 0 1.00 1652	veh/h v % % pc/h
a (Exhibit 24-6) b (Exhibit 24-6) c (Exhibit 24-6) d (Exhibit 24-6) Weaving intensity factor Weaving and non-weaving Number of lanes required unconstrained operation Maximum number of lanes Type of operation is	r, Wi speeds, Si d for , Nw (Exhibit 2 , Nw (max) (Exh	Weavin 0.15 2.20 0.97 0.80 1.59 34.27 24-7) hibit 24	.g 7)	Non-Wea 0.00 4.00 1.30 0.75 0.27 54.43 2.18 1.40 Constra	aving	
Weaving Segmen	t Speed Dengit		lofq	ervice =	and Canaci	tv
Weaving segment speed, Weaving segment density Level of service, LOS Capacity of base condit Capacity as a 15-minute Capacity as a full-hour	s , D ion, cb flow rate, c volume, ch	42.61 25.32 C 7176 6675 6341	mph pc/mi pc/h pc/h pc/h	/ln	and capaci	

Limitations on Weaving Segments\_

		If Max Exce	eded See Note
	Analyzed	Maximum	Note
Weaving flow rate, Vw	2036	2800	a
Average flow rate (pcphpl)	1078	2300	b
Volume ratio, VR	0.47	0.35	С
Weaving ratio, R	0.19	N/A	d
Weaving length (ft)	2070	2500	е
Notes:			

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

- b. Capacity constrained by basic freeway capacity.
- c. Capacity occurs under constrained operating conditions.
- d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
- e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
- f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
- g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
- h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
- i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

	Operatic	onal Ana	lysis_			
Analyst: Agency/Co.: Date Performed: Analysis Time Period: Freeway/Dir of Travel: Weaving Location: Jurisdiction: Analysis Year: Description: Year 2030	SEH Inc. 11/13/2009 AM Peak US 160 Westbou CR 233 On US 5 Year 2030 Traffic Operat	und 550 Off tions An	alysis	of the	US 160 FE	IS
	Inp	outs				
Freeway free-flow speed Weaving number of lanes Weaving segment length, Terrain type Grade Length Weaving type Volume ratio, VR Weaving ratio, R	, SFF , N L	6 4 2 R 8 0 0 0 0	0 070 011ing .45 .33		mph ft % mi Multilane	or C-D
Conve	ersion to pc/h	Under E	ase Co	nditions	5	
		Non-We V	aving V	Weav V	ving V	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population adjust Flow rate, v	r E, ER t, fHV tment, fP	A-C 1240 0.95 326 5 0 2.5 2.0 0.930 1.00 1403	B-D 40 0.95 11 5 2.5 2.0 0.93 1.00 45	A-1 345 0.95 91 5 0 2.5 2.0 0 0.93 1.00 390	B-C         695         183         5         0         2.5         2.0         30       0.930         1.00         786	veh/h v % % pc/h
7	Weaving and Nor	n-Weavin	lg Spee	ds		
a (Exhibit 24-6) b (Exhibit 24-6) c (Exhibit 24-6) d (Exhibit 24-6) Weaving intensity factor Weaving and non-weaving Number of lanes required unconstrained operation Maximum number of lanes	r, Wi speeds, Si d for , Nw (Exhibit 2 Nw (max) (Exh	Weavin 0.15 2.20 0.97 0.80 0.95 40.65	7)	Non-Wea 0.00 4.00 1.30 0.75 0.13 59.18 2.00 1.40	aving	
Type of operation is	, NW (Max) (Exi	IIDIC 24	i-/)	Constra	ained	÷
weaving Segment	L Speea, Densit	y, Leve	el oi S	ervice a	and Capaci	ι <u>Υ</u>
Weaving segment speed, S Weaving segment density Level of service, LOS Capacity of base condit: Capacity as a 15-minute Capacity as a full-hour	S , D ion, cb flow rate, c volume, ch	49.14 13.35 B 7176 6675 6341	mph pc/mi pc/h pc/h pc/h	/ln		
		If Max Exce	eded See Note			
----------------------------	----------	-------------	---------------			
	Analyzed	Maximum	Note			
Weaving flow rate, Vw	1176	2800	a			
Average flow rate (pcphpl)	656	2300	b			
Volume ratio, VR	0.45	0.35	С			
Weaving ratio, R	0.33	N/A	d			
Weaving length (ft)	2070	2500	е			
Notes:						

a. Weaving segments longer than 2500 ft. are treated as isolated merge and diverge areas using the procedures of Chapter 25, "Ramps and Ramp Junctions".

- b. Capacity constrained by basic freeway capacity.
- c. Capacity occurs under constrained operating conditions.
- d. Three-lane Type A segments do not operate well at volume ratios greater than 0.45. Poor operations and some local queuing are expected in such cases.
- e. Four-lane Type A segments do not operate well at volume ratios greater than 0.35. Poor operations and some local queuing are expected in such cases.
- f. Capacity constrained by maximum allowable weaving flow rate: 2,800 pc/h (Type A), 4,000 (Type B), 3,500 (Type C).
- g. Five-lane Type A segments do not operate well at volume ratios greater than 0.20. Poor operations and some local queuing are expected in such cases.
- h. Type B weaving segments do not operate well at volume ratios greater than 0.80. Poor operations and some local queuing are expected in such cases.
- i. Type C weaving segments do not operate well at volume ratios greater than 0.50. Poor operations and some local queuing are expected in such cases.

		RAM	PS AN	ID RAMF	, JNNC.	TIONS W	/OR	KSHEE	Т			
General Infor	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eeway/Dir of Travel $US \ 160^{\circ}$			S 160 Westbound			
Agency or Co	mpany		J					nction CR 233			ff Ramp	
Date Performe	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	PM Peak			Ana	alysis Ye	ar		Year	2030		
Project Descri	iption Yea	ar 2030 Tra	affic Op	perations	Analysi	is of the l	JS <sup>·</sup>	160 FEIS	5			
Inputs		<b>T</b>										
Upstream Adj	Ramp	Ierrain									Downstre Ramp	am Adj
Yes	On										Ves	🔲 On
No 🔽	Off										No No	Off
L <sub>up</sub> = ft		S	=	60 0 mpł	<u>ו</u>		=	= 40.0 r	moh		L <sub>down</sub> =	ft
Vu = ve	h/h	· ·	FF 5	sketch ( s	how lan		TR V	V)			VD =	veh/h
	a no/h Un	dar Bass (	) ondit	iono		юз, с <sub>А</sub> , с	D, • I	R' f/				
Conversion		der base C	onait	IONS	1	1	1	1				
(pc/h)	V (Veh/hr)	PHF	Те	errain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>		f <sub>HV</sub> f <sub>p</sub>	
Freeway	2595	0.95	Ro	lling	5	0	0	.930	1.00		2936	
Ramp	280	0.95	Rol	lling	2	0	0	.971	1.00		304	
UpStream												
DownStream												
	Me	rge Areas							Diverge	Area	S	
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_R + (V_F - V_R)P_{FD}$						
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)						
$P_{\text{EM}}$ = using E	quation					$P_{FD} = 1.000$ using Equation 0						
$V_{\rm m} = nc/h$	1					$V_{} = 20$	36	nc/h	_ 4.0.0.0.			
$r_{12}$ point	ocks					$r_{12} - 2 r$	50 v C	books				
		Maxin			E2	Capach	<u>y C</u>	Actua	I I N	Javin		
	Actual				1:	<u>\/_\/</u>		2026		160		No
V <sub>FO</sub>		See Exh	bit 25-		-	V FI V F	$v_{\rm FI} = v_{\rm F}$ 2936			4000		NO
						V <sub>12</sub>		2936		4400	:All	NO
V <sub>B12</sub>		4600	:All			$V_{FO} = V_{FO}$		2632		460	0	No
						V <sub>R</sub>		304		210	0	No
Level of Serv	vice Detern	nination (i	f not F	)		Level of	<sup>r</sup> Se	rvice De	etermina	ation	(if not F	
$D_{R} = 5.475 + 0.00734 v_{R} + 0.0078 V_{12} - 0.00627 L_{\Lambda}$					$D_{\rm R} = 4.252 + 0.0086 V_{12} - 0.009 L_{\rm D}$					L <sub>D</sub>		
$D_R = (pc/mi/ln)$						$D_{\rm R} = 20.5 (\text{pc/mi/ln})$						
LOS = (Exhibit 25-4)					LOS= C (Exhibit 25-4)							
Speed Estimation						Speed E	Estil	mation	,			
$M_{\rm S}$ = (Exibit 25-19)					$D_{\rm s} = 0.390$ (Exhibit 25-19)							
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> = 53.0 mph (Exhibit 25-19)						
$S_0 = mph$	(Exhibit 25	-19)				$S_0 = N/A \text{ mph} (\text{Exhibit 25-19})$						
S= mph	(Exhibit 25	-14)				S =	53.	0 mph (	Exhibit 2	25-15	5)	

		RAM	PS AN	ID RAMF	, JNNC.	TIONS W	/OR	KSHEE	Т			
General Infor	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eeway/Dir of Travel US 160			50 W	estbound	1	
Agency or Co	mpany		J					nction CR 233			ff Ramp	
Date Performe	ed	11/13/20	11/13/2009 Ju					risdiction				
Analysis Time	Period	AM Peak	-		Ana	alysis Yea	ar		Year	2030		
Project Descri	iption Yea	ar 2030 Tra	affic Op	perations	Analysi	is of the l	JS <sup>·</sup>	160 FEIS	3			
Inputs		<b>T</b> '.								1		
Upstream Adj	Ramp	Ierrain									Downstre Ramp	am Adj
Yes	On										Ves	🔲 On
No 🔽	Off										No No	Cff Off
L <sub>up</sub> = ft		<u> </u>		60 0 mpt	<u> </u>			- 40.0 r	mnh		L <sub>down</sub> =	ft
	h/h	0	FF -	Wetch ( a	ı boyulor		FR <sup>-</sup>	- 40.01	прп		VD =	veh/h
vu – ve			3 		snow lan	ies, L <sub>A</sub> , L	D, V I	R, <sup>v</sup> f)				
Conversion t	o pc/h Und	der Base C	condit	ions	1	1	1	1		[		
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	%Rv		f <sub>HV</sub>	f <sub>p</sub>		v=v/PHF f <sub>HV</sub> f <sub>p</sub>	
Freeway	1875	0.95	Rol	lling	5	0	0	.930	1.00		2122	
Ramp	290	0.95	Rol	lling	2	0	0	.971	1.00	) (	314	
UpStream												
DownStream												
	Me	rge Areas							Diverge	Areas	S	
Estimation of v <sub>12</sub> Estimation of v <sub>12</sub>												
	V <sub>12</sub> =	V <sub>F</sub> (P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$						
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>FO</sub> = (Equation 25-8 or 25-9)						
$P_{\rm EM} = u \sin \alpha E$	auation	,				$P_{FD} = 1.000$ using Equation 0						
$V_{\rm e} = nc/h$	4.0					$V_{-} = 21$	$\frac{1}{2}$	nc/h	-quality			
	aka					$v_{12} = 2122$ pC/II						
		Movin			E2							
	Actual	IVIAXIII	lum	<u> </u>		<u> </u>						LUG F !
V <sub>FO</sub>		See Exhi	bit 25-		_	$V_{FI}=V_F$ 2122		2122		4600		INO
		1				V <sub>12</sub>		2122		4400	:All	No
V <sub>B12</sub>		4600	:All			$V_{FO} = V_{FO}$	-	1808		460	0	No
						V <sub>R</sub>		314		210	0	No
Level of Serv	vice Detern	nination (i	f not F	)		Level of	' Se	rvice De	etermin	ation	(if not F)	
$D_{p} = 5.475 + 0.00734 v_{p} + 0.0078 V_{12} - 0.00627 L_{A}$					$D_{\rm p} = 4.252 + 0.0086 V_{12} - 0.009 L_{\rm p}$					L <sub>D</sub>		
$D_R = (pc/mi/ln)$						$D_{\rm R} = 13.5 (\text{pc/ mi /ln})$						
LOS = (Exhibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estimation						Speed E	Estil	mation	,			
$M_{\rm S}$ = (Exibit 25-19)					$D_{\rm s} = 0.391$ (Exhibit 25-19)							
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> = 53.0 mph (Exhibit 25-19)						
$S_0 = mph$	(Exhibit 25	-19)				$S_0 = N/A \text{ mph} (\text{Exhibit 25-19})$						
S = mph (Exhibit 25-14)						S =	53.	0 mph (	Exhibit 2	25-15	i)	

		RAMP	S AND	RAM	) JUN	CTIONS	WORKS	SHEE	Т		
General	Informat	ion				Site Inf	ormatio	n			
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/13/200	SEH Inc. F J 11/13/2009 J				reeway/Dir of Travel US 160 Ea unction CR 223 O urisdiction			) Eastbound 3 On Ramp	
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Yea	ır 2030		
Project Desc	Project Description Year 2030 Traffic Operations Analysis of the US 160 FEIS										
Inputs		Torrain Dolli	20						- 1		
Upstream Ac	lj Ramp		ng							Downstrear	m Adj Ramp
F Yes	Cn On									Ves	On
No No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft						40.0				
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V <sub>F</sub>	r <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	ph		Vd =	veh/h
Convers	sion to pc	/h Under	Base	Condi	tions	1		1	1		
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	$f_{HV}$		f <sub>p</sub>	v=V/PHF f <sub>H</sub>	<sub>IV</sub> f <sub>p</sub>
Freeway	2395	0.95	Roll	ng	5	0	0.930	1.0	00	2710	
Ramp UnStream	400	0.95	R0II	ing	2	0	0.971	1.0	00	434	
DownStream	 n										
	J	Merge Area	S			Diverge Areas					
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12			
	 V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)			$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$					
L <sub>EO</sub> = (Equ	uation 25-2 or 2	25-3)				$L_{FO} = (Equation 25-8 \text{ or } 25-9)$					
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation					
V <sub>12</sub> = 2710	pc/h					V <sub>12</sub> = pc/h					
Capacity	v Checks					Capaci	ty Check	rs			
	Actua	al Max	limum	LOS	S F?		Actu	lal	Maxir	num	LOS F?
						V <sub>FI</sub> =V <sub>F</sub>			See Exhil	oit 25-14	
V <sub>FO</sub>	3144	See Ex	hibit 25-7	N	0	V <sub>12</sub> 4			4400	4400:All	
V <sub>R12</sub>	3144	460	)0:All	N	0	$V_{FO} = V_F - V_R$ See E			See Exhil	Exhibit 25-14	
						V <sub>R</sub>			See Exh	ibit 25-3	
Level of	Service I	Determin	ation (	if not	F)	Level o	of Servic	e Det	ermina	ation (if	f not F)
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0.0	0086 V <sub>12</sub>	- 0.009 L <sub>D</sub>	
D <sub>R</sub> = 20.6 (pc/ m/ln)				D <sub>R</sub> = (pc/ m/ln)							
LOS = C (Exhibit 25-4) LC					LOS= (Exhibit 25-4)						
Speed Estimation Speed Estimation											
$M_{\rm s} = 0.294$ (Exibit 25-19)						$D_s = (Exhibit 25-19)$					
S <sub>p</sub> = 54	.7 mph (Exhib	oit 25-19)				S <sub>R</sub> = r	nph (Exhibit	25-19)			
$S_0 = N/$	A mph (Exhibi	, it 25-19)				S <sub>0</sub> = r	nph (Exhibit	25-19)			
S= 54.7 mph (Exhibit 25-14)						S = mph (Exhibit 25-15)					

	Operational Analy	sis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To:	11/13/2009 AM Peak Westbound SH 172 to CR 233		
Analysis Year: Description: Year 2030	Year 2030 Traffic Operations	Analysis of the	US 160 FEIS
	Flow Inputs and A	djustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCI Heavy vehicle adjustment Driver population factor Flow rate, vp	F 5, ER 5, fHV 6, fp	1875 0.95 493 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1061	veh/h v % % mi pc/h/ln
	Speed Inputs and .	Adjustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	Decca inputD and i clearance fLW tment, fLC ustment, fLD ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	_LOS and Performan	ce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1061 60.0 2 17.7 B	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Anal	ysis				
Analyst:SEH Inc.Agency or Company:11/13/2009Date Performed:11/13/2009Analysis Time Period:PM PeakFreeway/Direction:EastboundFrom/To:US 550/CR 233 to SH 172Jurisdiction:Jurisdiction:Analysis Year:Year 2030Description:Year 2030Traffic Operations Analysis of the US 160 FEIS						
	Flow Inputs and	Adjustments				
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCI Heavy vehicle adjustment Driver population factor Flow rate, vp	F E, ER E, fHV F, fp	2795 0.95 736 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1581	veh/h v % % mi pc/h/ln			
	Speed Inputs and	Adjustments				
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	Speed Inputs and clearance ELW cment, fLC ustment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h			
	_LOS and Performa	nce Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1581 60.0 60.0 2 26.4 D	pc/h/ln mi/h mi/h pc/mi/ln			

	Operational Ana	alysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed:	11/13/2009		
Analysis Time Period:	AM Peak		
Freeway/Direction:	Eastbound		
From/To:	CR 233 to SH 17	2	
Jurisdiction:		_	
Analysis Year:	Year 2030		
Description: Year 2030	Traffic Operatio	ons Analysis of the	e US 160 FEIS
	Flow Inputs and	d Adjustments	
Volume, V		1755	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		462	v
Trucks and buses		5	<u>0</u> 0
Recreational vehicles		0	010
Terrain type:		Rolling	
Grade		0.00	₽ •
Segment length		0.00	mi
Trucks and buses PCE, E	['	2.5	
Recreational vehicle PCI	S, ER	2.0	
Heavy venicle adjustment	C, IHV	0.930	
Driver population factor	r, ip	1.00	ng/h/ln
FIOW face, vp		995	pc/11/11
	Speed Inputs a	nd Adjustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	LLW	0.0	mi/n
Lateral clearance adjust	LMENL, ILC	0.0	m1/n
Number of lange adjust	ascillenc, LID	0.0	$lll \perp / ll$
Free-flow greed FFS	ent, in	4.5	mi/h
FIEE-IIOW Speed, FFS		Urban Freeway	
	LOS and Perform	nance Measures	
Eleverate an		0.0.2	ng/h/ln
Free-flow greed FFC		60 0	pc/11/111 mi/h
Average pagenger-car g	heed S	60.0	mi/h
Number of lange N	pecu, b	2	III / 11
Density. D		16.5	pc/mi/ln
Level of service, LOS		B	F ~ / m / 11
		_	

\_\_\_\_\_

 _Operational	Analysis

Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: Year 2030	11/13/2009 PM Peak Westbound Between CR 233 Ramp Year 2030 Traffic Operations Flow Inputs and Ad	s Analysis of the justments	US 160 FEIS
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor Flow rate, vp	F 5, ER 5, fHV 5, fp	2315 0.95 609 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1310	veh/h v % % mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW Ement, fLC Istment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	LOS and Performanc	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1310 60.0 60.0 2 21.8 C	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Ana	alysis			
Analyst:	SEH Inc.				
Agency or Company:					
Date Performed:	11/13/2009				
Analysis Time Period:	AM Peak				
Freeway/Direction: Westbound					
From/To:	Between CR 233 F	Ramps			
Jurisdiction:		÷			
Analysis Year: Year 2030					
Description: Year 2030	Traffic Operatio	ons Analysis of the	e US 160 FEIS		
	Flow Inputs and	l Adjustments			
Volume, V		1585	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		417	v		
Trucks and buses		5	00		
Recreational vehicles		0	00		
Terrain type:		Rolling			
Grade		0.00	00		
Segment length		0.00	mi		
Trucks and buses PCE, E	Г	2.5			
Recreational vehicle PC	E, ER	2.0			
Heavy vehicle adjustmen	t, fHV	0.930			
Driver population factor	r, fp	1.00			
Flow rate, vp	, <u>r</u>	897	pc/h/ln		
Speed Inputs and Adjustments					
Lane width		12.0	ft		
Right-shoulder lateral clearance		6.0	ft.		
Interchange density		0.50	interchange/mi		
Number of lanes. N		2	incer enange, ar		
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment, fLW		0.0	mi/h		
Lateral clearance adjustment, fLC		0.0	mi/h		
Interchange density adjustment, fID		0.0	mi/h		
Number of lanes adjustment, fN		4.5	mi/h		
Free-flow speed, FFS		60.0	mi/h		
1100 110W Speca, 115		Urban Freeway			
	LOS and Perform	nance Measures			
Flow rate, vp		897	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car s	peed, S	60.0	mi/h		
Number of lanes, N		2			
Density, D		14.9	pc/mi/ln		
Level of service, LOS		В	-		

	Operational Anal	ysis				
Analyst:	SEH Inc.					
Agency or Company:						
Date Performed:	11/13/2009					
Analysis Time Period: PM Peak						
Freeway/Direction:	Eastbound					
From/10.	Between CR 233 Rai	liips				
Analygig Vear:	$V_{Par}$ 2030					
Description: Year 2030	Traffic Operation	s Analysis of the	e US 160 FEIS			
Flow Inputs and Adjustments						
Volume, V		2395	veh/h			
Peak-hour factor, PHF		0.95				
Peak 15-min volume, v15		630	v			
Trucks and buses		5	00			
Recreational vehicles		0	00			
Terrain type:		Rolling				
Grade Commont longth		0.00	oto .			
Segment length	<b>T</b>	0.00	mı			
Pograptional wobigle DCL, E		2.5				
Heavy vehicle adjustmen	с, <u>ск</u> + fhv	2.0 0 930				
Driver population factor	r, fp	1 00				
Flow rate, vp		1355	pc/h/ln			
Speed Inputs and Adjustments						
Lane width		12 0	ft			
Right-shoulder lateral	clearance	6.0	ft			
Interchange density		0.50	interchange/mi			
Number of lanes, N		2				
Free-flow speed:		Measured				
FFS or BFFS		60.0	mi/h			
Lane width adjustment, :	flw -	0.0	mi/h			
Lateral clearance adjustment, fLC		0.0	mi/h			
Interchange density adjustment, fID		0.0	mi/h			
Number of lanes adjustment, iN		4.5	mi/n mi/h			
Free-flow speed, FFS		Urban Freeway	111 / 11			
	LOS and Performa:	nce Measures				
Flow rate im		1255	ng/h/ln			
Free-flow speed FFS		60 0	mi/h			
Average passenger-car si	peed. S	60.0	mi/h			
Number of lanes. N		2				
Density, D		22.6	pc/mi/ln			
Level of service, LOS		С	-			

	Operational Analy	vsis				
Analyst:	SEH Inc					
Agency or Company:						
Date Performed:	11/13/2009					
Analysis Time Period:	AM Peak					
Freeway/Direction: Eastbound						
From/To:	Between CR 233 Ram	nps				
Jurisdiction:		-				
Analysis Year:	Year 2030					
Description: Year 2030	Traffic Operations	Analysis of the	US 160 FEIS			
	Flow Inputs and A	Adjustments				
Volume, V		1560	veh/h			
Peak-hour factor, PHF		0.95				
Peak 15-min volume, v15		411	v			
Trucks and buses		5	<u>0</u>			
Recreational vehicles		0	<u>0</u>			
Terrain type:		Rolling				
Grade		0.00	00			
Segment length		0.00	mi			
Trucks and buses PCE, ET	Г	2.5				
Recreational vehicle PCI	E, ER	2.0				
Heavy vehicle adjustment	t, fHV	0.930				
Driver population factor	r, fp	1.00				
Flow rate, vp		883	pc/h/ln			
Speed Inputs and Adjustments						
Lane width		12.0	ft			
Right-shoulder lateral clearance		6.0	ft			
Interchange density		0.50	interchange/mi			
Number of lanes, N		2				
Free-flow speed:		Measured				
FFS or BFFS		60.0	mi/h			
Lane width adjustment, fLW		0.0	mi/h			
Lateral clearance adjustment, fLC		0.0	mi/h			
Interchange density adjustment, fID		0.0	mi/h			
Number of lanes adjustment, fN		4.5	mi/h			
Free-flow speed, FFS		60.0	mi/h			
		Urban Freeway				
	_LOS and Performar	nce Measures				
Flow rate, vp		883	pc/h/ln			
Free-flow speed, FFS		60.0	mi/h			
Average passenger-car sp	peed, S	60.0	mi/h			
Number of lanes, N		2				
Density, D		14.7	pc/mi/ln			
Level of service, LOS		В				

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	Operational A	nalysis				
Analyst:	SEH Inc.					
Agency or Company:	11/13/2009					
Analysis Time Period:	PM Peak					
Freeway/Direction:	Westbound					
From/To:	CR 233 to Gran	dview				
Jurisdiction:						
Analysis Year:	Year 2030					
Description: Year 2030	Traffic Operat	ions Analysis of th	e US 160 FEIS			
	Flow Inputs a	nd Adjustments				
Volume, V		3815	veh/h			
Peak-hour factor, PHF		0.95				
Peak 15-min volume, v15		1004	v			
Trucks and buses		5	8			
Recreational vehicles		0	00			
Terrain type:		Rolling				
Grade		0.00	00			
Segment length		0.00	mi			
Trucks and buses PCE, E	Γ	2.5				
Recreational vehicle PC	E, ER	2.0				
Heavy vehicle adjustmen	t, IHV	0.930				
Driver population factor	r, Ip	1420	ng/h/ln			
Flow rate, vp		1439	pc/n/m			
Speed Inputs and Adjustments						
Lane width	_	12.0	ft			
Right-shoulder lateral clearance		6.0	ft			
Interchange density		0.50	interchange/mi			
Number of lanes, N		3				
Free-flow speed:		Measured				
FFS OF BFFS	C T 1.1	60.0	mi/n			
Lane width adjustment, ILW		0.0	$(\Pi \perp / \Pi)$			
Lateral clearance adjustment, ILC		0.0	mi/h			
Interchange density adjustment, IID		3.0	mi/h			
Number of lanes adjustment, IN		5.0	mi/h			
riee-liow speed, rrs		Urban Freeway				
	LOS and Perfo	rmance Measures				
Flow rate vo		1439	ng/h/ln			
Free-flow speed FFS		60.0	mi/h			
Average passenger-car si	peed. S	60.0	mi/h			
Number of lanes. N		3				
Density, D		24.0	pc/mi/ln			
Level of service, LOS		C	<b>-</b> · ·			

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	Operational Ana	lysis				
Analyst:	SEH Inc.					
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To:	11/13/2009 AM Peak Westbound CR 233 to Grandv	iew				
Jurisdiction: Analysis Year: Description: Year 2030	Year 2030 Traffic Operatio	ns Analysis of the	e US 160 FEIS			
Flow Inputs and Adjustments						
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET	С 7 Бр	2320 0.95 611 5 0 Rolling 0.00 0.00 2.5 2.0	veh/h v % % mi			
Heavy vehicle adjustment Driver population factor Flow rate, vp	s, ER , fHV , fp Speed Inputs an	2.0 0.930 1.00 875	pc/h/ln			
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjust Interchange density adju Number of lanes adjustmo Free-flow speed, FFS	Speed Inputs an clearance fLW tment, fLC istment, fID ent, fN LOS and Perform	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway ance Measures	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h			
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	875 60.0 60.0 3 14.6 B	pc/h/ln mi/h mi/h pc/mi/ln			

	Operational Analy	ysis			
Analyst:	SEH Inc.				
Date Performed: Analysis Time Period: Freeway/Direction:	11/13/2009 PM Peak Eastbound				
From/To:	Grandview to CR 2	33			
Analysis Year:	Year 2030				
Description: Year 2030	Traffic Operations	s Analysis of the	e US 160 FEIS		
	Flow Inputs and A	Adjustments			
Volume, V		3460	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		911	V		
Trucks and buses		5	00		
Recreational vehicles		0	00		
Terrain type:		Rolling	<b>0</b> .		
Grade Sogmont longth		0.00	8 		
Trucks and buses DCF F	г	2 5			
Recreational vehicle PCI	- F. F.B.	2.0			
Heavy vehicle adjustmen	t, fhV	0.930			
Driver population facto:	r, fp	1.00			
Flow rate, vp		1305	pc/h/ln		
Speed Inputs and Adjustments					
Lane width		12.0	ft		
Right-shoulder lateral	clearance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		3			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment, fLW		0.0	mi/h		
Lateral clearance adjustment, fLC		0.0	mi/n		
Interchange density adjustment, flD		0.0	mi/n mi/h		
Number of lanes adjustment, iN		5.0	mi/h		
Free-llow speed, FFS		Urban Freeway			
	LOS and Performa	nce Measures			
Flow rate, vp		1305	pc/h/ln		
Free-flow speed. FFS		60.0	mi/h		
Average passenger-car si	peed, S	60.0	mi/h		
Number of lanes, N		3			
Density, D		21.8	pc/mi/ln		
Level of service, LOS		С			

	Operational Ana	lysis		
Analyst:	SEH Inc.			
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To:	11/13/2009 AM Peak Eastbound Grandview to CR 233			
Analysis Year: Description: Year 2030	Year 2030 2030 Traffic Operations Analysis of the US 160 FEIS			
	Flow Inputs and	Adjustments		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor	C 5, ER 2, fHV 5, fp	2650 0.95 697 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00	veh/h v % % mi	
Flow rate, vp		1000	pc/h/ln	
Speed Inputs and Adjustments				
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW Ement, fLC ustment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h	
LOS and Performance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1000 60.0 60.0 3 16.7 B	pc/h/ln mi/h mi/h pc/mi/ln	

	Operational Analys	is	
nalyst: SEH Inc. gency or Company: ate Performed: 11/13/2009 nalysis Time Period: PM Peak reeway/Direction: Westbound rom/To: Between ramp C and D urisdiction: nalysis Year: Year 2030 pescription: Year 2030 Traffic Operations Analysis of the US 160 FEIS			
	Flow Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population factor Flow rate, vp	r E, ER E, fhV r, fp	3440 0.95 905 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1298	veh/h v % % mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjus Interchange density adjust Number of lanes adjustmo Free-flow speed, FFS	fLW fment, fLC ustment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h mi/h
LOS and Performance Measures			
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1298 60.0 60.0 3 21.6 C	pc/h/ln mi/h mi/h pc/mi/ln

