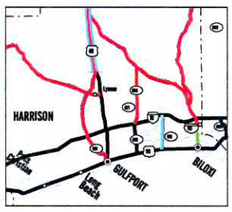
Appendix C

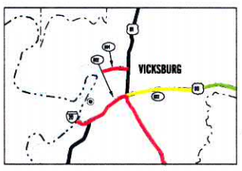
Vision 21 Map
and
Traffic Analysis

LOOKING A.H.E.A.D.

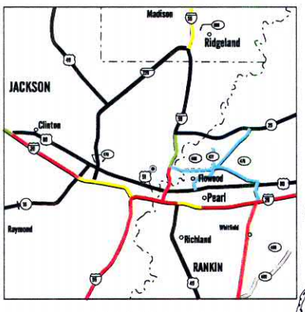
MDOT VISION 21



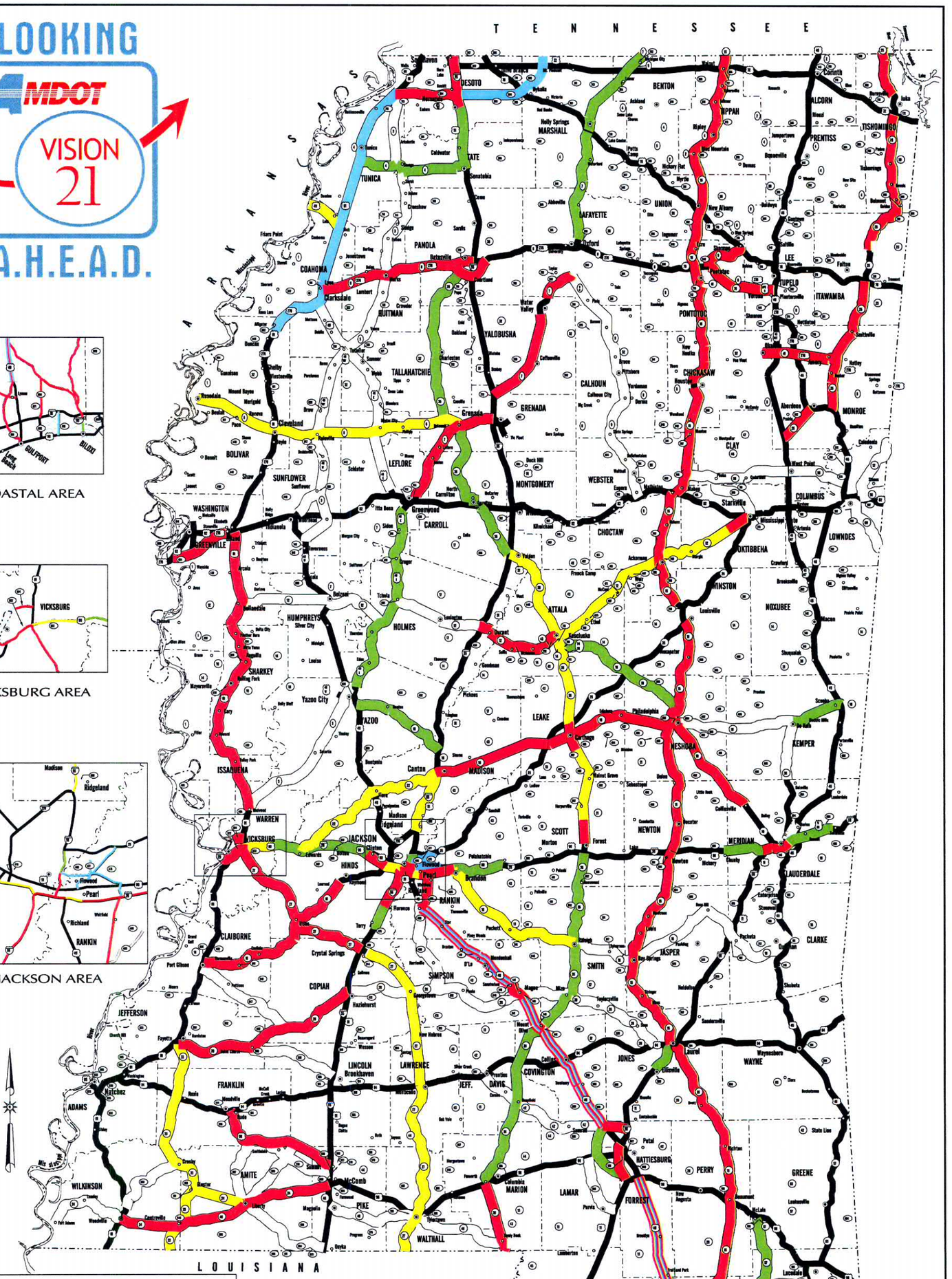
COASTAL AREA



VICKSBURG AREA



JACKSON AREA



LEGEND

- Committed
- Immediate
- Mid-range
- Long-range
- Passing Lanes
- Special Funding

The Special Funding Category consists of needs that are contingent upon obtaining additional Federal Funding.

- U.S. 49

As an immediate Need, US 49 will have 100 million of said improvements along the entire corridor. Special Funding will be required for Interstate Standards.

VISION 21

REGULAR SESSION
2002 LEGISLATURE

© 2002

MISSISSIPPI DEPARTMENT OF TRANSPORTATION
PLANNING DIVISION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

TRANSVERSE MERCATOR PROJECTION,
STATE PLANE COORDINATE SYSTEM 1983

SCALE IN MILES

Traffic Analysis
Interstate 20 Improvements

Vicksburg, Mississippi

December 14, 2011

Prepared for:

The Mississippi Department of Transportation

Prepared by:

NEEL-SCHAFFER

TABLE OF CONTENTS

Summary Table: I-20 Eastbound 1
Summary Table: I-20 Westbound 2
Summary Table: Collector Distributer Road 3
Traffic Analysis Reports: Existing (2007) Conditions 4
Traffic Analysis Reports: Alternate A (2040) No Build Conditions 43
Traffic Analysis Reports: Alternate B (2040) One way Frontage Roads 79
Traffic Analysis Reports: Alternate C (2040) Two-way Frontage Roads 116
Traffic Analysis Reports: Collector-Distributer Road for Alternates C and D 153

TABLE OF FIGURES

Figure 1 Interchange Ramp Spacing for Existing and No Build Conditions (1 of 3) 36
Figure 2 Interchange Ramp Spacing for Existing and No Build Conditions (2 of 3) 37
Figure 3 Interchange Ramp Spacing for Existing and No Build Conditions (3 of 3) 38
Figure 4 Existing (2007) Traffic Volumes (1 of 4) 39
Figure 5 Existing (2007) Traffic Volumes (2 of 4) 40
Figure 6 Existing (2007) Traffic Volumes (3 of 4) 41
Figure 7 Existing (2007) Traffic Volumes (4 of 4) 42
Figure 8 Alternate A (2040 No Build) Traffic Volumes (1 of 4) 75
Figure 9 Alternate A (2040 No Build) Traffic Volumes (2 of 4) 76
Figure 10 Alternate A (2040 No Build) Traffic Volumes (3 of 4) 77
Figure 11 Alternate A (2040 No Build) Traffic Volumes (4 of 4) 78
Figure 12 Interchange Ramp Spacing for Alternate B (1 of 3) 109
Figure 13 Interchange Ramp Spacing for Alternate B (2 of 3) 110
Figure 14 Interchange Ramp Spacing for Alternate B (3 of 3) 111
Figure 15 Alternate B (2040) Traffic Volumes (1 of 4) 112
Figure 16 Alternate B (2040) Traffic Volumes (2 of 4) 113
Figure 17 Alternate B (2040) Traffic Volumes (3 of 4) 114
Figure 18 Alternate B (2040) Traffic Volumes (4 of 4) 115
Figure 19 Interchange Ramp Spacing for Alternate C (1 of 3) 146
Figure 20 Interchange Ramp Spacing for Alternate C (2 of 3) 147
Figure 21 Interchange Ramp Spacing for Alternate C (3 of 3) 148
Figure 22 Alternate C (2040) Traffic Volumes (1 of 4) 149
Figure 23 Alternate C (2040) Traffic Volumes (2 of 4) 150
Figure 24 Alternate C (2040) Traffic Volumes (3 of 4) 151
Figure 25 Alternate C (2040) Traffic Volumes (4 of 4) 152
Figure 26 Collector-Distributer Road Ramp Spacing for Alternates B and C 162

Traffic Analysis: I-20 Eastbound

Location	Analysis	Existing		Alternate A (2040)		Alternate B (2040)		Alternate C (2040)	
		Density	LOS	Density	LOS	Density	LOS	Density	LOS
I-20 EB at MS River Bridge	Freeways	7.3	A	15.8	B	15.8	B	15.8	B
I-20 EB at Washington Ave off ramp	Diverge	6.1	A	15.6	B	15.6	B	15.6	B
I-20 EB from Washington Ave to US 61 South	Weave	7.1	A	14.5	B	14.5	B	14.5	B
I-20 EB from US 61 South to Halls Ferry Rd	Weave	12.3	B	34.0	D	18.9	B	18.9	B
I-20 EB at Halls Ferry Rd on ramp	Merge	17.2	B	33.3	D	24.3	C	22.2	C
I-20 EB from Halls Ferry Rd to Indiana Ave	Freeways	15.4	B	33.2	D	22.1	C	20.8	C
I-20 EB at Indiana Ave off ramp	Diverge	19.2	B	36.9	E	33.4	D	28.8	D
I-20 EB at Indiana Ave on ramp	Merge	18.7	B	35.8	E				
I-20 EB at Indiana Ave on ramp	Merge with 1 Added Lane (Capacity Check)					Ramp at 16% Capacity Downstream I-20 at 42% Capacity		Ramp at 40% Capacity Downstream I-20 at 48% Capacity	
I-20 EB from Indiana Ave to Clay St	Freeways	17.9	B	40.7	E				
I-20 EB from Indiana Ave to C-D Road Off Ramp	Freeways					16.0	B	18.0+	C
I-20 EB at EB Clay St off ramp	Diverge	22.5	C	41.3	E				
I-20 EB at C-D Road Off Ramp	Major Diverge					10.9	B	12.3	B
I-20 EB between Off and On Ramps for C-D Road	Freeways					11.7	B	12.0	B
I-20 EB at WB Clay St off loop	Diverge	18.8	B	36.8	E				
I-20 EB from Clay St on ramp to US 61 N ramps	Weave	13.5	B	28.7	D				
I-20 EB at US 61 North SB on loop	Merge	14.2	B	24.6	C				
I-20 EB at US 61 North NB on ramp	Merge	13.1	B	24.5	C				
I-20 EB at C-D Road On Ramp	Merge					16.8	B	16.9	B
I-20 EB east of US 61 North	Freeways	10.7	A	21.9	C	21.9	C	21.9	C

Traffic Analysis: I-20 Westbound

Location	Analysis	Existing		Alternate A (2040) No Build		Alternate B (2040) One-way Frontage Roads		Alternate C (2040) Two-way Frontage Roads	
		Density	LOS	Density	LOS	Density	LOS	Density	LOS
I-20 WB east of US 61 North	Freeways	10.4	A	21.3	C	21.3	C	21.3	C
I-20 WB at C-D Road off ramp	Major Diverge					10.1	B	10.1	B
I-20 WB between off and on ramps for C-D Road	Freeways					11.1	B	11.1	B
I-20 WB off ramp to US 61 North NB	Diverge	13.8	B	26.0	C				
I-20 WB at US 61 North SB off ramp	Diverge	9.3	A	19.2	B				
I-20 WB at US 61 North on ramp	Merge	15.7	B	29.0	D				
I-20 WB between US 61 North to Clay St	Freeways	13.3	B	27.0	D				
I-20 WB at Clay St off ramp	Diverge	16.8	B	32.1	D				
I-20 WB at WB Clay St on loop	Merge	16.0	B	29.4	D				
I-20 WB at EB Clay St on ramp	Merge	17.9	B	31.7	D				
I-20 WB at C-D Road on ramp	Merge with 2 Added Lanes (Capacity Check)					Ramp at 47% Capacity Downstream I-20 at 48% Capacity		Ramp at 55% Capacity Downstream I-20 at 54% Capacity	
I-20 WB - Btwn Clay St to Indiana Ave	Freeways	14.4	B	28.7	D				
I-20 WB from C-D Road on ramp to Indiana Ave	Freeways					17.5	B	19.3	C
I-20 WB off ramp to Indiana Ave.	Diverge	19.1	B	34.3	D	24.7	C	27.8	C
I-20 WB at Indiana Ave on ramp	Merge	16.8	B	30.5	D	18.9	B	17.3	B
I-20 WB between Indiana Ave and Halls Ferry Rd	Freeways	14.3	B	28.3	D	19.2	C	18.6	C
I-20 WB at Halls Ferry Rd off ramp	Diverge	15.8	B	30.9	D	25.5	C	23.3	C
I-20 WB from Halls Ferry Rd to US 61 South	Weave	11.4	B	26.4	C	15.4	B	15.4	B
I-20 WB from US 61 South to Washington Ave	Weave	13.1	B	29.9	D				
I-20 WB at US 61 South on ramp	Merge with 1 Added Lane (Capacity Check)					Ramp at 13% Capacity Downstream I-20 at 24% Capacity		Ramp at 13% Capacity Downstream I-20 at 24% Capacity	
I-20 WB between US 61 South and Washington Ave	Freeways (4-lane Segment)					8.6	A	8.6	A
I-20 WB between US 61 South and Washington Ave	Freeways (3-lane Segment)					11.5	B	11.5	B
I-20 WB at Washington Ave off ramp	Diverge with 1 Dropped Lane (Capacity Check)					Ramp at 24% Capacity		Ramp at 24% Capacity	
I-20 WB at Washington Ave on ramp	Merge	9.2	A	16.7	B	16.4	B	16.4	B
I-20 WB at MS River Bridge	Freeways	7.9	A	15.3	B	15.3	B	15.3	B

Traffic Analysis: Collector-Distributer Road Eastbound

Location	Analysis	Existing		Alternate A (2040) No Build		Alternates B and C (2040)	
		Density	LOS	Density	LOS	Density	LOS
C-D Road EB at Clay St off ramp	Diverge					27.6	C
C-D Road EB from Clay St to US61 North	Weave					13.6	B
C-D Road EB at US 61 North Northbound off ramp	Major Diverge					9.1	A
C-D Road EB at US 61 North on ramp	Merge					8.9	A

Traffic Analysis: Collector-Distributer Road Westbound

Location	Analysis	Existing		Alternate A (2040) No Build		Alternates B and C (2040)	
		Density	LOS	Density	LOS	Density	LOS
C-D Road WB east of US 61 North/SR 27 off ramp	Single Lane Capacity Check					Single-lane at 59% Capacity	
C-D Road WB - Off ramp from C-D to US 61/SR 27	Single Lane Capacity Check					Ramp at 34% Capacity	
C-D Road WB from US 61 North to Clay St	Weave					17.0	B
C-D Road WB from Clay St to N. Frontage Rd	Weave					16.4	B

Traffic Analysis Reports:
Existing Conditions

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	760	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	211	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	473	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	473	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	7.3	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 EB at Washington Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	760	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	102	vph
Length of first accel/decel lane	700	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	760		102			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	211		28			v
Trucks and buses	24		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.893		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	946		114			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 946 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	946	4700	No
$v_{FO} = v_F - v_R$	832	4700	No
v_R	114	1900	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	946	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 6.1 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	D_S = 0.568	
Space mean speed in ramp influence area,	S_R = 51.9	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 51.9	mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 EB
Weaving Location:	Washington Ave to US 61 South
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB from Washington Ave to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1500	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	
Volume ratio, VR	0.38	
Weaving ratio, R	0.20	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	575	70	83	346	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	160	19	23	96	v
Trucks and buses	25	1	15	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.995	0.930	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	718	78	99	388	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.29	0.15
Weaving and non-weaving speeds, Si	57.59	62.73