Operational Analysis				
Analyst:	SEH Inc.			
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	11/13/2009 AM Peak Westbound Between ramp C	and D		
Analysis Year: Year 2030 Description: Year 2030 Traffic Operations Analysis of the US 160 FEIS				
	Flow Inputs an	nd Adjustments		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles		1940 0.95 511 5 0	veh/h v % %	
Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV		Rolling 0.00 0.00 2.5 2.0 0.930	% mi	
Driver population factor, fp Flow rate, vp		1.00 732	pc/h/ln	
Speed Inputs and Adjustments				
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjust Interchange density adjust Number of lanes adjustmo Free-flow speed, FFS	ELW Ement, fLC ustment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h	
LOS and Performance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	732 60.0 60.0 3 12.2 B	pc/h/ln mi/h mi/h pc/mi/ln	

	Operational Anal	ysis			
Analyst:	SEH Inc.				
Date Performed: Analysis Time Period:	11/13/2009 AM Peak				
Freeway/Direction: From/To:	Eastbound Between Ramp A & B				
Analysis Year: Description: Year 2030	Year 2030 O Traffic Operations Analysis of the US 160 FEIS				
	Flow Inputs and I	Adjustments			
Volume, V		3460	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		911	V		
Trucks and buses		5	o o		
Recreational vehicles		0	0		
Terrain type:		Rolling	•		
Grade		0.00			
Segment length		0.00	mı		
Degreetional webigle DCL		2.5			
Recreational vehicle PC	L, LK - fuv	2.0			
Driver population factor	r fr	1 00			
Flow rate, vp		1305	pc/h/ln		
	Speed Inputs and Adjustments				
Lane width		12.0	ft		
Right-shoulder lateral of	clearance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		3			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment, :	ELW	0.0	mi/h		
Lateral clearance adjustment, fLC		0.0	mi/h		
Interchange density adjustment, fID		0.0	mi/h		
Number of lanes adjustment, fN		3.0	mi/h		
Free-flow speed, FFS		60.0 Urban Freeway	mı/h		
	LOS and Performa	nce Measures			
Flow rate vo		1305	pc/h/ln		
Free-flow speed FFS		60.0	mi/h		
Average passenger-car si	peed, S	60.0	mi/h		
Number of lanes. N		3			
Density, D		21.8	pc/mi/ln		
Level of service, LOS		C	<u> </u>		

Operational Analysis					
Analyst:	SEH Inc.				
Agency or Company:	11/12/2000				
Analyzia Time Deriod:	II/IS/2009				
Froeway/Direction:	Factbound				
Freeway/Direction:	Potwoon Pamp A	D D			
Jurisdiction:	Between Ramp A &	х Б			
Analysis Year:	Vear 2030				
Description: Year 2030 Traffic Operations Analysis of the US 160 FEIS					
	Flow Inputs and	d Adjustments			
Volume, V		2650	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		697	v		
Trucks and buses		5	00		
Recreational vehicles		0	<b>0</b> 0		
Terrain type:		Rolling			
Grade		0.00	0		
Segment length		0.00	mi		
Trucks and buses PCE, E	<u>T</u>	2.5			
Recreational vehicle PC	E, ER	2.0			
Heavy vehicle adjustmen	t, IHV	0.930			
Driver population facto	r, Ip	1.00	ng/h/ln		
FIOW TALE, VP		1000	pe/11/11		
	Speed Inputs and Adjustments				
Lane width	_	12.0	ft		
Right-shoulder lateral	clearance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		3			
Free-flow speed:		Measured			
FFS Or BFFS	£1.14	60.0	mi/n		
Lane width adjustment, ILW		0.0	mi/h		
Lateral clearance adjustment, inc		0.0	mi/h		
Number of lance adjustment fN		3.0	mi/h		
Free flow greed EFC		5.0	mi/h		
Fice flow Spece, Frb		Urban Freewa	ay		
LOS and Performance Measures					
Flow rate, vp		1000	pc/h/ln		
Free-flow speed. FFS		60.0	mi/h		
Average passenger-car s	peed, S	60.0	mi/h		
Number of lanes, N	1 · · · · · · · · · · · · · · · · · · ·	3	,		
Density, D		16.7	pc/mi/ln		
Level of service, LOS		В	_		

	Operational Analys	is	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	11/13/2009 PM Peak Westbound Between ramp C and Year 2030	Е	
Description: Year 2030 Traffic Operations Analysis of the US 160 FEIS			
	Flow Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		4030 0.95 1061 5 0 Rolling	veh/h v % %
Segment length Trucks and buses PCE, E Recreational vehicle PCI Heavy vehicle adjustment Driver population facto: Flow rate, vp	r E, ER E, fhV r, fp	0.00 2.5 2.0 0.930 1.00 1520	°mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, S Lateral clearance adjust Interchange density adjust Number of lanes adjustme Free-flow speed, FFS	fLW tment, fLC ustment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
LOS and Performance Measures			
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1520 60.0 60.0 3 25.3 C	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Analys	is				
Analyst:	SEH Inc.					
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	11/13/2009 AM Peak Westbound Between ramp C and	E				
Analysis Year: Description: Year 2030	Year 2030 Traffic Operations	Analysis of the	US 160 FEIS			
Flow Inputs and Adjustments						
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCI Heavy vehicle adjustment	С 5, ER - fнv	2940 0.95 774 5 0 Rolling 0.00 0.00 2.5 2.0 0.930	veh/h v % % mi			
Driver population factor	r, fp	1.00				
Flow rate, vp		1109	pc/n/ln			
Speed Inputs and Adjustments						
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW ELW cment, fLC astment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h			
LOS and Performance Measures						
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1109 60.0 60.0 3 18.5 C	pc/h/ln mi/h mi/h pc/mi/ln			

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	Operational Analys	is			
Analyst:	SEH Inc.				
Agency or Company: Date Performed: 11/13/2009 Analysis Time Period: PM Peak Freeway/Direction: Eastbound From/To: Between Ramp A Jurisdiction:					
Analysis Year: Year 2030 Description: Year 2030 Traffic Operations Analysis of the US 160 FEIS					
	Flow Inputs and Ad	ljustments			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor Flow rate, vp	r 5, ER 5, fHV 5, fp	2980 0.95 784 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1124	veh/h v % % mi pc/h/ln		
Speed Inputs and Adjustments					
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	Speed inputs and A clearance fLW tment, fLC istment, fID ent, fN LOS and Performance	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h		
Flow rate, vp		1124	pc/h/ln		
Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D	peed, S	60.0 60.0 3 18.7	mi/h mi/h pc/mi/ln		
LEVEL OF SELVICE, LOS					

	Operational Analy	vsis	
Analyst: Agency or Company: Date Performed:	SEH Inc. 11/13/2009		
Analysis Time Period:	AM Peak		
Freeway/Direction:	Eastbound		
From/To:	Between Ramp A & F	3	
Jurisdiction:			
Analysis Year:	Year 2030		
Description: Year 2030	Traffic Operations	Analysis of the	US 160 FEIS
	Flow Inputs and A	djustments	
Volume, V		2030	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		534	v
Trucks and buses		5	8
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	8
Segment length		0.00	mi
Trucks and buses PCE, E	Г	2.5	
Recreational vehicle PC	E, ER	2.0	
Heavy vehicle adjustmen	t, fHV	0.930	
Driver population factor	r, fp	1.00	
Flow rate, vp		766	pc/h/ln
	Speed Inputs and	Adjustments	
Lane width		12.0	ft
Right-shoulder lateral	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		3	5
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	flW	0.0	mi/h
Lateral clearance adjus	tment, fLC	0.0	mi/h
Interchange density adj	ustment, fID	0.0	mi/h
Number of lanes adjustment, fN		3.0	mi/h
Free-flow speed, FFS		60.0	mi/h
		Urban Freeway	
	LOS and Performar	nce Measures	
Flow rate, vp		766	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	peed, S	60.0	mi/h
Number of lanes, N		3	
Density, D		12.8	pc/mi/ln
Level of service, LOS		В	_

	Operational Ana	alysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: 11/13/2009 Analysis Time Period: PM Peak Freeway/Direction: Westbound From/To: West of Grandview Jurisdiction: Analysis Year: Year 2030 Description: Year 2030 Traffic Operations		2W	
		ons Analysis of th	e US 160 FEIS
	Flow Inputs and	l Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor	C, ER 2, fHV 2, fp	4620 0.95 1216 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00	veh/h v % % mi
Flow rate, vp		1/43	pc/n/ln
	Speed Inputs ar	nd Adjustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW Ement, fLC astment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	_LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1743 60.0 59.9 3 29.1 D	pc/h/ln mi/h mi/h pc/mi/ln

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ven/n v % % mi
pc/h/ln
ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
pc/h/ln mi/h mi/h pc/mi/ln
_

	Operational Ana	lysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	11/13/2009 PM Peak Eastbound West of Grandvie	ew	
Description: Year 2030	Traffic Operation	ns Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		4525 0.95 1191 5 0 Rolling	veh/h v % %
Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp		0.00 0.00 2.5 2.0 0.930 1.00	% mi
FIOW face, vp	Spood Inputs on	1707	pc/11/111
	Speed inputs and	a Adjustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, T Lateral clearance adjust Interchange density adjust Number of lanes adjustmo Free-flow speed, FFS	ELW Ement, fLC ustment, fID ent, fN	12.0 6.0 0.50 3 Measured 60.0 0.0 0.0 0.0 3.0 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	_LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1707 60.0 59.9 3 28.5 D	pc/h/ln mi/h mi/h pc/mi/ln
Density, D Level of service, LOS		28.5 D	pc/mi/ln

	Operational Anal	ysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To:	11/13/2009 AM Peak Eastbound West of Grandwie	147	
Jurisdiction:		**	
Analysis Year: Description: Year 2030	Year 2030 Traffic Operation	s Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15		2830 0.95 745	veh/h v
Trucks and buses		5	00
Recreational vehicles Terrain type: Grade		0 Rolling 0.00	8 
Trucks and buses PCE, E Recreational vehicle PCI	F S, ER - fux	2.5 2.0 0.930	μT
Driver population factor	c, fp	1.00	
Flow rate, vp	-, <u>-</u> _	1067	pc/h/ln
	Speed Inputs and	Adjustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment, t	ELW	0.0	mi/h
Lateral clearance adjust	cment, fLC	0.0	mi/h
Interchange density adju	istment, fID	0.0	mi/h
Number of lanes adjustme	ent, IN	3.0	mi/h mi/h
Free-frow speed, FFS		Urban Freeway	m1/11
	_LOS and Performa	nce Measures	
Flow rate, vp		1067	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car sp	peed, S	60.0	mi/h
Number of lanes, N		3	, , , ,
Density, D		17.8 P	pc/mi/in
HEVEL OF SELVICE, HOS		D	

	Operational Anal	ysis	
Analyst:	SEH Inc.		
Agency or Company:			
Date Performed:	11/13/2009		
Analysis Time Period:	PM Peak		
Freeway/Direction:	Westbound		
From/To:	Between SH 172 Ra	mps	
Jurisdiction:			
Analysis Year:	Year 2030		
Description: Year 2030	Traffic Operation	is Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume, V		1505	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		396	v
Trucks and buses		5	oo
Recreational vehicles		0	oo
Terrain type:		Rolling	
Grade		0.00	0
Segment length		0.00	mi
Trucks and buses PCE, E	Г	2.5	
Recreational vehicle PCI	E, ER	2.0	
Heavy venicle adjustment	C, IHV	0.930	
Driver population factor	r, Ip	1.00	
FIOW face, vp		052	pc/11/11
	Speed Inputs and	Adjustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,		0.0	mi/h
Lateral clearance adjust	cment, ILC	0.0	mi/n
Interchange density adju	astment, IID	0.0	mi/h
Free flow greed FES	ent, IN	4.5	mi/h
Free-riow speed, Frs		UU.U Urban Ercoway	111 / 11
		UIDAII FIEEway	
	_LOS and Performa	nce Measures	
Flow rate, vp		852	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car sp	peed, S	60.0	mi/h
Number of lanes, N		2	
Density, D		14.2	pc/mi/ln
Level of service, LOS		В	

	Operational Analy	sis	
Analyst:	SEH Inc.		
Agency or Company:	11/13/2009		
Analysis Time Deriod:	AM Deak		
Freeway/Direction:	Westbound		
From/To:	Retween SH 172 Par		
Jurisdiction:		ip b	
Analysis Year:	Year 2030		
Description: Year 2030	Traffic Operations	Analysis of the	US 160 FEIS
	Flow Inputs and A	djustments	
Volume, V		935	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		246	v
Trucks and buses		5	00
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	00
Segment length		0.00	mi
Trucks and buses PCE, ET	ſ	2.5	
Recreational vehicle PCI	E, ER	2.0	
Heavy vehicle adjustment	E, fHV	0.930	
Driver population factor	r, fp	1.00	
Flow rate, vp		529	pc/h/ln
	Speed Inputs and	Adjustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment, i	LW	0.0	mi/h
Lateral clearance adjust	cment, ILC	0.0	mi/h
Interchange density adju	istment, IID	0.0	mi/h
Number of lanes adjustme	ent, IN	4.5	mi/h
Free-Ilow speed, FFS			m1/h
		Urban Freeway	
	LOS and Performan	ce Measures	
Flow rate, vp		529	pc/h/ln
Free-flow speed, FFS	_	60.0	mi/h
Average passenger-car sp	peed, S	60.0	mi/h
Number of lanes, N		2	
Density, D		8.8	pc/mi/ln
Level of service, LOS		A	

	Operational Ana	lysis	
Analyst:	SEH Inc.		
Agency or Company:			
Date Performed:	11/13/2009		
Analysis Time Period:	PM Peak		
Freeway/Direction:	Eastbound		
From/To:	Between SH 172 R	amps	
Jurisdiction			
Analysis Year:	Year 2030 Twoffig Operatio	and Apply and the	NG 160 PETC
Description: fear 2030	Ifallic Operatio	IS ANALYSIS OF CHE	5 05 100 FEI2
	Flow Inputs and	Adjustments	
Volume, V		1555	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		409	V
Trucks and buses		5	00
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	8
Segment length		0.00	mi
Trucks and buses PCE, E	Г	2.5	
Recreational vehicle PC	E, ER	2.0	
Heavy vehicle adjustmen	t, fHV	0.930	
Driver population facto	r, fp	1.00	
Flow rate, vp		880	pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width		12.0	ft
Right-shoulder lateral	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	flW	0.0	mi/h
Lateral clearance adjus	tment, fLC	0.0	mi/h
Interchange density adj	ustment, fID	0.0	mi/h
Number of lanes adjustm	ent, fN	4.5	mi/h
Free-flow speed, FFS		60.0	mi/h
		Urban Freeway	
	LOS and Perform	ance Measures	
Flow rate, vp		880	pc/h/ln
Free-flow speed. FFS		60.0	mi/h
Average passenger-car s	peed, S	60.0	mi/h
Number of lanes. N		2	•
Density, D		14.7	pc/mi/ln
Level of service, LOS		В	_

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	Operational Anal	ysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed:	11/13/2009		
Analysis Time Period:	AM Peak		
Freeway/Direction:	Eastbound		
From/To:	Between SH 172 Ra	mps	
Jurisdiction:		-	
Analysis Year:	Year 2030		
Description: Year 2030	Traffic Operation	s Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume, V		1145	veh/h
Peak-hour factor, PHF		0.95	
Peak 15-min volume, v15		301	v
Trucks and buses		5	00
Recreational vehicles		0	oo
Terrain type:		Rolling	
Grade		0.00	8
Segment length		0.00	mi
Trucks and buses PCE, E	Г	2.5	
Recreational vehicle PCI	E, ER	2.0	
Heavy vehicle adjustment	C, IHV	0.930	
Driver population factor	r, ip	1.00	
Flow face, vp		040	pc/11/11
	Speed Inputs and	Adjustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS OT BFFS	5 7 7 7	60.0	mi/n
Lane width adjustment, I	LLW	0.0	mi/n mi/h
Interchange dengity adjust	lilenc, ILC	0.0	mi/h
Number of lange delisity adjust	aschienc, LID	0.0	$m_{1}/h$
Free-flow greed FFS	enc, in	4.5	mi/h
File filw speed, Fib		Urban Freeway	111 / 11
	_LOS and Performa	nce Measures	
			<u></u>
Flow rate, vp		648 60 0	pc/n/ln mi/h
Free-riow speed, FFS	and g	60.0	$m_{1}/m_{1}$
Number of lance N	peeu, s	20.0	1111/11
Density D		⊿ 10 8	ng/mi/ln
Level of service, LOS		10.0 A	P.C./ IIIT / TII

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	_Operational Analy	ysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	11/13/2009 PM Peak Westbound SH 172 to CR 233		
Analysis Year: Description: Year 2030	Year 2030 Traffic Operations	a Analysis of the	NIS 160 FEIS
	Flow Inputs and A	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15		2595 0.95 683	veh/h
Trucks and buses Recreational vehicles Terrain type: Grade Segment length		5 0 Rolling 0.00 0.00	8 8 mi
Trucks and buses PCE, ET Recreational vehicle PCE Heavy vehicle adjustment Driver population factor	, ER , fHV , fp	2.5 2.0 0.930 1.00 1468	nc/h/ln
FIOW TALE, VP	Speed Inputs and	Adjustments	
I and width	_speed inputs and	12.0	
Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW Ement, fLC stment, fID ent, fN	6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0	ft interchange/mi mi/h mi/h mi/h mi/h mi/h mi/h
	LOS and Performa	nce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1468 60.0 60.0 2 24.5 C	pc/h/ln mi/h mi/h pc/mi/ln

Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS

## **Appendix B**

## **Alternative G Modified**

At-Grade Intersection Evaluation Worksheets

PM Peak Period Year 2030 Traffic Volumes At-Grade Intersections

	٦	-	$\rightarrow$	•	-	•	1	1	1	1	Ŧ	~
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ኘኘ	<u></u>	1	٢	<u>†</u> †	1	ሻሻ	•	1	۲	•	1
Volume (vph)	385	1555	855	125	1505	90	685	105	115	135	80	405
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	4.0	5.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	405	1637	900	132	1584	95	721	111	121	142	84	426
RTOR Reduction (vph)	0	0	352	0	0	40	0	0	0	0	0	0
Lane Group Flow (vph)	405	1637	548	132	1584	55	721	111	121	142	84	426
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free
Actuated Green, G (s)	17.0	70.0	70.0	11.0	64.0	64.0	30.0	26.0	145.0	20.0	16.0	145.0
Effective Green, g (s)	17.0	70.0	70.0	11.0	64.0	64.0	30.0	26.0	145.0	20.0	16.0	145.0
Actuated g/C Ratio	0.12	0.48	0.48	0.08	0.44	0.44	0.21	0.18	1.00	0.14	0.11	1.00
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0		4.0	5.0	
Lane Grp Cap (vph)	402	1708	764	134	1562	699	710	334	1583	244	206	1583
v/s Ratio Prot	c0.12	0.46		0.07	c0.45		c0.21	0.06		0.08	c0.05	
v/s Ratio Perm			0.35			0.03			0.08			0.27
v/c Ratio	1.01	0.96	0.72	0.99	1.01	0.08	1.02	0.33	0.08	0.58	0.41	0.27
Uniform Delay, d1	64.0	36.1	29.7	66.9	40.5	23.4	57.5	51.9	0.0	58.6	60.1	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	46.8	13.9	5.7	73.9	26.3	0.2	37.7	2.7	0.1	9.8	5.9	0.4
Delay (s)	110.8	50.0	35.4	140.8	66.8	23.7	95.2	54.6	0.1	68.3	66.0	0.4
Level of Service	F	D	D	F	E	С	F	D	А	E	E	A
Approach Delay (s)		53.9			69.9			78.4			23.7	
Approach LOS		D			E			E			С	
Intersection Summary												
HCM Average Control Delay	у		59.0	Н	CM Level	l of Servic	e		E			
HCM Volume to Capacity ra	itio		0.94									
Actuated Cycle Length (s)			145.0	S	um of los	t time (s)			18.0			
Intersection Capacity Utiliza	tion		90.5%	IC	CU Level of	of Service	<u>;</u>		E			
Analysis Period (min)			15									

c Critical Lane Group

PM Peak Period Year 2030 Traffic Volumes At-Grade Intersections

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ	<b>†</b> †	1	۲.	<b>†</b> †	1	ሻሻ	<b>†</b>	1	ሻሻ	1	1
Volume (vph)	720	2395	345	90	2315	190	570	85	150	250	85	930
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	4.0	4.0	5.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	758	2521	363	95	2437	200	600	89	158	263	89	979
RTOR Reduction (vph)	0	0	0	0	0	60	0	0	0	0	0	0
Lane Group Flow (vph)	758	2521	363	95	2437	140	600	89	158	263	89	979
Turn Type	Prot		Free	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			Free			Free
Actuated Green, G (s)	23.0	88.0	150.0	12.0	77.0	77.0	20.0	14.0	150.0	18.0	12.0	150.0
Effective Green, g (s)	23.0	88.0	150.0	12.0	77.0	77.0	20.0	14.0	150.0	18.0	12.0	150.0
Actuated g/C Ratio	0.15	0.59	1.00	0.08	0.51	0.51	0.13	0.09	1.00	0.12	0.08	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	
Lane Grp Cap (vph)	526	2076	1583	142	1817	813	458	174	1583	412	149	1583
v/s Ratio Prot	c0.22	0.71		0.05	c0.69		c0.17	0.05		0.08	0.05	
v/s Ratio Perm			0.23			0.09			0.10			c0.62
v/c Ratio	1.44	1.21	0.23	0.67	1.34	0.17	1.31	0.51	0.10	0.64	0.60	0.62
Uniform Delay, d1	63.5	31.0	0.0	67.1	36.5	19.5	65.0	64.7	0.0	62.9	66.7	0.0
Progression Factor	0.94	1.11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	199.5	96.9	0.0	22.3	157.3	0.5	154.5	10.3	0.1	7.4	16.4	1.8
Delay (s)	259.1	131.3	0.0	89.4	193.8	19.9	219.5	75.1	0.1	70.3	83.1	1.8
Level of Service	F	F	А	F	F	В	F	E	А	E	F	A
Approach Delay (s)		144.8			177.5			163.4			20.8	
Approach LOS		F			F			F			С	
Intersection Summary												
HCM Average Control Delay			137.8	Н	HCM Level of Service				F			
HCM Volume to Capacity ratio			1.27									
Actuated Cycle Length (s)			150.0	S	Sum of lost time (s)				13.0			
Intersection Capacity Utilization			119.1%	IC	ICU Level of Service				Н			
Analysis Period (min)			15									

c Critical Lane Group
	≯	-	-	•	1	1	
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	ሻሻ	<b>^</b>	<b>^</b>	1	ሻሻ	1	
Volume (vph)	550	3290	3675	135	170	590	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	5.0	5.0	5.0	4.0	4.0	
Lane Util. Factor	0.97	0.95	0.95	1.00	0.97	1.00	
Frt	1.00	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	3539	3539	1583	3433	1583	
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	3539	3539	1583	3433	1583	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	 
Adj. Flow (vph)	579	3463	3868	142	179	621	
RTOR Reduction (vph)	0	0	0	28	0	0	
Lane Group Flow (vph)	579	3463	3868	114	179	621	
Turn Type	Prot			Perm		Free	
Protected Phases	7	4	8		1		
Permitted Phases				8		Free	
Actuated Green, G (s)	18.0	129.0	107.0	107.0	12.0	150.0	
Effective Green, g (s)	18.0	129.0	107.0	107.0	12.0	150.0	
Actuated g/C Ratio	0.12	0.86	0.71	0.71	0.08	1.00	
Clearance Time (s)	4.0	5.0	5.0	5.0	4.0		
Lane Grp Cap (vph)	412	3044	2524	1129	275	1583	
v/s Ratio Prot	c0.17	0.98	c1.09		c0.05		
v/s Ratio Perm				0.07		0.39	
v/c Ratio	1.41	1.14	1.53	0.10	0.65	0.39	
Uniform Delay, d1	66.0	10.5	21.5	6.6	67.0	0.0	
Progression Factor	1.00	1.00	1.15	2.08	1.00	1.00	
Incremental Delay, d2	196.5	66.5	239.8	0.0	11.4	0.7	
Delay (s)	262.5	77.0	264.5	13.8	78.3	0.7	
Level of Service	F	E	F	В	E	А	
Approach Delay (s)		103.6	255.6		18.1		
Approach LOS		F	F		В		
Intersection Summary							
HCM Average Control Delay	/		164.7	H	CM Level	of Service	
HCM Volume to Capacity ra	tio		1.44				
Actuated Cycle Length (s)			150.0	Si	um of lost	t time (s)	
Intersection Capacity Utiliza	tion		136.4%	IC	U Level o	of Service	
Analysis Period (min)			15				

AM Peak Period Year 2025 Traffic Volumes At-Grade Intersections

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ኘኘ	<u>††</u>	1	۳	<u>†</u> †	1	ኘኘ	•	1	٢	•	1
Volume (vph)	260	1145	350	70	935	70	685	55	65	50	40	255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	4.0	4.0	5.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	274	1205	368	74	984	74	721	58	68	53	42	268
RTOR Reduction (vph)	0	0	245	0	0	49	0	0	0	0	0	0
Lane Group Flow (vph)	274	1205	123	74	984	25	721	58	68	53	42	268
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			Free
Actuated Green, G (s)	10.0	33.5	33.5	10.0	33.5	33.5	22.5	28.5	100.0	10.0	16.0	100.0
Effective Green, g (s)	10.0	33.5	33.5	10.0	33.5	33.5	22.5	28.5	100.0	10.0	16.0	100.0
Actuated g/C Ratio	0.10	0.34	0.34	0.10	0.34	0.34	0.22	0.28	1.00	0.10	0.16	1.00
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0		4.0	5.0	
Lane Grp Cap (vph)	343	1186	530	177	1186	530	772	531	1583	177	298	1583
v/s Ratio Prot	c0.08	c0.34		0.04	0.28		c0.21	0.03		0.03	0.02	
v/s Ratio Perm			0.08			0.02			0.04			c0.17
v/c Ratio	0.80	1.02	0.23	0.42	0.83	0.05	0.93	0.11	0.04	0.30	0.14	0.17
Uniform Delay, d1	44.0	33.2	24.0	42.3	30.6	22.5	38.0	26.4	0.0	41.8	36.1	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	17.5	30.2	1.0	7.1	6.8	0.2	19.8	0.4	0.1	4.3	1.0	0.2
Delay (s)	61.5	63.4	25.0	49.4	37.4	22.6	57.8	26.8	0.1	46.0	37.1	0.2
Level of Service	Е	E	С	D	D	С	E	С	А	D	D	А
Approach Delay (s)		55.5			37.2			51.0			11.2	
Approach LOS		E			D			D			В	
Intersection Summary												
HCM Average Control Delay	A Average Control Delay 45					of Servic	e		D			
HCM Volume to Capacity rat	CM Volume to Capacity ratio 0.											
Actuated Cycle Length (s)	Si	um of los	t time (s)			13.0						
Intersection Capacity Utilizat	tion		77.9%	IC	U Level	of Service	;		D			
Analysis Period (min)			15									

AM Peak Period Year 2025 Traffic Volumes At-Grade Intersections

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ	<b>†</b> †	1	<u> </u>	<b>†</b> †	1	ሻሻ	<b>†</b>	1	ሻሻ	1	1
Volume (vph)	735	1560	355	95	1585	195	180	60	50	145	60	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0	5.0	4.0	5.0	4.0	4.0	5.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	774	1642	374	100	1668	205	189	63	53	153	63	584
RTOR Reduction (vph)	0	0	0	0	0	96	0	0	0	0	0	0
Lane Group Flow (vph)	774	1642	374	100	1668	109	189	63	53	153	63	584
Turn Type	Prot		Free	Prot		Perm	Prot		Free	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			Free			Free
Actuated Green, G (s)	31.0	74.0	140.0	22.0	65.0	65.0	10.0	16.0	140.0	10.0	16.0	140.0
Effective Green, g (s)	31.0	74.0	140.0	22.0	65.0	65.0	10.0	16.0	140.0	10.0	16.0	140.0
Actuated g/C Ratio	0.22	0.53	1.00	0.16	0.46	0.46	0.07	0.11	1.00	0.07	0.11	1.00
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0	4.0	5.0		4.0	5.0	
Lane Grp Cap (vph)	760	1871	1583	278	1643	735	245	213	1583	245	213	1583
v/s Ratio Prot	c0.23	0.46		0.06	c0.47		c0.06	0.03		0.04	0.03	
v/s Ratio Perm			0.24			0.07			0.03			c0.37
v/c Ratio	1.02	0.88	0.24	0.36	1.02	0.15	0.77	0.30	0.03	0.62	0.30	0.37
Uniform Delay, d1	54.5	29.0	0.0	52.7	37.5	21.6	63.9	56.8	0.0	63.2	56.8	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	37.4	6.2	0.4	3.6	26.1	0.4	20.7	3.5	0.0	11.4	3.5	0.7
Delay (s)	91.9	35.2	0.4	56.3	63.6	22.0	84.5	60.3	0.0	74.6	60.3	0.7
Level of Service	F	D	A	E	E	С	F	E	A	E	E	A
Approach Delay (s)		46.3			58.9			64.9			19.5	
Approach LOS		D			E			E			В	
Intersection Summary												
HCM Average Control Delay	y		47.8	Н	CM Level	of Servic	e		D			
HCM Volume to Capacity ratio 0.89												
Actuated Cycle Length (s)			140.0	S	um of los	t time (s)			13.0			
Intersection Capacity Utiliza	tion		88.3%	IC	CU Level	of Service			E			
Analysis Period (min)			15									