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.25
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	60.68	mph
Weaving segment density, D	7.05	pc/mi/ln
Level of service, LOS	A	
Capacity of base condition, cb	5970	pc/h
Capacity as a 15-minute flow rate, c	5307	pc/h
Capacity as a full-hour volume, ch	4776	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	487	4000	a
Average flow rate (pcphpl)	427	2350	b
Volume ratio, VR	0.38	0.80	c
Weaving ratio, R	0.20	N/A	d
Weaving length (ft)	1500	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 EB
Weaving Location:	US 61 South to Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 EB from US 61 South to Halls Ferry Rd

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1400	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	A	
Volume ratio, VR	0.45	
Weaving ratio, R	0.21	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	750	133	171	587	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	208	37	48	163	v
Trucks and buses	25	2	2	15	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.990	0.990	0.930	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	937	149	191	701	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.15	0.0035
b (Exhibit 24-6)	2.20	4.00
c (Exhibit 24-6)	0.97	1.30
d (Exhibit 24-6)	0.80	0.75
Weaving intensity factor, Wi	0.56	0.31
Weaving and non-weaving speeds, Si	50.22	56.88

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.38
Maximum number of lanes, Nw (max) (Exhibit 24-7)	1.40
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	53.67	mph
Weaving segment density, D	12.28	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	4800	pc/h
Capacity as a 15-minute flow rate, c	4267	pc/h
Capacity as a full-hour volume, ch	3840	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	892	2800	a
Average flow rate (pcphpl)	659	2350	b
Volume ratio, VR	0.45	0.45	c
Weaving ratio, R	0.21	N/A	d
Weaving length (ft)	1400	2500	e

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.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB at Halls Ferry Rd on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1337	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	326	vph
Length of first accel/decel lane	600	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1337	326		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	371	91		v
Trucks and buses	21	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.905	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1642	366		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1642 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2008	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1642	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.2 pc/mi/ln

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

Speed Estimation

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

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Halls Ferry Rd to Indiana Ave
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB from Halls Ferry Rd to Indiana Ave

Flow Inputs and Adjustments

Volume, V	1663	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	462	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1002	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1002	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.4	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB at Indiana Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1663	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	108	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1663		108			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	462		30			v
Trucks and buses	17		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.922		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	2005		121			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2005 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2005	4700	No
$v_{FO} = v_F - v_R$	1884	4700	No
v_R	121	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2005	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 19.2 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.439

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

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

Space mean speed for all vehicles, S = 54.9 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB at Indiana Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1555	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	394	vph
Length of first accel/decel lane	750	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1555	394		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v_{15}	432	109		v
Trucks and buses	18	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, E_T	1.5	1.5		
Recreational vehicle PCE, E_R	1.2	1.2		
Heavy vehicle adjustment, f_{HV}	0.917	0.990		
Driver population factor, f_P	1.00	1.00		
Flow rate, v_p	1883	442		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1883 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2325	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1883	4400	No

!

Level of Service Determination (if not F)

Density, D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 18.7 pc/mi/ln

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

Speed Estimation

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

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Indiana Ave to Clay St
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB from Indiana Ave to Clay St

Flow Inputs and Adjustments

Volume, V	1949	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	541	v
Trucks and buses	15	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1164	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1164	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	17.9	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 EB at EB Clay St off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1949	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	383	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1949		383			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	541		106			v
Trucks and buses	15		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.930		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	2328		430			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2328 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2328	4700	No
$v_{FO} = v_F - v_R$	1898	4700	No
v_R	430	2000	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2328	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 22.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.467

Space mean speed in ramp influence area, S_R = 54.3 mph

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

Space mean speed for all vehicles, S = 54.3 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 EB at WB Clay St off loop

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1566	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	84	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1566		84			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	435		23			v
Trucks and buses	18		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.917		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	1897		94			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1897 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1897	4700	No
$v_{FO} = v_F - v_R$	1803	4700	No
v_R	94	1900	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1897	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 18.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.566

Space mean speed in ramp influence area, S_R = 52.0 mph

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

Space mean speed for all vehicles, S = 52.0 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB at US 61 North SB on loop

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	883	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	152	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	883	152		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	245	42		v
Trucks and buses	25	16		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.889	0.926		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1104	182		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1104 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1286	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1104	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 14.2 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.325	
Space mean speed in ramp influence area,	S_R = 57.5	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 57.5	mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB at US 61 North NB on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1035	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	83	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1035	83		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	288	23		v
Trucks and buses	25	10		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.889	0.952		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1294	97		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1294 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1391	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1294	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 13.1 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.302	
Space mean speed in ramp influence area,	S_R = 58.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 58.1	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2007

Description: I-20 EB east of US 61 North

Flow Inputs and Adjustments

Volume, V	1118	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	311	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	696	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	696	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	10.7	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Mark Sorrell
Neel-Schaffer Inc

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB east of US 61 North

Flow Inputs and Adjustments

Volume, V	1087	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	302	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	676	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	676	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	10.4	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB off ramp to US 61 North NB

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1087	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	200	vph
Length of first accel/decel lane	230	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	72	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	750	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1087		200		72		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	302		56		20		v
Trucks and buses	24		18		3		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.893		0.917		0.985		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	1353		242		81		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 1353 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1353	4700	No
$v_{FO} = v_F - v_R$	1111	4700	No
v_R	242	2000	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1353	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 13.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.450

Space mean speed in ramp influence area, S_R = 54.7 mph

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

Space mean speed for all vehicles, S = 54.7 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 WB at US 61 North SB off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	887	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	72	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	200	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	750	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	887		72		200		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	246		20		56		v
Trucks and buses	25		3		18		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.889		0.985		0.917		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	1109		81		242		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 1109 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1109	4700	No
$v_{FO} = v - v_R$	1028	4700	No
v_R	81	1900	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1109	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 9.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.565

Space mean speed in ramp influence area, S_R = 52.0 mph

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

Space mean speed for all vehicles, S = 52.0 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date performed:	1/26/2010
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB at US 61 North on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	815	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	609	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	72	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1100	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	815	609	72	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	226	169	20	v
Trucks and buses	25	6	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.971	0.985	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1019	697	81	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1019 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1716	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1019	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.311	
Space mean speed in ramp influence area,	S_R = 57.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.8	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer, Inc.
Date Performed:	1/26/2010
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Btwn US 61 North and Clay St
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB from US 61 North to Clay Street

Flow Inputs and Adjustments

Volume, V	1424	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	396	v
Trucks and buses	18	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.917	
Driver population factor, fp	1.00	
Flow rate, vp	862	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	862	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	13.3	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date performed:	1/26/2010
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Clay Street
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 WB at Clay St off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1424	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	252	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	273	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1424		252		273		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	396		70		76		v
Trucks and buses	18		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.917		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	1725		283		306		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1725 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1725	4700	No
$v_{FO} = v_F - v_R$	1442	4700	No
v_R	283	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1725	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 16.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.453

Space mean speed in ramp influence area, S_R = 54.6 mph

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

Space mean speed for all vehicles, S = 54.6 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB at WB Clay St on loop

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1172	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	273	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	252	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1172	273	252	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	326	76	70	v
Trucks and buses	18	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.917	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1419	306	283	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1419 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1725	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1419	4400	No

!

Level of Service Determination (if not F)

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

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

Speed Estimation

Intermediate speed variable,	M_S = 0.320
Space mean speed in ramp influence area,	S_R = 57.6 mph
Space mean speed in outer lanes,	S_O = N/A mph
Space mean speed for all vehicles,	S = 57.6 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 WB at EB Clay St on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1445	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	113	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	273	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	1250	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1445	113	273	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	401	31	76	v
Trucks and buses	18	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.917	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1750	127	306	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1750 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1877	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1750	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.9 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.322
Space mean speed in ramp influence area,	S_R = 57.6 mph
Space mean speed in outer lanes,	S_O = N/A mph
Space mean speed for all vehicles,	S = 57.6 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Btwn Clay St and Indiana Ave
Jurisdiction:	
Analysis Year:	2007
Description: I-20 WB -	Btwn Clay St to Indiana Ave

Flow Inputs and Adjustments

Volume, V	1558	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	433	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	939	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	939	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	14.4	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB off ramp to Indiana Ave.

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1558	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	185	vph
Length of first accel/decel lane	150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1558		185			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	433		51			v
Trucks and buses	17		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.922		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	1878		208			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1878 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1878	4700	No
$v_{FO} = v_F - v_R$	1670	4700	No
v_R	208	2000	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1878	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 19.1 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.447

Space mean speed in ramp influence area, S_R = 54.7 mph

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

Space mean speed for all vehicles, S = 54.7 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB at Indian Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1373	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	174	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1373	174		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	381	48		v
Trucks and buses	19	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.913	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1670	195		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1670 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1865	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1670	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.311	
Space mean speed in ramp influence area,	S_R = 57.8	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 57.8	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Indiana Ave to Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB between Indiana Ave and Halls Ferry Rd

Flow Inputs and Adjustments

Volume, V	1547	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	430	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	932	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	932	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	14.3	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB at Halls Ferry Rd off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1547	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	346	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1547		346			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	430		96			v
Trucks and buses	17		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.922		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	1865		388			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1865 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1865	4700	No
$v_{FO} = v_F - v_R$	1477	4700	No
v_R	388	2000	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1865	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 15.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.463

Space mean speed in ramp influence area, S_R = 54.4 mph

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

Space mean speed for all vehicles, S = 54.4 mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 WB
Weaving Location:	Halls Ferry Rd to US 61 South
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB from Halls Ferry Rd to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1200	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	C	
Volume ratio, VR	0.57	
Weaving ratio, R	0.12	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	158	496	112	705	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	44	138	31	196	v
Trucks and buses	2	13	2	25	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.939	0.990	0.889	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	177	586	125	881	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.30	6.00
c (Exhibit 24-6)	0.80	1.10
d (Exhibit 24-6)	0.60	0.60
Weaving intensity factor, Wi	0.53	0.47
Weaving and non-weaving speeds, Si	51.02	52.35

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.95
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.00
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	51.59	mph
Weaving segment density, D	11.43	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	5202	pc/h
Capacity as a 15-minute flow rate, c	5150	pc/h
Capacity as a full-hour volume, ch	4635	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1006	3500	a
Average flow rate (pcphpl)	589	2350	b
Volume ratio, VR	0.57	0.50	c
Weaving ratio, R	0.12	0.40	d
Weaving length (ft)	1200	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 WB
Weaving Location:	US 61 South to Washington Ave
Jurisdiction:	
Analysis Year:	2007
Description:	I-20 WB from US 61 South to Washington Ave

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	2	
Weaving segment length, L	1000	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	C	
Volume ratio, VR	0.75	
Weaving ratio, R	0.10	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	224	42	639	77	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	62	12	178	21	v
Trucks and buses	1	10	25	1	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.995	0.952	0.889	0.995	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	250	49	798	85	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.30	6.00
c (Exhibit 24-6)	0.80	1.10
d (Exhibit 24-6)	0.60	0.60
Weaving intensity factor, Wi	0.75	1.01
Weaving and non-weaving speeds, Si	46.35	42.39

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.41
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.00
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	45.28	mph
Weaving segment density, D	13.05	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb		pc/h
Capacity as a 15-minute flow rate, c		pc/h
Capacity as a full-hour volume, ch		pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	883	3500	a
Average flow rate (pcphpl)	591	2350	b
Volume ratio, VR	0.75	0.50	c
Weaving ratio, R	0.10	0.40	d
Weaving length (ft)	1000	2500	e

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.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB at Washington Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	681	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	143	vph
Length of first accel/decel lane	650	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	681	143		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	189	40		v
Trucks and buses	25	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.889	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	851	160		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 851 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1011	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	851	4400	No

!

Level of Service Determination (if not F)

Density, D_R = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A = 9.2 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.299	
Space mean speed in ramp influence area,	S_R = 58.1	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 58.1	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2007

Description: I-20 WB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	824	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	229	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	513	pc/h/ln

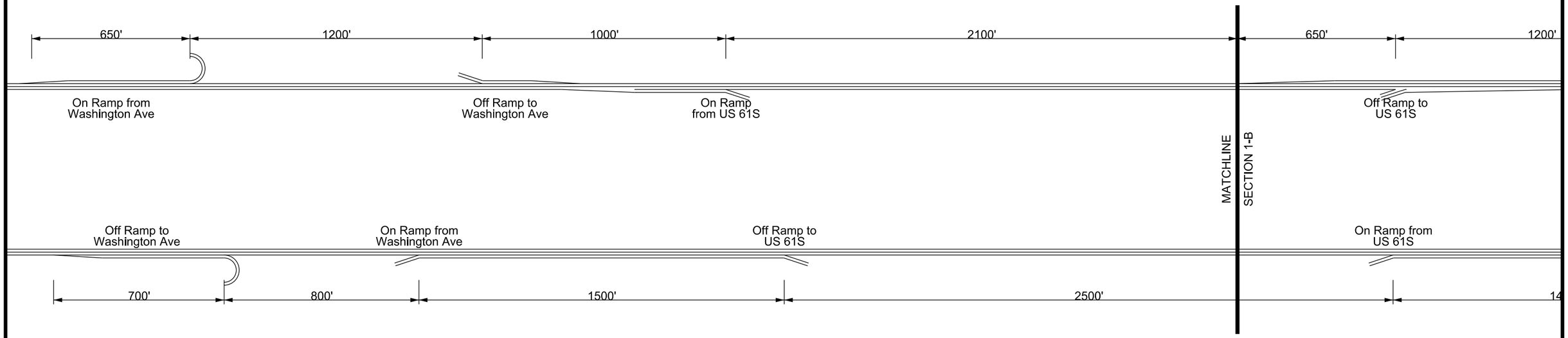
Speed Inputs and Adjustments

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	65.0	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	65.0	mi/h
	Urban Freeway	

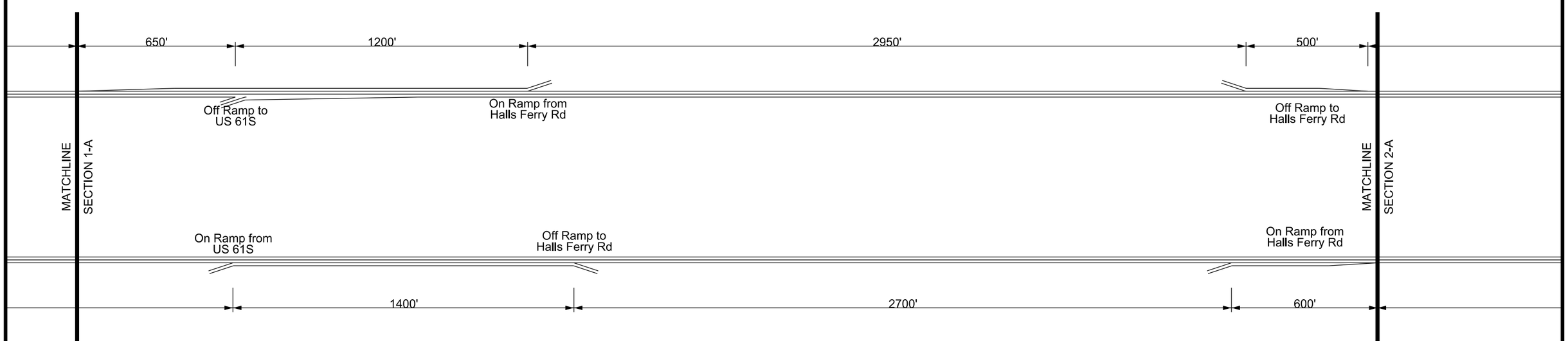
LOS and Performance Measures

Flow rate, vp	513	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	7.9	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.



SECTION 1-A



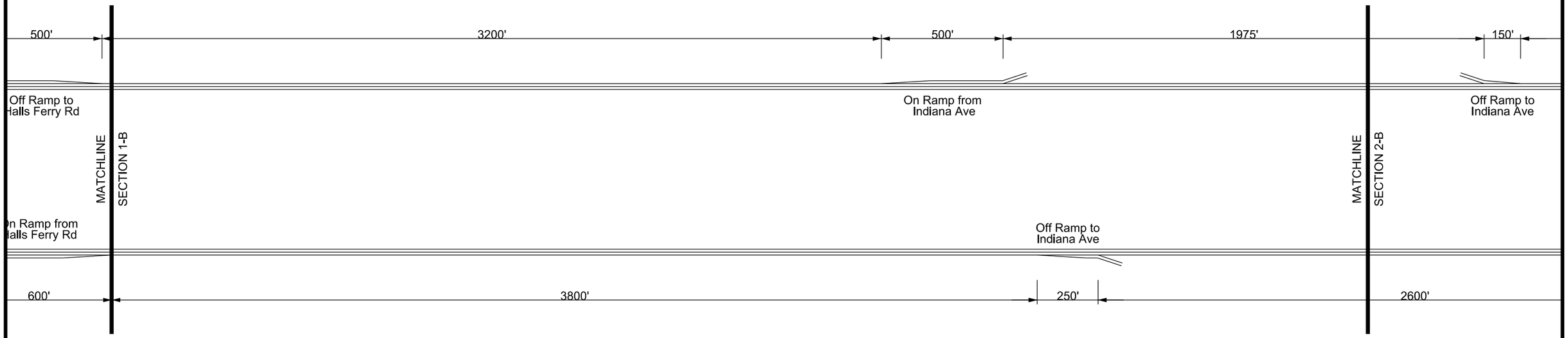
SECTION 1-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

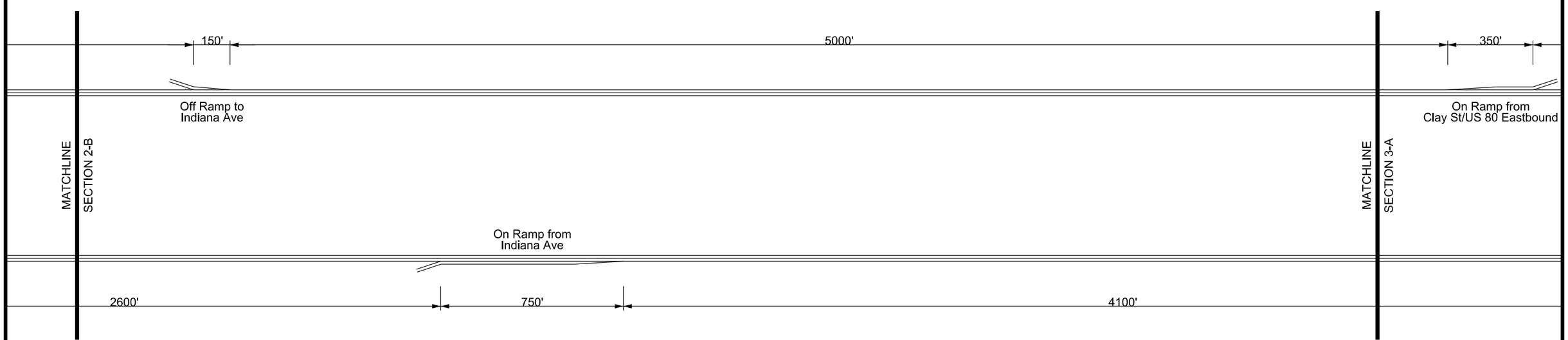
NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR EXISTING AND NO BUILD CONDITIONS
INTERSTATE 20, VICKSBURG, MS

FIGURE
1



SECTION 2-A



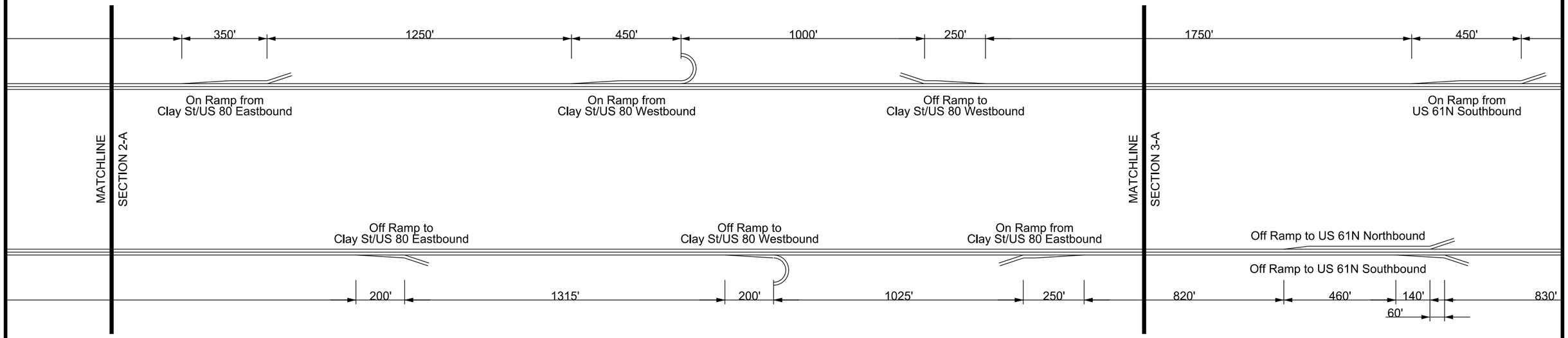
SECTION 2-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

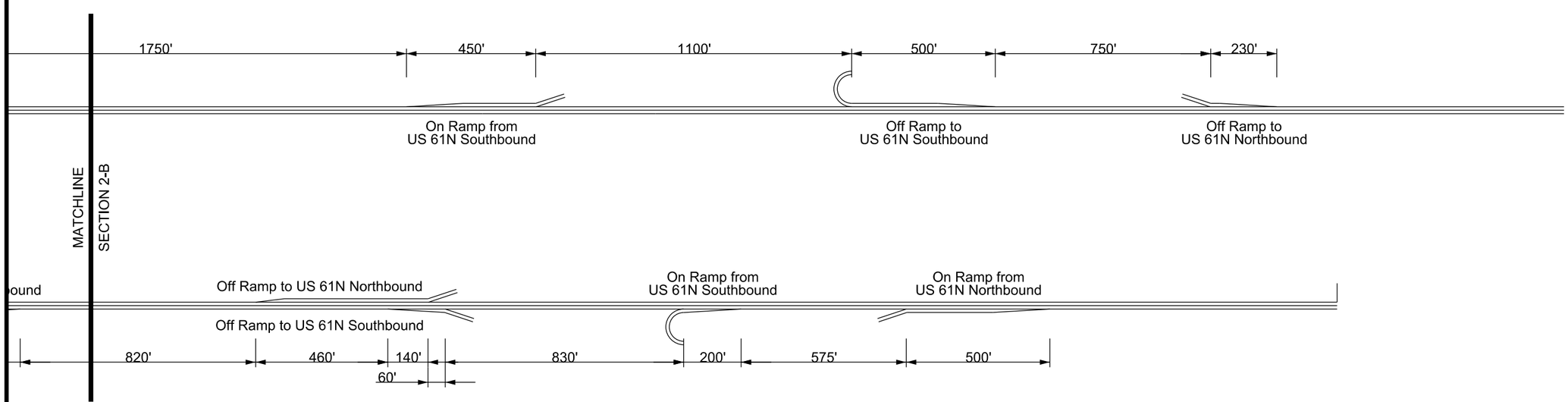
NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR EXISTING AND NO BUILD CONDITIONS
INTERSTATE 20, VICKSBURG, MS

FIGURE
2



SECTION 3-A



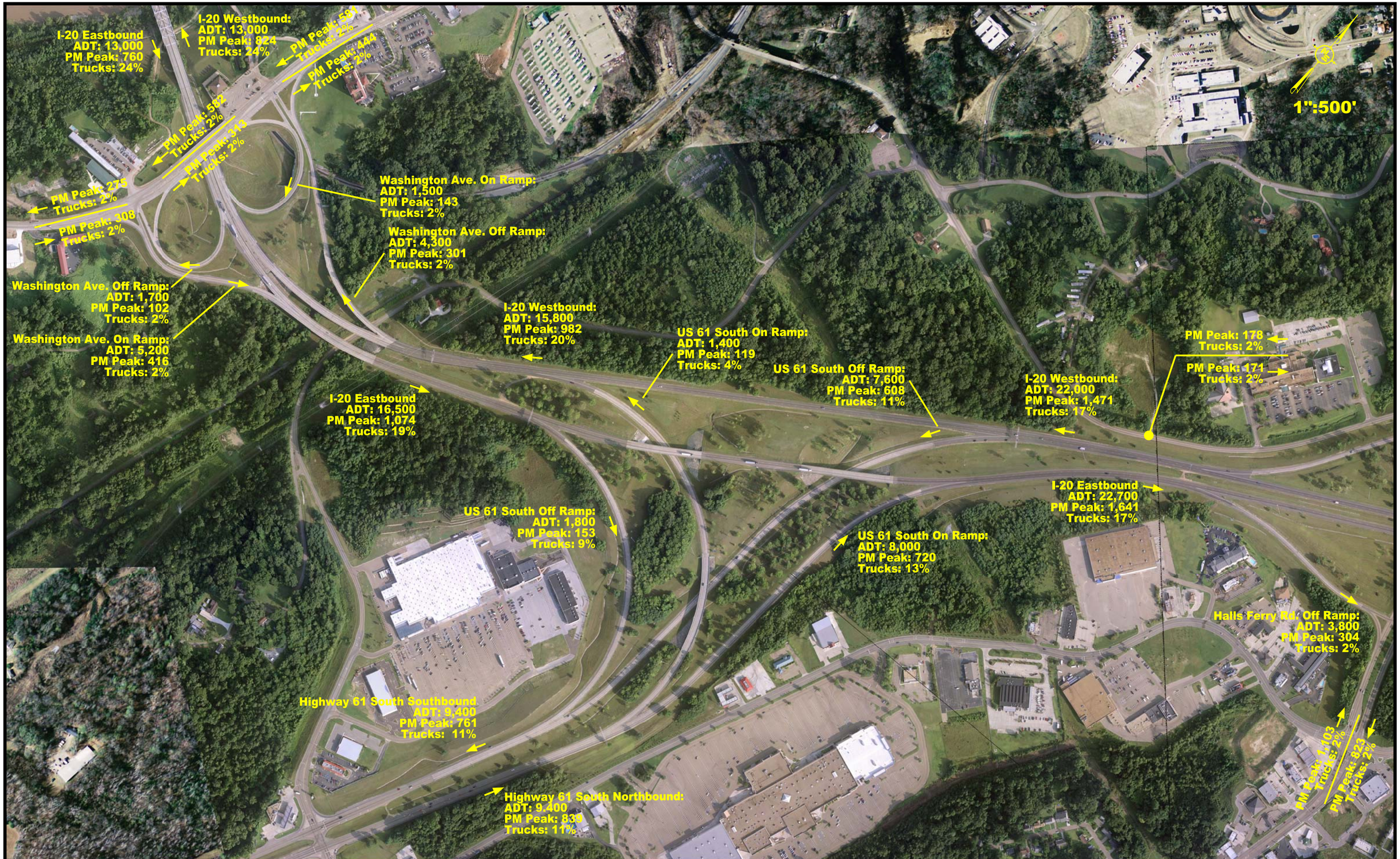
SECTION 3-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR EXISTING AND NO BUILD CONDITIONS
INTERSTATE 20, VICKSBURG, MS

FIGURE
3



NEEL-SCHAFFER
Solutions you can build upon

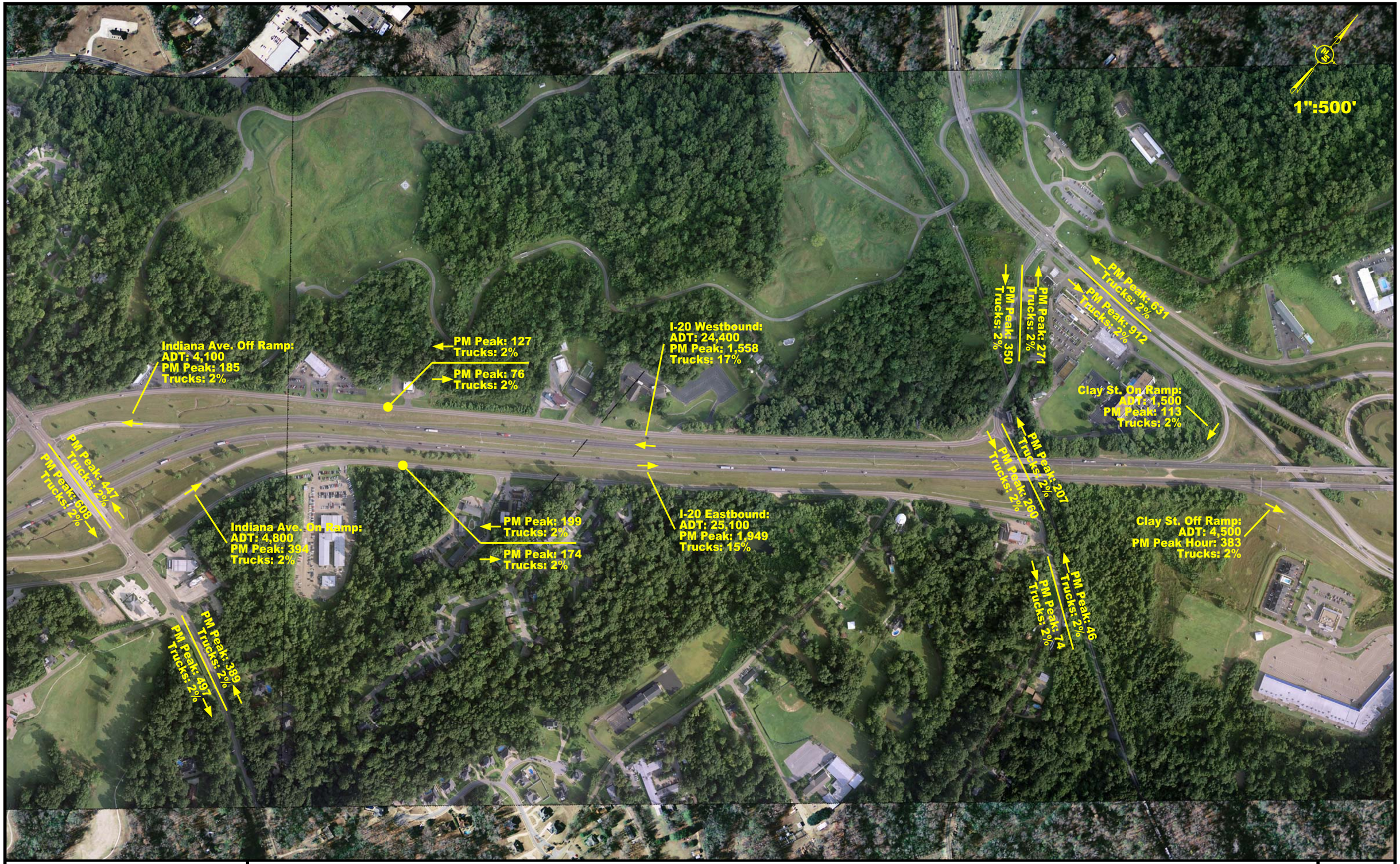
EXISTING TRAFFIC VOLUMES (2007)

FIGURE
4

NEEL-SCHAFFER
Solutions you can build upon

EXISTING TRAFFIC VOLUMES (2007)