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Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations	ሻሻ	<u>^</u>	<b>^</b>	1	ሻሻ	1	
Volume (vph)	550	2535	2175	140	110	385	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	5.0	5.0	5.0	4.0	4.0	
Lane Util. Factor	0.97	0.95	0.95	1.00	0.97	1.00	
Frt	1.00	1.00	1.00	0.85	1.00	0.85	
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	3539	3539	1583	3433	1583	
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	3539	3539	1583	3433	1583	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	
Adj. Flow (vph)	579	2668	2289	147	116	405	
RTOR Reduction (vph)	0	0	0	55	0	0	
Lane Group Flow (vph)	579	2668	2289	92	116	405	
Turn Type	Prot			Perm		Free	
Protected Phases	7	4	8		1		
Permitted Phases				8		Free	
Actuated Green, G (s)	18.0	91.0	69.0	69.0	10.0	110.0	
Effective Green, g (s)	18.0	91.0	69.0	69.0	10.0	110.0	
Actuated g/C Ratio	0.16	0.83	0.63	0.63	0.09	1.00	
Clearance Time (s)	4.0	5.0	5.0	5.0	4.0		
Lane Grp Cap (vph)	562	2928	2220	993	312	1583	
v/s Ratio Prot	c0.17	0.75	c0.65		c0.03		
v/s Ratio Perm				0.06		0.26	
v/c Ratio	1.03	0.91	1.03	0.09	0.37	0.26	
Uniform Delay, d1	46.0	6.7	20.5	8.1	47.0	0.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	45.9	5.5	27.6	0.2	3.4	0.4	
Delay (s)	91.9	12.2	48.1	8.3	50.4	0.4	
Level of Service	F	В	D	А	D	А	
Approach Delay (s)		26.4	45.7		11.5		
Approach LOS		С	D		В		
Intersection Summary							
HCM Average Control Delay			32.7	H	CM Level	l of Service	
HCM Volume to Capacity rati	ю		0.96				
Actuated Cycle Length (s)			110.0	Si	um of lost	t time (s)	
Intersection Capacity Utilizati	on		95.0%	IC	U Level o	of Service	
Analysis Period (min)			15				

Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS

## **Appendix C**

## **Alternative F Modified**

Interchange Evaluation Worksheets

PM Peak Period Year 2030 Traffic Volumes Alternative F Modified

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	5		1	ሻሻ	•	1	5	•	1
Volume (vph)	625	0	855	125	0	155	685	105	115	220	120	700
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	658	0	900	132	0	163	721	111	121	232	126	737
RTOR Reduction (vph)	0	0	267	0	0	23	0	0	65	0	0	37
Lane Group Flow (vph)	658	0	633	132	0	140	721	111	56	232	126	700
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			16
Actuated Green, G (s)	35.0		67.5	35.0		67.5	37.7	20.8	64.3	37.7	20.8	64.3
Effective Green, g (s)	35.0		67.5	35.0		67.5	37.7	20.8	55.8	37.7	20.8	55.8
Actuated g/C Ratio	0.29		0.56	0.29		0.56	0.31	0.17	0.46	0.31	0.17	0.46
Clearance Time (s)	9.0			9.0			9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1001		890	516		890	1079	323	736	556	323	736
v/s Ratio Prot	0.19			0.07			0.21	0.06		0.13	0.07	
v/s Ratio Perm			c0.40			0.09			0.04			c0.44
v/c Ratio	0.66		0.71	0.26		0.16	0.67	0.34	0.08	0.42	0.39	0.95
Uniform Delay, d1	37.2		19.1	32.5		12.6	35.7	43.6	17.8	32.5	44.0	30.8
Progression Factor	0.94		0.87	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5		2.7	0.3		0.1	1.6	2.9	0.0	0.5	3.5	21.8
Delay (s)	36.6		19.3	32.8		12.7	37.3	46.5	17.9	33.0	47.5	52.6
Level of Service	D		В	С		В	D	D	В	С	D	D
Approach Delay (s)		26.6			21.7			35.9			47.9	
Approach LOS		С			С			D			D	
Intersection Summary												
HCM Average Control Delay	/		34.5	Н	CM Leve	el of Servic	e		С			
HCM Volume to Capacity ra	tio		0.91									
Actuated Cycle Length (s)			120.0	S	um of los	st time (s)			27.0			
Intersection Capacity Utiliza	tion		86.1%	IC	U Level	of Service	:		E			
Analysis Period (min)			15									
c Critical Lane Group												

AM Peak Period Year 2030 Traffic Volumes Alternative F Modified

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		1	5		1	ሻሻ	•	1	5	•	1
Volume (vph)	500	0	350	70	0	140	685	55	65	105	65	445
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97		1.00	1.00		1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		1583	1770		1583	3433	1863	1583	1770	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	526	0	368	74	0	147	721	58	68	111	68	468
RTOR Reduction (vph)	0	0	254	0	0	102	0	0	29	0	0	39
Lane Group Flow (vph)	526	0	114	74	0	45	721	58	39	111	68	429
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			5			5			16			16
Actuated Green, G (s)	22.3		27.8	22.3		27.8	27.8	24.9	52.2	27.8	24.9	52.2
Effective Green, g (s)	22.3		27.8	22.3		27.8	27.8	24.9	52.2	27.8	24.9	52.2
Actuated g/C Ratio	0.25		0.31	0.25		0.31	0.31	0.28	0.58	0.31	0.28	0.58
Clearance Time (s)	5.0		5.0	5.0		5.0	5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	851		489	439		489	1060	515	918	547	515	918
v/s Ratio Prot	c0.15			0.04			c0.21	0.03		0.06	0.04	
v/s Ratio Perm			0.07			0.03			0.02			c0.27
v/c Ratio	0.62		0.23	0.17		0.09	0.68	0.11	0.04	0.20	0.13	0.47
Uniform Delay, d1	30.1		23.2	26.6		22.1	27.2	24.3	8.1	22.9	24.4	10.9
Progression Factor	1.02		0.88	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3		0.2	0.2		0.1	1.8	0.4	0.0	0.2	0.5	0.4
Delay (s)	32.0		20.6	26.8		22.2	29.0	24.7	8.2	23.1	25.0	11.3
Level of Service	С		С	С		С	С	С	А	С	С	В
Approach Delay (s)		27.3			23.7			27.1			14.7	
Approach LOS		С			С			С			В	
Intersection Summary												
HCM Average Control Delay	/		23.8	Н	CM Leve	l of Servic	e		С			
HCM Volume to Capacity ra	tio		0.61									
Actuated Cycle Length (s)			90.0	S	um of los	st time (s)			15.0			
Intersection Capacity Utiliza	tion		55.4%	IC	U Level	of Service	;		В			
Analysis Period (min)			15									
c Critical Lane Group												

PM Peak Period Year 2030 Traffic Volumes Alternative F Modified

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻሻ		11	ሻሻ		1	ሻሻ	•	1	ሻሻ	•	1
Volume (vph)	960	0	1410	330	0	260	1160	190	460	335	130	1225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	9.0		9.0	9.0		9.0	9.0	8.5	9.0	9.0	8.5	9.0
Lane Util. Factor	0.97		0.88	0.97		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1011	0	1484	347	0	274	1221	200	484	353	137	1289
RTOR Reduction (vph)	0	0	189	0	0	5	0	0	168	0	0	0
Lane Group Flow (vph)	1011	0	1295	347	0	269	1221	200	316	353	137	1289
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			156
Actuated Green, G (s)	36.0		66.5	36.0		66.5	42.0	15.5	60.0	42.0	15.5	120.0
Effective Green, g (s)	36.0		66.5	36.0		66.5	42.0	15.5	51.5	42.0	15.5	111.5
Actuated g/C Ratio	0.30		0.55	0.30		0.55	0.35	0.13	0.43	0.35	0.13	0.93
Clearance Time (s)	9.0			9.0			9.0	8.5		9.0	8.5	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1030		1544	1030		877	1202	241	679	1202	241	1471
v/s Ratio Prot	0.29			0.10			0.36	0.11		0.10	0.07	
v/s Ratio Perm			0.46			0.17			0.20			c0.81
v/c Ratio	0.98		0.84	0.34		0.31	1.02	0.83	0.46	0.29	0.57	0.88
Uniform Delay, d1	41.7		22.3	32.7		14.4	39.0	51.0	24.4	28.3	49.1	1.6
Progression Factor	1.00		1.00	0.90		0.75	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.5		4.2	0.2		0.2	30.0	26.9	0.5	0.1	9.4	6.2
Delay (s)	65.2		26.4	29.6		10.9	69.0	77.9	24.9	28.4	58.5	7.8
Level of Service	E		С	С		В	E	E	С	С	E	A
Approach Delay (s)		42.1			21.4			58.7			15.8	
Approach LOS		D			С			E			В	
Intersection Summary												
HCM Average Control Delay	y		38.0	Н	CM Leve	el of Servio	ce		D			
HCM Volume to Capacity ra	tio		0.88									
Actuated Cycle Length (s)			120.0	S	um of los	st time (s)			9.0			
Intersection Capacity Utiliza	tion		123.5%	IC	U Level	of Service	;		Н			
Analysis Period (min)			15									
c Critical Lane Group												

AM Peak Period Year 2030 Traffic Volumes Alternative F Modified

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ		11	ሻሻ		1	ሻሻ	•	1	ሻሻ	•	1
Volume (vph)	976	0	675	335	0	265	1180	165	560	200	90	750
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97		0.88	0.97		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1027	0	711	353	0	279	1242	174	589	211	95	789
RTOR Reduction (vph)	0	0	200	0	0	6	0	0	261	0	0	0
Lane Group Flow (vph)	1027	0	511	353	0	273	1242	174	328	211	95	789
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			156
Actuated Green, G (s)	29.0		51.0	29.0		51.0	34.0	12.0	46.0	34.0	12.0	90.0
Effective Green, g (s)	29.0		51.0	29.0		51.0	34.0	12.0	46.0	34.0	12.0	90.0
Actuated g/C Ratio	0.32		0.57	0.32		0.57	0.38	0.13	0.51	0.38	0.13	1.00
Clearance Time (s)	5.0			5.0			5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1106		1579	1106		897	1297	248	809	1297	248	1583
v/s Ratio Prot	c0.30			0.10			c0.36	0.09		0.06	0.05	
v/s Ratio Perm			0.18			0.17			0.21			c0.50
v/c Ratio	0.93		0.32	0.32		0.30	0.96	0.70	0.41	0.16	0.38	0.50
Uniform Delay, d1	29.5		10.3	23.0		10.2	27.3	37.3	13.6	18.6	35.6	0.0
Progression Factor	1.00		1.00	0.74		1.38	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.1		0.1	0.1		0.2	15.8	15.3	0.3	0.1	4.4	0.2
Delay (s)	42.6		10.5	17.2		14.3	43.1	52.6	13.9	18.6	40.1	0.2
Level of Service	D		В	В		В	D	D	В	В	D	A
Approach Delay (s)		29.5			15.9			35.3			1.2	
Approach LOS		С			В			D			A	
Intersection Summary												
HCM Average Control Delay	y		25.6	Н	CM Leve	el of Servio	ce		С			
HCM Volume to Capacity ra	itio		0.85									
Actuated Cycle Length (s)			90.0	S	um of los	st time (s)			10.0			
Intersection Capacity Utiliza	tion		88.4%	IC	CU Level	of Service	;		E			
Analysis Period (min)			15									
c Critical Lane Group												

		RAMP	S AND	RAM	) JUN	CTIONS	WORKS	SHEE	Γ				
General	Informati	ion				Site Inf	ormatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir o Inction Irisdiction	f Travel	US <sup>2</sup> SH <sup>2</sup>	160 Eastb 172 On Ra	ound amp			
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Yea	r 2030				
Project Desc	ription Year 2	2030 Traffic (	perations	Analysis	of the US	5 160 FEIS							
Inputs		Torrain Dolli	na						- 1				
Upstream Ac	lj Ramp		ng						C	Downstrear	m Adj Ramp		
F Yes	Cn On									Yes	On		
No No	Cff Off								Ľ	down =	ft		
L <sub>up</sub> =	ft			<u> </u>			40.0						
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V <sub>F</sub>	<sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	ph	V	/D =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	1		1					
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>	1	f <sub>p</sub> V	v=V/PHF f <sub>HV</sub> f <sub>p</sub>			
Freeway	1470	0.95	Roll	ng	5	0	0.930	1.0	0	1663			
Ramp UnStream	335	0.95	ROIL	ng	2		0.971	1.0	0	303			
DownStream	 ח												
	4,	Merge Areas	5		,			Diverge	e Areas				
Estimati	on of v <sub>12</sub>					Estima	tion of v	12					
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)				,	V <sub>12</sub> = V <sub>R</sub>	+ (V <sub>F</sub> - V <sub>F</sub>	<sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Eq	uation 25-8 c	or 25-9)					
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 1663	pc/h					V <sub>12</sub> = pc/h							
Capacity	/ Checks					Capacity Checks							
	Actua	al Max	timum	LOS	S F?		Actu	lal	Maxim	num	LOS F?		
						V <sub>FI</sub> =V <sub>F</sub>	-	9	See Exhib	it 25-14			
V <sub>FO</sub>	2026	See Ex	hidit 25-7	N	0	V <sub>12</sub>			4400:	All			
V <sub>R12</sub>	2026	460	)0:All	N	0	$V_{FO} = V_{F}$	-	5	See Exhib	it 25-14			
						V <sub>R</sub>			See Exhil	oit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level o	of Servic	e Dete	ermina	ntion (if	f not F)		
D <sub>R</sub> =	5.475 + 0.0073	34 v <sub>R</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.2	252 + 0.0	086 V <sub>12</sub> -	0.009 L <sub>D</sub>			
D <sub>R</sub> =	11.9 (pc/ m/ln)					D <sub>R</sub> = (pc/ m/ln)							
LOS =	B (Exhibit 25-4	4)				LOS= (Exhibit 25-4)							
Speed E	stimation	1				Speed Estimation							
M <sub>S</sub> = 0.2	233 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 55	.8 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = N/.	A mph (Exhibi	t 25-19)				S <sub>0</sub> = r	nph (Exhibit	25-19)					
S= 55	.8 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

		RAMP	S AND	RAM	P JUN	CTIONS	WORK	SHE	ET				
General	Informat	ion				Site Inf	formatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir o Inction Irisdiction	of Travel	U S	S 160 Ea H 172 O	astbound n Ramp			
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2030				
Project Desc	ription Year	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS							
Inputs		Torrain Dolli	na							1			
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft												
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	9 <sub>FR</sub> = 40.0 r <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	1				4			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	HV <sup>f</sup> p		
Freeway	1090	0.95	Roll	ing	5	0	0.930		1.00	1233			
Ramp UnStroam	1/0	0.95	Roll	ing	2	0	0.971	_	1.00	184			
DownStream	<u>่</u>				 								
	]	Merge Areas	5 5		J			Dive	erge Area	S			
Estimati	ion of v <sub>12</sub>					Estima	tion of <b>v</b>	12					
	 V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)			$V_{12} = V_R + (V_F - V_R)P_{FD}$							
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{EQ} =$ (Equation 25-8 or 25-9)							
P <sub>EM</sub> = 1.000	using Equation	on 0				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 1233	pc/h					$V_{12} = pc/h$							
	/ Checks					Capacity Checks							
	Actua	al Max	imum	LOS	S F?		Act	ual	Ma	aximum	LOS F?		
									See Ex	hibit 25-14			
V <sub>FO</sub>	1417	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44	400:All			
V <sub>R12</sub>	1417	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Ex	khibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not l	F)	Level c	of Servic	e De	etermi	ination (i	f not F)		
D <sub>R</sub> =	5.475 + 0.007	34 v <sub>R</sub> + 0.007	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>			D <sub>R</sub> = 4.	252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>			
D <sub>R</sub> =	7.2 (pc/ m/ln)					D <sub>R</sub> = (	pc/ m/ln)						
LOS =	A (Exhibit 25-4		LOS= (Exhibit 25-4)										
Speed E	stimation			Speed	Estimat	ion							
$M_{s} = 0.2$	219 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 56	.0 mph (Exhib	it 25-19)		S <sub>R</sub> = mph (Exhibit 25-19)									
$S_0 = N/2$	A mph (Exhibi	t 25-19)			S <sub>0</sub> = mph (Exhibit 25-19)								
S=56	.0 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

RAMPS AND RAMP JUNCTIONS WORKSHEET												
General Infor	rmation			Sit	te Infori	mation						
Analyst		SEH Inc.			Fre	eway/Dir	of <sup>-</sup>	Travel	US 16	0 Eas	tbound	
Agency or Co	mpany				Jur	nction			SH 17	2 Off	Ramp	
Date Performe	ed	11/13/20	09		Jur	isdiction						
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 2	2030		
Project Descri	ption Yea	ar 2030 Tra	affic Op	perations	Analysi	s of the l	JS 1	160 FEIS	6	_		
Inputs		Tarrain										
Upstream Adj	Ramp	rerrain								D R	ownstrea amp	ım Adj
Yes	On									Г	Yes	🔲 On
No 🔽	Off									Γ	No	Cff
L <sub>up</sub> = ft		S	_	60 0 mpt	<u> </u>		-	- 400 r	nnh	L	down =	ft
	h/h	Ũ	FF - c	kotch ( c	how lon		FR <sup>-</sup>	- +0.01 \/\	прп	V	D =	veh/h
			)	in an a		es, L <sub>A</sub> , L	D, V F	ς, ν <sub>f</sub> )				
Conversion t	o pc/n Und	der Base C	ondit	ions	1	1	1					
$ \begin{array}{ c c c c c c } \hline (pc/h) & V & PHF & Terrain & Truck & \% Rv & f_{HV} & f_p & f_{HV} f_p \\ \hline Freeway & 2950 & 0.95 & Rolling & 5 & 0 & 0.930 & 1.00 & 3338 \\ \hline \end{array} $												
Freeway	2950	0.95	Rol	lling	5	0	0.	.930	1.00		3338	
Ramp	1480	0.95	Rol	lling	2	0	0.	.971	1.00 1605			
UpStream												
DownStream												
	Me	rge Areas						D	Diverge A	Areas		
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>				
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	$= V_R +$	(V <sub>F</sub> - ۱	V <sub>R</sub> )P <sub>FD</sub>	
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	tion 25-8	3 or 25-9	)		
$P_{\text{EM}}$ = using E	quation					$P_{ED} = 1.0$	000	usina E	Equation	0		
$V_{\rm m} = nc/h$						$V_{} = 33$	38	nc/h	- 9			
$r_{12}$ point	ocks					$\mathbf{C}_{12} = 55$		bocks				
	Actual	Maxin			F2	Capach	<u>y Ci</u>	Actual		lavimi	im	
	Actual				1:	V -V		2220		4600		No No
V <sub>FO</sub>		See Exh	bit 25-		_	V FI V F		2220		4000	/	NO
						V <sub>12</sub>		3338		1400:A		No
V <sub>R12</sub>		4600	:All			$V_{FO} = V_{F}$ $V_{R}$	-	1733		4600		No
						V <sub>R</sub>		1605		2100		No
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	termina	ntion (	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 <sub>R</sub> = (po	c/ mi /ln)					D <sub>R</sub> =	24.0	0 (pc/ mi	/ln)			
LOS = (Ex	khibit 25-4)					LOS=	C (E	Exhibit 2	5-4)			
Speed Estim	ation					Speed E	stir	nation				
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.50	07 (Exhi	bit 25-19	9)		
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	50.9	9 mph (I	Exhibit 2	25-19)		
S <sub>0</sub> = mph	$S_0 = mph$ (Exhibit 25-19) $S_0 = N/A mph$ (Exhibit 25-19)											
S= mph	(Exhibit 25	-14)				S =	50.9	9 mph (I	Exhibit 2	25-15)		

RAMPS AND RAMP JUNCTIONS WORKSHEET													
General Info	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 10	60 E	astbound		
Agency or Co	mpany				Jur	nction			SH 1'	72 O	ff Ramp		
Date Perform	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period	AM Peak	-		Ana	alysis Yea	ar		Year	2030	)		
Project Descr	iption Yea	ar 2030 Tra	affic Op	perations	Analysi	s of the l	JS <sup>·</sup>	160 FEIS	5				
Inputs		<b>T</b>									1		
Upstream Adj	Ramp	Terrain									Downstre Ramp	am Adj	
Yes	On										Tes 🗐	🗖 On	
No 🔽	Off										🗖 No	Cff Off	
L <sub>up</sub> = ft		<u> </u>		60.0 mpt	<u> </u>			- 40.01	mph		L <sub>down</sub> =	ft	
	h/h	0	FF -	lkotob ( a	ı boyulor	VD = veh/h						veh/h	
vu – ve			D, V I	$R^{,V}f^{)}$									
Conversion t	o pc/h Und	der Base C	condit	ions	1	1	1	1					
$\begin{array}{ c c c c c }\hline (pc/h) & V & PHF & Terrain & Truck & \% Rv & f_{HV} & f_p & f_{HV} f_p \\\hline Freeway & 1940 & 0.95 & Rolling & 5 & 0 & 0.930 & 1.00 & 2195 \\\hline \end{array}$													
Freeway	1940	0.95	Rol	ling	5	0	0	.930	1.00	)			
Ramp	850	0.95	Rol	ling	2	0	0	.971	1.00	)			
UpStream													
DownStream													
	Me	rge Areas						1	Diverge	Area	S		
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_R + (V_F - V_R)P_{FD}$							
$L_{EO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EO</sub> = (E	qua	ation 25-	8 or 25-	9)			
$P_{\text{EM}}$ = using E	quation	·				$P_{ED} = 1.0$	000	usina	Equation	n 0			
$V_{\rm m} = nc/h$	1					$V_{ro} = 2195 \text{ pc/h}$							
Capacity Ch	ocks					$\mathbf{C}_{12} = \mathbf{Z}_{11}$	)) v C	bocks					
		Maxin		201	F2	Capach	<u>y Cl</u>	Actua		Mavir	num	LOS F2	
	Actual				1:	V -V		2105	<u> </u>	160		No	
V <sub>FO</sub>		See Exh	bit 25-		-	V FI	:	2195		400		No No	
	<u> </u>					v <sub>12</sub>		2195		4400	J.Ali	NO	
V <sub>R12</sub>		4600	:All			$V_{FO} = V_{F}$ $V_{R}$	-	1273		460	0	No	
						V <sub>R</sub>		922		210	0	No	
Level of Serv	vice Detern	nination (i	f not F	)		Level of	<sup>-</sup> Se	rvice De	etermin	atior	n (if not F)		
D <sub>R</sub> = 5.475 +	+ 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -		D	<sub>R</sub> = 4.252	2 + 0.00	86 V	<sub>12</sub> - 0.009	L <sub>D</sub>			
D <sub>R</sub> = (po	c/ mi /ln)			D <sub>R</sub> =	14.	1 (pc/ m	i /ln)						
LOS = (Ex	xhibit 25-4)					LOS=	B (I	Exhibit 2	5-4)				
Speed Estim	ation					Speed E	sti	mation	,				
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.4	46 (Exhi	bit 25-1	9)			
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	52.	0 mph (	Exhibit 2	25-19	9)		
S <sub>0</sub> = mph	S <sub>0</sub> =	N/A	A mph (	Exhibit 2	25-19	9)							
S= mph	(Exhibit 25	-14)				S =	52.	0 mph (	Exhibit	25-18	5)		

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET				
General	Informati	ion				Site Inf	<sup>f</sup> ormatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U U	S 160 We S 550/CF	estbound R 233 On Rar	np		
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2030				
Project Desc	ription Year 2	2030 Traffic C	perations	Analysis	of the US	160 FEIS							
Inputs		Torrain Dolli	na							1			
Upstream Ad	j Ramp	Tellalli Kulli	ny							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft									down			
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( s	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	5 <sub>FR</sub> = 40.0 n <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions								
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	HV <sup>f</sup> p		
Freeway	2235	5	0	0.930		1.00	2529						
Ramp UnStream	2385	2	0	0.971		1.00	2586						
DownStream	<u> </u>												
	J	Merge Areas	5 5					Dive	rge Areas	5			
Estimati	on of v <sub>12</sub>					Estima	tion of v	12					
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)			$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
L <sub>EO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{EQ} = $ (Equation 25-8 or 25-9)							
P <sub>EM</sub> = 1.000	using Equation	on 0				P <sub>FD</sub> = using Equation							
$V_{12} = 2529$	pc/h					$V_{12} = pc/h$							
	/ Checks						tv Chec	ks					
	Actua	al Max	imum	LOS	S F?		Act	ual	Ma	ximum	LOS F?		
						V <sub>EI</sub> =V <sub>E</sub>			See Ex	hibit 25-14			
V <sub>FO</sub>	5115	See Ex	hibit 25-7	Y∈	es	V <sub>12</sub>			44	00:All			
V <sub>R12</sub>	5115	460	)0:All	Ye	ès	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Ex	hibit 25-14			
						V <sub>R</sub>			See Ex	khibit 25-3			
Level of	Service L	Determin	ation (	if not l	F)	Level o	of Servic	e De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4.	252 + (	0.0086 V <sub>1</sub>	<sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	21.4 (pc/ m/ln)		D <sub>R</sub> = (pc/ m/ln)										
LOS =	F (Exhibit 25-4		LOS= (Exhibit 25-4)										
Speed E	stimation		Speed Estimation										
$M_{s} = 0.6$	579 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 47	.8 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
$S_0 = N/2$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = mph (Exhibit 25-19)							
S= 47	.8 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

		RAMP	S AND	RAM	> JUN	CTIONS	WORK	SHE	ET				
General	Informati	ion				Site Inf	formatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U U	S 160 W S 550/C	estbound R 233 On Rai	np		
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2030	)			
Project Desc	ription Year 2	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS							
Inputs		Torrain Dolli	20							1			
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	C Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft												
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch (	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	9 <sub>FR</sub> = 40.0 r <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	4							
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	HV <sup>f</sup> p		
Freeway	1395	5	0	0.930	<u> </u>	1.00	1579						
Ramp UnStream	1930	2	0	0.971		1.00	2093						
DownStream	1												
	ļ	Merge Areas	5 5					Dive	erge Area	IS			
Estimati	on of v <sub>12</sub>					Estima	tion of <b>v</b>	12					
	V	$T_{12} = V_F (P_{FM})$	)			$V_{12} = V_R + (V_F - V_R)P_{FD}$							
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{EQ} = $ (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 1579	pc/h					V <sub>12</sub> = pc/h							
Capacity	/ Checks					Capaci	ty Chec	ks					
	Actua	il Max	timum	LOS	S F?		Act	ual	Ma	aximum	LOS F?		
V	2472	Soo Ev	hihit 25 7		0	V <sub>FI</sub> =V <sub>F</sub>			See Ex	xhibit 25-14			
V FO	3072	See Ex			0	V <sub>12</sub>			44	400:All			
V <sub>R12</sub>	3672	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See E	xhibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service L	Determin	ation (	if not	F)	Level c	of Servic	e De	etermi	ination (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4.	252 +	0.0086 V	/ <sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	10.3 (pc/ m/ln)		D <sub>R</sub> = (	pc/ m/ln)									
LOS =	B (Exhibit 25-4		LOS= (Exhibit 25-4)										
Speed E	stimation		Speed	Estimat	ion								
M <sub>S</sub> = 0.1	183 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 56	.7 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
$S_0 = N/2$	A mph (Exhibi	t 25-19)			S <sub>0</sub> = mph (Exhibit 25-19)								
S= 56	.7 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET deral Information Site Information												
General Infor	mation			Sit	te Infor	mation							
Analyst		SEH Inc.			Fre	eeway/Dir	of T	ravel	US 160 W	Vestbour	nd Nff D		
Agency or Co	mpany				Ju	nction			US 550/C	.K 233 (	лі катр		
Date Performe	ed	11/13/200	)9		Ju	risdiction				_			
Analysis Time	Period	PM Peak			An	alysis Yea	ar		Year 2030	)			
Project Descri	ption Yea	ar 2030 Tra	ffic Op	erations	Analys	is of the l	JS 10	60 FEIS					
Inputs	[•	T = ++ = !+=								1			
Upstream Adj	Ramp	rrain								Downstr Ramp	eam Adj		
Yes	On									Tes 🗐	🗖 On		
No 🗖	Off									🔲 No	Cff		
L <sub>up</sub> = ft	-							40.0		L <sub>down</sub> =	ft		
	h/h	5	FF = (	50.0 mph	)	S	FR =	40.0 m	pn	VD =	veh/h		
vu = ve	<u>n/n</u>		S	ketch (s	how lar	nes, L <sub>A</sub> , L	D, VR	,V <sub>f</sub> )					
Conversion t	o pc/h Unc	der Base C	onditi	ons	1	1	1	1			-		
(pc/h)V (Veh/hr)PHFTerrainTruck%Rv $f_{HV}$ $f_p$ $V=V/PHF$ $f_{HV}$ $f_p$ Freeway28250.95Rolling500.9301.003197											-		
Freeway	2825	0.95	Rol	ling	5	0 0.930 1.00 3197							
Ramp	590	0.95	Rol	ling	2	0	0.9	971	1.00	640			
UpStream													
DownStream													
	Me	rge Areas		_			-	Di	verge Area	IS			
Estimation of	f v <sub>12</sub>					Estimation of v <sub>12</sub>							
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
L <sub>EQ</sub> = (Equat	ion 25-2 or	25-3)				$L_{EQ} = (E$	quat	ion 25-8	or 25-9)				
P <sub>FM</sub> = using E	quation					$P_{FD} = 1.000$ using Equation 0							
V <sub>12</sub> = pc/h						$V_{12} = 31$	97 p	oc/h					
Capacity Che	ecks					Capacit	y Ch	ecks					
	Actual	Maxim	um	LOS	F?			Actual	Maxii	mum	LOS F?		
V		See Exhi	bit 25-			V <sub>FI</sub> =V <sub>F</sub>	;	3197	46	00	No		
¥ FO		7				V <sub>12</sub>		3197	4400	):All	No		
V <sub>R12</sub>		4600:	All		-	$V_{FO} = V_{F}$ $V_{R}$	= -	2557	460	00	No		
						V <sub>R</sub>		640	210	00	No		
Level of Serv	ice Detern	nination (if	not F	)	·	Level of	Ser	vice Det	erminatio	n (if not l	F)		
D <sub>R</sub> = 5.475 +	- 0.00734 v	<sub>R</sub> + 0.0078	3 V <sub>12</sub> -	0.00627	L <sub>A</sub>		D <sub>R</sub>	= 4.252 ·	+ 0.0086 V	/ <sub>12</sub> - 0.00	9 L <sub>D</sub>		
D <sub>R</sub> = (pc	:/ mi /ln)				$D_{\rm P} = 22.7  (\rm pc/mi/ln)$								
LOS = (E)	(hibit 25-4)					LOS= C (Exhibit 25-4)							
Speed Estima	ation					Speed Estimation							
M <sub>S</sub> = (Exibi	t 25-19)					D <sub>s</sub> =	0.42	1 (Exhibi	it 25-19)				
S <sub>R</sub> = mph	(Exhibit 25·	-19)				S <sub>R</sub> =	52.4	mph (E	xhibit 25-1	9)			
S <sub>0</sub> = mph	(Exhibit 25-	-19)				S <sub>0</sub> =	N/A	mph (E	xhibit 25-1	9)			
S= mph	(Exhibit 25	-14)				S =	52.4	mph (E	xhibit 25-1	5)			

	RAMPS AND RAMP JUNCTIONS WORKSHEET eral Information Site Information												
General Info	rmation			Sit	te Infor	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of T	ravel	US 160 W	Vestbour	nd		
Agency or Co	mpany				Ju	nction			US 500/C	.R 233 (	JII Ramp		
Date Performe	ed	11/13/20	)9		Ju	risdiction				_			
Analysis Time	Period	AM Peak			An	alysis Yea	ar		Year 203	0			
Project Descr	iption Yea	ar 2030 Tra	offic Op	perations	Analys	is of the l	JS 10	60 FEIS					
Inputs		Tarrain								1			
Upstream Adj	Ramp	rerrain								Downsti Ramp	ream Adj		
Yes	On									Ves	🗖 On		
No 🗖	Off									No 🗐	C Off		
L <sub>up</sub> = ft				60.0 mph				40.0 m	nh	L <sub>down</sub> =	ft		
	h/h	3	FF	bu.u mpn Skotob ( o	l bourlor	VD = veh/h							
Vu = Ve	, , ,		5		now lar	nes, L <sub>A</sub> , L	D, VR	, v <sub>f</sub> )					
Conversion t	to pc/h Und	der Base C	;ondit	ions	[	1	1	1			E		
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	$\frac{1}{2} \frac{1}{2} \frac{1}$				F			
Freeway	1995	0.95	Rol	ling	5	0	0.9	930	1.00 2257				
Ramp	600	0.95	Rol	ling	2	0	0.9	971	1.00	651			
UpStream						<u></u>							
DownStream													
	Me	erge Areas				 		D	iverge Area	as			
Estimation o	t v <sub>12</sub>					Estimation of V <sub>12</sub>							
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
L <sub>EQ</sub> = (Equat	ion 25-2 or	25-3)				$L_{EQ} = (E$	quat	ion 25-8	or 25-9)				
P <sub>FM</sub> = using E	quation					$P_{FD} = 1.000$ using Equation 0							
V <sub>12</sub> = pc/h						$V_{12} = 2257 \text{ pc/h}$							
Capacity Che	ecks					Capacit	y Ch	ecks					
	Actual	Maxim	num	LOS	F?			Actual	Maxi	mum	LOS F?		
V		See Exhi	bit 25-			V <sub>FI</sub> =V <sub>F</sub>	:	2257	46	00	No		
¥ FO		7				V <sub>12</sub>		2257	4400	D:All	No		
V <sub>R12</sub>		4600	All			$V_{FO} = V_{FO}$	= -	1606	460	00	No		
						V <sub>R</sub>		651	210	00	No		
Level of Serv	vice Detern	nination (i	f not F	)	·	Level of	Ser	vice De	terminatio	n (if not	F)		
D <sub>R</sub> = 5.475 +	+ 0.00734 v	r <sub>R</sub> + 0.0078	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		D <sub>R</sub>	= 4.252	+ 0.0086 V	′ <sub>12</sub> - 0.00	9 L <sub>D</sub>		
$D_R = (pc$	c/ mi /ln)				$D_{\rm p} = 14.7  (\rm pc/mi/ln)$								
LOS = (Ex	xhibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.42	2 (Exhil	oit 25-19)				
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	52.4	mph (E	xhibit 25-1	9)			
S <sub>0</sub> = mph	(Exhibit 25	-19)				S <sub>0</sub> =	N/A	mph (E	xhibit 25-1	9)			
S= mph	(Exhibit 25	-14)				S =	52.4	mph (E	Exhibit 25-1	5)			

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET				
General	Informati	ion				Site Inf	<sup>f</sup> ormatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir o Inction Irisdiction	of Travel	U U	S 160 Ea S 550/CF	stbound R 223 On Rar	np		
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2030				
Project Desc	ription Year 2	2030 Traffic C	perations	Analysis	of the US	160 FEIS							
Inputs		Torrain Dolli	20							1			
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft									down			
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S s, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	9 <sub>FR</sub> = 40.0 n <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	4							
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub> v=V/PHF f <sub>HV</sub> 1		HV <sup>f</sup> p		
Freeway	2155	5	0	0.930		1.00	2439						
Ramp	/95	2	0	0.971		1.00	862						
DownStream	 1												
	J	Merge Areas	5 5		J			Dive	rge Areas				
Estimati	ion of v <sub>12</sub>					Estima	tion of v	12					
	V		)			$V_{12} = V_R + (V_F - V_R)P_{FD}$							
$L_{EO} = (Equ$	ation 25-2 or 2	25-3)				$L_{FO} = $ (Equation 25-8 or 25-9)							
$P_{EM} = 1.000$	using Equation	on 0				$P_{FD} =$ using Equation							
$V_{12} = 2439$	pc/h					$V_{12} = pc/h$							
	/ Checks						tv Chec	ks					
	Actua	Max	imum	105	S F?	Joapaor	Act	ual	Ma	ximum	LOS F?		
						V <sub>E1</sub> =V <sub>E</sub>		uai	See Ex	hibit 25-14			
V <sub>FO</sub>	3301	See Ex	hibit 25-7	N	0	V <sub>12</sub>	·		44	00:All			
V <sub>D12</sub>	3301	460	)0:All	N	0	$V_{FO} = V_F$ $V_{D}$	-		See Ex	hibit 25-14			
112						V <sub>R</sub>			See Ex	hibit 25-3			
Level of	Service I	Determin	ation (	if not i	F)	Level o	of Servic	e De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4.	252 + (	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	21.6 (pc/ m/ln)		$D_R = (pc/m/ln)$										
LOS =	C (Exhibit 25-4		LOS= (Exhibit 25-4)										
Speed E	stimation		Speed	Estimat	ion								
$M_{s} = 0.3$	309 (Exibit 25	-19)		D <sub>s</sub> = (Exhibit 25-19)									
S <sub>R</sub> = 54	.4 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
$S_0 = N/2$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = mph (Exhibit 25-19)							
S=54	.4 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

		RAMP	S AND	RAM	) JUN	CTIONS		SHE	ET				
General	Informati	ion				Site Inf	formatio	on					
Analyst2 Agency or Co Date Perforn	ompany ned	SEH Inc. 11/18/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	L L	IS 160 Ea IS 550/CI	astbound R 223 On Rar	mp		
Analysis Tim	e Period	AM Peak			Ar	nalysis Year		Y	ear 2030				
Project Desc	ription Year 2	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS							
Inputs		Torroin Dolli	22							1			
Upstream Ac	lj Ramp		ny							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft							<u> </u>					
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = 40.0 <sub>R'</sub> V <sub>f</sub> )	mph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	4							
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>l</sub>	<sub>HV</sub> f <sub>p</sub>		
Freeway	1180	0.95	Roll	ng	5	0	0.930		1.00	1335			
Ramp UnStream	/60	2	0	0.971		1.00	824						
DownStream	<u>ן</u> ח							_					
	J	Merge Areas	 S		J		1	Dive	erge Area	S			
Estimati	on of v <sub>12</sub>					Estima	tion of	V <sub>12</sub>					
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)					V <sub>12</sub> =	V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>FO</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{EQ} = (Equation 25-8 \text{ or } 25-9)$							
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 1335	pc/h					$V_{12} = pc/h$							
Capacity	/ Checks					Capaci	ity Cheo	cks					
	Actua	al Max	imum	LOS	S F?	<u> </u>	A	ctual	Ma	iximum	LOS F?		
						V <sub>FI</sub> =V <sub>F</sub>			See Ex	hibit 25-14			
V <sub>FO</sub>	2159	See Ex	hibit 25-7	N	0	V <sub>12</sub>			44	100:All			
V <sub>R12</sub>	2159	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Ex	khibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not i	F)	Level c	of Servi	ce De	etermi	nation (i	f not F)		
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4	1.252 +	0.0086 V	<sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	12.7 (pc/ m/ln)		D <sub>R</sub> = (pc/ m/ln)										
LOS =	B (Exhibit 25-4	1)				LOS= (Exhibit 25-4)							
Speed E	stimation	1				Speed Estimation							
M <sub>S</sub> = 0.2	237 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 55	.7 mph (Exhib	it 25-19)				S <sub>R</sub> = r	mph (Exhib	oit 25-19	))				
$S_0 = N/$	A mph (Exhibi	t 25-19)				S <sub>0</sub> = r	mph (Exhi	oit 25-1	9)				
S=55	.7 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET eral Information Site Information												
General Infor	rmation			Sit	te Infor	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of T	ravel	US 160 E	Eastboun	d NG D		
Agency or Cor	mpany				Ju	nction			08 330/0	CR 233 C	JII Kamp		
Date Performe	ed	11/13/200	)9		Ju	risdiction							
Analysis Time	Period	PM Peak			An	alysis Yea	ar		Year 203	0			
Project Descri	ption Yea	ar 2030 Tra	iffic Op	perations	Analys	is of the l	JS 10	60 FEIS					
Inputs	[•	T								1			
Upstream Adj	Ramp	Ierrain								Downsti Ramp	eam Adj		
Yes	On									Tes 🗐	🗖 On		
No 🗖	Off									🗖 No	C Off		
L <sub>up</sub> = ft	-							40.0		$L_{down} =$	ft		
	h/h	S	FF = 0	50.0 mph	) 		FR =	40.0 m	iph	VD =	veh/h		
vu = ve	n/n		S	ketch (s	how lar	nes, L <sub>A</sub> , L	D,VR	,V <sub>f</sub> )					
Conversion t	o pc/h Und	der Base C	Conditi	ions	1						-		
$\begin{array}{ c c c c c }\hline (pc/h) & V & PHF & Terrain & Truck & %Rv & f_{HV} & f_p & f_{HV} & f_p \\\hline Freeway & 4525 & 0.95 & Rolling & 5 & 0 & 0.930 & 1.00 & 5120 \\\hline \end{array}$													
Freeway	4525	0.95	Rol	ling	5	0	0.9	930	1.00	5120			
Ramp	2370	0.95	Rol	ling	2	0	0.9	971	1.00	2570			
UpStream						ļ							
DownStream													
	Me	rge Areas				<b>F</b> - (' (	•	D	iverge Area	as			
Estimation of	r v <sub>12</sub>					Estimation of $v_{12}$							
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub>	= V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FC</sub>	)		
L <sub>EQ</sub> = (Equati	ion 25-2 or	25-3)				$L_{EQ} = (E$	quat	ion 25-8	or 25-9)				
P <sub>FM</sub> = using E	quation					$P_{FD} = 0.450$ using Equation 0							
V <sub>12</sub> = pc/h						$V_{12} = 37$	17 p	oc/h					
Capacity Che	ecks					Capacity	y Ch	ecks					
	Actual	Maxim	num	LOS	F?			Actual	Maxi	imum	LOS F?		
V=-		See Exhi	bit 25-		_	V <sub>FI</sub> =V <sub>F</sub>		5120	69	00	No		
. FO		7				V <sub>12</sub>		3717	440	0:All	No		
V <sub>R12</sub>		4600:	All		_	$V_{FO} = V_{FO}$	-	2550	69	00	No		
						V <sub>R</sub>		2570	41	00	No		
Level of Serv	rice Detern	nination (it	f not F	)		Level of	Ser	vice Det	terminatio	n (if not l	F)		
D <sub>R</sub> = 5.475 +	- 0.00734 v	0.00627	L <sub>A</sub>		D <sub>R</sub>	= 4.252	+ 0.0086 \	/ <sub>12</sub> - 0.00	9 L <sub>D</sub>				
D <sub>R</sub> = (pc			$D_{\rm R} = 13.7  (\rm pc/mi/ln)$										
LOS = (Ex	(hibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estima	ation					Speed Estimation							
M <sub>S</sub> = (Exibi	t 25-19)					D <sub>s</sub> =	0.59	4 (Exhib	oit 25-19)				
S <sub>R</sub> = mph	(Exhibit 25-	-19)				S <sub>R</sub> =	49.3	mph (E	xhibit 25-1	9)			
S <sub>0</sub> = mph	(Exhibit 25-	-19)				S <sub>0</sub> =	64.2	mph (E	xhibit 25-1	9)			
S= mph	(Exhibit 25	-14)				S =	52.7	mph (E	xhibit 25-1	5)			

	RAMPS AND RAMP JUNCTIONS WORKSHEET eral Information Site Information												
General Infor	rmation			Sit	te Infor	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of Ti	ravel	US 160 E	astboun	d Mff D a mar		
Agency or Co	mpany				Ju	nction			US 550/C	CR 233 C	JII Ramp		
Date Performe	ed	11/13/20	)9		Ju	risdiction				-			
Analysis Time	Period	AM Peak			An	alysis Yea	ar		Year 2030	)			
Project Descri	ption Yea	ar 2030 Tra	offic Op	perations	Analys	is of the L	JS 16	50 FEIS		_			
Inputs		Torroin								1_			
Upstream Adj	Ramp	renam								Downstr Ramp	eam Adj		
Yes	On									Tes 🗐	🗖 On		
🗆 No 🔎	Off									🗖 No	Cff Off		
L <sub>up</sub> = ft				00.0				10.0	- 1	L <sub>down</sub> =	ft		
	h /h	S	FF = 0	60.0 mph	) 		FR <sup>=</sup>	40.0 m	on	VD =	veh/h		
vu = ve	n/n		S	sketch (s	how lar	nes, L <sub>A</sub> , L	<sub>D</sub> , V <sub>R</sub> ,	V <sub>f</sub> )					
Conversion t	o pc/h Und	der Base C	Conditi	ions	[	v=V/Pt					-		
(pc/h)	V (Veh/hr)	PHF	Te	rrain	Truck	%Rv	f	н	f <sub>p</sub>	f <sub>HV</sub> f <sub>p</sub>	-		
Freeway	2830	0.95	Rol	ling	5	0 0.930 1.00 3202							
Ramp	1650	0.95	Rol	ling	2	0	0.9	971	1.00	1789			
UpStream						<u></u>				<u></u>			
DownStream						ļ							
	Me	rge Areas						Di	verge Area	IS			
Estimation of	t v <sub>12</sub>					Estimation of V <sub>12</sub>							
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )						V <sub>12</sub> =	= V <sub>R</sub> + (V <sub>F</sub>	- V <sub>R</sub> )P <sub>FD</sub>			
L <sub>EQ</sub> = (Equat	ion 25-2 or	25-3)				$L_{EQ} = (E$	quati	on 25-8	or 25-9)				
P <sub>FM</sub> = using E	quation					P <sub>FD</sub> =0.450 using Equation 0							
V <sub>12</sub> = pc/h						$V_{12} = 24$	25 р	oc/h					
Capacity Che	ecks					Capacity	y Che	ecks					
	Actual	Maxim	num	LOS	F?			Actual	Maxii	mum	LOS F?		
V		See Exhi	bit 25-			V <sub>FI</sub> =V <sub>F</sub>		3202	69	00	No		
* FO		7				V <sub>12</sub>		2425	4400	):All	No		
V <sub>R12</sub>		4600	All			$V_{FO} = V_{FO}$	-	1413	690	00	No		
						V <sub>R</sub>		1789	410	00	No		
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Serv	vice Dete	ermination	n (if not l	F)		
D <sub>R</sub> = 5.475 +	- 0.00734 v	<sub>R</sub> + 0.007	8 V <sub>12</sub> -	0.00627	L <sub>A</sub>		D <sub>R</sub> :	= 4.252 -	+ 0.0086 V	/ <sub>12</sub> - 0.009	9 L <sub>D</sub>		
D <sub>R</sub> = (pc			$D_{\rm R} = 2.6  (\rm pc/mi/ln)$										
LOS = (Ex	(hibit 25-4)					LOS= A (Exhibit 25-4)							
Speed Estimation	ation					Speed Estimation							
M <sub>S</sub> = (Exibi	t 25-19)					D <sub>s</sub> =	0.524	4 (Exhibi	t 25-19)				
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	50.6	mph (E	khibit 25-1	9)			
$S_0 = mph$	(Exhibit 25	-19)				S <sub>0</sub> =	65.8	mph (E	khibit 25-1	9)			
S= mph	(Exhibit 25	-14)				S =	53.6	mph (E	khibit 25-1	5)			

		RAMP	S AND	RAM	) JUN	CTIONS	WORK	SHE	ET				
General	Informati	on				Site Inf	ormatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	f Travel	U SI	S 160 We H 172 On	stbound Ramp			
Analysis Tim	e Period	PM Peak			Ar	nalysis Year		Y	ear 2030				
Project Desc	ription Year 2	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS							
Inputs		Torrain Dolli	na							1			
Upstream Ad	j Ramp		ny							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft			<u> </u>			10.0						
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	S es, L <sub>A</sub> , L <sub>D</sub> ,V <sub>I</sub>	r <sub>FR</sub> = 40.0 m <sub>R</sub> ,V <sub>f</sub> )	iph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	1				1			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f <sub>ł</sub>	₁v <sup>f</sup> p		
Freeway	1440	5	0	0.930	<u> </u>	<u>1.00</u>	1629						
Ramp UnStream	1385	<u> </u>	0	0.971		1.00	1502						
DownStream	ן ו												
	J.	Merge Areas	5		,			Dive	rge Areas				
Estimati	on of v <sub>12</sub>					Estima	tion of v	12					
	V	<sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)			$V_{12} = V_R + (V_F - V_R)P_{FD}$							
L <sub>EQ</sub> = (Equ	ation 25-2 or 2	25-3)				$L_{EQ} = $ (Equation 25-8 or 25-9)							
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 1629	pc/h					$V_{12} = pc/h$							
Capacity	/ Checks					Capacity Checks							
	Actua	I Max	timum	LOS	S F?		Act	ual	Max	imum	LOS F?		
V	2121	See Ev	hihit DE 7	N	•	V <sub>FI</sub> =V <sub>F</sub>	:		See Exh	nibit 25-14			
v <sub>FO</sub>	3131	See Ex	11011 25-7		0	V <sub>12</sub>			44(	)0:All			
V <sub>R12</sub>	3131	460	)0:All	N	0	$V_{FO} = V_F$ $V_R$	-		See Exh	nibit 25-14			
				,		V <sub>R</sub>			See Ex	hibit 25-3			
Level of	Service L	Determin	ation (	if not l	F)	Level o	of Servic	e De	etermin	nation (in	f not F)		
D <sub>R</sub> =	5.475 + 0.0073			D <sub>R</sub> = 4.2	252 + (	0.0086 V <sub>12</sub>	<sub>2</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	20.0 (pc/ m/ln)		D <sub>R</sub> = (pc/ m/ln)										
LOS =	B (Exhibit 25-4		LOS= (Exhibit 25-4)										
Speed E	stimation		Speed	Estimati	ion								
M <sub>S</sub> = 0.2	293 (Exibit 25	-19)				D <sub>s</sub> = (Exhibit 25-19)							
S <sub>R</sub> = 54	.7 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
S <sub>0</sub> = N//	Amph (Exhibi	t 25-19)				S <sub>0</sub> = mph (Exhibit 25-19)							
S= 54	.7 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

		RAMP	S AND	RAM	> JUN	CTIONS	WORK	SHE	ET				
General	Informat	ion				Site Inf	formatio	n					
Analyst2 Agency or Co Date Perform	ompany ned	SEH Inc. 11/13/200	)9		Fr Ju Ju	eeway/Dir c Inction Irisdiction	of Travel	U S	S 160 W H 172 O	'estbound n Ramp			
Analysis Tim	e Period	AM Peak			A	nalysis Year		Y	ear 2030	)			
Project Desc	ription Year	2030 Traffic C	perations	Analysis	of the US	5 160 FEIS							
Inputs		Torrain Dolli	na							1			
Upstream Ac	lj Ramp		ng							Downstrea	m Adj Ramp		
F Yes	Cn On									Ves	On		
No No	Cff Off									L <sub>down</sub> =	ft		
L <sub>up</sub> =	ft			<u> </u>									
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	<sub>FR</sub> = 40.0 ι <sub>R</sub> ,V <sub>f</sub> )	nph		VD =	veh/h		
Convers	ion to pc	/h Under	Base	Condi	tions	1				-			
(pc/h)	V (Veh/hr)	PHF	Ter	rain	Truck	%Rv	f <sub>HV</sub>		f <sub>p</sub>	v=V/PHF f	<sub>HV</sub> f <sub>p</sub>		
Freeway	865	5	0	0.930		1.00	979						
Ramp UnStream	1130	<u> </u>	0	0.971	_	1.00	1225						
DownStream	 ח												
	4,	Merge Areas	5		,			Dive	erge Area	IS			
Estimati	on of v <sub>12</sub>					Estima	tion of	/12					
	V	/ <sub>12</sub> = V <sub>F</sub> ( P <sub>FM</sub>	)			$V_{12} = V_R + (V_F - V_R)P_{FD}$							
L <sub>EQ</sub> = (Equ	iation 25-2 or 2	25-3)				$L_{EQ} = (Eq)$	uation 25-8	or 25-9	9)				
P <sub>FM</sub> = 1.000	using Equation	on O				P <sub>FD</sub> = using Equation							
V <sub>12</sub> = 979	pc/h					V <sub>12</sub> = pc/h							
Capacity	/ Checks			1		Capaci	ty Chec	ks	1	1	1		
	Actua	al Max	timum	LOS	S F?		Ac	tual	Ma	aximum	LOS F?		
V	2204	See Ex	hihit 25.7	N	0	V <sub>FI</sub> =V <sub>F</sub>	-		See Ex	xhibit 25-14			
* FO	2204	JUC LA			0	V <sub>12</sub>			44	400:All			
V <sub>R12</sub>	2204	460	)0:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>R</sub>	-		See Ex	xhibit 25-14			
						V <sub>R</sub>			See E	xhibit 25-3			
Level of	Service I	Determin	ation (	if not	F)	Level c	of Servic	e De	etermi	ination (i	f not F)		
D <sub>R</sub> =	5.475 + 0.007			D <sub>R</sub> = 4	.252 +	0.0086 V	′ <sub>12</sub> - 0.009 L <sub>D</sub>						
D <sub>R</sub> =	12.9 (pc/ m/ln)		$D_R = (pc/m/ln)$										
LOS =	B (Exhibit 25-4		LOS= (Exhibit 25-4)										
Speed E	stimatior		Speed Estimation										
$M_{\rm S} = 0.2$	239 (Exibit 25	-19)		D <sub>s</sub> = (Exhibit 25-19)									
S <sub>R</sub> = 55	.7 mph (Exhib	it 25-19)				S <sub>R</sub> = mph (Exhibit 25-19)							
$S_0 = N/2$	A mph (Exhibi	t 25-19)			S <sub>0</sub> = mph (Exhibit 25-19)								
S= 55	.7 mph (Exhib	it 25-14)				S = mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET neral Information Site Information												
General Infor	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of	Travel	US 16	0 Westbou	ind		
Agency or Co	mpany				Jur	nction			SH 17	2 Off Ran	ıp		
Date Performe	ed	11/12/20	)9		Jur	isdiction							
Analysis Time	Period	PM Peak			Ana	alysis Yea	ar		Year 2	2030			
Project Descri	ption Yea	ar 2030 Tra	offic Op	perations	Analysi	s of the l	JS ^	160 FEIS	;				
Inputs		Torroin											
Upstream Adj	Ramp	Terrain								Downs Ramp	tream Adj		
Yes	On									Tes Yes	s 🔽 On		
No 🔽	Off									No 🗐	C Off		
L <sub>up</sub> = ft		S		60 0 mpt			<u> </u>	- 400 r	nnh	L <sub>down</sub> =	= ft		
	h/h	0	FF - '	Wetch ( a	ı boyulor		FR <sup>-</sup>	- +0.01	прп	VD =	veh/h		
vu = ve			3		snow lan	es, L <sub>A</sub> , L	D, V I	R, V <sub>f</sub> )					
Conversion t	o pc/h Und	der Base C	Condit	ions	1	1	1						
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	k %Rv f <sub>HV</sub> f <sub>p</sub>			f <sub>HV</sub> f <sub>p</sub>	1F			
Freeway	1720	0.95	Rol	lling	5	0 0.930 1.00				194	6		
Ramp	280	0.95	Rol	lling	2	0	0	.971	1.00	304	ł		
UpStream					<u> </u>								
DownStream													
	Me	rge Areas					_	C	Diverge A	Areas			
Estimation of	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	= V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$							
$L_{FQ} = (Equat)$	ion 25-2 or	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
$P_{EM}$ = using E	quation					$P_{ED} = 1.0$	000	usina E	Equation	0			
$V_{40} = pc/h$	•					$V_{12} = 1946 \text{ pc/h}$							
Canacity Che	ocks					Canacit		hecks					
	Actual	Maxim	num		F?	oupuon	<u>y Ci</u>	Actual		laximum	LOS F?		
			L:4 OF			V=V_		19/16		4600	No		
V <sub>FO</sub>		See Exh	DIT 25-		-			1046		4000	No		
		· ·		<u> </u>		$v_{12}$		1946	2	1400:All	INO		
V <sub>R12</sub>		4600	All			v <sub>FO</sub> – v <sub>F</sub> V <sub>R</sub>	-	1642		4600	No		
						V <sub>R</sub>		304		2100	No		
Level of Serv	vice Detern	nination (i	f not F	)		Level of	Se	rvice De	termina	tion (if not	t F)		
D <sub>R</sub> = 5.475 +	- 0.00734 v	0.00627	L <sub>A</sub>		D <sub>F</sub>	<sub>R</sub> = 4.252	2 + 0.008	86 V <sub>12</sub> - 0.0	09 L <sub>D</sub>				
D <sub>R</sub> = (po	:/ mi /ln)			$D_{R} = 12.0 \text{ (pc/ mi /ln)}$									
LOS = (Ex	(hibit 25-4)					LOS= B (Exhibit 25-4)							
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.3	90 (Exhi	bit 25-19	))			
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	53.	0 mph (I	Exhibit 2	5-19)			
$S_0 = mph$	(Exhibit 25	-19)				S <sub>0</sub> =	N/A	A mph (B	Exhibit 2	5-19)			
S= mph	(Exhibit 25	-14)				S = 53.0  mph (Exhibit 25-15)							

	RAMPS AND RAMP JUNCTIONS WORKSHEET neral Information Site Information												
General Info	rmation			Sit	te Infori	mation							
Analyst		SEH Inc.			Fre	eway/Dir	of <sup>-</sup>	Travel	US 16	0 We	stbound		
Agency or Co	mpany				Jur	nction			SH 17	2 Off	Ramp		
Date Perform	ed	11/13/20	09		Jur	isdiction							
Analysis Time	Period	AM Peak	-		Ana	alysis Yea	ar		Year 2	2030			
Project Descr	iption Yea	ar 2030 Tra	affic Op	perations	Analysi	is of the l	JS 1	60 FEIS	3				
Inputs	[,	<b>T</b> '.											
Upstream Adj	Ramp	Ierrain								D R	ownstrea amp	am Adj	
Yes	On									Г	Yes	Cn 🕅	
No 🔽	Off									Γ	No	Cff Off	
L <sub>up</sub> = ft		<u> </u>		60.0 mpt	<u> </u>			- 40 0 r	mnh	L	down =	ft	
	h/h	0	FF -	lkotob ( a	ı boyulor		FR <sup>-</sup>	- +0.01	прп	V	D =	veh/h	
vu – ve			3 		snow lan	ies, L <sub>A</sub> , L	D, <sup>V</sup> F	<sub>۲</sub> , ۷ <sub>f</sub> )					
Conversion t	to pc/h Und	ler Base C	Condit	ions	1	1	1			- he			
(pc/h)	V (Veh/hr)	PHF	Те	rrain	Truck	$ k \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $				=v/PHF <sub>IV</sub> f <sub>p</sub>			
Freeway	1075	0.95	Rol	ling	5	0 0.930 1.00 1216							
Ramp	210	0.95	Rol	ling	2	0	0.	.971	1.00		228		
UpStream													
DownStream													
	Me	rge Areas					_		Diverge A	Areas			
Estimation o	f v <sub>12</sub>					Estimat	ion	of v <sub>12</sub>					
	V <sub>12</sub> =	· V <sub>F</sub> ( P <sub>FM</sub> )				$V_{12} = V_R + (V_F - V_R)P_{FD}$							
$L_{FO} = (Equat)$	ion 25-2 or	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)							
$P_{EM}$ = using E	quation					$P_{ED} = 1.0$	000	usina l	Equation	0			
$V_{40} = pc/h$						$V_{12} = 1216 \text{ pc/h}$							
Canacity Che	acks					$v_{12} = 1216$ pc/n							
		Maxim	m		F2	Capacity	<u>y Ci</u>	Actua		lavimi	im [	LOS F2	
	71010101					VV		1216	1 10	4600		No	
V <sub>FO</sub>		See Exh	bit 25-		-	V.		1210		14000		No	
						$V_{FO} = V_F$		988		4600		No	
V <sub>R12</sub>		4600	:All		-	V_ V_		228		2100		No	
Loval of Sara	vice Detern	ination (i	f not E	<u> </u>				zzo	torming	2100	if not E)	110	
D = 5.475			0 \/	0.00627	· 1	Lever							
$D_{\rm R} = 5.475$	+ 0.00734 V	R + 0.007	<sup>0</sup> <sup>1</sup> 2	0.00027	∟ <sub>A</sub>	$D_{\rm R} = 4.252 \pm 0.0086 {\rm v_{12}} - 0.009 {\rm L_{\rm D}}$							
$D_R = (pot)$	c/ mi /ln)					$D_{\rm R} = 5.7  (\text{pc/mi/ln})$							
LOS = (E)	xhibit 25-4)					LOS= A (Exhibit 25-4)							
Speed Estim	ation					Speed Estimation							
M <sub>S</sub> = (Exib	it 25-19)					D <sub>s</sub> =	0.38	84 (Exhi	bit 25-19	9)			
S <sub>R</sub> = mph	(Exhibit 25	-19)				S <sub>R</sub> =	53.	I mph (	Exhibit 2	25-19)			
S <sub>0</sub> = mph	(Exhibit 25-	-19)				S <sub>0</sub> =	N/A	A mph (	Exhibit 2	5-19)			
S= mph	(Exhibit 25	-14)				S =	53.	1 mph (	Exhibit 2	25-15)			