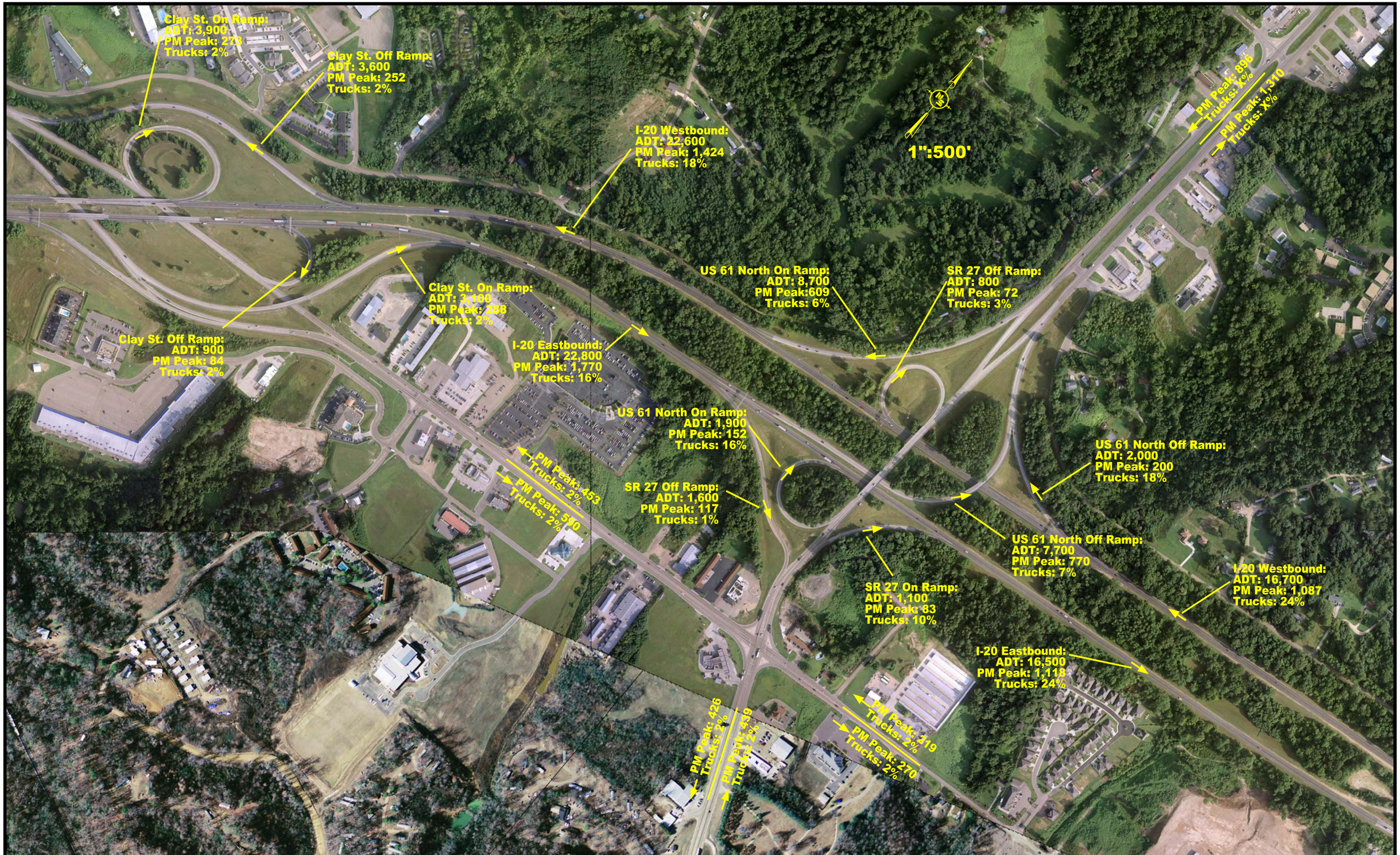
FIGURE
5



NEEL-SCHAFFER
Solutions you can build upon

EXISTING TRAFFIC VOLUMES (2007)

FIGURE
6



NEEL-SCHAFFER
Solutions you can build upon

EXISTING TRAFFIC VOLUMES (2007)

FIGURE
7

Traffic Analysis Reports:
Alternate A

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	1646	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	457	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1024	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1024	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.8	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 EB at Washington Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1646	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	138	vph
Length of first accel/decel lane	700	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1646		138			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	457		38			v
Trucks and buses	24		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.893	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	2048	155	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 2048 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2048	4700	No
$v_{FO} = v - v_F - v_R$	1893	4700	No
v_R	155	1900	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2048	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 15.6 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	D_S = 0.572	
Space mean speed in ramp influence area,	S_R = 51.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 51.8	mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 EB
Weaving Location:	Washington Ave to US 61 South
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB from Washington Ave to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1500	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	
Volume ratio, VR	0.30	
Weaving ratio, R	0.30	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1314	112	194	480	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	365	31	54	133	v
Trucks and buses	25	1	15	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.995	0.930	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1642	125	231	538	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.41	0.21
Weaving and non-weaving speeds, Si	53.90	60.31

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.02
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	58.21	mph
Weaving segment density, D	14.52	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	6344	pc/h
Capacity as a 15-minute flow rate, c	5639	pc/h
Capacity as a full-hour volume, ch	5075	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	769	4000	a
Average flow rate (pcphpl)	845	2350	b
Volume ratio, VR	0.30	0.80	c
Weaving ratio, R	0.30	N/A	d
Weaving length (ft)	1500	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 EB
Weaving Location:	US 61 South to Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 EB from US 61 South to Halls Ferry Rd

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1400	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	A	
Volume ratio, VR	0.46	
Weaving ratio, R	0.14	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1571	189	223	1328	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	436	53	62	369	v
Trucks and buses	25	2	2	15	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.990	0.990	0.930	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1963	212	250	1586	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.35	0.0020
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	2.63	0.46
Weaving and non-weaving speeds, Si	30.16	52.74
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)		1.52
Maximum number of lanes, Nw (max) (Exhibit 24-7)		1.40
Type of operation is		Constrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	39.28	mph
Weaving segment density, D	34.04	pc/mi/ln
Level of service, LOS	D	
Capacity of base condition, cb	4800	pc/h
Capacity as a 15-minute flow rate, c	4267	pc/h
Capacity as a full-hour volume, ch	3840	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1836	2800	a
Average flow rate (pcphpl)	1337	2350	b
Volume ratio, VR	0.46	0.45	c
Weaving ratio, R	0.14	N/A	d
Weaving length (ft)	1400	2500	e

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.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB at Halls Ferry Rd on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2899	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	463	vph
Length of first accel/decel lane	600	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2899	463		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	805	129		v
Trucks and buses	21	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.905	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3559	520		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3559 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4079	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3559	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 33.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.509	
Space mean speed in ramp influence area,	S_R = 53.3	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 53.3	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Halls Ferry Rd to Indiana Ave
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB from Halls Ferry Rd to Indiana Ave

Flow Inputs and Adjustments

Volume, V	3362	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	934	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	2027	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2027	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	61.0	mi/h
Number of lanes, N	2	
Density, D	33.2	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB at Indiana Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3362	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	146	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3362		146			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	934		41			v
Trucks and buses	17		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.922		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	4053		164			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4053 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4053	4700	No
$v_{FO} = v_F - v_R$	3889	4700	No
v_R	164	2000	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4053	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 36.9 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.443

Space mean speed in ramp influence area, S_R = 54.8 mph

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

Space mean speed for all vehicles, S = 54.8 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB at Indiana Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3216	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	562	vph
Length of first accel/decel lane	750	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3216	562		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	893	156		v
Trucks and buses	18	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.917	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3895	631		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3895 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4526	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3895	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 35.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.629
Space mean speed in ramp influence area,	S_R = 50.5 mph
Space mean speed in outer lanes,	S_0 = N/A mph
Space mean speed for all vehicles,	S = 50.5 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Indiana Ave to Clay St
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB from Indiana Ave to Clay St

Flow Inputs and Adjustments

Volume, V	3778	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1049	v
Trucks and buses	15	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2256	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2256	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	55.4	mi/h
Number of lanes, N	2	
Density, D	40.7	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 EB at EB Clay St off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3778	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	519	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3778		519			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1049		144			v
Trucks and buses	15		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.930		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	4513		582			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 4513 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4513	4700	No
$v_{FO} = v - v_F - v_R$	3931	4700	No
v_R	582	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4513	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 41.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	D_S = 0.480	
Space mean speed in ramp influence area,	S_R = 54.0	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 54.0	mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 EB at WB Clay St off loop

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3259	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	112	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3259		112			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	905		31			v
Trucks and buses	18		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.917		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	3947		126			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3947 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3947	4700	No
$v_{FO} = v_F - v_R$	3821	4700	No
v_R	126	1900	No
v_{av34}	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$	> 2700 pc/h?	No	
Is $v_{3\ or\ av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3947	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 36.4 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.569

Space mean speed in ramp influence area, S_R = 51.9 mph

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

Space mean speed for all vehicles, S = 51.9 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB at US 61 North SB on loop

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1797	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	320	vph
Length of first accel/decel lane	200	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1797	320		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	499	89		v
Trucks and buses	25	16		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.889	0.926		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	2246	384		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2246 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2630	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$	> 2700 pc/h?	No	
Is $v_{3 \text{ or } av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2246	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 24.6 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.365	
Space mean speed in ramp influence area,	S_R = 56.6	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 56.6	mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB at US 61 North NB on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2117	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	173	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2117	173		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	588	48		v
Trucks and buses	25	10		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.889	0.952		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	2646	202		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2646 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2848	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2646	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 24.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.353	
Space mean speed in ramp influence area,	S_R = 56.9	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 56.9	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 EB east of US 61 North

Flow Inputs and Adjustments

Volume, V	2290	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	636	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1425	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1425	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.9	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Mark Sorrell
Neel-Schaffer Inc

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB east of US 61 North

Flow Inputs and Adjustments

Volume, V	2226	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	618	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1385	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1385	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB off ramp to US 61 North NB

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2226	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	420	vph
Length of first accel/decel lane	230	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	153	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	750	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2226	420	153	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	618	117	43	v
Trucks and buses	24	18	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.893	0.917	0.985	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2770	509	173	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2770 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2770	4700	No
$v_{FO} = v_F - v_R$	2261	4700	No
v_R	509	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2770	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 26.0 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.474

Space mean speed in ramp influence area, S_R = 54.1 mph

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

Space mean speed for all vehicles, S = 54.1 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB at US 61 North SB off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1806	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	153	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	420	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	Off	
Distance to adjacent ramp	750	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1806		153		420		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	502		43		117		v
Trucks and buses	25		3		18		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.889		0.985		0.917		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	2258		173		509		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2258 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2258	4700	No
$v_{FO} = v_F - v_R$	2085	4700	No
v_R	173	1900	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$	> 2700 pc/h?	No	
Is $v_{3\ or\ av34}$	> 1.5 v_{12} /2	No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2258	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 19.2 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.574

Space mean speed in ramp influence area, S_R = 51.8 mph

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

Space mean speed for all vehicles, S = 51.8 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date performed:	1/26/2010
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB at US 61 North on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1653	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1215	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	153	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1100	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1653	1215	153	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	459	338	43	v
Trucks and buses	25	6	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.971	0.985	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2066	1391	173	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2066 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3457	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2066	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 29.0 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.413	
Space mean speed in ramp influence area,	S_R = 55.5	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 55.5	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer, Inc.
Date Performed:	1/26/2010
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Btwn US 61 North and Clay St
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB between US 61 North to Clay St

Flow Inputs and Adjustments

Volume, V	2868	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	797	v
Trucks and buses	18	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.917	
Driver population factor, fp	1.00	
Flow rate, vp	1737	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1737	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.3	mi/h
Number of lanes, N	2	
Density, D	27.0	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date performed:	1/26/2010
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Clay Street
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB at Clay St off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2868	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	361	vph
Length of first accel/decel lane	225	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	368	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	2868		361		368		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	797		100		102		v
Trucks and buses	18		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.917		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	3473		405		413		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3473 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3473	4700	No
$v_{FO} = v_F - v_R$	3068	4700	No
v_R	405	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3473	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 32.1 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.464

Space mean speed in ramp influence area, S_R = 54.3 mph

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

Space mean speed for all vehicles, S = 54.3 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB at WB Clay St on loop

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2507	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	368	vph
Length of first accel/decel lane	450	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	361	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2507	368	361	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	696	102	100	v
Trucks and buses	18	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.917	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3036	413	405	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3036 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3449	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3036	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 29.4 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.421
Space mean speed in ramp influence area,	S_R = 55.3 mph
Space mean speed in outer lanes,	S_0 = N/A mph
Space mean speed for all vehicles,	S = 55.3 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Clay St
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB at EB Clay St on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2875	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	154	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	368	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	1250	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2875	154	368	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	799	43	102	v
Trucks and buses	18	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.917	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3482	173	413	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3482 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3655	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3482	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 31.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.447	
Space mean speed in ramp influence area,	S_R = 54.7	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 54.7	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Btwn Clay St and Indiana Ave
Jurisdiction:	
Analysis Year:	2040 No Build
Description: I-20 WB -	Btwn Clay St to Indiana Ave

Flow Inputs and Adjustments

Volume, V	3029	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	841	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1826	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1826	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.7	mi/h
Number of lanes, N	2	
Density, D	28.7	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: Sorrell
Agency/Co.: Neel-Schaffer Inc.
Date performed: 2/16/09
Analysis time period:
Freeway/Dir of Travel: I-20 WB
Junction: Indiana Ave
Jurisdiction:
Analysis Year: 2040 No Build
Description: I-20 WB off ramp to Indiana Ave.

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3029	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	263	vph
Length of first accel/decel lane	150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3029		263			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	841		73			v
Trucks and buses	17		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			

Heavy vehicle adjustment, fHV	0.922	0.990	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	3652	295	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 3652 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3652	4700	No
$v_{FO} = v - v_F - v_R$	3357	4700	No
v_R	295	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3652	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 34.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.455

Space mean speed in ramp influence area, S_R = 54.5 mph

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

Space mean speed for all vehicles, S = 54.5 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB at Indian Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2766	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	235	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2766	235		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	768	65		v
Trucks and buses	19	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.913	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3365	264		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 3365 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3629	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3365	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 30.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.433	
Space mean speed in ramp influence area,	S_R = 55.0	mph
Space mean speed in outer lanes,	S_O = N/A	mph
Space mean speed for all vehicles,	S = 55.0	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Indiana Ave to Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB between Indiana Ave and Halls Ferry Rd

Flow Inputs and Adjustments

Volume, V	3001	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	834	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1809	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1809	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.8	mi/h
Number of lanes, N	2	
Density, D	28.3	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB at Halls Ferry Rd off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3001	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	493	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3001		493			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	834		137			v
Trucks and buses	17		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.922		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	3618		553			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3618 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3618	4700	No
$v_{FO} = v_F - v_R$	3065	4700	No
v_R	553	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3618	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 30.9 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	D_S = 0.478	
Space mean speed in ramp influence area,	S_R = 54.0	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 54.0	mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 WB
Weaving Location:	Halls Ferry Rd to US 61 South
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB from Halls Ferry Rd to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1200	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	C	
Volume ratio, VR	0.55	
Weaving ratio, R	0.09	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	207	1115	161	1393	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	58	310	45	387	v
Trucks and buses	2	13	2	25	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.939	0.990	0.889	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	232	1319	180	1741	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.30	6.00
c (Exhibit 24-6)	0.80	1.10
d (Exhibit 24-6)	0.60	0.60
Weaving intensity factor, Wi	0.88	0.94
Weaving and non-weaving speeds, Si	44.20	43.42
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)	1.98	
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.00	
Type of operation is	Unconstrained	

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	43.85	mph
Weaving segment density, D	26.39	pc/mi/ln
Level of service, LOS	C	
Capacity of base condition, cb	5202	pc/h
Capacity as a 15-minute flow rate, c	5150	pc/h
Capacity as a full-hour volume, ch	4635	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1921	3500	a
Average flow rate (pcphpl)	1157	2350	b
Volume ratio, VR	0.55	0.50	c
Weaving ratio, R	0.09	0.40	d
Weaving length (ft)	1200	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 WB
Weaving Location:	US 61 South to Washington Ave
Jurisdiction:	
Analysis Year:	2040 No Build
Description:	I-20 WB from US 61 South to Washington Ave

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	2	
Weaving segment length, L	1000	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	C	
Volume ratio, VR	0.78	
Weaving ratio, R	0.07	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	310	117	1284	117	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	86	33	357	33	v
Trucks and buses	1	10	25	1	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.995	0.952	0.889	0.995	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	346	136	1605	130	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.30	6.00
c (Exhibit 24-6)	0.80	1.10
d (Exhibit 24-6)	0.60	0.60
Weaving intensity factor, Wi	1.31	2.27
Weaving and non-weaving speeds, Si	38.84	31.81
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)	1.45	
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.00	
Type of operation is	Unconstrained	

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	37.06	mph
Weaving segment density, D	29.91	pc/mi/ln
Level of service, LOS	D	
Capacity of base condition, cb		pc/h
Capacity as a 15-minute flow rate, c		pc/h
Capacity as a full-hour volume, ch		pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded See Note Maximum	Note
Weaving flow rate, Vw	1735	3500	a
Average flow rate (pcphpl)	1108	2350	b
Volume ratio, VR	0.78	0.50	c
Weaving ratio, R	0.07	0.40	d
Weaving length (ft)	1000	2500	e

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.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB at Washington Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1401	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	195	vph
Length of first accel/decel lane	650	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1401	195		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	389	54		v
Trucks and buses	25	2		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.889	0.990		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1751	219		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1751 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1970	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1751	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.316	
Space mean speed in ramp influence area,	S_R = 57.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 57.7	mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2040 No Build

Description: I-20 WB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	1596	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	443	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	993	pc/h/ln

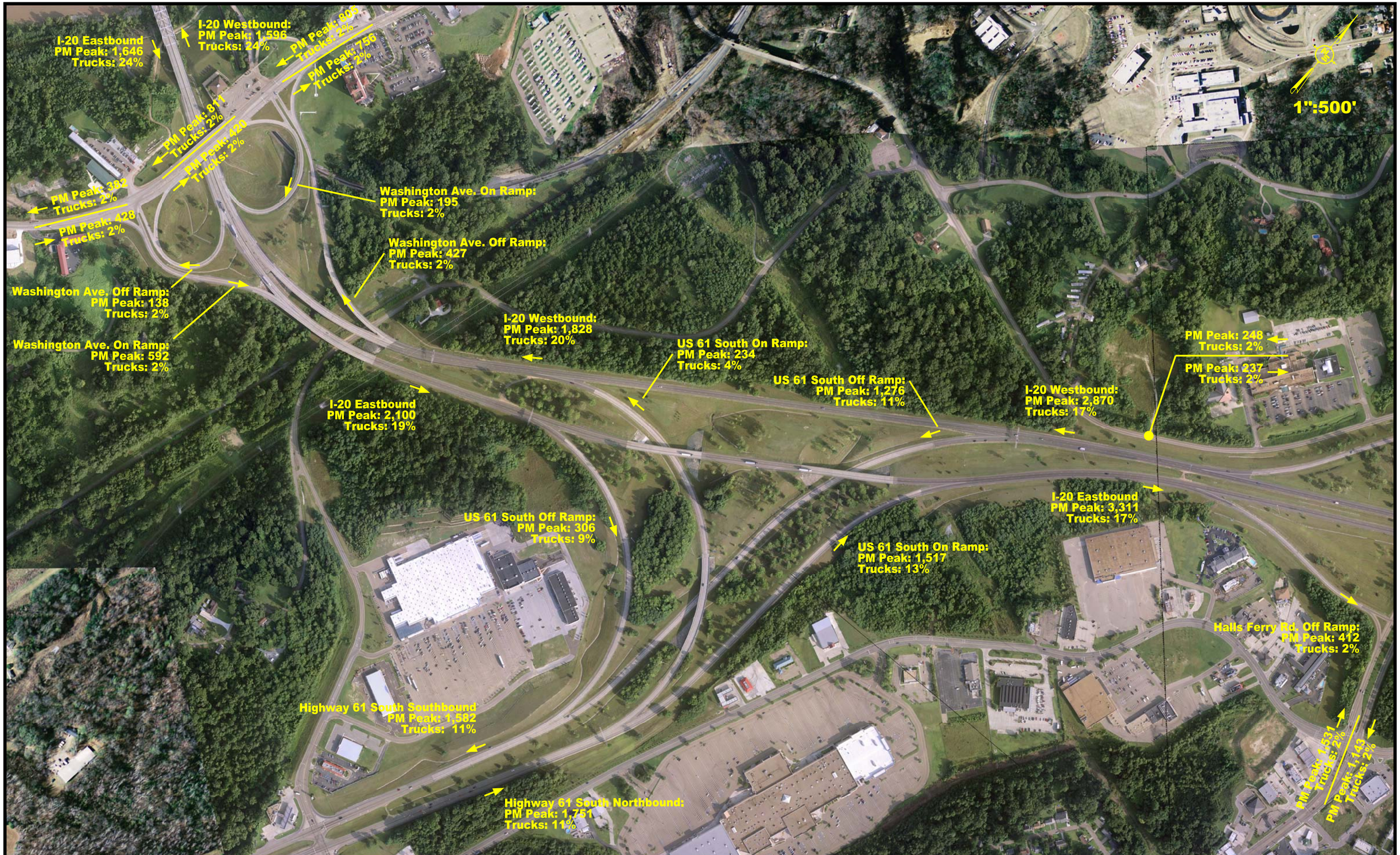
Speed Inputs and Adjustments

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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	993	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.3	pc/mi/ln
Level of service, LOS	B	

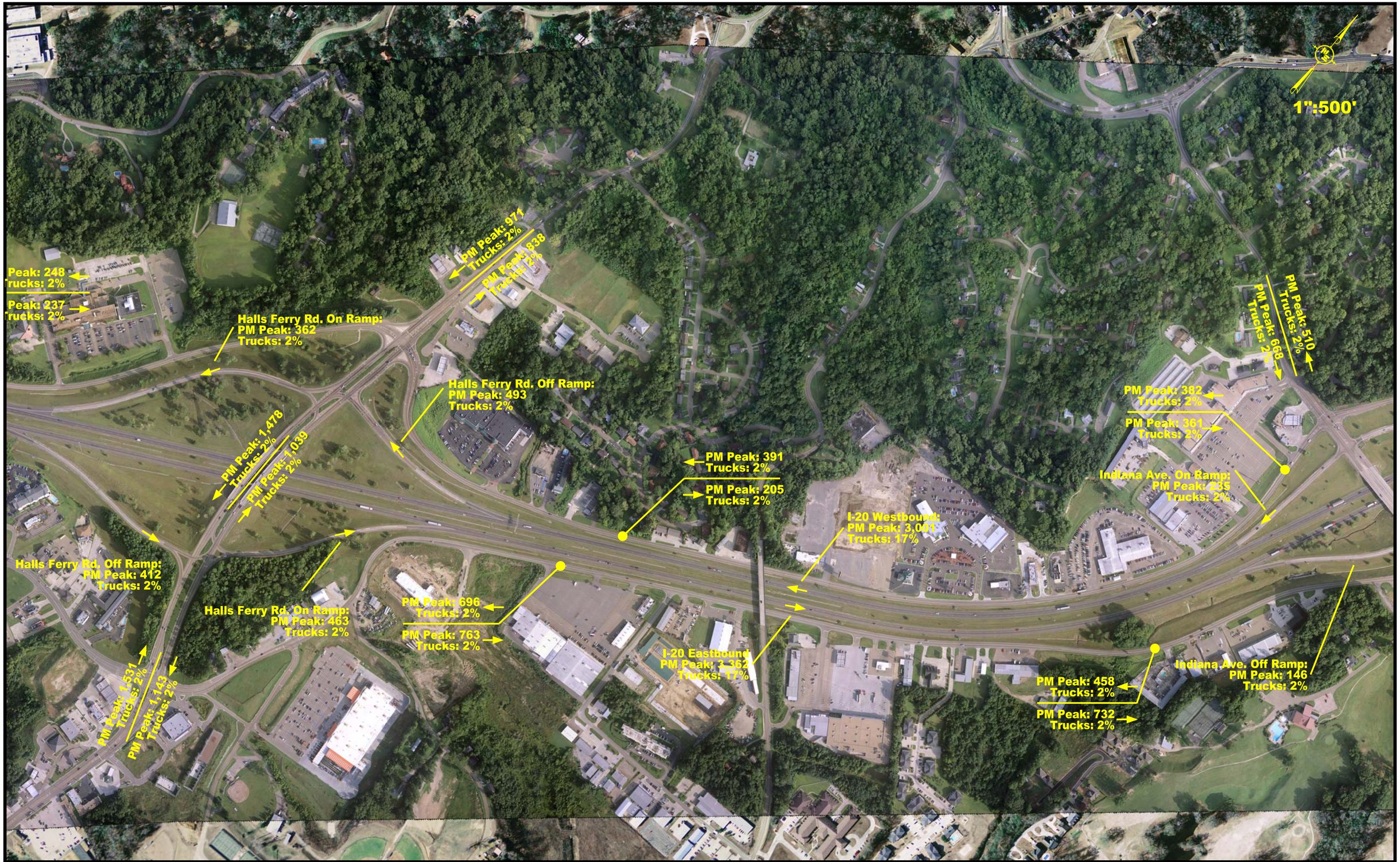
Overall results are not computed when free-flow speed is less than 55 mph.



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE A TRAFFIC VOLUMES (2040 NO BUILD)

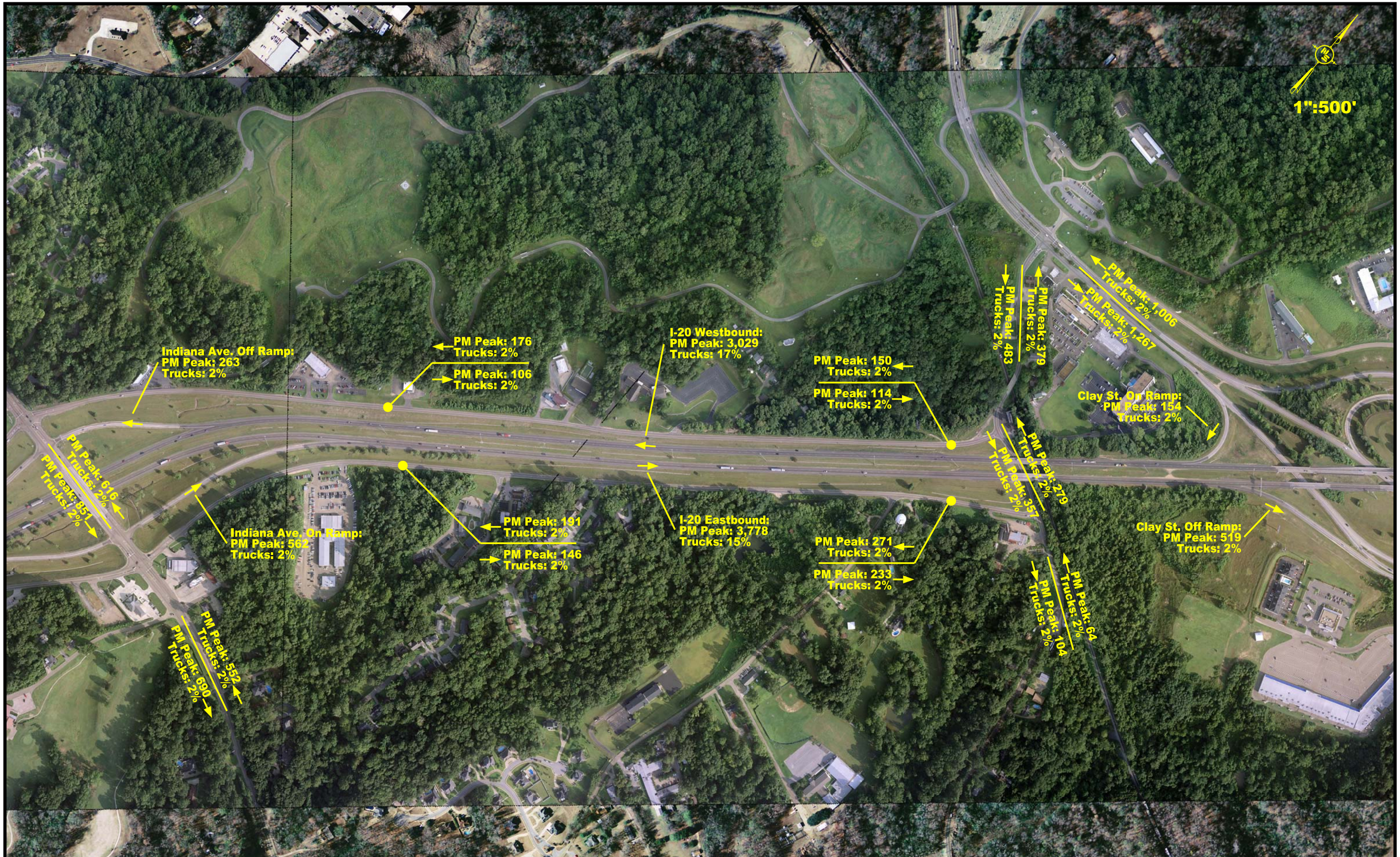
FIGURE
8



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE A TRAFFIC VOLUMES (2040 NO BUILD)

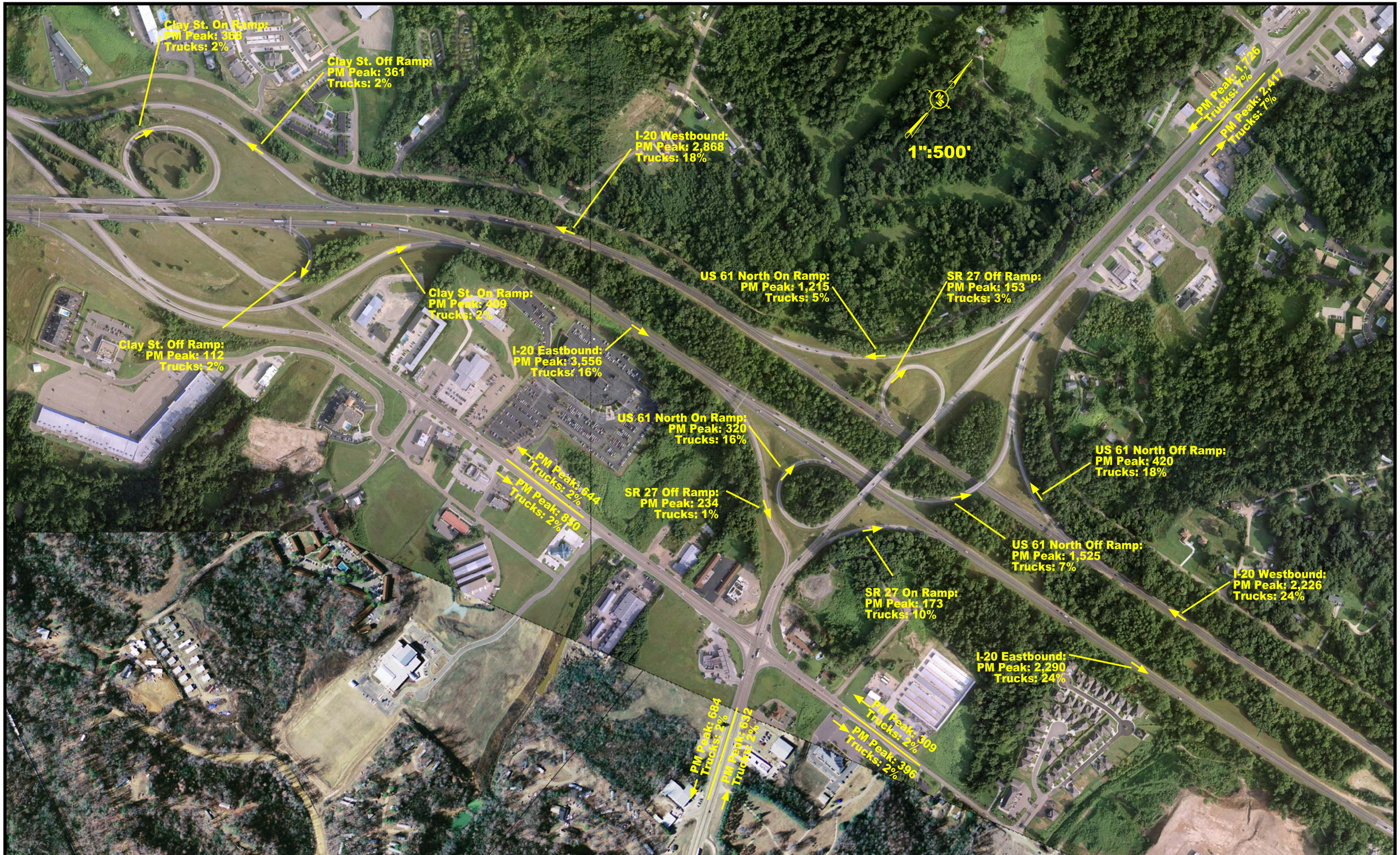
FIGURE
9



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE A TRAFFIC VOLUMES (2040 NO BUILD)

FIGURE
10



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE A TRAFFIC VOLUMES (2040 NO BUILD)

FIGURE
11

Traffic Analysis Reports:
Alternate B

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	1646	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	457	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1024	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1024	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.8	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB at Washington Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1646	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	138	vph
Length of first accel/decel lane	700	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	592	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	800	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1646		138		592		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	457		38		164		v
Trucks and buses	24		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.893		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	2048		155		664		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2048 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2048	4700	No
$v_{FO} = v_F - v_R$	1893	4700	No
v_R	155	1900	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2048	4600	No

!