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Analys	is					
Analyst:	SEH Inc.						
Agency or Company:							
Date Performed:	11/13/2009						
Analysis Time Period:	PM Peak						
Freeway/Direction:	Eastbound						
From/To:	West of US 550/CR	233					
Jurisdiction:							
Analysis Year:	Year 2030						
Description: Year 2030	Traffic Operations	Analysis of the	US 160 FEIS				
	Flow Inputs and Ad	justments					
Volume, V		4525	veh/h				
Peak-hour factor, PHF		0.95					
Peak 15-min volume, v15		1191	v				
Trucks and buses		5	<u>o</u> o				
Recreational vehicles		0	00				
Terrain type:		Rolling					
Grade		0.00	00				
Segment length		0.00	mi				
Trucks and buses PCE, E	Г	2.5					
Recreational vehicle PCI	E, ER	2.0					
Heavy vehicle adjustment	z, <sup>f</sup> HV	0.930					
Driver population factor	r, ip	1.00	() ()				
Flow rate, vp		1707	pc/h/ln				
Speed Inputs and Adjustments							
Lane width		12.0	ft				
Right-shoulder lateral of	clearance	6.0	ft				
Interchange density		0.50	interchange/mi				
Number of lanes, N		3					
Free-flow speed:		Measured					
FFS or BFFS	_	60.0	mi/h				
Lane width adjustment,	LW	0.0	mi/h				
Lateral clearance adjust	cment, iLC	0.0	mi/h				
Interchange density adju	istment, IID	0.0	mi/n				
Number of lanes adjustme	ent, IN	3.0	mi/h				
Free-llow speed, FFS		00.0	111/11				
		UIDAN FIEEway					
	_LOS and Performanc	e Measures					
Flow rate, vp		1707	pc/h/ln				
Free-flow speed, FFS		60.0	mi/h				
Average passenger-car sp	peed, S	59.9	mi/h				
Number of lanes, N		3					
Density, D		28.5	pc/mi/ln				
Level of service, LOS		D					

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Analys	is				
Analyst:	SEH Inc.					
Agency or Company: Date Performed:	11/13/2009					
Analysis Time Period:	AM Peak					
Freeway/Direction:	Eastbound					
From/To:	West of US 550/CR	233				
Jurisdiction:						
Analysis Year:	Year 2030					
Description: Year 2030	Traffic Operations	Analysis of the	US 160 FEIS			
	Flow Inputs and Ad	justments				
Volume, V		2830	veh/h			
Peak-hour factor, PHF		0.95				
Peak 15-min volume, v15		745	v			
Trucks and buses		5	90			
Recreational vehicles		0	<u>o</u> o			
Terrain type:		Rolling				
Grade		0.00	oo			
Segment length		0.00	mi			
Trucks and buses PCE, E		2.5				
Recreational vehicle PCI	E, ER	2.0				
Heavy vehicle adjustment	z, thv	0.930				
Driver population factor	r, ip	1.00				
Flow rate, vp		1007	pc/11/11			
Speed Inputs and Adjustments						
Lane width		12.0	ft			
Right-shoulder lateral of	clearance	6.0	ft			
Interchange density		0.50	interchange/mi			
Number of lanes, N		3				
Free-flow speed:		Measured				
FFS or BFFS		60.0	mi/h			
Lane width adjustment, i		0.0	mi/h			
Lateral clearance adjust	cment, ILC	0.0	mi/n			
Interchange density adju	istment, IID	0.0	mi/n			
Free flow greed FES	ent, IN	3.0	mi/h			
Fiee-liow speed, Frs		UU.U IIrhan Freeway				
		Orban Freeway				
	_LOS and Performanc	e Measures				
Flow rate, vp		1067	pc/h/ln			
Free-flow speed, FFS		60.0	mı/h			
Average passenger-car sp	peed, S	60.0	mı/h			
Number of lanes, N		3 17 0				
Density, D		⊥/.ŏ ₽	pc/m1/ln			
Level of service, LOS		D				

nc52000. Dasic rieeway sequences Release 4.11	HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Anal	ysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: 11/13/2009 Analysis Time Period: PM Peak Freeway/Direction: Westbound From/To: Between SH 172		mps	
Jurisdiction: Analysis Year: Description: Year 2030	Year 2030 Traffic Operation	s Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles		1440 0.95 379 5 0	veh/h v % %
Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment	C, ER 2, ER 2, fHV	Rolling 0.00 2.5 2.0 0.930	% mi
Flow rate, vp		1.00 815	pc/h/ln
	Speed Inputs and	l Adjustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	Elearance LW ment, fLC astment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	_LOS and Performa	nce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	815 60.0 60.0 2 13.6 B	pc/h/ln mi/h mi/h pc/mi/ln

nc52000. Dasic rieeway sequences Release 4.11	HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Anal	ysis	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: 11/13/2009 Analysis Time Period: AM Peak Freeway/Direction: Westbound From/To: Between SH 172 F		mps	
Analysis Year: Description: Year 2030	Year 2030 Traffic Operation	s Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCI Heavy vehicle adjustment Driver population factor Flow rate, vp	5, ER 5, fhv 5, fp	865 0.95 228 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 489	veh/h v % % mi pc/h/ln
110# 1000/ VP	Speed Inputs and	Adjustments	F 0, 11, 111
	Speed inputs and		
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW Ement, fLC astment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h
	_LOS and Performa	nce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	489 60.0 60.0 2 8.1 A	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Analys	is	
Analyst:	SEH Inc.		
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	11/13/2009 PM Peak Eastbound Between SH 172 Ramp	s	
Description: Year 2030	Traffic Operations	Analysis of the	US 160 FEIS
	Flow Inputs and Ad	justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor Flow rate, vp	r E, ER c, fhV c, fp	1470 0.95 387 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 832	veh/h v % % mi pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	fLW fLW tment, fLC ustment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h mi/h
	_LOS and Performanc	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	832 60.0 60.0 2 13.9 B	pc/h/ln mi/h mi/h pc/mi/ln

	Operational Ana	lysis	
Analyst:	SEH Inc.		
Agency or Company:	11/12/2000		
Date Performed:	11/13/2009		
Analysis lime Period:	AM Peak		
Freeway/Direction:	Eastbound		
From/To:	Between SH 172 Ra	amps	
Analygig Voor:	Voor 2020		
Description: Year 2030	Traffic Operation	ns Analysis of the	e US 160 FEIS
	Flow Inputs and	Adjustments	
Volume V		1090	veh/h
Peak-hour factor, PHF		0.95	V CHI/ H
Peak 15-min volume. v15		287	V
Trucks and buses		5	old •
Recreational vehicles		0	00
Terrain type:		Rolling	
Grade		0.00	8
Segment length		0.00	mi
Trucks and buses PCE, E	Г	2.5	
Recreational vehicle PCI	E, ER	2.0	
Heavy vehicle adjustment	t, fHV	0.930	
Driver population factor, fp		1.00	
Flow rate, vp		617	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width		12.0	ft
Right-shoulder lateral of	clearance	6.0	ft
Interchange density		0.50	interchange/mi
Number of lanes, N		2	2
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment, :	ELW	0.0	mi/h
Lateral clearance adjust	tment, fLC	0.0	mi/h
Interchange density adju	ustment, fID	0.0	mi/h
Number of lanes adjustme	ent, fN	4.5	mi/h
Free-flow speed, FFS		60.0	mi/h
		Urban Freeway	
	_LOS and Performa	ance Measures	
Flow rate, vp		617	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	peed, S	60.0	mi/h
Number of lanes, N	-	2	
Density, D		10.3	pc/mi/ln
Level of service, LOS		А	

	Operational A	nalysis		
Analyst:	SEH Inc.			
Date Performed: Analysis Time Period:	11/13/2009 PM Peak			
Freeway/Direction: From/To: Jurisdiction:	Westbound SH 172 to US 550/CR 233			
Analysis Year: Description: Year 2030	Year 2030 ) Traffic Operations Analysis of the US 160 FEIS			
	Flow Inputs a	nd Adjustments		
Volume, V		2825	veh/h	
Peak-hour factor, PHF		0.95		
Peak 15-min volume, v15		743	v	
Trucks and buses		5	00	
Recreational vehicles		0	00	
Terrain type:		Rolling		
Grade		0.00	oo	
Segment length		0.00	mi	
Trucks and buses PCE, E		2.5		
Recreational vehicle PCI	S, ER	2.0		
Heavy venicle adjustment	L, IHV	0.930		
Driver population factor, ip		1.00		
Flow rate, vp		1238	pc/11/11	
	Speed Inputs	and Adjustments		
Lane width		12.0	ft	
Right-shoulder lateral clearance		6.0	ft	
Interchange density		0.50	interchange/mi	
Number of lanes, N		2		
Free-flow speed:		Measured		
FFS or BFFS	_	60.0	mi/h	
Lane width adjustment,	ELW . CT C	0.0	mi/h	
Lateral clearance adjust	tment, fLC	0.0	mi/h	
Interchange density adju	istment, flD	0.0	mi/h	
Number of lanes adjustment, iN		4.5	mi/h	
Free-Ilow speed, FFS		60.0	m1/h	
		Urban Freeway		
LOS and Performance Measures				
Flow rate, vp		1598	pc/h/ln	
Free-flow speed, FFS		60.0	mi/h	
Average passenger-car speed, S		60.0	mi/h	
Number of lanes, N		2	/ . / .	
Density, D		26.6	pc/mi/in	
Level of service, LOS		D		

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Analy	ysis			
Analyst:	SEH Inc.				
Agency or Company: Date Performed:	11/13/2009				
Analysis Time Period:	AM Peak				
Freeway/Direction:	Westbound				
From/To:	SH 172 to US 550/0	CR 233			
Jurisdiction:					
Analysis Year:	Year 2030				
Description: Year 2030	Traffic Operations	s Analysis of the	US 160 FEIS		
	Flow Inputs and A	Adjustments			
Volume, V		1995	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		525	v		
Trucks and buses		5	00		
Recreational vehicles		0	00		
Terrain type:		Rolling			
Grade		0.00	00		
Segment length		0.00	mi		
Trucks and buses PCE, E	Г 	2.5			
Recreational vehicle PCI	E, ER	2.0			
Heavy vehicle adjustment	C, IHV	0.930			
Driver population factor, fp		1120			
Flow rate, vp		1129	pc/11/11		
	Speed Inputs and	Adjustments			
Lane width		12.0	ft		
Right-shoulder lateral clearance		6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		2			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment, i	ELW	0.0	mi/h		
Lateral clearance adjust	cment, ILC	0.0			
Interchange density adju	istment, IID	0.0			
Number of lanes adjustment, IN		4.5	mi/n mi/h		
Free-flow speed, FFS		U.U Urban Erooway			
		UIDAN FIEEway			
LOS and Performance Measures					
Flow rate, vp		1129	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car sp	peed, S	60.0	mi/h		
Number of lanes, N		2			
Density, D		18.8	pc/mi/in		
Level of service, LOS		C			

	Operational Ana	lysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: Year 2030	SEH Inc. 11/13/2009 PM Peak Eastbound US 550/CR 233 to SH 172 Year 2030 0 Traffic Operations Analysis of the US 160 FEIS			
	Flow Inputs and	Adjustments		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor Flow rate, vp	r E, ER E, fHV C, fp	2950 0.95 776 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1669	veh/h v % % mi pc/h/ln	
		] ] ]		
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	Speed Inputs and clearance ELW tment, fLC istment, fID ent, fN LOS and Performa	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h	
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1669 60.0 60.0 2 27.8 D	pc/h/ln mi/h mi/h pc/mi/ln	

	Operational Anal	ysis			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: Year 2030	SEH Inc. 11/13/2009 AM Peak Eastbound US 550/CR 233 to SH 172 Year 2030 2030 Traffic Operations Analysis of the US 160 FEIS				
	Flow Inputs and	Adjustments			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor Flow rate, vp	F 5, ER 5, fHV 5, fp	1940 0.95 511 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 1098	veh/h V % % mi pc/h/ln		
	Speed Inputs and	l Adjustments			
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW ELW cment, fLC ustment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h		
LOS and Performance Measures					
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	1098 60.0 60.0 2 18.3 C	pc/h/ln mi/h mi/h pc/mi/ln		
HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Ana	lysis			
Analyst:	Analyst: SEH Inc.				
Agency or Company:					
Date Performed:	11/13/2009				
Analysis Time Period:	PM Peak				
Freeway/Direction:	Westbound				
From/To:	Between CR 233/U	S 550 Ramps			
Jurisdiction:					
Analysis Year: Description: Year 2030	Year 2030 Traffic Operation	ns Analysis of the	US 160 FEIS		
	- Flow Inputs and	Adjustments			
Volume, V			ven/n		
Peak-Hour Lactor, PHF		0.95			
Trucks and buses		500	V 9		
Pograational wohiglog		0			
Terrain type:		Polling	6		
Grade		0 00	<u>e</u>		
Segment length		0.00	mi		
Trucks and buses PCE. E	۲	2 5			
Recreational vehicle PC	- 5. FR	2.0			
Heavy vehicle adjustment	, fhv	0.930			
Driver population factor	r, fp	1.00			
Flow rate, vp	· 1	1265	pc/h/ln		
	Speed Inputs and	d Adjustments			
Lane width		12.0	ft		
Right-shoulder lateral (	learance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		2			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment, f	LW	0.0	mi/h		
Lateral clearance adjust	ment, fLC	0.0	mi/h		
Interchange density adju	istment, fID	0.0	mi/h		
Number of lanes adjustme	ent, fN	4.5	mi/h		
Free-flow speed, FFS		60.0	mi/h		
		Urban Freeway			
	_LOS and Perform	ance Measures			
Flow rate, vp		1265	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car sp	peed, S	60.0	mi/h		
Number of lanes, N		2			
Density, D		21.1	pc/mi/ln		
Level of service, LOS		C			

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Ana	lysis			
Analyst:	SEH Inc.				
Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	11/13/2009 AM Peak Westbound Between CR 233/US 550 Ramps				
Description: Year 2030	Traffic Operatio	ns Analysis of the	e US 160 FEIS		
	Flow Inputs and	Adjustments			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCH Heavy vehicle adjustment Driver population factor Flow rate, vp	f 5, ER 2, fHV 5, fp	1395 0.95 367 5 0 Rolling 0.00 0.00 2.5 2.0 0.930 1.00 789	veh/h v % % mi		
FIOW TACE, VP			pc/11/111		
	Speed Inputs an	d Adjustments			
Lane width Right-shoulder lateral of Interchange density Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, f Lateral clearance adjust Interchange density adju Number of lanes adjustme Free-flow speed, FFS	ELW Ement, fLC astment, fID ent, fN	12.0 6.0 0.50 2 Measured 60.0 0.0 0.0 0.0 4.5 60.0 Urban Freeway	ft ft interchange/mi mi/h mi/h mi/h mi/h mi/h		
	_LOS and Perform	ance Measures			
Flow rate, vp Free-flow speed, FFS Average passenger-car sp Number of lanes, N Density, D Level of service, LOS	peed, S	789 60.0 60.0 2 13.1 B	pc/h/ln mi/h mi/h pc/mi/ln		

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Ana	lysis			
Analyst:	SEH Inc.				
Date Performed:	Performed: 11/13/2009				
Analysis Time Period:	PM Peak				
Freeway/Direction:	Eastbound				
From/To:	Between CR 233/U	IS 550 Ramps			
Jurisdiction:					
Analysis Year:	Year 2030				
Description: Year 2030	Traffic Operatio	ons Analysis of the	e US 160 FEIS		
	Flow Inputs and	l Adjustments			
Volume, V		2155	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		567	v		
Trucks and buses		5	oto		
Recreational vehicles		0	00		
Terrain type:		Rolling			
Grade		0.00	₽		
Segment length		0.00	mi		
Trucks and buses PCE, E	Г	2.5			
Recreational vehicle PCI	E, ER	2.0			
Heavy vehicle adjustment	C, IHV	0.930			
Driver population factor	r, Ip	1.00			
Flow rate, vp		1219	pe/m/m		
	Speed Inputs an	d Adjustments			
Lane width		12.0	ft		
Right-shoulder lateral of	clearance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		2			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment,		0.0	mi/h		
Lateral clearance adjust	cment, ILC	0.0	mi/n		
Interchange density adju	istment, IID	0.0	(11)		
Errop flow grood EES	ent, in	4.5	mi/h		
riee-liow speed, rrs		Urban Freeway			
	LOS and Perform	ance Measures			
Flow rate wo		1210	ng/h/ln		
Free-flow speed FFS		60 0	mi/h		
Average passenger-car s	peed. S	60 0	mi/h		
Number of lanes N	ccu, b	2			
Density, D		20.3	pc/mi/ln		
Level of service. LOS		C	r - ,,		
,		-			

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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	Operational Ana	alysis			
Analyst:	Analyst: SEH Inc.				
Agency or Company:					
Date Performed:	11/13/2009				
Analysis Time Period:	AM Peak				
Freeway/Direction:	Eastbound				
From/To:	Between CR 233/U	JS 550 Ramps			
Jurisdiction:					
Analysis Year: Description: Year 2030	Year 2030 Traffic Operatic	ons Analysis of the	e US 160 FEIS		
	Flow Inputs and	l Adjustments			
	I				
Volume, V		1180	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		311	V		
Trucks and buses		5	б 0.		
Recreational vehicles		U Dolling	6		
Crado			Q.		
Graue Sogmont longth		0.00	6 mi		
Trucks and buses DCF F	T	2 5	III I		
Recreational vehicle DC	T FR	2.5			
Heavy vehicle adjustmen	t, fHV	0 930			
Driver population facto	r, fp	1 00			
Flow rate, vp	-/ -P	668	pc/h/ln		
	Cread Innuts of	d Adjustments			
	speed inputs an	la Adjustments			
Lane width		12.0	ft		
Right-shoulder lateral	clearance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		2			
Free-flow speed:		Measured			
FFS or BFFS	_	60.0	mi/h		
Lane width adjustment,	£LW	0.0	mi/h		
Lateral clearance adjus	tment, fLC	0.0	mi/h		
Interchange density adj	ustment, IID	0.0	mi/h		
Number of lanes adjustm	ent, IN	4.5	mi/h		
Free-Ilow speed, FFS			m1/n		
		Urban Freeway			
	LOS and Perform	nance Measures			
Flow rate, vp		668	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car s	peed, S	60.0	mi/h		
Number of lanes, N		2			
Density, D		11.1	pc/mi/ln		
Level of service, LOS		В			

HCS2000:	Basic	Freeway	Segments	Release	4.1f
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Operational Analysis					
Analvst:	SEH Inc.				
Agency or Company:					
Date Performed:	11/13/2009				
Analysis Time Period:	PM Peak				
Freeway/Direction:	Westbound				
From/To:	West of US 550/CR 2	233			
Jurisdiction:	No				
Analysis Year: Description: Year 2030	rear 2030 Traffic Operations	Analysis of the	US 160 FEIS		
	_Flow Inputs and Ad	ljustments			
Volumo V		4620	woh/h		
Peak-hour factor PHF		0 95	veii/ii		
Peak 15-min volume, v15		1216	V		
Trucks and buses		5	<ul> <li>ola</li> </ul>		
Recreational vehicles		0	oto		
Terrain type:		Rolling			
Grade		0.00	8		
Segment length		0.00	mi		
Trucks and buses PCE, ET		2.5			
Recreational vehicle PCE	, ER	2.0			
Heavy vehicle adjustment	, fhV	0.930			
Driver population factor	, ip	1.00	() ()		
Flow rate, vp		1743	pc/h/ln		
	_Speed Inputs and A	djustments			
Lane width		12.0	ft		
Right-shoulder lateral c	learance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		3			
Free-flow speed:		Measured			
FFS OT BFFS	T T.7	60.0	mi/h		
Lane width adjustment, i	LW mont fic	0.0	mi/h		
Interchance density adju	stment fID	0.0	mi/h		
Number of lanes adjustme	$f_{\rm N}$	3 0	mi/h		
Free-flow speed. FFS	iic, in	60.0	mi/h		
		Urban Freeway	/		
	_LOS and Performand	e Measures			
Flow rate, vp		1743	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car sp	eed, S	59.9	mi/h		
Number of lanes, N		3	-		
Density, D		29.1	pc/mi/ln		
Level of service, LOS		D			

HCS2000: Basic	: Freeway	Segments	Release	4.1f
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	Operational Anal	lysis			
Analyst:	SEH Inc.				
Agency or Company:					
Date Performed:	11/13/2009				
Analysis Time Period:	AM Peak				
Freeway/Direction:	Westbound				
From/To:	West of US 550/CF	R 233			
Jurisdiction.	Voor 2020				
Description: Year 2030	Traffic Operation	ns Analysis of the	e US 160 FEIS		
	Flow Inputs and	Adjustments			
Volume, V		3325	veh/h		
Peak-hour factor, PHF		0.95			
Peak 15-min volume, v15		875	v		
Trucks and buses		5	00		
Recreational vehicles		0	90		
Terrain type:		Rolling			
Grade		0.00	8.		
Segment length	_	0.00	mi		
Trucks and buses PCE, E		2.5			
Recreational vehicle PC		2.0			
Driver population factor	, LHV r fr	1 00			
Flow rate vp	_, тр	1254	pc/h/ln		
Flow face, vp		1251	pc/ 11/ 111		
	Speed Inputs and	l Adjustments			
Lane width		12.0	ft		
Right-shoulder lateral of	clearance	6.0	ft		
Interchange density		0.50	interchange/mi		
Number of lanes, N		3			
Free-flow speed:		Measured	. (1		
FFS OT BFFS	ET 1.1	60.0	mi/h		
Lane width adjustment, I	LUW Fmont fic	0.0	mi/h		
Interchange dengity adjust	istment fID	0.0	mi/h		
Number of lanes adjustme	ant fN	3 0	mi/h		
Free-flow speed. FFS		60.0	mi/h		
		Urban Freeway			
	_LOS and Performa	ance Measures			
Flow rate, vp		1254	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car sp	peed, S	60.0	mi/h		
Number of lanes, N		3			
Density, D		20.9	pc/mi/ln		
Level of service, LOS		С			

### SEH MEMORANDUM

# Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f) Alternatives

December 23, 2010



TO:	Mike McVaugh, PE - CDOT Region 5
FROM:	Phil Weisbach, PE Jon E. Larson, PE Jon F. Luson
DATE:	December 23, 2010
RE:	Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f) Alternatives SEH No. CODOT - 105181

#### **Executive Summary**

Alternatives for the US 550 connection to the US 160 corridor were originally evaluated in the US Highway 160 from Durango to Bayfield Final Environmental Impact Statement (FEIS) dated May 2006. The US 160 Highway from Durango to Bayfield Record of Decision (US 160 ROD) documented selection of Grandview Alternative G Modified as the Preferred Alternative which included an interchange of US 160 with US 550 approximately 0.6 miles east of the current intersection. In the Preferred Alternative, the US 550 connection crossed a large ranch property owned by the Webb family. CDOT is currently re-evaluating the connection of US 550 to US 160 due to late discoveries including the designation of a portion of the Webb Ranch as an eligible historic property.

This memo analyzes whether the alternatives being considered in the 4(f) analysis meet the capacity requirements of the purpose and need in the year 2030. This analysis looks at projected traffic in the year 2030 to evaluate if the roadway will meet the capacity requirements for the purpose and need 20 years into the future. The Section 4(f) alternatives focus on the connection of US 550 to US 160 in the Grandview Section. All of the alternatives assume that there is an existing Grandview trumpet interchange and single point urban interchanges (SPUIs) at CR 233 (Three Springs) and SH 172/CR 234. The need for these three interchanges in the Grandview Section is explained in a separate technical memorandum: Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS dated December 4, 2009. The traffic volumes have been adjusted to the year 2030 requiring the auxiliary lanes in each direction to extend from the west limit of the Grandview Section to the CR 233 (Three Springs) Interchange. The modified auxiliary lanes are included in each of the alternatives. For example; G Modified is the same as in the FEIS except it includes auxiliary lanes in each direction from the west limit of the Grandview Section to the CR 233 (Three Springs) Interchange. F Modified is the same as in the FEIS except it includes the Grandview Interchange and auxiliary lanes in each direction from the west limit of the Grandview Section to the CR 233 (Three Springs) Interchange. Preliminary Alternative A is the same as in the FEIS except it includes the Grandview Interchange and auxiliary lanes in each direction from west limit of the Grandview Section to the CR 233 (Three Springs). For these reasons, "Revised" has been added to the titles of these alternatives.

The technical results and supporting data of these analyses are included in the appendices of this memo.

The following describes the alternatives being considered for the Section 4(f) analysis:

A. US 550 at US 160 At-Grade Intersection Alternative. This alternative includes a revised US 550 at US 160 signalized intersection at its current location in the year 2030 (Feasibility Alternative 1B in the FEIS). The analysis for this alternative also addresses design variations T.1.4, T.1.6, and T.4.4 (These design variations are similar except for

minor differences in vertical grade and horizontal alignment which do not affect the traffic operational analysis at the intersection). This alternative assumes there is a Grandview trumpet interchange east of the intersection and SPUIs at CR 233 (Three Springs) and SH 172/CR 234.

- B. **Partial Interchange at the Existing US 550 / US 160 Intersection.** This alternative includes a partial interchange at the existing US 550/US 160 location. The analysis for this alternative also addresses design variations T.2.4, T.2.6, T.3.4, and T.3.6 (These design variations are similar except for minor differences in vertical grade and horizontal alignment which do not affect the traffic operational analysis). This alternative assumes there is a Grandview trumpet interchange east of the partial interchange and SPUIs at CR 233 (Three Springs) and SH 172/CR 234.
- C. **Revised Preliminary Alternative A.** This alternative includes grade-separated trumpet interchanges at the existing US 550/US 160 connection and at the Grandview Interchange with SPUIs at SH 172/CR 234 and CR 233 (Three Springs).
- D. **Revised G Modified.** This alternative connects US 550 to US 160 via the Grandview trumpet interchange, and CR 233 (Three Springs) and SH 172/ CR 234 would be SPUI interchanges.
- E. Revised F Modified and Eastern Realignment Alternative. These two alternatives will both connect to the CR 233 (Three Springs) interchange. The Revised F Modified includes an additional trumpet interchange at the Grandview Interchange, and SPUI interchanges at CR 233 (Three Springs) and SH 172/CR 234. US 550 would connect to US 160 at the CR 233 (Three Springs) interchange. The Eastern Realignment Alternative has a different US 550 alignment when compared to the Revised F Modified US 550 alignment, but both alignments connect to US 160 at the Three Springs/ CR 233 interchange. The traffic operational analysis for both alternatives is the same.
- F. Western Realignment Alternative. This alternative would relocate the existing US 550/US 160 intersection to the west where it would intersect US 160 with a directional interchange. This alternative assumes there is a Grandview trumpet interchange and SPUIs at CR 233 (Three Springs) and SH 172/CR 234.

The purpose for improvements to the US 160 corridor include increasing travel efficiency and capacity to meet current and future needs, while improving safety for the traveling public by reducing the number and severity of accidents, and controlling access. The design year of the US 160 FEIS was 2025. The analysis performed in this memorandum will use the same methodology as the FEIS except the design year is adjusted to 2030.

	Year 2030 Analysis	Purpose and Need for Capacity			
		Met	Not Met		
Α	US 550 @ US 160 At-Grade Intersection Alternatives		$\checkmark$		
В	Partial Interchange @ Existing US 550 / US 160	$\checkmark$			
C	Revised Preliminary Alternative A	$\checkmark$			
D	Revised G Modified	$\checkmark$			
Е	Revised F Modified & Eastern Realignment Alternative	$\checkmark$			
F	Western Realignment Alternative		$\checkmark$		

**<u>Summary of Results:</u>** The results of the analysis performed are summarized below:

#### **Evaluation Criteria**

The interchange alternatives were evaluated to determine if each alternative met operational level of service requirements as described in the Executive Summary of the FEIS, based on guidance in the AASHTO Policy on Geometric Design of Highways and Streets 2004 (AASHTO Green Book) and capacity analysis performed according to the methods described in the <u>Highway Capacity Manual</u><sup>1</sup> (HCS). This memorandum deals with the capacity analysis and not design. Traffic volumes used in the analysis are year 2030 peak hour volumes that were projected from the year 2025 volumes documented in <u>Appendix A, Traffic Report, Figure 8 of the US 160 FEIS</u>. The 2025 background traffic volumes were projected based on the background annual growth rates in the accepted methodology in the FEIS to calculate the year 2030 background scenario. The trips generated by the Grandview development were combined with the year 2030 background volumes to generate the year 2030 total peak hour volumes used in the analysis.

For the purposes of this analysis, US 160 is assumed to be east/west and US 550 is assumed to be north/south.

#### **<u>US 160 Interchanges and Signalized Intersections</u>**

The capacity requirement for the purpose and need of the Grandview Section is as follows:

- A Level of Service (LOS) D or better for an urban signalized intersection, including signalized intersections at single point urban interchanges (SPUI), and its individual legs or movements during the peak hour in year 2030; and
- A LOS D or better for urban interchange merge, diverge, weaving area, auxiliary lanes. and/or freeway sections during the peak hour in year 2030.

<sup>&</sup>lt;sup>1</sup> <u>Highway Capacity Manual - Special Report 209</u>. Transportation Research Board. National Research Council. 2000.

Anything worse than LOS D for any intersection, leg, movement, ramp, auxiliary lane, or freeway section is considered "failing," and not meeting the purpose and need. These criteria were applied to the alternatives analyzed in this memorandum.

#### **US 160 Continuous Through Lanes**

#### **Preferred Alternative**

The Preferred Alternative in the US 160 FEIS included a four-lane typical section, two continuous lanes in each direction, throughout the corridor with a westbound auxiliary lane and eastbound climbing lane from the west limit of the Grandview Section to the future connection of US 160 and US 550. Auxiliary lanes were added to maintain an operational level of service of D by improving the merge, diverge and weave movements, by helping to make safer lane transitions to and from the future US 160/US 550 interchange.