Level of Service Determination (if not F)

Density, D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D = 15.6 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.572

Space mean speed in ramp influence area, S_R = 51.8 mph

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

Space mean speed for all vehicles, S = 51.8 mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 EB
Weaving Location:	Washington Ave to US 61 South
Jurisdiction:	
Analysis Year:	2040 Alt B
Description:	I-20 EB from Washington Ave to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1500	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	
Volume ratio, VR	0.30	
Weaving ratio, R	0.30	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1314	112	194	480	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	365	31	54	133	v
Trucks and buses	25	1	15	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.995	0.930	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1642	125	231	538	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.41	0.21
Weaving and non-weaving speeds, Si	53.90	60.31
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)	1.02	
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50	
Type of operation is	Unconstrained	

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	58.21	mph
Weaving segment density, D	14.52	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	6344	pc/h
Capacity as a 15-minute flow rate, c	5639	pc/h
Capacity as a full-hour volume, ch	5075	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	769	4000	a
Average flow rate (pcphpl)	845	2350	b
Volume ratio, VR	0.30	0.80	c
Weaving ratio, R	0.30	N/A	d
Weaving length (ft)	1500	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Mark Sorrell
Neel-Schaffer Inc

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date Performed:	1/30/09
Analysis Time Period:	PM Peak
Freeway/Dir of Travel:	I-20 Eastbound
Weaving Location:	US 61S to Halls Ferry
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB between US 61 South to Halls Ferry Rd off ramp

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	4	
Weaving segment length, L	1700	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	
Volume ratio, VR	0.47	
Weaving ratio, R	0.20	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1473	272	321	1245	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	409	76	89	346	v
Trucks and buses	12	2	2	13	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.943	0.990	0.990	0.939	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1734	305	360	1473	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.56	0.48
Weaving and non-weaving speeds, Si	50.25	52.15

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	2.09
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	51.24	mph
Weaving segment density, D	18.89	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	7530	pc/h
Capacity as a 15-minute flow rate, c	7104	pc/h
Capacity as a full-hour volume, ch	6394	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1833	4000	a
Average flow rate (pcphpl)	968	2350	b
Volume ratio, VR	0.47	0.80	c
Weaving ratio, R	0.20	N/A	d
Weaving length (ft)	1700	2500	e

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.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB at Halls Ferry Rd on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2718	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	867	vph
Length of first accel/decel lane	650	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	527	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2825	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2718	867	527	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	755	241	146	v
Trucks and buses	21	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.905	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3337	973	591	pcph

Estimation of V12 Merge Areas

L_{EQ} = 3298.91 (Equation 25-2 or 25-3)

P_{FM} = 0.604 Using Equation 3

$v_{12} = v_F (P_{FM})$ = 2014 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4310	7050	No
$v_{3\ or\ av34}$	1323 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2014	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 24.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.353
Space mean speed in ramp influence area,	S_R = 56.9 mph
Space mean speed in outer lanes,	S_0 = 62.0 mph
Space mean speed for all vehicles,	S = 58.4 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Halls Ferry Rd to Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB from Halls Ferry Rd to Indiana Ave

Flow Inputs and Adjustments

Volume, V	3585	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	996	v
Trucks and buses	16	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.926	
Driver population factor, fp	1.00	
Flow rate, vp	1434	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1434	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	22.1	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB at Indiana Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3585	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	527	vph
Length of first accel/decel lane	875	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	867	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2825	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3585		527		867		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	996		146		241		v
Trucks and buses	16		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.926		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	4302		591		973		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4302 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4302	4700	No
$v_{FO} = v_F - v_R$	3711	4700	No
v_R	591	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4302	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 33.4 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.481

Space mean speed in ramp influence area, S_R = 53.9 mph

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

Space mean speed for all vehicles, S = 53.9 mph

HCM Lane Addition Capacity Check

Location: I-20 EB at Indiana Ave on ramp with resulting lane addition

This analysis follows the guidelines described on pages 25-9 and 25-10 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the downstream of the lane addition, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway after the lane addition are the best indicators to the likely operation. Summarized below is the capacity of the ramp roadway as well as the downstream capacity. A freeway analysis for the resulting number of lanes was performed using HCS.

RAMP ROADWAY CAPACITY CHECK

Given:

Ramp Roadway Volume	281 vph
P_T	2%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.99
v_F	316 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***16%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

DOWNSTREAM FREEWAY CAPACITY CHECK

Given:

Volume	3339 vph
P_T	15%
PHF	0.90
f_p	1.00
Free-Flow Speed	65 mph
Number of Lanes	4

Calculated:

f_{HV}	0.93
v_F	3989 pc/h
Downstream Capacity	9400 pc/h
Percentage of Downstream Capacity	***42%***

Exhibit 25-7. Capacity Values for Merge Areas

Freeway Free-Flow Speed (mi/h)	Maximum Downstream Freeway Flow, v (pc/h)				Max Desirable Flow Entering Influence Area, V_{R12} (pc/h)
	Number of Lanes in One Direction				
	2	3	4	>4	
≥ 70	4800	7200	9600	2400/ln	4600
65	4700	7050	9400	2350/ln	4600
60	4600	6900	9200	2300/ln	4600
55	4500	6750	9000	2250/ln	4600

Source: Highway Capacity Manual 2000

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Clay St to US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB from Indiana Ave to CD Rd off ramp

Flow Inputs and Adjustments

Volume, V	3339	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	928	v
Trucks and buses	15	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.8*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1039	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	4	
Free-flow speed:	Measured	
FFS or BFFS	65.0	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	1.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1039	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	4	
Density, D	16.0	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Major Diverge Areas

Location: Major Diverge of I-20 EB and US 61 N / Clay St Collector-Distributer Rd

Equation 25-12:

$$D = 0.0109 \times \frac{v_F}{N}$$

D = Average density across all freeway lanes for a distance of 1500 ft upstream of diverge (pc/mi/ln)

v_F = Freeway flow rate approaching diverge area (pc/h/ln)

N = Number of lanes on freeway segment approaching diverge area

Given:

Volume	3339 vph
P_T	15%
PHF	0.90
f_p	1.00
N	4 lanes

Calculated:

f_{HV}	0.93
v_F	3989 pc/h
D	10.9 pc/mi/ln

LOS B

(Analysis performed as described on pages 25-16 through 25-17 of the HCM 2000)

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Clay St to US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB West of US 61 North Overpass

Flow Inputs and Adjustments

Volume, V	1137	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	316	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.8*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.833	
Driver population factor, fp	1.00	
Flow rate, vp	758	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	758	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	11.7	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst: Sorrell
Agency/Co.: Neel-Schaffer Inc.
Date performed: 2/18/09
Analysis time period:
Freeway/Dir of Travel: I-20 EB
Junction:
Jurisdiction:
Analysis Year: 2040 Alt B
Description: I-20 EB at C-D Road On Ramp east of US61N

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1137	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1153	vph
Length of first accel/decel lane	325	ft
Length of second accel/decel lane	975	ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1137	1153		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	316	320		v
Trucks and buses	25	7		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.8*	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.833	0.966		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1516	1326		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 Using Equation 0
$v_{12} = v_F (P_{FM})$ = 1516 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2842	4700	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1516	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.8 pc/mi/ln
Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.274
Space mean speed in ramp influence area, S_R = 58.7 mph
Space mean speed in outer lanes, S_0 = N/A mph
Space mean speed for all vehicles, S = 58.7 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 EB east of US 61 North

Flow Inputs and Adjustments

Volume, V	2290	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	636	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1425	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1425	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.9	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Mark Sorrell
Neel-Schaffer Inc

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB east of US 61 North

Flow Inputs and Adjustments

Volume, V	2226	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	618	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1385	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1385	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Major Diverge Areas

Location: Major Diverge of I-20 WB and US 61 N / Clay St Collector-Distributer Rd

Equation 25-12:

$$D = 0.0109 \times \frac{v_F}{N}$$

D = Average density across all freeway lanes for a distance of 1500 ft upstream of diverge (pc/mi/ln)

v_F = Freeway flow rate approaching diverge area (pc/h)

N = Number of lanes on freeway segment approaching diverge area

Given:

Volume	2226 vph
P_T	24%
PHF	0.90
f_p	1.00
N	3 lanes

Calculated:

f_{HV}	0.89
v_F	2771 pc/h
D	10.1 pc/mi/ln

LOS B

(Analysis performed as described on pages 25-16 through 25-17 of the HCM 2000)

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	After C-D Rd Exit
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB West of US 61 North Overpass

Flow Inputs and Adjustments

Volume, V	1156	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	321	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	723	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	723	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	11.1	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Lane Addition Capacity Check

Location: I-20 WB at C-D Road on ramp with resulting lane addition

This analysis follows the guidelines described on pages 25-9 and 25-10 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the downstream of the lane addition, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway after the lane addition are the best indicators to the likely operation. Summarized below is the capacity of the ramp roadway as well as the downstream capacity. A freeway analysis for the resulting number of lanes was performed using HCS.

RAMP ROADWAY CAPACITY CHECK

Given:

Ramp Roadway Volume	1675 vph
P_T	5%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Two-Lane
Estimated Ramp FFS	45 mph

Calculated:

f_{HV}	0.98
v_F	1908 pc/h
Ramp Capacity	4100 pc/h
Percentage of Ramp Capacity	***47%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

DOWNSTREAM FREEWAY CAPACITY CHECK

Given:

Volume	2831 vph
P_T	17%
PHF	0.90
f_p	1.00
Free-Flow Speed	65 mph
Number of Lanes	3

Calculated:

f_{HV}	0.92
v_F	3413 pc/h
Downstream Capacity	7050 pc/h
Percentage of Downstream Capacity	***48%***

Exhibit 25-7. Capacity Values for Merge Areas

Freeway Free-Flow Speed (mi/h)	Maximum Downstream Freeway Flow, v (pc/h)				Max Desirable Flow Entering Influence Area, V_{R12} (pc/h)
	Number of Lanes in One Direction				
	2	3	4	>4	
≥ 70	4800	7200	9600	2400/ln	4600
65	4700	7050	9400	2350/ln	4600
60	4600	6900	9200	2300/ln	4600
55	4500	6750	9000	2250/ln	4600

Source: Highway Capacity Manual 2000

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	C-D Rd On Ramp to Indiana Off
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB between C-D Rd On Ramp and Indiana Off Ramp

Flow Inputs and Adjustments

Volume, V	2831	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	786	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1138	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1138	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	17.5	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB at Indiana Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2831	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	225	vph
Length of first accel/decel lane	975	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1675	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2380	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2831	225	1675	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	786	63	465	v
Trucks and buses	16	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.926	0.990	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3397	253	1908	pcph

Estimation of V12 Diverge Areas

L_{EQ} = 14687.88 Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 6

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3397 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3397	7050	No
$v_{FO} = v_F - v_R$	3144	7050	No
v_R	253	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3397	4600	No

!

Level of Service Determination (if not F)

Density, D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D = 24.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.451

Space mean speed in ramp influence area, S_R = 54.6 mph

Space mean speed in outer lanes, S_0 = 71.3 mph

Space mean speed for all vehicles, S = 54.6 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB at Indian Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2606	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	500	vph
Length of first accel/decel lane	925	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	568	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2805	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2606	500	568	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	724	139	158	v
Trucks and buses	20	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.909	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3185	561	637	pcph

Estimation of V12 Merge Areas

L_{EQ} = 3054.06 (Equation 25-2 or 25-3)

P_{FM} = 0.608 Using Equation 3

$v_{12} = v_F (P_{FM})$ = 1938 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3746	7050	No
$v_{3\ or\ av34}$	1247 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1938	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 18.9 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.304
Space mean speed in ramp influence area,	S_R = 58.0 mph
Space mean speed in outer lanes,	S_0 = 62.3 mph
Space mean speed for all vehicles,	S = 59.4 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Indiana Ave to Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB between Indiana Ave and Halls Ferry Rd

Flow Inputs and Adjustments

Volume, V	3106	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	863	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1248	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1248	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.2	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 Alt B
Description:	I-20 WB at Halls Ferry Rd off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3106	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	568	vph
Length of first accel/decel lane	300	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	500	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2805	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3106		568		500		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	863		158		139		v
Trucks and buses	17		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.922		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	3744		637		561		pcph

Estimation of V12 Diverge Areas

L_{EQ} = 5160.99 (Equation 25-8 or 25-9)

P_{FD} = 0.692 Using Equation 6

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2786 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3744	7050	No
$v_{FO} = v_F - v_R$	3107	7050	No
v_R	637	2000	No
$v_{3\ or\ av34}$	958 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2786	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 25.5 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.485

Space mean speed in ramp influence area, S_R = 53.8 mph

Space mean speed in outer lanes, S_0 = 71.3 mph

Space mean speed for all vehicles, S = 57.4 mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 WB
Weaving Location:	Halls Ferry Rd to US 61 South
Jurisdiction:	
Analysis Year:	2040 Alt B
Description:	I-20 WB from Halls Ferry Rd to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	4	
Weaving segment length, L	2500	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	C	
Volume ratio, VR	0.46	
Weaving ratio, R	0.13	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	148	1410	184	1128	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	41	392	51	313	v
Trucks and buses	2	19	2	19	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.913	0.990	0.913	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	166	1715	206	1372	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.30	6.00
c (Exhibit 24-6)	0.80	1.10
d (Exhibit 24-6)	0.60	0.60
Weaving intensity factor, Wi	0.39	0.30
Weaving and non-weaving speeds, Si	54.61	57.42
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)	1.97	
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.00	
Type of operation is	Unconstrained	

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	56.10	mph
Weaving segment density, D	15.41	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	7574	pc/h
Capacity as a 15-minute flow rate, c	7499	pc/h
Capacity as a full-hour volume, ch	6749	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1578	3500	a
Average flow rate (pcphpl)	864	2350	b
Volume ratio, VR	0.46	0.50	c
Weaving ratio, R	0.13	0.40	d
Weaving length (ft)	2500	2500	e

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.

HCM Lane Addition Capacity Check

Location: I-20 WB at US 61 South on ramp with resulting lane addition

This analysis follows the guidelines described on pages 25-9 and 25-10 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the downstream of the lane addition, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway after the lane addition are the best indicators to the likely operation. Summarized below is the capacity of the ramp roadway as well as the downstream capacity. A freeway analysis for the resulting number of lanes was performed using HCS.

RAMP ROADWAY CAPACITY CHECK

Given:

Ramp Roadway Volume	234 vph
P_T	4%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.98
v_F	266 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***13%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

DOWNSTREAM FREEWAY CAPACITY CHECK

Given:

Volume	1828 vph
P_T	20%
PHF	0.90
f_p	1.00
Free-Flow Speed	65 mph
Number of Lanes	4

Calculated:

f_{HV}	0.91
v_F	2235 pc/h
Downstream Capacity	9400 pc/h
Percentage of Downstream Capacity	***24%***

Exhibit 25-7. Capacity Values for Merge Areas

Freeway Free-Flow Speed (mi/h)	Maximum Downstream Freeway Flow, v (pc/h)				Max Desirable Flow Entering Influence Area, V_{R12} (pc/h)
	Number of Lanes in One Direction				
	2	3	4	>4	
≥ 70	4800	7200	9600	2400/ln	4600
65	4700	7050	9400	2350/ln	4600
60	4600	6900	9200	2300/ln	4600
55	4500	6750	9000	2250/ln	4600

Source: Highway Capacity Manual 2000

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	US 61 S to Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB between US 61 South and Washington Ave

Flow Inputs and Adjustments

Volume, V	1828	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	508	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	559	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	4	
Free-flow speed:	Measured	
FFS or BFFS	65.0	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	1.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	559	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	4	
Density, D	8.6	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	US 61 S to Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB between US 61 South and Washington Ave

Flow Inputs and Adjustments

Volume, V	1828	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	508	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	745	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	745	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	11.5	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Lane Drop Capacity Check

Location: I-20 WB Off Ramp at Washington Ave - Single lane drop

This analysis follows the guidelines described on page 25-16 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the ramp roadway itself, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway prior to the lane drop are the best indicators to the likely operation of a ramp resulting from a lane drop.