#### Year 2030 Traffic Operations Analysis

In the analysis, the projected traffic volumes were extended to the year 2030. The background traffic on US 160 was increased from the year 2025 to 2030, and the trip generation from a fully developed Grandview Area Plan increased traffic on the US 160 mainline as well as the entering and exiting traffic volumes to US 160. Due to the increased entering/exiting volumes, auxiliary lanes will need to be extended, from those assumed in the US 160 FEIS. The auxiliary lanes in the year 2030 need to be extended to the future CR 233 (Three Springs) interchange to maintain a LOS D for the traffic operations of the merge, diverge and weaving movements along US 160.

Since the number of continuous through lanes remains constant throughout the US 160 corridor and auxiliary lanes are not carried through any of the interchanges, auxiliary lanes are not considered capacity-adding improvement measures. However, they can be utilized to improve the traffic operations between two successive interchanges and to assist in accommodating high entering/exiting traffic volumes. Without auxiliary lanes at high volume locations, bottleneck areas can result due to poor levels of service for the merging, diverging, and weaving movements. Areas of congestion such as bottleneck locations typically coincide with areas that exhibit poor accident ratings. Auxiliary lanes help to solve merge, diverge and weave issues as well as improve the safety complications associated with poor traffic operations.

#### Section 4(f) Alternatives Under Consideration

Utilizing the year 2030 volumes developed along the US 160 corridor five alternatives were analyzed. The alternatives were evaluated to determine if each met capacity requirements as described in the purpose and need of the FEIS but in the design year 2030. The analysis considers two through lanes in each direction and one auxiliary lane in each direction extending from the CR 233 (Three Springs) interchange to the west end of the Grandview Section. The auxiliary lanes are not continuous over the entire distance from CR 233 to the west end of the Grandview Section. The auxiliary lanes drop off at the off ramps for the Grandview Interchange and begin again where the Grandview Interchange on ramps merge with US 160.

#### A. US 550 at US 160 At-Grade Intersection Alternative – Figure 1

The EIS considered a signalized intersection at the existing US 550/US 160 intersection (Feasibility Alternative 1B) and determined that this option did not meet the purpose and need. This alternative is being re-evaluated in light of new information, including traffic information provided by Krager and Associates in a letter sent by attorney Thomas McNeill on behalf of the owners of the Webb Ranch to the FHWA. This analysis also addresses the capacity requirements for the design variations T.1.4, T.1.6, and T.4.

Each design variation illustrates US 550 intersecting US 160 as an at-grade intersection at the existing US 550/US 160 intersection location. The intersection geometry is also the same for T.1.4, T.1.6 and T.4.4 as illustrated in Figure 1. The differences occur approximately 500 feet away from the US 550/US 160 intersection where the horizontal curvature and grade varies. The design variations are contained in Appendix A for reference.

- **Design Variation T.1.4** shows a 1050-foot radius and a 4% grade;
- Design Variation T.1.6 shows a 925-foot radius and a 6% grade; and
- **Design Variation T.4.4** shows a 1250-foot radius and a 4% grade.

Since these design variations occur away from US 550 / US 160, they do not influence the traffic operations at the intersection and do not affect the results of the analysis.

#### Connection of US 550 to US 160

The Krager and Associates analysis states that an at-grade signalized intersection will operate at LOS C with three through lanes in each direction on US 160. While the volumes used in the analysis were derived from the year 2025 volumes found in Figure 8 of the US 160 FEIS (refer to Appendix A of this memo), this analysis only accounts for the volumes on three legs of the Grandview interchange and does not include the traffic accessing US 160 from the north leg of the Grandview interchange. The Krager and Associates conclusions were erroneously based on traffic volumes that are lower than what was documented in the US 160 FEIS. Using volumes that account for all of the traffic that would be expected at the intersection in the year 2030, the intersection is expected to operate at LOS D during the morning peak period (80 second cycle length) and LOS E during the evening peak period (90 second cycle length) with the number of lanes proposed by Krager and Associates. In addition, the volume to capacity ratios (v/c) for the individual lanes are approaching a v/c ratio of 1.0 and traffic queues expected during the evening peak period will be in excess of 1,750 feet (Approximately 88 vehicles). Modifying/increasing the traffic signal cycle lengths will further degrade the intersection level of service and no additional capacity can be achieved for this alternative.

#### Adjacent interchanges in the Grandview Section

This analysis also evaluated the LOS conditions for the other interchanges identified in the Grandview Section. The analysis verified that the other interchanges in the section all meet the capacity requirements for the purpose and need in the year 2030. The analysis worksheets are contained in Appendix A for reference.

#### **Conclusion**

This alternative does not meet capacity requirements for the purpose and need because an intersection is not adequate to maintain LOS D in the evening peak hour.

#### B. Partial Interchange at the Existing US 550 at US 160 Intersection – Figure 2

This alternative proposes to modify the signalized intersection at US 160/US 550 by eliminating the left turn movement from northbound US 550 to westbound US 160 and replacing it with a loop ramp to service the left turn volumes at the intersection. To accommodate the through volumes, US 160 would have two through lanes and one auxiliary lane westbound from the CR 233 (Three Springs) interchange through the US 550 intersection. US 160 eastbound would have two through lanes and one climbing lane from west of the US 550 intersection to the CR 233 / Three Springs interchange. This analysis will also address the capacity requirements for the design variations T.2.4, T.2.6, T.3.4, and T.3.6.

Each design variation illustrates US 550 intersecting US 160 as an at-grade intersection at the existing US 550/US 160 intersection location but with a flyover to accommodate the northbound left turn movement. The intersection geometry and flyover ramp movement are the same for T.2.4, T.2.6, T.3.4

and T.3.6 as illustrated in Figure 2. The differences occur approximately 500 feet away from the US 550/US 160 intersection where the horizontal curvature and grade varies, and the location and radius of the flyover. The design alternatives are contained in Appendix B for reference.

- **Design Variation T.2.4** shows a 1050-foot radius and a 4% grade. The location of the flyover has half of the loop on each the north and south side of US 160;
- **Design Variation T.2.6** shows a 925-foot radius and 6% grade. The location of the flyover has half of the loop on each the north and south side of US 160;
- **Design Variation T.3.4** shows a 1050-foot radius and a 4% grade. The location of the flyover loop is entirely on the north side of US 160; and
- **Design Variation T.3.6** shows a 925-foot radius and a 6% grade. The location of the flyover loop is entirely on the north side of US 160.

Since these design variations occur away from US 550 / US 160, they do not influence the traffic operations at the intersection and do not affect the results of the analysis.

#### Connection of US 550 to US 160

The signalized intersection is expected to operate at LOS A in the morning (60 second cycle length) and LOS A in the evening (90 second cycle length). The loop ramp has an approximate design speed of 30 MPH and the merge for the loop ramp is expected to operate at LOS B in the morning peak hour and LOS C in the evening peak hour. The westbound to southbound double-left turn movement is expected to operate at LOS C in the morning and LOS D in the evening. During the evening peak period the eastbound through movement is expected to operate at LOS C and traffic queues are expected to be in excess of 900 feet. All other movements are expected to operate at LOS A during the both peak periods. In addition, the volume to capacity ratios (v/c) for the individual lanes are approaching a v/c ratio of 1.0 during the evening peak period.

#### Adjacent interchanges in the Grandview Section

This analysis also evaluated the LOS conditions for the other interchanges identified in the Grandview Section. The analysis verified that the other interchanges in the section all meet the capacity requirements for the purpose and need in the year 2030. The analysis worksheets are contained in Appendix B for reference.

#### **Conclusion**

The alternative does satisfy the capacity requirements for the purpose and need in the year 2030.

#### C. Revised Preliminary Alternative A – Figure 3

The FEIS considered an interchange at US 550/US 160 (Preliminary Alternative A). However, the Preliminary Alternative A was not considered to be a reasonable alternative because it has poor geometry which combines 6 percent grades, sharp curves and maximum super-elevation on a north-facing slope that will create icing conditions and hazards in the winter. In part, because of these reasons, Preliminary Alternative A from the EIS was not considered to be reasonable or practicable and was dismissed without the traffic operations being analyzed. This alternative is being re-evaluated despite the geometric problems to determine whether the traffic operations will meet the purpose and need for capacity.

The Revised Preliminary Alternative A proposes a Single Point Urban Interchange (SPUI) at SH 172/CR 234 and CR 233 (Three Springs) with a grade separated trumpet interchange at the existing US 550/US 160 connection. This alternative has been revised from the FEIS to include a grade separated trumpet interchange (Grandview Interchange) east of the existing US 550/US 160 Intersection. To accommodate the through volumes, US 160 would have two through lanes and one auxiliary lane westbound from the

CR 233 (Three Springs) interchange through the US 550 interchange. US 160 eastbound would have two through lanes and one climbing lane from west of the US 550 interchange to the CR 233 (Three Springs) interchange. The analysis worksheets are contained in Appendix C for reference.

#### Connection of US 550 to US 160

The weaving segment for eastbound US 160 between US 550 interchange and Grandview interchange is expected to operate at LOS B during the morning peak period and LOS C during the evening peak period. All merge and diverge sections between US 550 and US 160 are expected to operate at LOS B during the morning peak period and LOS C during the evening peak period.

#### Adjacent interchanges in the Grandview Section

This analysis also evaluated the LOS conditions for the other interchanges identified in the Grandview Section. The analysis verified that the other interchanges in the section all meet the capacity requirements for the purpose and need in the year 2030.

#### **Conclusion**

This alternative satisfies the capacity requirements of the purpose and need. The planned interchange and auxiliary lane configurations are adequate to accommodate the projected volumes at LOS D or better with US 550 connecting to this location.

#### D. Revised G Modified – Figure 4

This alternative includes two through lanes in each direction through the Grandview Section with eastbound and westbound auxiliary lanes from the CR 233 (Three Springs) interchange to the west end of the section. A trumpet interchange is assumed at the Grandview location and a SPUI is assumed at the CR 233 (Three Springs) and SH 172 / CR 234 interchanges.

#### Connection of US 550 to US 160

The merge and diverge movements at the Grandview Interchange are expected to operate at LOS B or better during the morning peak period and LOS C or better during the evening peak period. The weaving segment for westbound US 160 between Three Springs interchange and Grandview interchange is expected to operate at LOS B during the morning peak period and LOS C during the evening peak period.

The roundabout at the intersection between US 550 and the US 160 ramps is expected to operate at LOS A during the morning and evening peak periods. Each approach to the roundabout is expected to operate at LOS A during the morning and evening peak periods as well. The analysis worksheets are contained in Appendix D for reference.

#### Adjacent interchanges in the Grandview Section

This analysis also evaluated the LOS conditions for the other interchanges identified in the Grandview Section. The analysis verified that the other interchanges in the section all meet the capacity requirements for the purpose and need in the year 2030.

#### **Conclusion**

The analysis shows that this alternative satisfies the capacity requirements of the purpose and need in the year 2030. This alternative accommodates the projected year 2030 volumes at LOS D or better.

#### E. Revised F Modified and Eastern Realignment Alternative – Figure 5

These two alternatives will both connect to the CR 233 (Three Springs) interchange. The Revised F Modified includes an additional trumpet interchange at the Grandview Interchange, and SPUI interchanges at CR 233 (Three Springs) and SH 172/CR 234. US 550 would connect to US 160 at CR

233 (Three Springs) interchange. The Eastern Realignment Alternative has a different US 550 alignment when compared to the Revised F Modified US 550 alignment, but both alignments connect to US 160 at the CR 233 (Three Springs) interchange. The traffic operational analysis is the same for both alternatives where they connect to US 160. Frontage roads will parallel both alignments from US 160 to CR 220. These roads will provide local access to the properties south of US 160. US 160 will have two through lanes and one auxiliary lane in each direction from the west ramps of the Grandview Interchange to the west ramps of the CR 233 (Three Springs) interchange. The analysis assumes two through lanes in each direction through the Grandview Section with eastbound and westbound auxiliary lanes from the CR 233 (Three Springs) interchange to the section. The analysis worksheets are contained in Appendix E for reference.

#### Connection of US 550 to US 160

The merge and diverge movements at the CR 233 (Three Springs) Interchange are expected to operate at LOS B or better during the morning peak period and LOS C or better during evening peak period. The weaving segment for westbound US 160 between Three Springs interchange and Grandview interchange is expected to operate at LOS B during the morning peak period and LOS C during the evening peak period.

The signalized intersection in the center of the interchange is expected to operate at LOS C during the morning and evening peak periods (90 second cycle AM, 110 second cycle PM), and all of individual movements are expected to operate at LOS D or better during both peak periods. During the evening peak period, the individual movements operating at-capacity are the eastbound left turn and right turn movements as well as the northbound left turn movement which are expected to operate at volume to capacity ratios (v/c) near 1.0. Traffic queues are expected to be in excess of 600 feet.

#### Adjacent interchanges in the Grandview Section

This analysis also evaluated the LOS conditions for the other interchanges identified in the Grandview Section. The analysis verified that the other interchanges in the section all meet the capacity requirements for the purpose and need in the year 2030.

#### **Conclusion**

This alternative satisfies the capacity requirements of the purpose and need. The interchange is adequate to accommodate the projected volumes at LOS D or better with US 550 connecting to this location.

#### F. Western Realignment Alternative - Figure 6 & 7

This alternative proposes to relocate US 550 to the west where it would intersect US 160 with a directional interchange thus eliminating the signalized intersection of US 160/US 550. The alignment would include two river crossings requiring bridges. Two of the ramps from the interchange would terminate approximately 700 feet from the existing River Road signalized intersection on US 160. The traffic operational results for the interchange do not include the impacts of the traffic signal operation at River Road. Impacts due to the proximity of River Road are described below. The analysis worksheets are contained in Appendix F for reference.

#### Connection of US 550 to US 160

The Western Realignment Interchange is expected to operate at LOS C or better during the morning and evening peak periods in the analysis. However, when the interaction of the River Road signalized intersection with the interchange is analyzed, there is a queuing of traffic in the evening peak period of approximately 1,700 feet (85 vehicles) on US 160 (Figure 7). The queues on US 160 will force queues to form on the ramp itself, congesting the merge area such that a free flow merge could not occur.

Ramp merge calculations in the HCS software assume free flow operations and cannot analyze the queue impacts from a closely spaced signalized intersection downstream from the ramp merge point. The results of the HCS analysis determines the ramp merge has acceptable operations even though the proximity of the traffic signal would cause congestion on the ramp. Our operations analysis evaluated this relationship and determined that the expected vehicle stoppages at the interchange merge area is a capacity failure.

Unlike the other alternatives, this interchange will experience congestion and capacity problems due to the close proximity of the River Road signalized intersection to the westbound on ramp to US 160. Intersection queues, westbound at River Road, during the evening peak period will extend beyond the merge for the US 550 to US 160 on ramp. This will cause vehicles to stop on the ramp during the evening peak period. Approaching vehicles on US 550 would not be able to see the stopped vehicles due to the interchange ramp design and curvature. The speed differential between approaching vehicles and stopped vehicles on the ramp will create an unsafe condition that could result in a high probability of sideswipe and rear-end accidents. This alternative does not meet the purpose and need for capacity, resulting in an unsafe roadway condition between the interchange and the adjacent signalized intersection. This is considered a failing condition as it is not consistent with the purpose and need to have a known design that contributes to congestion and safety issues. The analysis worksheets are contained in Appendix G for reference.

#### Adjacent interchanges in the Grandview Section

This analysis also evaluated the LOS conditions for the other interchanges identified in the Grandview Section. The analysis verified that the other interchanges in the section all meet the capacity requirements for the purpose and need in the year 2030.

#### **Conclusion**

The proximity of River Road to the US 550 westbound on-ramp to US 160 will create queue conflicts, congestion, and backups at the westbound interchange on-ramp. The Western Realignment does not meet the purpose and need for capacity resulting in an unsafe roadway condition between the interchange and the adjacent signalized intersection.

#### **Conclusions**

- **US 550 at US 160 At-Grade Intersection Alternative.** This includes design variations T.1.4, T.1.6, T.4.4. This alternative does not meet the capacity requirements of the purpose and need because the geometry of the US 160/US550 intersection is not adequate to maintain LOS D in the evening peak hour.
- **Partial Interchange at the Existing US 550 at US 160 Intersection.** This analysis also addresses the capacity requirements for the design variations T.2.4, T.2.6, T.3.4, and T.3.6. The alternative does satisfy the capacity requirements for the purpose and need.
- **Revised Preliminary Alternative A.** This alternative satisfies the capacity requirements of the purpose and need. The planned interchange and auxiliary lane configurations are adequate to accommodate the projected volumes at LOS D or better with US 550 connecting to this location.
- **Revised G Modified.** With year 2030 traffic volumes, this alternative meets the capacity requirements in the purpose and need.
- **Revised F Modified and Eastern Realignment Alternative.** Both of these alternatives meet the capacity requirements of the purpose and need due to the additional Grandview Interchange which reduces the traffic impacts of the fully developed residential and commercial area in Grandview to the north of the CR 233 (Three Springs) interchange.

**Western Realignment Alternative.** Capacity is a criteria of the purpose and need, this alternative does not satisfy the capacity requirement of the purpose and need. The proximity of River Road to US 550 northbound to westbound US 160 on-ramp causes capacity queuing conflicts with the on-ramp and potential safety issues, this alternative does not satisfy the purpose and need.

# Capacity Analysis and Comparison of Alternatives beyond the Horizon Year of 2030

In a separate report (US 160 Section 4(f) Alternatives Considered in the Least Harm Analysis – The Degree to Which Each Alternative Meets the Purpose and Need for the Project, dated December 23, 2010) an analysis was performed to determine which of alternatives that met the criteria of LOS D or better for the 2030 traffic capacity analysis performed best if traffic were increased beyond the volumes used for the 2030 analysis. In this analysis, traffic was increased at the intersections of US 160/US 550 in 2% increments until a movement failed (i.e., resulted in LOS E or worse) that could not be corrected by simply optimizing the traffic operations at the intersections and without adding additional lanes at the intersection. The results of this analysis showed that the signalized US 160/US 550 (Three Springs Interchange) intersection for Revised F Modified and the Eastern Realignment alternative failed with the first 2% increase of traffic at the intersection, while the roundabout intersection in Revised G Modified remained at LOS A for the overall intersection and all movements with the same 2% increase in traffic. This analysis showed that the US 160/US 550 intersection in Revised F Modified and the Eastern Realignment was approaching capacity with the 2030 traffic volumes, and exceeded the capacity of the intersection with only a slight increase in traffic beyond the 2030 volumes while the roundabout intersection in Revised G Modified had substantial reserve capacity beyond the 2030 volumes. As a result of this analysis, it was concluded that the roundabout at the Grandview Interchange (Revised G Modified) has more reserve capacity than a signalized intersection at the Three Springs Interchange (Revised F Modified) and thus Revised G Modified better meets the project purpose and need.

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Attachments	
p:\ae\c\codot\105181\to #3 - us 160 interchange analysis\project\	_final memos_december 2010\3\3_2030 traffic ops analysis for the us 550 at us 160 section 4f_12-23-2010_final.docx



### Year 2030 Traffic Volumes



Year 2030 Traffic Operation Analysis for the US 550 at US 160 Section 4(f) Alternatives Revised Alternative G Modified

Drawn by	NWS	Job #	105181	Figure	4	
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### SEH MEMORANDUM

US 160 Section 4(f) Alternatives Considered in the Least Harm Analysis—The Degree to Which Each Alternative Meets the Purpose and Need for the Project

January 5, 2011



TO:	Mike McVaugh, PE - CDOT Region 5
FROM:	Phil Weisbach, PE Jon E. Larson, PE
DATE:	January 5, 2011
RE:	US 160 Section 4(f) Alternatives Considered in the Least Harm Analysis – The Degree to Which Each Alternative Meets the Purpose and Need for the Project SEH No. CODOT - 105181

#### **Executive Summary**

Alternatives for the US 550 connection to the US 160 corridor were originally evaluated in the US Highway 160 from Durango to Bayfield Final Environmental Impact Statement (FEIS) dated May 2006. The US 160 Highway from Durango to Bayfield Record of Decision (US 160 ROD) documented selection of Grandview Alternative G Modified as the Preferred Alternative which included an interchange of US 160 with US 550 approximately 0.6 miles east of the current intersection.

A separate memo entitled *Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f)* (December 23, 2010) analyzes whether the alternatives being considered in the 4(f) analysis meet the capacity requirements of the purpose and need in the year 2030. The analysis looks at projected traffic in the year 2030 to evaluate if the roadway will meet the capacity requirements for the purpose and need 20 years into the future. The Section 4(f) alternatives focus on the connection of US 550 to US 160 in the Grandview Section. All of the alternatives assume that there is an existing Grandview trumpet interchange and single point urban interchanges (SPUIs) at CR 233 (Three Springs) and SH 172/CR 234. The need for these three interchanges in the Grandview Section is explained in a separate technical memorandum: *Year 2030 Traffic Operations Analysis for Alternatives of the US 160 FEIS* dated September 17, 2010.

Of the alternatives considered in the Section 4(f) analysis, three alternatives are being considered under the least harm analysis. These alternatives include Revised G Modified, Revised F Modified, and the Eastern Realignment. One of the balancing factors when considering the least overall harm is the degree to which each alternative meets the purpose and need for the project This analysis evaluates the degree to which these alternatives meet the purpose and need and focuses specifically on the connection of US 550 to US 160. The alternative that exhibits the highest degree of meeting the purpose and need provides the most overall benefit to the access, safety and capacity of US 160 throughout its 20-year design.

The technical traffic analysis data for this memo is included in the attached appendices at the end of this document.

This analysis addresses several fundamental questions:

- A. Which alternative exhibits more desirable access control along US 160?
- B. Which alternative is 'more safe' and exhibits the least overall potential for harm to the motorists?
- C. Which alternative exhibits the most reserve capacity at the intersection where US 550 connects with US 160?
- D. Which alternative has the highest degree of meeting the purpose and need for access, safety and capacity?

The purpose for improvements to the US 160 corridor include increasing travel efficiency and capacity to meet current and future needs, while improving safety for the traveling public by reducing the number and severity of accidents, and controlling access. The design year of the US 160 FEIS was 2025. The analysis performed in this memorandum will be the same as the FEIS except the design year is changed to 2030.

Summary of Results: The results of the analysis performed are summarized below:

US 160 Section 4(f) Alternatives Considered in the Least Harm Analysis	Revised G Modified	Revised F Modified <sup>1</sup>	Eastern Realignment <sup>1</sup>
Which alternative exhibits more desirable access control along US 160?	$\checkmark$	$\checkmark$	$\checkmark$
Which alternative is 'more safe' and exhibits the least overall potential for harm to the motorists?	$\checkmark$		
Which alternative exhibits the most reserve capacity at the intersection where US 550 connects with US 160?	$\checkmark$		
Which alternative has the highest degree of meeting the purpose and need for access, safety and capacity?	$\checkmark$		

**Fundamental Questions** 

Note:

1. The Revised F Modified and Eastern Realignment alternatives have different alignments, but both alternatives connect to US 160 at Three Springs. The traffic capacity, access, and safety analysis are the same for Revised F Modified and Eastern Realignment alternatives.

### Section 4(f) Alternatives Evaluated

The following describes the alternatives being considered in the least harm analysis for the Section 4(f) **Evaluation**:

- A. Revised G Modified Figure 1. This alternative connects US 550 to US 160 via the Grandview trumpet interchange which intersects with US 550 via a roundabout, and CR 233 (Three Springs) and SH 172/ CR 234 would be SPUI interchanges.
- B. Revised F Modified and Eastern Realignment Alternative Figure 2. These two alternatives will both connect to the CR 233 (Three Springs) interchange. The Revised F Modified includes an additional trumpet interchange at the Grandview Interchange, and SPUI interchanges at CR 233 (Three Springs) and SH 172/CR 234. US 550 would connect to US 160 at the CR 233 (Three Springs) interchange. The Eastern Realignment Alternative has a different US 550 alignment when compared to the Revised F Modified US 550 alignment, but both alignments connect to US 160 at the Three Springs/ CR 233 interchange. The traffic operational analysis for both alternatives is the same.

Figures 1 and 2 illustrate the alignments for these alternatives as well as the year 2030 traffic operations analysis from the Section 4(f) alternatives evaluation. The traffic volumes, interchange traffic control/laneage and interchange spacing will be used as the basis for the analysis to determine which alternative is more beneficial to the purpose and need.

#### **Evaluation of the Degree with which Alternatives Meet Purpose and Need** A. Access

Access control was evaluated to determine which alternative better promotes an access management system that meets the expectations of a high-speed, high volume highway through appropriate control of access frequency and spacing.

#### **Revised G Modified – Figure 1**

This alternative includes two through lanes in each direction through the Grandview Section with interchanges at the Grandview location, CR 233 (Three Springs) and SH 172 / CR 234. Local access within this corridor will be managed with a local frontage road system to limit direct access to the highway only at the interchanges. Additionally, this alternative includes establishing an access line along the corridor to preclude future additional accesses. Within the Grandview Section, there are no other accesses proposed other than the three interchanges. The approximate distances between the interchanges are tabulated below:

-	Between Grandview Interchange &	Three Springs Interchange	=	5,600 feet
	Detwoon Three Comings Intershopes	& SH 172 / CD 224	_	7 150 foot

- Between Three Springs Interchange & SH 172 / CR 234 = 7,150 feet

#### Revised F Modified and Eastern Realignment Alternative – Figure 2

This alternative includes two through lanes in each direction through the Grandview Section with interchanges at the Grandview location, CR 233 (Three Springs) and SH 172 / CR 234. Local access within this corridor will be managed with a local frontage road system to limit direct access to the highway only at the interchanges. Additionally, this alternative includes an access line along the corridor to preclude future additional accesses. Within the Grandview Section, there are no other accesses proposed other than the three interchanges. The approximate distances between the interchanges are tabulated below:

-	Between Grandview Interchange & Three Springs Interchange	=	5,600 feet
-	Between Three Springs Interchange & SH 172 / CR 234	=	7,150 feet

#### **Conclusion**

The analysis shows that access for the three alternatives exhibit the same frequency and spacing. Regardless of where US 550 connects to US 160, local access to US 160 is managed by a frontage road system to minimize access to US 160 only at the planned interchanges. *Therefore, the degree with which the alternatives meet purpose and need for access is the same for all three alternatives.* 

#### **B.** Safety

Safety was evaluated to determine which alternative more safely accommodates the traffic volumes associated with the connection of US 550 to US 160.

#### **<u>Revised G Modified – Figure 1</u>**

This alternative connects US 550 to US 160 via the Grandview trumpet interchange. However, traffic on US 550 is accommodated at its intersection with US 160 by a roundabout that is expected to operate at an acceptable level of service in the year 2030.

#### **Revised F Modified and Eastern Realignment Alternative – Figure 2**

This alternative connects US 550 to US 160 via the Three Springs SPUI interchange. Traffic on US 550 is accommodated at its intersection with US 160 by a SPUI and controlled by a traffic signal that is expected to operate at an acceptable level of service in the year 2030.

#### **Roundabouts Versus Traffic Signals**

One of the benefits of roundabout installations is the improvement in overall safety performance to other traffic control installations. Though the frequency of crashes is not always lower for roundabouts, there is a pronounced reduction in injury rates. The typical reasons for the increased safety level at roundabouts are<sup>1</sup>:

• **Roundabouts have fewer conflict points.** The frequency of crashes at an intersection is related to the number of conflict points. At a four-legged conventional signalized intersection, there are 32 vehicle-to-vehicle conflicts and 24 vehicle-to-pedestrian conflicts. At a four-legged roundabout, this number is reduced to 8 as shown in the figure below. The four dots in the roundabout illustrations represent two conflict points each for the merge conflict and the diverge conflict.



- Lower speeds and lower speed differential. Lower speeds associated with roundabouts allow drivers more time to react to potential conflicts.
- **Fewer number of driver decisions.** Drivers only need to be aware of vehicles to their left at entry of roundabouts. Drivers at traffic signals need to be aware of traffic coming from as many as three directions at any time. In addition the driver must remain aware of the signal indication while monitoring the vehicle movements through the intersection.
- Less severe crashes. Severity of crashes is based on the relative speed and angle of the conflicting streams. Most vehicles travel at similar speeds through roundabouts with a small angle between the vehicle paths. The potential for hazardous conflicts, such as right angle and left turn head-on crashes is eliminated in roundabout use.

Research shows that roundabouts can be an effective way to improve safety at intersections. In a review of 55 sites that were converted from four-way intersections to roundabouts, before and after crash data shows a reduction in crashes 35% (1,122 to 726). More importantly, the severe injury crashes were reduced 76% (from 296 to 72).<sup>2</sup>

#### **Conclusion**

The analysis shows that a roundabout controlled intersection is more likely to provide safer operations than a conventional traffic signal due to the lower speeds, fewer conflicting movements and the elimination of head-on and broad-side crashes that are typically associated with injury crashes. Regarding safety, to accommodate the significant volume of traffic from US 550, use of a roundabout at the Grandview Interchange would be safer than sending US 550 to a traffic signal at the Three Springs Interchange. *Therefore, the Revised G Modified has a higher degree of safety benefit compared to Revised F Modified and the Eastern Realignment Alternative.* 

<sup>&</sup>lt;sup>1</sup> <u>Roundabouts: An Information Guide</u>. Federal Highway Administration (Report No. FHWA-RD-00-067). June 2000

<sup>&</sup>lt;sup>2</sup> <u>Roundabouts in the United States</u>. National Cooperative Highway Research Program (Report 572). Transportation Research Board. 2007.

#### C. Capacity

The capacity analysis evaluates the connection of US 550 to US 160 to determine which alternative can accommodate more future traffic volume growth beyond the year 2030 forecasted volumes. The year 2030 volumes and traffic represent the basis for which the reserve capacity is measured in the additional analysis. The procedure involved in evaluating the alternatives consists of:

- Begin with the Year 2030 traffic volumes and report results;
- Inflate the traffic volumes at the intersection of US 550 / US 160 in 2% increments until an intersection or individual movement for an alternative fails;
- For the traffic signal operations, the signal phasing and cycle length is then optimized to see if a timing solution could extend the capability of the traffic operations to have capacity for more volume;
- After optimization of the signal phasing and cycle length, the volumes are increased to the point where a movement cannot meet LOS D or better, the alternative is considered to fail; then
- The last alternative that continues to meet the purpose and need for capacity is considered to have the most reserve capacity.

Table 1 illustrates the level of service analysis results. Level of service worksheets are contained in Appendix A for reference.