Given:

Ramp Roadway Volume	427 vph
P_T	2%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.99
v_F	480 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***24%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB at Washington Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1401	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	195	vph
Length of first accel/decel lane	700	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	427	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1200	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1401	195	427	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	389	54	119	v
Trucks and buses	25	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1751	219	479	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1751 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1970	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1751	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.4 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, M_S = 0.314

Space mean speed in ramp influence area, S_R = 57.8 mph

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

Space mean speed for all vehicles, S = 57.8 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2040 Alt B

Description: I-20 WB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	1596	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	443	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	993	pc/h/ln

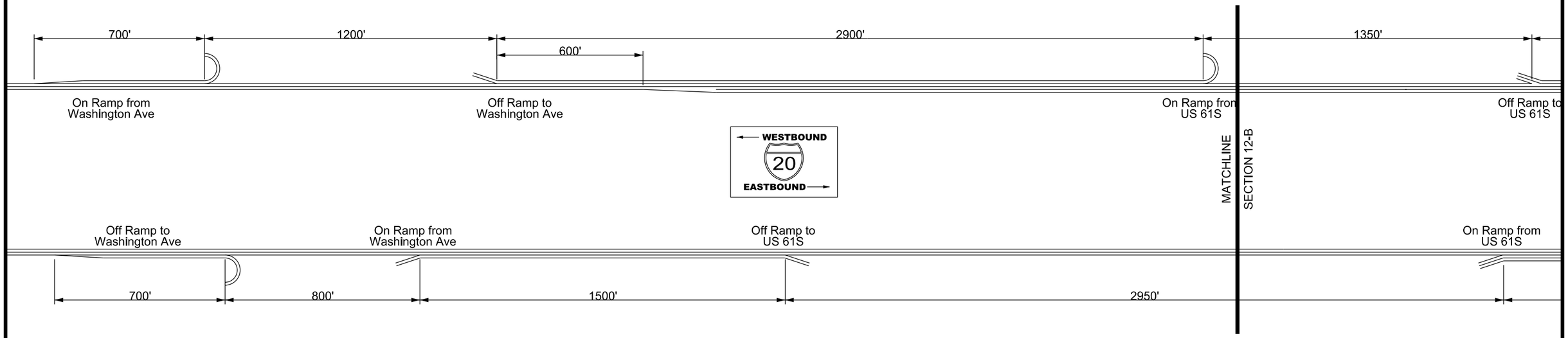
Speed Inputs and Adjustments

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	65.0	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	65.0	mi/h
	Urban Freeway	

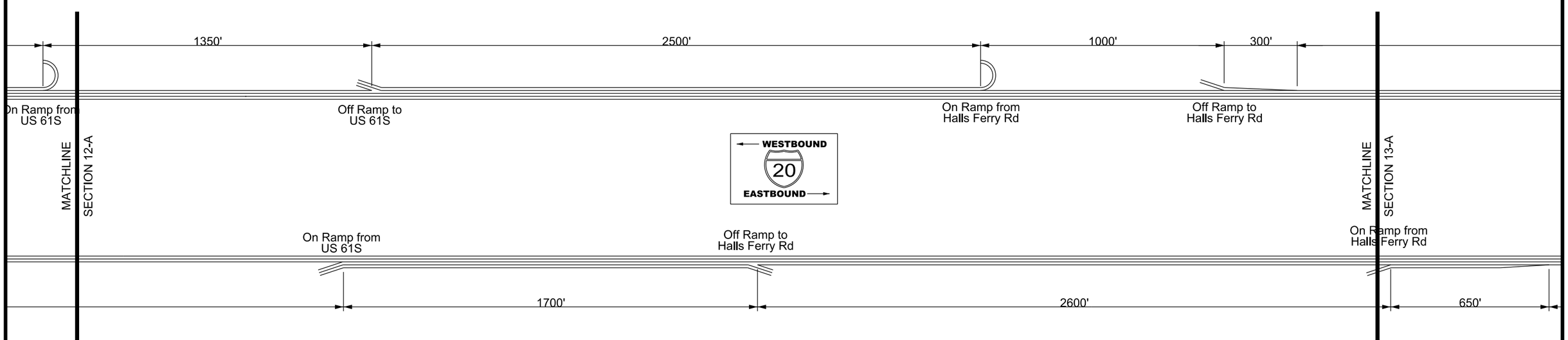
LOS and Performance Measures

Flow rate, vp	993	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.3	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.



SECTION 12-A



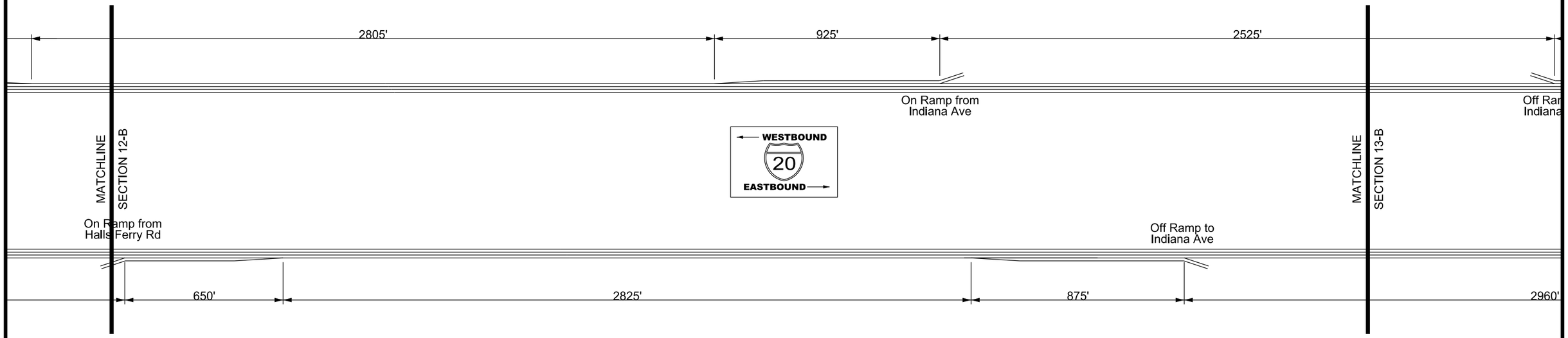
SECTION 12-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

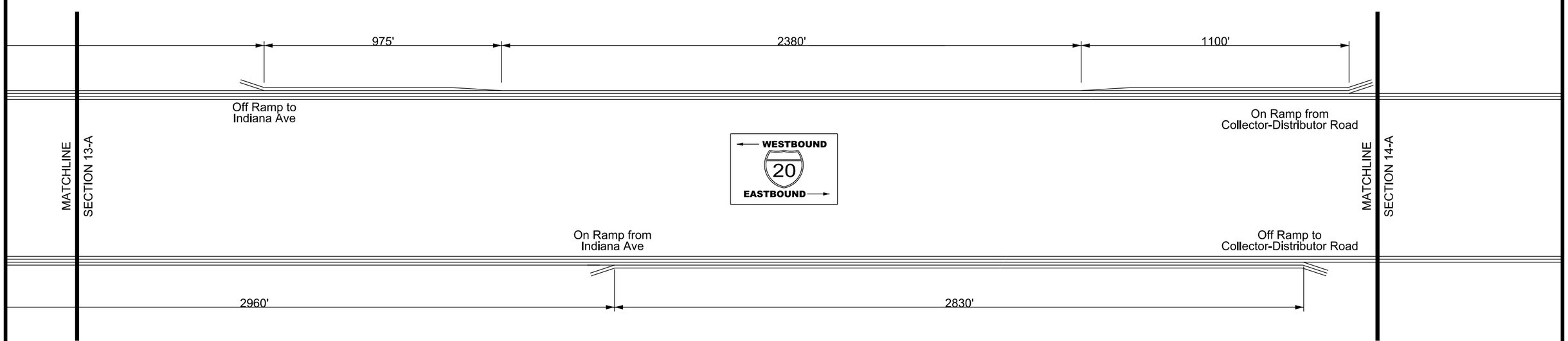
NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR ALTERNATE B
INTERSTATE 20, VICKSBURG, MS

FIGURE
12



SECTION 13-A



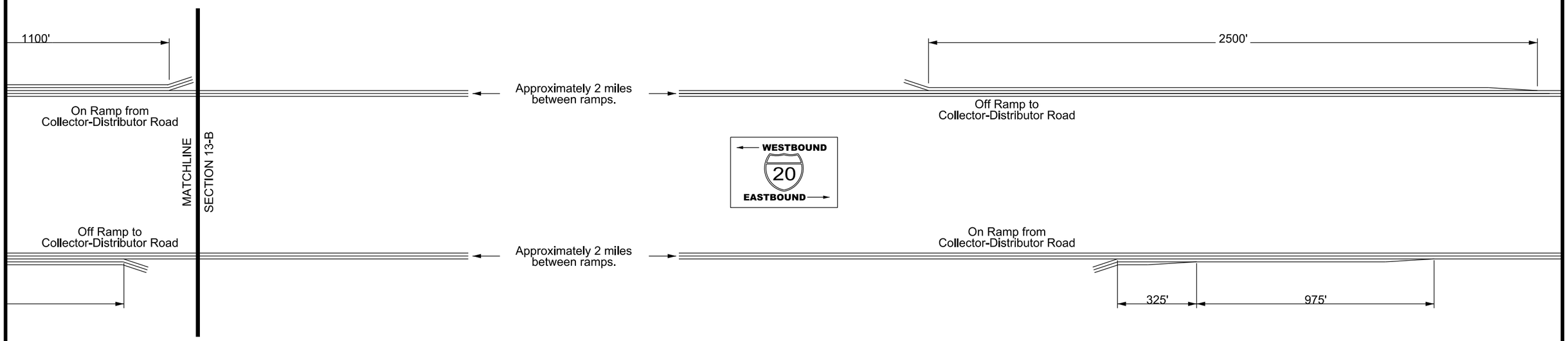
SECTION 13-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR ALTERNATE B
INTERSTATE 20, VICKSBURG, MS

FIGURE
13



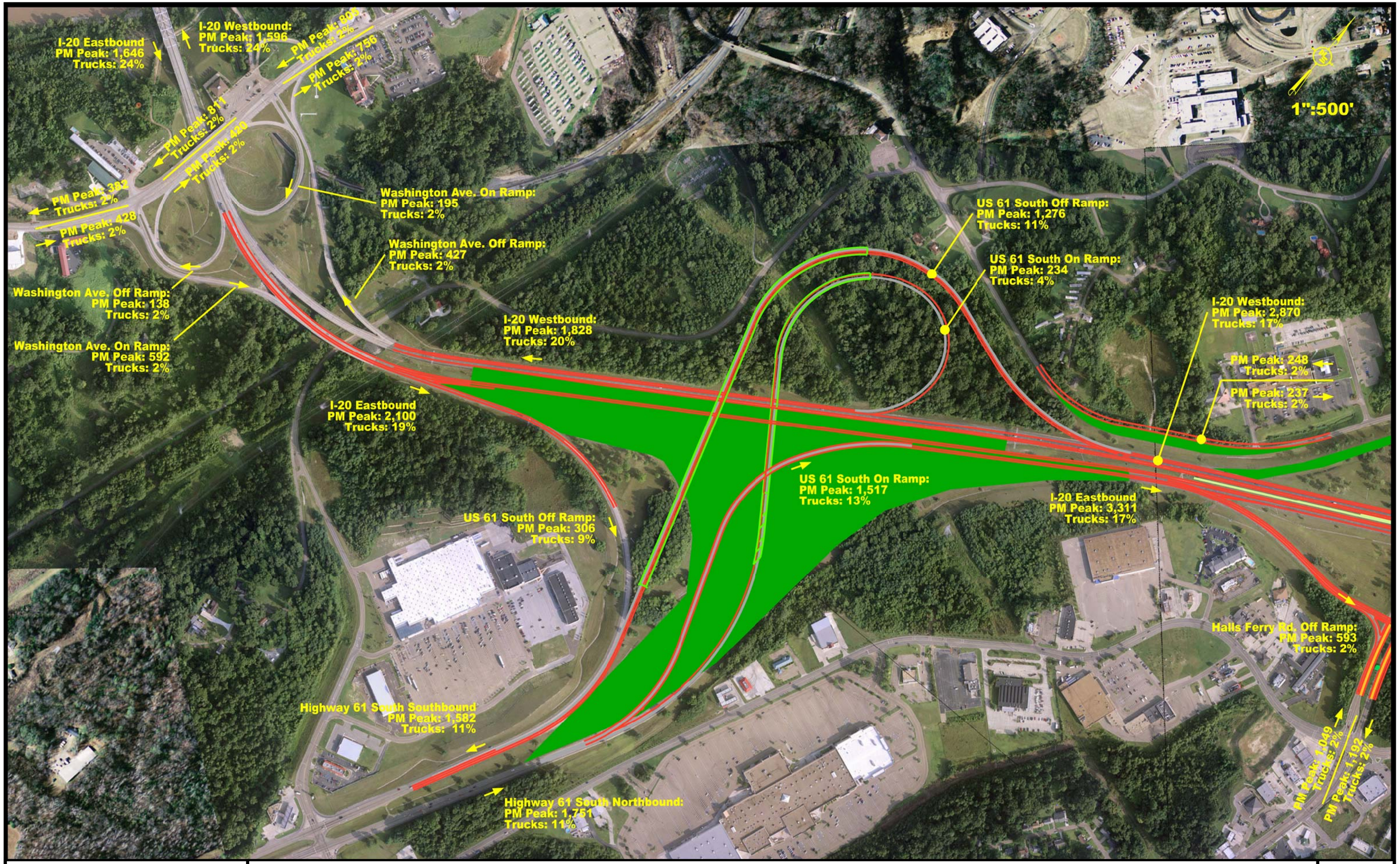
SECTION 14-A

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR ALTERNATE B
INTERSTATE 20, VICKSBURG, MS

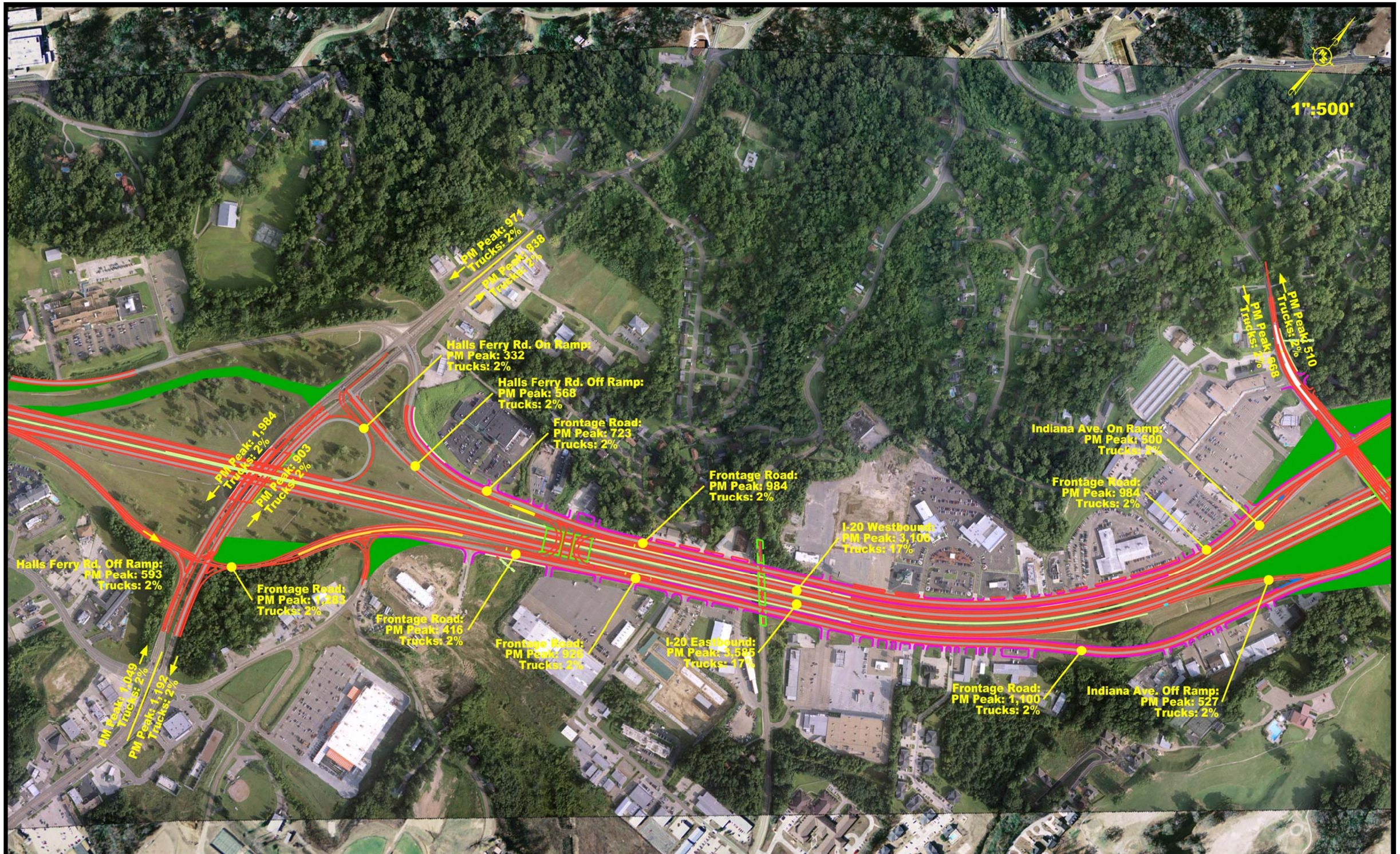
FIGURE
14



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE B TRAFFIC VOLUMES (2040)
ONE-WAY FRONTAGE ROADS