#### **Revised G Modified**

This alternative connects US 550 to US 160 via the Grandview trumpet interchange. Traffic on US 550 is accommodated at its intersection with US 160 by a roundabout. The roundabout configuration has 220-foot inscribed circle diameter and includes two circulation lanes with right turn bypass lanes for the eastbound and northbound directions. The US 550 northbound connection to US 160 westbound (Ramp C) is accomplished by a right-turn bypass at the roundabout. The roundabout also connects to Ramp C for any vehicles that need to go westbound on US 160.

The roundabout was analyzed using RODEL. To be consistent with the US 160 Section 4(f) analysis, the roundabout was analyzed with a capacity factor of 0.9 for the two-lane approaches. Additionally, it was evaluated at an 85% confidence level, which simulates the worst few minutes of the peak period instead of the average delay spread across the peak period. The results in RODEL with these assumptions are considered conservative, which provides an increased level of confidence that the results are dependable.

**Year 2030 Traffic Volumes.** The roundabout overall and each approach are expected to operate well at LOS A during the morning and evening peak periods. The merge from Ramp C is expected to operate at LOS B during the morning peak period and LOS C during the evening peak period.

**Year 2030 Traffic Volumes + 2% Inflation.** This scenario evaluates the roundabout approaches and Ramp C, but inflates the year 2030 traffic volumes on each approach by 2% to determine if the roundabout is able to absorb this level of volume increase beyond the year 2030. The roundabout as well as each approach is expected to operate well at LOS A during the morning and evening peak periods. The merge from Ramp C is expected to operate at LOS B during the morning peak period and LOS C during the evening peak period. The roundabout would have to exhibit an 84% increase in traffic volume beyond the year 2030 traffic volumes before it experiences a failing LOS E at one of its movements. Consequently, Ramp C would have to exhibit a 67% increase in traffic volume beyond the year 2030 traffic volumes before the merge operations diminish from an acceptable LOS D to a failing LOS F.

#### **Revised F Modified and Eastern Realignment Alternative**

This alternative connects US 550 to US 160 via the Three Springs interchange. Traffic on US 550 is accommodated at its intersection with US 160 by a SPUI. The intersection configuration includes the following:

- Eastbound approach Two left turn lanes and two right turn lanes.
- Westbound approach Two left turn lanes and one right turn lane.
- Northbound approach Two left turn lanes, one through lane and one right turn lane.
- Southbound approach Two left turn lanes, one through lane and one right turn lane.

The traffic signal was modeled in Synchro to emulate SPUI operations which are more efficient than a conventional intersection.

**Year 2030 Traffic Volumes.** The signalized intersection at the Three Springs SPUI is expected to operate at LOS C during the morning and evening peak periods and all of individual movements are expected to operate at LOS D or better during both peak periods.

**Year 2030 Traffic Volumes + 2% Inflation.** This scenario evaluates the SPUI, but inflates the year 2030 traffic peak hour turning movements by 2% to determine if the intersection is able to absorb this level of volume increase beyond the year 2030. The signalized intersection at the Three Springs SPUI is expected to operate at acceptable LOS C during the morning and evening peak periods. However, the northbound left turn is expected to operate at LOS E during evening peak period. Numerous signal phasing and cycle length combinations were attempted, but the signal operations could not be improved to acceptable levels. A 2% increase for the northbound left turn equates to approximately 25-30 vehicles in the morning and evening peak periods. This minor increase creates a failing northbound left turn movement.

#### **Conclusion**

The analysis shows that the traffic signal fails if traffic volumes were increased by 2% beyond the year 2030 projected traffic volumes. The analysis shows that the roundabout can be expected to accommodate an increase in traffic by 84% and Ramp C can be expected to accommodate an increase in traffic by 67% beyond the year 2030 projected traffic volumes. Therefore, it is clear that there is more reserve capacity with the roundabout than the traffic signal. *Therefore, the roundabout at the Grandview Interchange (Revised G Modified) has more reserve capacity than a signalized intersection at the Three Springs Interchange (Revised F Modified).* 

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Attachments
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Internetion and Critical Movements	Year 2030 Traffic Volumes <sup>1</sup>				Year 2030 Traffic Volumes + 2% Inflation				
Intersection and Critical Movements	AM Peak	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	Delay <sup>2</sup>	LOS	Delay <sup>2</sup>	LOS	Delay <sup>2</sup>	LOS	Delay <sup>2</sup>	LOS	
R	Revised G Modified								
US 550 @ Grandview (Roundabout)	2.6	Α	3.1	Α	2.3	Α	2.7	Α	
Eastbound Approach	3.0	А	3.6	А	2.4	А	3.0	А	
Northbound Approach	4.2	А	4.8	Α	4.2	Α	5.4	А	
Westbound Approach	2.4	А	2.4	А	2.4	Α	2.4	А	
Southbound Approach	2.4	А	3.0	А	1.8	А	2.4	А	
Revised F Modified	& Easte	rn Rea	alignmer	t Alte	rnative				
US 550 @ Three Springs (Traffic Signal)	25.8	С	30.9	С	26.6	С	32.5	С	
Eastbound Left	31.6	С	52.5	D	33.4	С	54.9	D	
Eastbound Right	10.1	В	21.0	С	10.1	В	22.1	С	
Westbound Left	10.2	В	35.2	D	25.9	С	35.3	D	
Westbound Right	21.9	С	10.4	В	9.2	Α	10.4	В	
Northbound Left	50.2	D	54.8	D	50.0	D	59.7	E	
Northbound Through	42.9	D	53.0	D	42.7	D	53.6	D	
Northbound Right	17.0	В	23.8	С	17.3	В	24.1	С	
Southbound Left	18.9	В	24.2	С	19.2	В	24.2	С	
Southbound Through	36.1	D	44.7	D	36.6	D	44.9	D	
Southbound Right	1.5	Α	2.1	Α	1.2	Α	2.2	Α	

#### Table 1. Reserve Capacity Comparison - Roundabout (Alt G) vs. Traffic Signal (Alt F)

Notes:

**1.** Traffic volumes referenced from <u>Year 2030 Traffic Operations Analysis for the US 550 at US 160 Section 4(f) Alternatives</u> Technical Memo (12-23-2010)

2. Delay is measured as seconds/vehicle.

US 160 Section 4(f) Alternatives Considered in the Least Harm Analysis – The Degree to Which Each Alternative Meets the Purpose and Need for the Project

# **Appendix A**

Level of Service Worksheets
#### Grandview Interchange Roundabout Analysis (Revised Alternative G Mod)

**Year 2030 Traffic Volumes:** 2-Lane Roundabout (ICD 220') with right turn bypass lanes for EB&NB (AM) (85% Confidence Level)

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**Year 2030 Traffic Volumes:** 2-Lane Roundabout (ICD 220') with right turn bypass lanes for EB&NB (PM) (85% Confidence Level)

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HOE QUEUE	ven	<u>ا</u>	0	6	1		6051 Ş	66.7
Finde F2	livect	F3neak	Ctp1F3	Peu F4f	Eact Efecta	ts F8econ	F9nept	F10mun Esc
11000 120		ropour	001 11 0	100 111		00 100000	TTPING	LIOLAN LSC

**Year 2030 Traffic Volumes + 2%:** 2-Lane Roundabout (ICD 220') with right turn bypass lanes for EB&NB (AM) (85% Confidence Level)

C:\WINDOWS\syste	m32\cmd.exe			- 🗆 ×
22:12:10	US 160	Rev Alt G Modifi	ied+2%	25
E (m) 8.50 L' (m) 24.40 U (m) 7.90 RAD (m) 42.70 PHI (d) 17.00 DIA (m) 67.10	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	8.50 17.40 7.90 34.70 22.00 67.10	TIME PERIOD mi TIME SLICE mi RESULTS PERIOD mi TIME COST \$/h FLOW PERIOD mi FLOW TYPE pcu/ve	n 90 n 15 n 15 75 r 15.00 n 15 75 h VEH
GRAD SEP	0 0	Ø	FLOW PEAK am/op/p	m AM
LEG NAME         PCU         F           EB         1.05         1.05           NB         1.05         1.05           WB         1.05         1.05           SB         1.05         1.05	LOWS (1st exit 000 000 480 000 075 000 140 005 240 000 165 385	2nd etcU>         FL(           0         1.0           0         1.0           0         1.0           0         1.0           0         1.0           0         1.0	OF         CL         FLOW RATIO           02         85         0.75         1.125         0.75           02         85         0.75         1.125         0.75           02         85         0.75         1.125         0.75           02         85         0.75         1.125         0.75           02         85         0.75         1.125         0.75           02         85         0.75         1.125         0.75           02         85         0.75         1.125         0.75	PLOW TIME 15 45 75 15 45 75 15 45 75 15 45 75 15 45 75
	PH	HI outside 20-80		
FLOW veh CAPACITY veh AVE DELAY mins MAX DELAY mins AVE QUEUE veh MAX QUEUE veh	490 77 1910 871 0.04 0.07 0.06 0.10 0 0 0 0	393 561 2051 2246 0.04 0.03 0.05 0.05 0 0 0 0	AUDEL L O VEH HR COST	s 2.3 S A S 1.0 S 14.8
rimoue rzuirect	ropeak GUPIPS	JPEV PHACE POST	tats recton raprit	FIORAN ESC

**Year 2030 Traffic Volumes + 2%:** 2-Lane Roundabout (ICD 220') with right turn bypass lanes for EB&NB (PM) (85% Confidence Level)

C:\WINDOWS\syste	m32\cmd.exe			- 🗆 🗙
22:12:10	US 160	Rev Alt G Modified	1+2%	26
E (m) 8.50	4.80 8.50	8.50	TIME PERIOD min	90
L' (m) 24.40	16.80 20.70	17.40	TIME SLICE min	15
U (m) 7.90	1 4.30 7.90	7.90	RESULTS PERIOD min	15 75
RAD (m) 42.70	39.60 42.70	34.70	TIME COST \$/hr	15.00
PHI (d) 17.00	20.30 20.70	22.00	FLOW PERIOD min	15 75
DIA (m) 67.10	67.10 67.10	67.10	FLOW TYPE pcu/veh	VEH
GRAD SEP	) 0 0	Ø	FLOW PEAK am/op/pm	PM
LEG NAME PCU I	LOWS (1st exit	2nd etcU) FLOF	CL FLOW RATIO FI	LOW TIME
EB 1.05	000 000 480	0 1.02	85 0.75 1.125 0.75 15	5 45 75 📗
NB 1.05	000 075 000	0 1.02	85 0.75 1.125 0.75 15	5 45 75 📗
WB 1.05	135 005 240	0 1.02	85 0.75 1.125 0.75 15	5 45 75 📘
SB 1.05	000 255 590	0 1.02	85 0.75 1.125 0.75 15	5 45 75 📘
	P	HI outside 20-80 👘		
FLOW veh	490 77	388 862		
CAPACITY veh	1698 766	2051 2246	AVDEL s	2.7
AVE DELAY mins	0.05 0.09	0.04 0.04	LOS	Ĥ
MAX DELAY mins	0.07 0.12	0.05 0.06	UEH HRS	1.4
AVE QUEUE veh	00	01	COST \$	20.3
MAX QUEUE veh	0 0	0 1		
F1mode F2direct	F3peak CtrlF	3rev F4fact F6stat	ts F8econ F9prnt F1	lØrun Esc

**Year 2030 Traffic Volumes + 84%:** 2-Lane Roundabout (ICD 220') with right turn bypass lanes for EB&NB (AM) (85% Confidence Level)

C:\WINDOWS\syste	m32\cmd.exe			- 🗆 🗙
5:1:11 E (m) 8.50 L' (m) 24.40 U (m) 7.90 RAD (m) 42.70 PHI (d) 17.00 DIA (m) 67.10 GRAD SEP	US 160 4.80 8.50 16.80 20.70 4.30 7.90 39.60 42.70 20.30 20.70 67.10 67.10 0 0 0	Rev Alt G Modified 8.50 17.40 7.90 34.70 22.00 67.10 0	+Xz         TIME PERIOD       mir         TIME SLICE       mir         RESULTS       PERIOD       mir         TIME       COST       \$/hi         FLOW       PERIOD       mir         FLOW       TYPE       pcu/vel         FLOW       PEAK       am/op/pr	40 90 15 15,75 15,00 15,75 15,00 15,75 VEH AM
LEG         NAME         PCU         1           EB         1.05         1.05         1.05           NB         1.05         1.05         1.05           WB         1.05         1.05         1.05           SB         1.05         1.05         1.05	RLOWS (1st exit 000 000 480 000 075 000 140 005 240 000 165 385	2nd etcU)         FLOF           0         1.84           0         1.84           0         1.84           0         1.84           0         1.84           0         1.84           0         1.84	CL         FLOW RATIO           85         0.75         1.125         0.75           85         0.75         1.125         0.75           85         0.75         1.125         0.75           85         0.75         1.125         0.75           85         0.75         1.125         0.75           85         0.75         1.125         0.75	PLON TIME 15 45 75 15 45 75 15 45 75 15 45 75 15 45 75
FLOW veh CAPACITY veh AUE DELAY mins MAX DELAY mins AUE QUEUE veh MAX QUEUE veh F1mode F2direct	883 138 1454 513 0.12 0.17 0.19 0.26 2 0 3 1 F3peak CtrlF3	708 1012 1734 2108 0.06 0.05 0.08 0.08 1 1 1 1 rev F4fact F6stat	AVDEL s L O S VEH HRS COST S S F8econ F9prnt	4.9 A 3.7 55.7 F1Ørun Esc

Year 2030 Traffic Volumes + 84%: 2-Lane Roundabout (ICD 220') with right turn bypass lanes for EB&NB (PM) (85% Confidence Level)

C:\WINDOWS\system32\cmd.exe	- 🗆 ×
5:1:11 US 160 Rev Alt G Modified+X%	41
E (m) _ 8.50 4.80 8.50 8.50 TIME PERI	OD min 90
L' (m) 24.40 16.80 20.70 17.40 TIME SLIC	E min 15
U (m) 7.90 4.30 7.90 7.90 RESULTS P	ERIOD min 15 75
RAD (m) 42.70 39.60 42.70 34.70 TIME COST	<b>\$∕hr</b> 15.00
PHI (d) 17.00 20.30 20.70 22.00 FLOW PERIC	OD min 1575
DIA <m> 67.10 67.10 67.10 FLOW TYPE</m>	pcu/veh VEH
GRAD SEP 0 0 0 0 FLOW PEAK	am/op/pm PM
LEG NAME PCU_ FLOWS (1st exit 2nd etcU) FLOF CL _ FLOW ]	RATIO FLOW_TIME
	125 0.75 15 45 75
NB 1.05 000 075 000 0 1.84 85 0.75 1.1	125 0.75 15 45 75
WB 1.05 135 005 240 0 1.84 85 0.75 1.3	125 0.75 15 45 75
SB 1.05 000 255 590 0 1.84 85 0.75 1.1	125 0.75 15 45 75
PHI outside 20-80	
PLOW veh 883 138 699 1555	
GHPHCITY Jeh 1071 324 1735 2108	HUDEL S 20.9
HUE DELHY mins 0.98 0.38 0.06 0.12	
THE ULLAY MINS 2.21 0.68 0.08 0.19	<b>UEH HRS 19.0</b>
HUE WELLE VEN 15 1 1 3	CUSI \$ 285.3
MAX QUEUE veh 34 1 1 5	
Fimode F2direct F3peak Utr1F3rev F4fact F6stats F8econ	Fyprnt F10run Esc

PM Peak Period3: US 160 & Three Springs/US 550Year 2030 Traffic Volumes Revised Alternative F Modified/Eastern Realignment Alternative/2010

Movement         EBL         EBT         EBR         WBL         WBT         WBR         NBL         NBT         NBR         SBL         SBT         SBR           Lane Configurations         1         0         1         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0 <t< th=""></t<>
Lane Configurations         1         0         0         9         1         1         0         0         8         5         9         0         9         1         1         0         0         1         0         0         9         1         1         0         1         0         1         0         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1
Volume (yph)720014103300190116016046025085930Ideal Flow (vphpl)1900 <td< td=""></td<>
Ideal Flow (vphpl)19001
Total Lost time (s)9.09.09.09.09.08.59.09.08.59.0Lane Util. Factor0.970.880.971.000.971.001.000.971.001.00Frt1.000.851.000.851.000.851.001.000.851.001.00Satd. Flow (prot)3433278734331583343318631583343318631583Satd. Flow (prot)3433278734331583343318631583343318631583Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtcustomProtected Phases11565656Permitted Phases565656161
Lane Util. Factor0.970.880.971.000.971.001.000.971.001.00Frt1.000.851.000.851.000.851.001.000.851.000.85Flt Protected0.951.000.951.000.951.000.951.000.951.000.95Satd. Flow (prot)3433278734331583343318631583343318631583Flt Permitted0.951.000.951.000.951.000.951.001.000.951.00Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtcustomProtected Phases11565656Permitted Phases </td
Frt1.000.851.000.851.001.000.851.001.000.85Flt Protected0.951.000.951.000.951.000.951.001.000.951.001.00Satd. Flow (prot)3433278734331583343318631583343318631583Flt Permitted0.951.000.951.000.951.000.951.001.000.951.00Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950
Fit Protected0.951.000.951.000.951.001.000.951.001.00Satd. Flow (prot)3433278734331583343318631583343318631583Fit Permitted0.951.000.951.000.951.000.951.001.000.951.001.00Satd. Flow (perm)3433278734331583343318631583343318631583Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtected Phases115656Permitted Phases55561156
Satd. Flow (prot)3433278734331583343318631583343318631583Flt Permitted0.951.000.951.000.951.000.951.001.000.951.001.00Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtcustomProtected Phases1156561156Virited Phases56565616156156
Fit Permitted       0.95       1.00       0.95       1.00       0.95       1.00       1.00       0.95       1.00       1.00       0.95       1.00 </td
Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.
Peak-hour factor, PHF       0.95 <t< td=""></t<>
Adj. Flow (vph)       758       0       1484       347       0       200       1221       168       484       263       89       979         RTOR Reduction (vph)       0       0       121       0       0       6       0       0       260       0       0       0         Lane Group Flow (vph)       758       0       1363       347       0       194       1221       168       224       263       89       979         Turn Type       Prot       custom       Prot       custom       Prot       custom       Prot       custom       Prot       custom       Prot       custom       Prot       5       6       5       6         Permitted Phases       5       5       5       1       1       5       6       1       5       6
RTOR Reduction (vph)         0         0         121         0         0         6         0         0         260         0
Lane Group Flow (vph)         758         0         1363         347         0         194         1221         168         224         263         89         979           Turn Type         Prot         custom         Prot         custom
Turn TypeProtcustomProtcustomProtcustomProtected Phases115656Permitted Phases565616156
Protected Phases         1         5         6         5         6           Permitted Phases         56         56         16         156
Permitted Phases 56 56 16 156
Actuated Green, G (s) 2/.0 65.5 27.0 65.5 40.0 16.5 52.0 40.0 16.5 110.0
Effective Green, g (s)27.065.527.065.540.016.543.540.016.5101.5
Actuated g/C Ratio         0.25         0.60         0.25         0.60         0.36         0.15         0.40         0.36         0.15         0.92
Clearance Time (s)         9.0         9.0         9.0         8.5         9.0         8.5
Vehicle Extension (s)         3.0
Lane Grp Cap (vph)         843         1660         843         943         1248         279         626         1248         279         1461
v/s Ratio Prot c0.22 0.10 c0.36 0.09 0.08 0.05
v/s Ratio Perm c0.49 0.12 0.14 0.62
v/c Ratio 0.90 0.82 0.41 0.21 0.98 0.60 0.36 0.21 0.32 0.67
Uniform Delay, d1         40.2         17.6         34.8         10.3         34.6         43.7         23.4         24.1         41.7         0.9
Progression Factor         1.00
Incremental Delay, d2 12.3 3.4 0.3 0.1 20.2 9.3 0.4 0.1 3.0 1.2
Delay (s) 52.5 21.0 35.2 10.4 54.8 53.0 23.8 24.2 44.7 2.1
Level of Service D C D B D D C C D A
Approach Delay (s)         31.7         26.1         46.6         9.3
Approach LOS C C D A
Intersection Summary
HCM Average Control Delay 30.9 HCM Level of Service C
HCM Volume to Capacity ratio 0.86
Actuated Cycle Length (s) 110.0 Sum of lost time (s) 18.0
Intersection Capacity Utilization 105.3% ICU Level of Service G
Analysis Period (min) 15

AM Peak Period 3: US 160 & Three Springs/US 550 Year 2030 Traffic Volumes Revised Alternative F Modified/Eastern Realignment Alternative2/2010

	٦	-	$\mathbf{i}$	4	+	•	1	1	1	1	ŧ	-
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ		11	ሻሻ		1	ሻሻ	•	1	ሻሻ	•	1
Volume (vph)	735	0	677	337	0	195	1180	135	560	145	60	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		6.0	5.0		6.0	6.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	0.97		0.88	0.97		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	774	0	713	355	0	205	1242	142	589	153	63	584
RTOR Reduction (vph)	0	0	183	0	0	16	0	0	327	0	0	0
Lane Group Flow (vph)	774	0	530	355	0	189	1242	142	262	153	63	584
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			156
Actuated Green, G (s)	27.0		52.0	27.0		52.0	33.0	13.0	46.0	33.0	13.0	90.0
Effective Green, g (s)	27.0		52.0	27.0		52.0	33.0	13.0	40.0	33.0	13.0	78.0
Actuated g/C Ratio	0.30		0.58	0.30		0.58	0.37	0.14	0.44	0.37	0.14	0.87
Clearance Time (s)	5.0			5.0			6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1030		1610	1030		915	1259	269	704	1259	269	1372
v/s Ratio Prot	c0.23			0.10			c0.36	c0.08		0.04	0.03	
v/s Ratio Perm			0.19			0.12			0.17			0.37
v/c Ratio	0.75		0.33	0.34		0.21	0.99	0.53	0.37	0.12	0.23	0.43
Uniform Delay, d1	28.5		9.9	24.6		9.1	28.3	35.7	16.6	18.9	34.1	1.3
Progression Factor	1.00		1.00	0.41		2.40	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.1		0.1	0.2		0.1	21.9	7.2	0.3	0.0	2.0	0.2
Delay (s)	31.6		10.0	10.2		21.9	50.2	42.9	17.0	18.9	36.1	1.5
Level of Service	С		В	В		С	D	D	В	В	D	A
Approach Delay (s)		21.3			14.5			39.8			7.5	
Approach LOS		С			В			D			А	
Intersection Summary												
HCM Average Control Dela	у		25.8	H	CM Leve	el of Servio	e		С			
HCM Volume to Capacity ra	ntio		0.82									
Actuated Cycle Length (s)			90.0	S	um of los	st time (s)			17.0			
Intersection Capacity Utiliza	ition		77.2%	IC	U Level	of Service	9		D			
Analysis Period (min)			15									
c Critical Lane Group												

PM Peak Period3: US 160 & Three Springs/US 550Year 2030 Traffic Volumes Revised Alternative F Modified/Eastern Realignment Alternative/2010

Movement         EBL         EBT         EBR         WBL         WBT         WBR         NBL         NBT         NBR         SBL         SBT         SBR           Lane Configurations         1         0         1         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0 <t< th=""></t<>
Lane Configurations         1         0         0         9         1         1         0         0         8         5         9         0         9         1         1         0         0         1         0         0         9         1         1         0         1         0         1         0         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1
Volume (yph)720014103300190116016046025085930Ideal Flow (vphpl)1900 <td< td=""></td<>
Ideal Flow (vphpl)19001
Total Lost time (s)9.09.09.09.09.08.59.09.08.59.0Lane Util. Factor0.970.880.971.000.971.001.000.971.001.00Frt1.000.851.000.851.000.851.001.000.851.001.00Satd. Flow (prot)3433278734331583343318631583343318631583Satd. Flow (prot)3433278734331583343318631583343318631583Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtcustomProtected Phases11565656Permitted Phases565656161
Lane Util. Factor0.970.880.971.000.971.001.000.971.001.00Frt1.000.851.000.851.000.851.001.000.851.000.85Flt Protected0.951.000.951.000.951.000.951.000.951.000.95Satd. Flow (prot)3433278734331583343318631583343318631583Flt Permitted0.951.000.951.000.951.000.951.001.000.951.00Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtcustomProtected Phases11565656Permitted Phases </td
Frt1.000.851.000.851.001.000.851.001.000.85Flt Protected0.951.000.951.000.951.000.951.001.000.951.001.00Satd. Flow (prot)3433278734331583343318631583343318631583Flt Permitted0.951.000.951.000.951.000.951.001.000.951.00Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950
Fit Protected0.951.000.951.000.951.001.000.951.001.00Satd. Flow (prot)3433278734331583343318631583343318631583Fit Permitted0.951.000.951.000.951.000.951.001.000.951.001.00Satd. Flow (perm)3433278734331583343318631583343318631583Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtected Phases115656Permitted Phases55561156
Satd. Flow (prot)3433278734331583343318631583343318631583Flt Permitted0.951.000.951.000.951.000.951.001.000.951.001.00Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.950.950.950.950.950.950.950.950.950.95Adj. Flow (vph)758014843470200122116848426389979RTOR Reduction (vph)0012100600260000Lane Group Flow (vph)758013633470194122116822426389979Turn TypeProtcustomProtcustomProtcustomProtcustomProtcustomProtected Phases1156561156Virited Phases56565616156156
Fit Permitted       0.95       1.00       0.95       1.00       0.95       1.00       1.00       0.95       1.00       1.00       0.95       1.00 </td
Satd. Flow (perm)3433278734331583343318631583343318631583Peak-hour factor, PHF0.950.
Peak-hour factor, PHF       0.95 <t< td=""></t<>
Adj. Flow (vph)       758       0       1484       347       0       200       1221       168       484       263       89       979         RTOR Reduction (vph)       0       0       121       0       0       6       0       0       260       0       0       0         Lane Group Flow (vph)       758       0       1363       347       0       194       1221       168       224       263       89       979         Turn Type       Prot       custom       Prot       custom       Prot       custom       Prot       custom       Prot       custom       Prot       custom       Prot       5       6       5       6         Permitted Phases       5       5       5       1       1       5       6       1       5       6
RTOR Reduction (vph)         0         0         121         0         0         6         0         0         260         0
Lane Group Flow (vph)         758         0         1363         347         0         194         1221         168         224         263         89         979           Turn Type         Prot         custom         Prot         custom
Turn TypeProtcustomProtcustomProtcustomProtected Phases115656Permitted Phases565616156
Protected Phases         1         5         6         5         6           Permitted Phases         56         56         16         156
Permitted Phases 56 56 16 156
Actuated Green, G (s) 2/.0 65.5 27.0 65.5 40.0 16.5 52.0 40.0 16.5 110.0
Effective Green, g (s)27.065.527.065.540.016.543.540.016.5101.5
Actuated g/C Ratio         0.25         0.60         0.25         0.60         0.36         0.15         0.40         0.36         0.15         0.92
Clearance Time (s)         9.0         9.0         9.0         8.5         9.0         8.5
Vehicle Extension (s)         3.0
Lane Grp Cap (vph)         843         1660         843         943         1248         279         626         1248         279         1461
v/s Ratio Prot c0.22 0.10 c0.36 0.09 0.08 0.05
v/s Ratio Perm c0.49 0.12 0.14 0.62
v/c Ratio 0.90 0.82 0.41 0.21 0.98 0.60 0.36 0.21 0.32 0.67
Uniform Delay, d1         40.2         17.6         34.8         10.3         34.6         43.7         23.4         24.1         41.7         0.9
Progression Factor         1.00
Incremental Delay, d2 12.3 3.4 0.3 0.1 20.2 9.3 0.4 0.1 3.0 1.2
Delay (s) 52.5 21.0 35.2 10.4 54.8 53.0 23.8 24.2 44.7 2.1
Level of Service D C D B D D C C D A
Approach Delay (s)         31.7         26.1         46.6         9.3
Approach LOS C C D A
Intersection Summary
HCM Average Control Delay 30.9 HCM Level of Service C
HCM Volume to Capacity ratio 0.86
Actuated Cycle Length (s) 110.0 Sum of lost time (s) 18.0
Intersection Capacity Utilization 105.3% ICU Level of Service G
Analysis Period (min) 15

AM Peak Period 3: US 160 & Three Springs/US 550 Year 2030 Traffic Volumes Revised Alternative F Modified/Eastern Realignment Alternative2/2010

	٦	-	$\mathbf{i}$	4	+	•	1	1	1	1	ŧ	-
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ካካ		11	ሻሻ		1	ሻሻ	•	1	ሻሻ	•	1
Volume (vph)	735	0	677	337	0	195	1180	135	560	145	60	555
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		6.0	5.0		6.0	6.0	6.0	5.0	6.0	6.0	5.0
Lane Util. Factor	0.97		0.88	0.97		1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433		2787	3433		1583	3433	1863	1583	3433	1863	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	774	0	713	355	0	205	1242	142	589	153	63	584
RTOR Reduction (vph)	0	0	183	0	0	16	0	0	327	0	0	0
Lane Group Flow (vph)	774	0	530	355	0	189	1242	142	262	153	63	584
Turn Type	Prot		custom	Prot		custom	Prot		custom	Prot		custom
Protected Phases	1			1			5	6		5	6	
Permitted Phases			56			56			16			156
Actuated Green, G (s)	27.0		52.0	27.0		52.0	33.0	13.0	46.0	33.0	13.0	90.0
Effective Green, g (s)	27.0		52.0	27.0		52.0	33.0	13.0	40.0	33.0	13.0	78.0
Actuated g/C Ratio	0.30		0.58	0.30		0.58	0.37	0.14	0.44	0.37	0.14	0.87
Clearance Time (s)	5.0			5.0			6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0			3.0			3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	1030		1610	1030		915	1259	269	704	1259	269	1372
v/s Ratio Prot	c0.23			0.10			c0.36	c0.08		0.04	0.03	
v/s Ratio Perm			0.19			0.12			0.17			0.37
v/c Ratio	0.75		0.33	0.34		0.21	0.99	0.53	0.37	0.12	0.23	0.43
Uniform Delay, d1	28.5		9.9	24.6		9.1	28.3	35.7	16.6	18.9	34.1	1.3
Progression Factor	1.00		1.00	0.41		2.40	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.1		0.1	0.2		0.1	21.9	7.2	0.3	0.0	2.0	0.2
Delay (s)	31.6		10.0	10.2		21.9	50.2	42.9	17.0	18.9	36.1	1.5
Level of Service	С		В	В		С	D	D	В	В	D	A
Approach Delay (s)		21.3			14.5			39.8			7.5	
Approach LOS		С			В			D			А	
Intersection Summary												
HCM Average Control Dela	у		25.8	H	CM Leve	el of Servio	e		С			
HCM Volume to Capacity ra	ntio		0.82									
Actuated Cycle Length (s)			90.0	S	um of los	st time (s)			17.0			
Intersection Capacity Utiliza	ition		77.2%	IC	U Level	of Service	9		D			
Analysis Period (min)			15									
c Critical Lane Group												

RAMPS AND RAMP JUNCTIONS WORKSHEET											
General	Informat	ion				Site Information					
Analyst2 Agency or C Date Perforn	ompany 1ed	SEH Inc. 1/5/2011			Fr Ju Ju	eeway/Dir on nction risdiction	of Trav	rel L C	IS 160 W Grandviev	/estbound w Ramp C	
Analysis Tim	e Period	AM Peak	<u> </u>		Ar	nalysis Year	r	Υ	'ear 2030	0 + 67% Inflati	on
Project Desc	ription Year	2030 Analysi	s for the U	S 550 at l	Js 160 Se	ection 4(f)					
inputs		Terrain Roll	ina							1	
Upstream Ac	lj Ramp		ing							Downstrea	m Adj Ramp
F Yes	Cn On									No	□ Off
Mo No	Cff Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft			<u> </u>						_	
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = ( <sub>R</sub> ,V <sub>f</sub> )	40.0 mph		Vd =	veh/h
Convers	sion to po	h Unde	' Base	Condi	tions						
(pc/h)	V (Veh/hr)	PHF	Terr	rain	Truck	%Rv	f	F HV	f <sub>p</sub>	v=V/PHF f <sub>ł</sub>	<sub>IV</sub> f <sub>p</sub>
Freeway	1940	0.95	Rolli	ng	5	0	0.9	930	1.00	2195	
Ramp	2312	0.95	Rolli	ng	2	0	0.9	971	1.00	2507	
UpStream			<u> </u>							_	
DownStream	11	Merge Area	s					Dive	erae Area	15	
Estimat	ion of V <sub>12</sub>		-			Estima	tion	of V <sub>12</sub>	<u> </u>		
	12 V - V (P )							12 V =	V + (V	- V )P	
= (Fai	vation 25-2 or 1	12	P			$I_{2} = (F_{0} = (F_{0} = 25.8 \text{ or } 25.9)$					
$E_{EQ} = 0.631$	usina Fauati	20-0) nn 1				$P_{rot} = using Equation$					
V = 1294	nc/h					$V_{rs} = nc/h$					
Canacit						Capacity Chacks					
Capacit			dimention		с го	Capaci		Actual	<u>Г</u>		
<u> </u>	ACIU	ai ivia.	amum	LUS	57?			Actual			LUSF?
V <sub>FO</sub>	4702	See Ex	hibit 25-7	N	0	v <sub>FI</sub> =v <sub>I</sub>	F		See E		
						V <sub>12</sub>			4	400:All	
V <sub>R12</sub>	3891	46	00:All	N	0	V <sub>FO</sub> = V <sub>F</sub> - V <sub>R</sub>			See E	xhibit 25-14	
						V <sub>R</sub>			See E	Exhibit 25-3	
Level of	Service	Determin	ation (	if not	F)	Level o	of Se	ervice De	eterm	ination (i	f not F)
D <sub>P</sub> =	5.475 + 0.007	34 v <sub>P</sub> + 0.00	78 V <sub>12</sub> - 0.0	00627 L <sub>A</sub>			D	) <sub>P</sub> = 4.252 +	0.0086 \	/ <sub>12</sub> - 0.009 L <sub>D</sub>	/
D <sub>P</sub> =	22.8 (pc/ m/ln)	)	12	л		D <sub>P</sub> =	(pc/ m/	/ln)		12 0	
LOS = C (Exhibit 25-4)						LOS=	、 (Exhibi	, it 25-4)			
Speed E	stimation	י <u>,</u> ו				Speed	Esti	mation			
		10)				D. =	(Fxhil	bit 25-19)			
$V_{S} = 0.0$	Emph (EXIDIL 25	- 17) NH DE 10)				$S_{p}=$	mph (I	Exhibit 25-10	))		
S <sub>R</sub> = 53	.5 mpn (Exhit	)IL 20-19)				-к S.=	mnh (	(Fyhihit 25.1	9)		
$S_0 = 58$	4 mph (Exhit	)11 25-19) 5# 25 14)				~0 C	mph (		<i>')</i>		
S= 54.4 mph (Exhibit 25-14)							mbu (I	EXMIDIT 25-15	))		

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Version 4.1f

		RAMF	'S AND	RAM	) JUN	CTIONS	S WC	RKSHE	ET			
General	Informat	ion				Site Information						
Analyst2 Agency or C Date Perforn	ompany 1ed	SEH Inc 1/5/2011			Fr Ju Ju	reeway/Dir of Travel unction urisdiction			IS 160 V Grandvie	Vestbound w Ramp C		
Analysis Tim	e Period	PM Peal	(	0 == 0	Ar	nalysis Year	r	Y	'ear 203	0 + 67% Inflati	on	
Project Desc	ription Year	2030 Analys	is for the U	S 550 at l	Js 160 Se	ection 4(f)						
inputs		Torrain Pol	lina									
Upstream Ac	lj Ramp		iing							Downstrea	m Adj Ramp	
F Yes	Cn On		Yes On									
Mo No	Cff Off									L <sub>down</sub> =	ft	
L <sub>up</sub> =	ft											
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	s, L <sub>A</sub> , L <sub>D</sub> ,V	$S_{FR} = (V_{FR})$	40.0 mph		VD =	veh/h	
Convers	sion to pa	/h Unde	r Base	Condi	tions	· A· D·	K P					
(nc/h)	V	рые	Tor	rain	Truck	%Dv	f	-	f	v–V/PHF f	f	
(pc/n)	(Veh/hr)					70KV		HV	'p	V= V/I III I	HV 'p	
Freeway	3440	0.95	Rolli	ing	5	0	0.9	930 971	1.00	3893		
UpStream	1773	0.75	IX0III	ing	2	0	0.7	//1	1.00	2141		
DownStream	n											
		Merge Area	S					Dive	erge Area	as		
Estimation of v <sub>12</sub>						Estima	ntion	of v <sub>12</sub>				
	١	$V_{12} = V_F (P_{FI})$	<sub>^</sub> )			$V_{12} = V_{R} + (V_{F} - V_{R})P_{FD}$						
L <sub>EQ</sub> = (Equ	uation 25-2 or 2	25-3)				L <sub>EQ</sub> = (Equation 25-8 or 25-9)						
P <sub>FM</sub> = 0.631	using Equation	on 1				P <sub>FD</sub> = using Equation						
V <sub>12</sub> = 2455	pc/h					$V_{12}^{-} = \text{pc/h}$						
Capacit	Checks					Capacity Checks						
	Actua	al Ma	ximum	LOS	S F?		Í	Actual	Maximum		LOS F?	
						V <sub>EI</sub> =V			See E	xhibit 25-14		
V <sub>FO</sub>	6034	See E	xhibit 25-7	N	0	V <sub>12</sub>			4	400:All		
V <sub>P12</sub>	4596	46	00:All	N	0	V <sub>FO</sub> = V <sub>F</sub> V <sub>P</sub>	-		See E	xhibit 25-14		
K1Z						V <sub>R</sub>			See I	Exhibit 25-3		
Level of	Service	Determir	nation (	if not	F)	Level o	of Se	ervice De	eterm	ination (i	f not F)	
D <sub>P</sub> =	5.475 + 0.007	34 v <sub>P</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L <sub>A</sub>		i	D	) <sub>P</sub> = 4.252 +	0.0086 \	V <sub>12</sub> - 0.009 L <sub>D</sub>	,	
D <sub>P</sub> =	28.4 (pc/ m/ln	)	12	л		D <sub>P</sub> =	(pc/ m/	/ln)		12 0		
LOS = D(Exhibit 25-4)						LOS=	۰ (Exhibi	, it 25-4)				
Speed E	stimation	י, ו				Speed	Esti	mation				
		10)				D. =	(Fxhil	bit 25-19)				
S = 0.3	0 mph (Evel	17) 17)				$S_{s} = mph (Exhibit 25.19)$						
$S_{R}^{-}$ 50		או ∠ט-דא) או טב דט				$\sim_{R^{-}}$ IIIpii (Exhibit 25-17) S = mph (Exhibit 25-10)						
S <sub>0</sub> = 56 S <sub>-</sub> 51	.o mpn (EXNI) 1 mph (Evbir	nt 25-19) ht 25-14)				S _	mnh /I	Evhihit 25-1	<i>·</i> )			
51.4 mph (Exhibit 25-14)							<b>S</b> = mpn (Exnitit 25-15)					

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Version 4.1f

		RAMF	S AND	RAM	) JUN	CTIONS	s wo	RKSHE	ET		
General Information							form	ation			
Analyst2 Agency or C Date Perforn	ompany ned	SEH Inc. F J 1/5/2011 J			Fr Ju Ju	reeway/Dir of Travel unction urisdiction			US 160 Westbound Grandview Ramp C		
Analysis Tim	e Period	PM Peal	(		Ar	nalysis Year	r	Y	/ear 2030	) +67% Inflatio	n+5cars
Project Desc	ription Year	2030 Analys	s for the U	S 550 at l	Js 160 Se	ection 4(f)					
inputs		Torrain Dol	ling								
Upstream Ac	lj Ramp	Terrain Rolling								Downstrea	m Adj Ramp
Tes Yes	Cn On										□ On
🔲 No	C Off									L <sub>down</sub> =	ft
L <sub>up</sub> =	ft										
Vu =	veh/h		S <sub>FF</sub> = 60	.0 mph Sketch ( :	show lane	es, L <sub>A</sub> , L <sub>D</sub> ,V	S <sub>FR</sub> = ' <sub>R'</sub> V <sub>f</sub> )	40.0 mph		Vd =	veh/h
Convers	ion to pc	h Unde	r Base	Condi	tions						
(pc/h)	V (Veh/hr)	PHF	Terr	rain	Truck	%Rv	f <sub>l</sub>	HV	f <sub>p</sub>	v=V/PHF f <sub>ł</sub>	IV <sup>f</sup> p
Freeway	3440	0.95	Rolli	ng	5	0	0.9	30	1.00	3893	
Ramp	1980	0.95	Rolli	ng	2	0	0.9	71	1.00	2147	
DownStream	0										
DownStream		Merge Area	S			Diverge Areas					
Estimat	ion of $v_{12}$					Estimation of v <sub>12</sub>					
	12	/ = V_ ( P	.)			$V_{12} = V_2 + (V_2 - V_2)P_{22}$					
I = (Fa	1ation 25-2 or 1	12 F V F 25-3)	۸×			$12 \cdot R \cdot VF \cdot R' FD$					
P = 0.631	using Equatio	±0.0) nn 1				$P_{ro} = using Equation$					
V = 2455	nc/h					$V_{10} = pc/h$					
Canacit	v Chocks					Capacity Checks					
Capach		Ma	vinum	1.09	2 52					ovimum	
	Actua		XIIIIUIII	num LO:		V -V		Actual		vhihit 25, 14	LUSF
V <sub>FO</sub>	6040	See E	See Exhibit 25-7 No		0	) $V_{FI} = V_F$					
Vara	4602	46	ΩΩ∙ΔΙΙ			$V_{FO} = V_F - V_P$			See Exhibit 25-14		
* R12	4002		00.7 11	163		V <sub>P</sub>			See Exhibit 25-3		
Level of	Service	Determir	nation (	if not	F)	Level	of Se	rvice D	eterm	ination (i	f not F)
$D_{p} =$	5.475 + 0.007	34 v <sub>D</sub> + 0.00	78 V <sub>12</sub> - 0.	00627 L	/		D	<sub>D</sub> = 4.252 +	0.0086 V	/ <sub>12</sub> - 0.009 L <sub>D</sub>	
$D_{\rm p} = 28.5 ({\rm pc/m/ln})$					$D_{\rm p} = (\rm pc/m/ln)$						
LOS = F(Exhibit 25-4)						LOS= (Exhibit 25-4)					
Speed Estimation					Speed Estimation						
						D = (Exhibit 25.19)					
$W_{\rm S} = -50.0$ mpb (Exhibit 25.10)						$S_{p}$ = mph (Exhibit 25-19)					
$S_{R}$ = 50.0 HIPH (EXHIBIT 25-14) S = 54.4 mph (Exhibit 25-10)						$S_{o} = mph$ (Exhibit 25-19)					
$S_0^{-}$ 50 $S_{-}$ 51	4 mph (EXMC	ni ∠o-19) hit 25-14)				S = mph (Exhibit 25-15)					
- 51.4 IIIpit (EATIIDIt 25-14)						<u> </u>	inhii (c		J)		

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Version 4.1f

# Final Safety Analysis for the US 550 at US 160 Section 4(f)

March 3, 2011

# STATE OF COLORADO

#### **DEPARTMENT OF TRANSPORTATION**

**TRAFFIC AND SAFETY UNIT REGION 5** 3803 N. Main Avenue, Suite 100 Durango, CO 81301 (907) 385-8360 Fax (970) 385-8361

March 3, 2011

Federal Highway Administration Attn: William Hansen, Operations Engineer (Region 5) 12300 W. Dakota Avenue Lakewood, CO 80228

RE: Safety Analysis for the US 550 at US 160 Section 4(f)

Mr. Hansen,

The intent of this memo is to update the accident data for the proposed connection of US 550 to US 160, that were originally evaluated in the US Highway 160 from Durango to Bayfield Final Environmental Impact Statement (US 160 FEIS). Several years have passed since the Record of Decision, a review of more recent accident statistics for these segments needed to be performed.

#### **US 160A from mile post 87.5 to 91.48**

In the US 160 FEIS, this segment of US 160 had an accident analysis performed for the period of December 31, 1996 to December 31, 2001. The accident data indicated that there were a total of 210 accidents with 145 being property damage only, 63 being injury accidents, and 2 fatal accidents.

By comparison, this segment of US 160 was analyzed for the more recent period of December 31, 2003 to December 31, 2008 (December 31, 2008 is the most recent accident information available in our database). The analysis of the accident data showed that during the more recent five-year history (2003 to 2008) the total number of accidents was higher at 249 total accidents, but the total of injury (32) and fatal (1) accidents declined.

The decline in the severity of the accidents can be attributed to recent improvements to US 160. US 160 was widened from a three lane roadway (one through lane west bound and two through lanes east bound) to a five lane section (two through lanes in both the east and westbound directions with a continuous center left turn lane). Also US 160 at Three Springs (CR 233) was recently improved with turn lanes and a signalized intersection. All of these improvements would help to reduce the potential for severe crashes. This is reflected in the fact that property damage only crashes increased while the injury and fatal crashes decreased in the most recent five year analysis.

The overall number of crashes has continued to increase in this segment of US 160; this is an indication that the roadway segment needs additional improvements to reduce accidents as traffic continues to increase. The average daily traffic from 2001 to 2008 increased from 20,775 vehicles per day to 26,257 vehicles per day, this is an increase in traffic of more than 26 percent. Likewise, the total number of accidents increased from 210 to 249, an 18 percent increase. The interim measures of developing a five



Safety Analysis for the US 550 at US 160 Section 4(f) March 3, 2011 Page 2 of 2

lane highway section and signal improvements has helped to reduce the severity of crashes but until the major left-turn movements are eliminated by the planned interchange improvements the number of rear end and broadside accidents will not decrease in this corridor. The original safety analysis from the FEIS and the analysis of this document support that the measures for safety improvement are still accurate and needed for this segment of US 160.

See the attached appendix for detailed accident summary information.

#### **US 550A from mile post 15.61 to 16.56**

In the US 160 FEIS, this segment of US 550 had an accident analysis performed for the period of December 31, 1996 to December 31, 2001. The accident data indicated that there were a total of 23 accidents with 16 being property damage only, 7 being injury accidents, and there were no fatal accidents.

By comparison, this segment of US 550 was analyzed for the more recent period of December 31, 2003 to December 31, 2008 (December 31, 2008 is the most recent accident information available in our database). The analysis of the accident data showed that during the more recent five-year history (2003 to 2008) the total number of accidents was higher at 28 total accidents, but the total of injury (6) accidents decreased by one accident and there were no fatal accidents. Overall there were no comparable differences in the accident statistics between the 2001 analysis and the 2008 analysis.

A comparison between the two data sets does show an increase in weather related accidents. In the 1996 to 2001 analysis the number of winter weather related accidents totaled 2 (icy). In the 2003 to 2008 analysis the number of winter weather related accidents increased to 11 accidents (wet, snowy, icy). A key component of the US 160 FEIS was to improve the overall safety of US 550 at Farmington Hill. This segment of US 550 is on a steep winding grade (6% or greater) with a northern exposure which sees very little sun light in the winter months. The 2008 accident analysis supports the original position of the US 160 FEIS that this segment of US 550 needs roadway safety improvements to reduce or eliminate the potential for weather related accidents. The need for safety improvements from the US 160 FEIS is still valid and needed based upon the more recent accident information.

See the attached appendix for detailed accident summary information.

Sincerely,

Michael D. Melang

Michael D. McVaugh Region 5 Traffic and Safety Engineer

Attach: Accident Appendix Cc: Kerrie Neet, Keith Powers, Ed Archuleta, Paul Jankowski, Lisa Schoch, Steven Cross Safety Analysis for the US 550 at US 160 Section 4(f)

**Accident Appendix** 

## US 550 at US 160 Section 4f Accident and Safety Analysis

### US 160A from Mile Post 87.50 to 91.48

Year	Property Damage Only	Injury	Fatal	Total
Dec. 1996 to Dec. 2001	145	63	2	210 <b>*</b>
Dec. 2003 to Dec. 2008	216	32	1	249
Significant Crash Types	1996 to 2001	2003 to 2008		
Rear End	106	107		
Sideswipe (Same)	16	22		
Approach Turn	12	24		
Head On	9	2		
Broadside	8	9		

### US 550A from Mile Post 15.61 to 16.56

Year	Property Damage Only	Injury	Fatal	Total
Dec. 1996 to Dec. 2001	16	7	0	23
Dec. 2003 to Dec. 2008	22	6	0	28
Significant Crash Types	1996 to 2001	2003 to 2008		
Rear End	6	4		
Sideswipe (Opposite)	4	4		
Overturning	4	5		
Overtaking Turn	1	0		
Broadside	1	0		
Sideswipe (Same)	1	1		

\* When running the analysis for 1996 to 2001, the total accidents did not correlate with the numbers from the FEIS (211 vs. 210). There may have been an error in the data collected that has since been corrected.

Colorado Department of TransportationMicrosoft Visual FoxPro 9 SP2 02/28/2011DR2447 FormatColorado Department of Transportation Safety and Traffic Engineering General Accident Summary ReportMicrosoft Visual FoxPro 9 SP2 02/28/2011DR2447 FormatSafety and Traffic Engineering General Accident Summary ReportJob #: 20110228141010									
Highway: 160A		Begin: 8	37.50 End: 91.48	From:12/31/1996 To:12/	31/2001				
Severity	N	umber of Vehicles _		Location					
PDO: 145 INJ: 63 104 FAT: 2 3 Total: 210	:Injured :Killed	One Ve Two Ve Three or Unk	ehicle:       37         hicles:       153         More:       20         anown:       0         Total:       210	On Road: Off Road: Unknown: <mark>Total:</mark>	190 20 0 <b>210</b>				
Accident Type									
Overturning: Other Non Collision: Pedestrians: Broadside: Head On: Rear End:	3 2 1 8 9 106	Sideswipe (Sam Sideswipe (Opposi Approach Tu Overtaking Tu Parked Motor Vehio Railway Vehio	ne): 16 te): 5 rrn: 12 rrn: 5 cle: 2 cle: 0	Bicycles: Domestic Animal: Wild Animal: Fixed Objects: Other Objects: Unknown: Total:	1 20 16 3 0 <b>210</b>				
Lighting Conditions	Main	line/Pamps/Frontage	Pde	Weather Conditions					
Daylight: Dawn or Dusk: Dark - Lighted: Dark - Unlighted: Unknown: <b>Total:</b>	159 6 6 37 2 210	M Frontage Intsx Frontage/I HOV Ur	lainline: 210 Ramps: 0 Roads: 0 Ramps: 0 Lanes: 0 known: 0 <b>Total: 210</b>	None: Rain: Snow/Sleet/Hail: Fog: Dust: Wind: Unknown:	190 6 12 0 0 0 2				
Vehicle Types	Vehicle	1 Vehicle 2 _	Vehicle 3	Total:	210				
Vehicle/Vehicle Combo (> 1 School Bus (All School E Non-School Bus (> 8) in Cor Trar Passenger C Passenger Car/Van w Pickup Truck/Utility Van w Pickup Truck/Utility Van w SUV w Moto SUV w Motorized Farm Equ Hit and Run - Un	0k Lbs): Busses): mmerce: hsit Bus: Car/Van: 12 //Trailer: Iity Van: //Trailer: SUV: 6 //Trailer: r Home: Bicycle: Bicycle: uipment: nknown: ght Rail: Other:	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0 15 0 1 0 1 0 4 0 0 0 0 0 0 0 0 0 0	Road Conditions         Dry:         Wet:         Muddy:         Snowy:         Icy:         Slushy:         Foreign Material:         With Road Treatment:         Unknown:         Total:         Accident Rates         PDO:       1.02 * * MVI         IN U:       0.44 *	178 15 0 2 9 2 0 1 3 <b>210</b> MT MVMT				
U	Other: nknown:	0 0 4 1	0	INJ: 0.44 * FAT: 1.40 ** <b>Total:</b>	1.47 *				
	Total: 2'	0 Total: 173	Total: 20						

Colorado Department of Transportation Safety and Traffic Engineering General Accident Summary ReportMicrosoft Visual FoxPro 9 SP2 02/28/2011DR2447 FormatColorado Department of Transportation Safety and Traffic Engineering Job #: 20110228141900									
Highway: 160A		E	Begin: 8	7.50	End: 91.48	From:12/31/2003 To:12	/31/2008		
Severity	Num	ber of Veh	icles			Location			
PDO: 216 INJ: 32 83:Injured FAT: 1 1:Killed Total: 249		T	One Ve Two Veh hree or I Unkr 1	hicle: icles: More: nown: <b>Total:</b>	71 158 20 0 <b>249</b>	On Road: Off Road: Unknown: <mark>Total:</mark>	228 21 0 <b>249</b>		
<mark>Accident Type</mark>	-								
Overturning: 5 Other Non Collision: 1 Pedestrians: 1 Broadside: 9 Head On: 2 Rear End: 107		Sideswipe ( Sideswipe ( Appr Overta Parked Mot Railwa	be (Same (Opposite oach Tur aking Tur or Vehicl ay Vehicl	e): e): n: e: e:	22 2 24 3 1 0	Bicycles: Domestic Animal: Wild Animal: Fixed Objects: Other Objects: Unknown: Total:	1 0 44 20 5 1 <b>249</b>		
Daylight: 174 Dawn or Dusk: 17 Dark - Lighted: 12 Dark - Unlighted: 43 Unknown: 3 Total: 249		Fi Intsx Fr	rontage F rontage F ontage/R HOV UnF	ainline: amps: Roads: amps: amps: Lanes: town: <b>Total:</b>	249 0 0 0 0 0 0 249	None: Rain: Snow/Sleet/Hail: Fog: Dust: Wind: Unknown:	223 6 16 0 0 1 3		
	Vehicle 1	Veh	icle 2	<u> </u>	Vehicle 3	Total:	249		
Vehicle/Vehicle Combo (> 10k Lbs): School Bus (All School Busses): Non-School Bus (> 8) in Commerce: Transit Bus: Passenger Car/Van: Passenger Car/Van w/Trailer: Pickup Truck/Utility Van: Pickup Truck/Utility Van w/Trailer: SUV: SUV w/Trailer: Motor Home: Bicycle: Motorized Bicycle: Farm Equipment: Hit and Run - Unknown: Light Rail: Other:	15 0 1 0 125 3 2 19 70 0 0 6 0 0 0 0 2 0		8 0 99 0 6 12 50 0 0 1 0 0 0		0 0 0 14 0 0 0 5 0 1 0 0 0 0 0 0	Road Conditions         Dry:         Wet:         Muddy:         Snowy:         Icy:         Slushy:         Foreign Material:         With Road Treatment:         Unknown:         Total:         Accident Rates         PDO:       1.26*         IN L:       0.19*	215 12 0 7 5 0 0 3 249 MVMT		
Other: Unknown:	0 4		0 1		0	FAT: 0.58** Total:	1.45 *		
Total	- 249	Total:	178	Total:	<b>20</b>				

Colorado Department of Transportation       Microsoft Visual FoxPro 9 SP2 02/28/2011         DR2447 Format       Colorado Department of Transportation         General Accident Summary Report       Job #: 20110228142322									
Highway: 550A		Begin: 1	5.61 End: 16.56	6 From:12/31/1996 To:12	31/2001				
Severity	Num	ber of Vehicles		Location					
PDO:         16           INJ:         7         9:Injure           FAT:         0         0:Killed           Total:         23	Ŀ	One Ve Two Ve Three or Unk	ehicle: 9 nicles: 12 More: 2 nown: 0 Total: 23	On Road: Off Road: Unknown: <mark>Total:</mark>	15 8 0 <b>23</b>				
Accident Type									
Overturning:4Other Non Collision:0Pedestrians:0Broadside:1Head On:0Rear End:6		Sideswipe (Sam Sideswipe (Opposit Approach Tu Overtaking Tu Parked Motor Vehic Railway Vehic	e): 1 e): 4 rn: 0 rn: 1 de: 0	Bicycles: Domestic Animal: Wild Animal: Fixed Objects: Other Objects: Unknown: Total:	0 0 4 2 0 <b>23</b>				
Lighting Conditions	<mark>Mainlin</mark>	e/Ramps/Frontage	Rds	Weather Conditions					
Daylight: 15 Dawn or Dusk: 1 Dark - Lighted: 1 Dark - Unlighted: 6 Unknown: 0 <b>Total: 23</b>		M F Frontage Intsx Frontage/F HOV Un	ainline:       23         Ramps:       0         Roads:       0         Ramps:       0         Lanes:       0         known:       0         Total:       23	None: Rain: Snow/Sleet/Hail: Fog: Dust: Wind: Unknown:	23 0 0 0 0 0 0				
_ Vehicle Types	Vehicle 1	Vehicle 2	Vehicle 3	Total:	23				
Vehicle/Vehicle Combo (> 10k Lbs School Bus (All School Busses Non-School Bus (> 8) in Commerc Transit Bu Passenger Car/Va Passenger Car/Van w/Traile Pickup Truck/Utility Va Pickup Truck/Utility Van w/Traile SU SUV w/Traile Motor Hom Bicycl Motorized Bicycl Farm Equipmer Hit and Run - Unknow Light Ra	i):       1         i):       0         e:       0         s:       0         n:       18         irr:       0         orr:       0         orr:       0         or:       0         oe:       0         oe:       0         oe:       0         oht:       0         or:       0         or:       0         or:       0	2 0 0 5 1 0 0 5 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Road Conditions         Dry:         Wet:         Muddy:         Snowy:         Icy:         Slushy:         Foreign Material:         With Road Treatment:         Unknown:         Total:         Accident Rates         PDO:       1.16*         INJ:       0.51*	21 0 0 2 0 0 0 0 23				
Tota	n. 2 II: 23	1 Total: 14	0 Total: 2		1.07				

Colorado Department of Transportation Safety and Traffic Engineering General Accident Summary Report Job #: 20110228142118									
Highway: 550A		Begin:	15.61	End: 16.56	From:12/31/2003 To:12	2/31/2008			
Severity	Num	ber of Vehicles			Location				
PDO: 22 INJ: 6 10:Injured FAT: 0 0:Killed Total: 28		One V Two V Three c Ur	/ehicle: ehicles: r More: known: <b>Total:</b>	18 8 2 0 <b>28</b>	On Road: Off Road: Unknown: <b>Total:</b>	13 15 0 <b>28</b>			
Accident Type									
Overturning:5Other Non Collision:1Pedestrians:0Broadside:0Head On:0Rear End:4		Sideswipe (Sa Sideswipe (Oppos Approach 1 Overtaking 1 Parked Motor Veh Railway Veh	me): site): Turn: Turn: iicle: iicle:	1 4 0 0 0 0	Bicycles Domestic Animal: Wild Animal: Fixed Objects: Other Objects: Unknown: <b>Total</b> :	0 0 3 9 1 0			
Lighting Conditions	Mainlin	e/Ramps/Frontag	e Rds		Weather Conditions				
Daylight: 15 Dawn or Dusk: 2 Dark - Lighted: 1 Dark - Unlighted: 10 Unknown: 0 <b>Total: 28</b>		Frontag Intsx Frontage HO L	Mainline Ramps e Roads /Ramps / Lanes Inknown	28 0 0 0 0 0 28	None: Rain: Snow/Sleet/Hail: Fog: Dust: Wind: Unknown:	21 1 6 0 0 0 0			
	/ehicle 1 _	Vehicle 2		Vehicle 3	Total:	28			
Vehicle/Vehicle Combo (> 10k Lbs): School Bus (All School Busses): Non-School Bus (> 8) in Commerce: Transit Bus: Passenger Car/Van: Passenger Car/Van w/Trailer: Pickup Truck/Utility Van w/Trailer: SUV: SUV w/Trailer: Motor Home: Bicycle: Motorized Bicycle: Farm Equipment: Hit and Run - Unknown: Light Rail: Other:	1 0 0 18 0 1 1 5 0 0 2 0 0 0 0 0 0 0 0 0 0 0			1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Road Conditions         Dry:         Wet:         Muddy:         Snowy:         Icy:         Slushy:         Foreign Material:         With Road Treatment:         Unknown:         Total:         Accident Rates         PDO:       1.52 *         INJ:       0.41 *	17 2 0 2 5 1 0 1 0 28 /MT 0 MVMT			
Unknown:	0	1		0	FAT: 0.00 ** Total:	<mark>1.93</mark> *			
Total:	28	Total: 10	Total	2	<u> </u>				