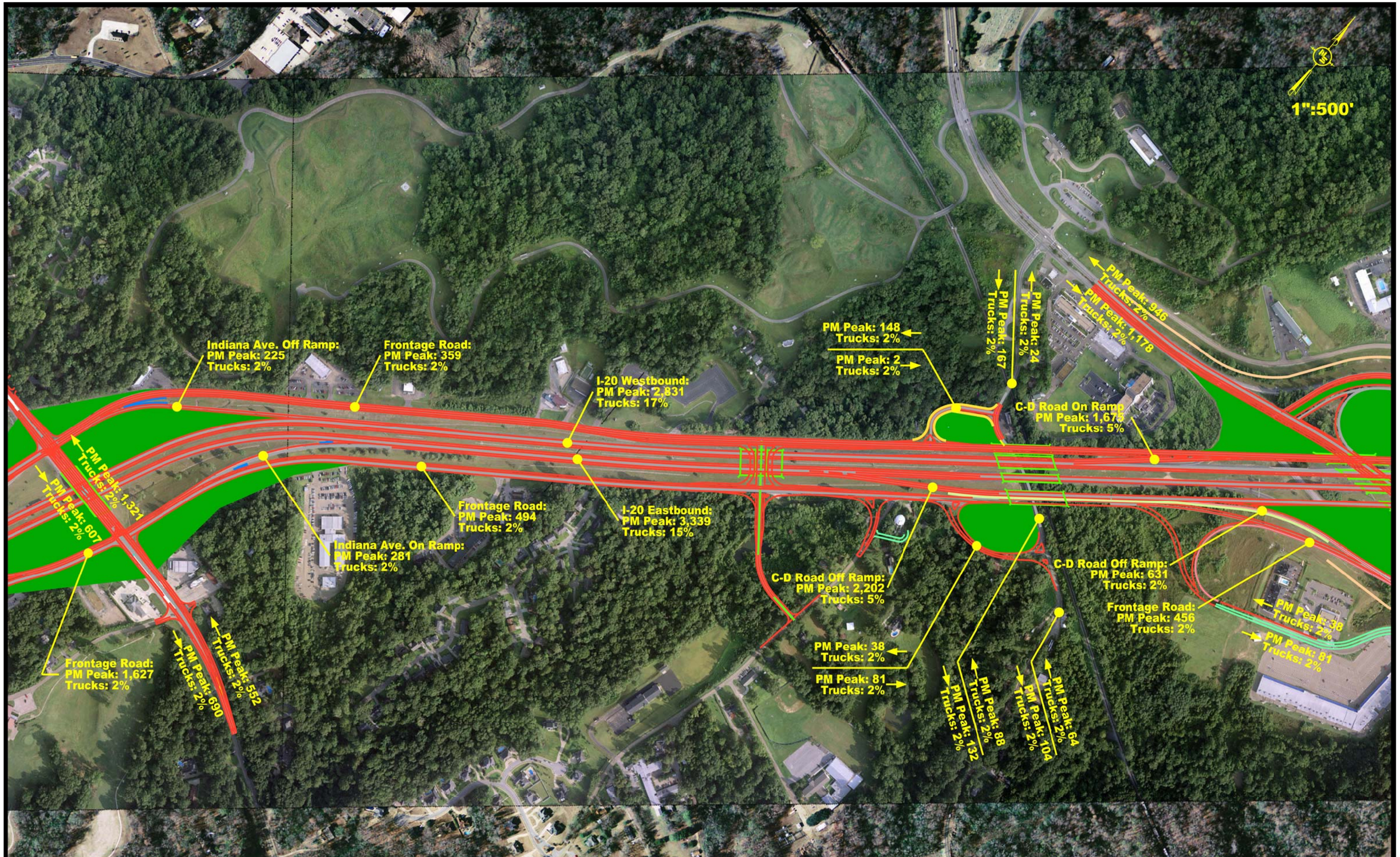
FIGURE
15



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE B TRAFFIC VOLUMES (2040)
ONE-WAY FRONTAGE ROADS

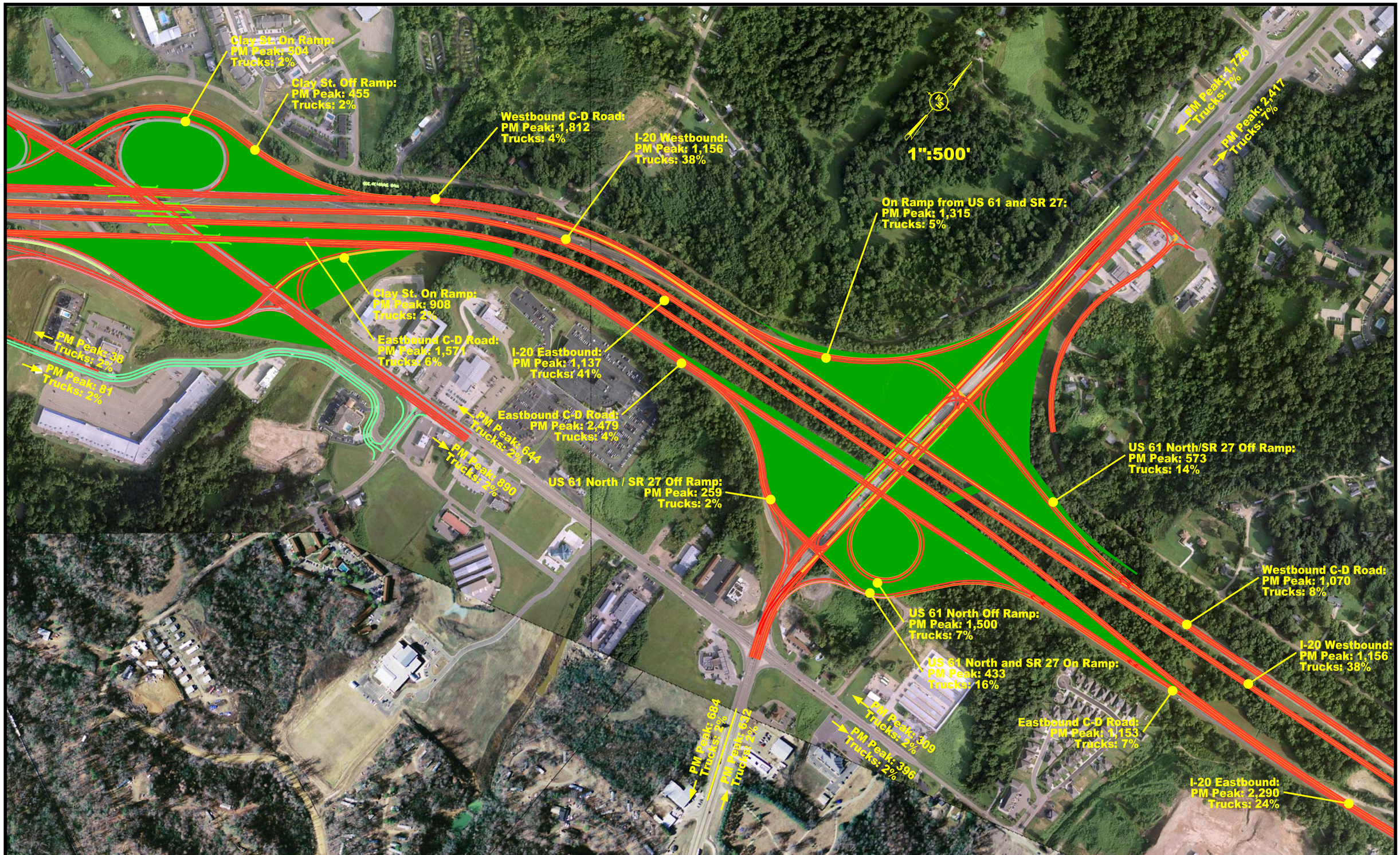
FIGURE
16



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE B TRAFFIC VOLUMES (2040)
ONE-WAY FRONTAGE ROADS

FIGURE
17



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE B TRAFFIC VOLUMES (2040)
ONE-WAY FRONTAGE ROADS

FIGURE
18

Traffic Analysis Reports:
Alternate C

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	1646	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	457	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1024	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1024	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.8	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB at Washington Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1646	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	138	vph
Length of first accel/decel lane	700	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	592	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	800	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	1646		138		592		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	457		38		164		v
Trucks and buses	24		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.893		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	2048		155		664		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2048 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2048	4700	No
$v_{FO} = v_F - v_R$	1893	4700	No
v_R	155	1900	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2048	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 15.6 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.572

Space mean speed in ramp influence area, S_R = 51.8 mph

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

Space mean speed for all vehicles, S = 51.8 mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 EB
Weaving Location:	Washington Ave to US 61 South
Jurisdiction:	
Analysis Year:	2040 Alt C
Description:	I-20 EB from Washington Ave to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1500	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	
Volume ratio, VR	0.30	
Weaving ratio, R	0.30	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1314	112	194	480	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	365	31	54	133	v
Trucks and buses	25	1	15	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.995	0.930	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1642	125	231	538	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.41	0.21
Weaving and non-weaving speeds, Si	53.90	60.31
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)	1.02	
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50	
Type of operation is	Unconstrained	

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	58.21	mph
Weaving segment density, D	14.52	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	6344	pc/h
Capacity as a 15-minute flow rate, c	5639	pc/h
Capacity as a full-hour volume, ch	5075	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	769	4000	a
Average flow rate (pcphpl)	845	2350	b
Volume ratio, VR	0.30	0.80	c
Weaving ratio, R	0.30	N/A	d
Weaving length (ft)	1500	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Mark Sorrell
Neel-Schaffer Inc

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date Performed:	1/30/09
Analysis Time Period:	PM Peak
Freeway/Dir of Travel:	I-20 Eastbound
Weaving Location:	US 61S to Halls Ferry
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB between US 61 South to Halls Ferry Rd off ramp

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	4	
Weaving segment length, L	1700	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	
Volume ratio, VR	0.47	
Weaving ratio, R	0.20	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1473	272	321	1245	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	409	76	89	346	v
Trucks and buses	12	2	2	13	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.943	0.990	0.990	0.939	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1734	305	360	1473	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.56	0.48
Weaving and non-weaving speeds, Si	50.25	52.15
Number of lanes required for unconstrained operation, Nw (Exhibit 24-7)	2.09	
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50	
Type of operation is	Unconstrained	

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	51.24	mph
Weaving segment density, D	18.89	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	7530	pc/h
Capacity as a 15-minute flow rate, c	7104	pc/h
Capacity as a full-hour volume, ch	6394	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1833	4000	a
Average flow rate (pcphpl)	968	2350	b
Volume ratio, VR	0.47	0.80	c
Weaving ratio, R	0.20	N/A	d
Weaving length (ft)	1700	2500	e

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.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB at Halls Ferry Rd on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2718	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	644	vph
Length of first accel/decel lane	650	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	304	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2825	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2718	644	304	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	755	179	84	v
Trucks and buses	21	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.905	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3337	723	341	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1903.43 (Equation 25-2 or 25-3)

P_{FM} = 0.596 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1988 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4060	7050	No
$v_{3\ or\ av34}$	1349 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1988	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 22.2 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.334
Space mean speed in ramp influence area,	S_R = 57.3 mph
Space mean speed in outer lanes,	S_0 = 61.9 mph
Space mean speed for all vehicles,	S = 58.8 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Halls Ferry Rd to Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB from Halls Ferry Rd to Indiana Ave

Flow Inputs and Adjustments

Volume, V	3362	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	934	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1351	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1351	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.8	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 EB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt C
Description:	I-20 EB at Indiana Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3362	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	304	vph
Length of first accel/decel lane	1150	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	644	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2825	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3362		304		644		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	934		84		179		v
Trucks and buses	17		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.922		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	4053		341		723		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4053 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4053	4700	No
$v_{FO} = v_F - v_R$	3712	4700	No
v_R	341	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12}/2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4053	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.459

Space mean speed in ramp influence area, S_R = 54.5 mph

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

Space mean speed for all vehicles, S = 54.5 mph

HCM Lane Addition Capacity Check

Location: I-20 EB at Indiana Ave on ramp with resulting lane addition

This analysis follows the guidelines described on pages 25-9 and 25-10 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the downstream of the lane addition, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway after the lane addition are the best indicators to the likely operation. Summarized below is the capacity of the ramp roadway as well as the downstream capacity. A freeway analysis for the resulting number of lanes was performed using HCS.

RAMP ROADWAY CAPACITY CHECK

Given:

Ramp Roadway Volume	707 vph
P_T	2%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.99
v_F	794 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***40%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

DOWNSTREAM FREEWAY CAPACITY CHECK

Given:

Volume	3765 vph
P_T	15%
PHF	0.90
f_p	1.00
Free-Flow Speed	65 mph
Number of Lanes	4

Calculated:

f_{HV}	0.93
v_F	4498 pc/h
Downstream Capacity	9400 pc/h
Percentage of Downstream Capacity	***48%***

Exhibit 25-7. Capacity Values for Merge Areas

Freeway Free-Flow Speed (mi/h)	Maximum Downstream Freeway Flow, v (pc/h)				Max Desirable Flow Entering Influence Area, V_{R12} (pc/h)
	Number of Lanes in One Direction				
	2	3	4	>4	
≥ 70	4800	7200	9600	2400/ln	4600
65	4700	7050	9400	2350/ln	4600
60	4600	6900	9200	2300/ln	4600
55	4500	6750	9000	2250/ln	4600

Source: Highway Capacity Manual 2000

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Clay St to US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB from Indiana Ave to CD Rd off ramp

Flow Inputs and Adjustments

Volume, V	3765	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1046	v
Trucks and buses	15	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.8*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1171	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	4	
Free-flow speed:	Measured	
FFS or BFFS	65.0	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	1.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1171	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	4	
Density, D	18.0+	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Major Diverge Areas

Location: Major Diverge of I-20 EB and US 61 N / Clay St Collector-Distributer Rd

Equation 25-12:

$$D = 0.0109 \times \frac{v_F}{N}$$

D = Average density across all freeway lanes for a distance of 1500 ft upstream of diverge (pc/mi/ln)

v_F = Freeway flow rate approaching diverge area (pc/h/ln)

N = Number of lanes on freeway segment approaching diverge area

Given:

Volume	3765 vph
P_T	15%
PHF	0.90
f_p	1.00
N	4 lanes

Calculated:

f_{HV}	0.93
v_F	4498 pc/h
D	12.3 pc/mi/ln

LOS B

(Analysis performed as described on pages 25-16 through 25-17 of the HCM 2000)

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	Clay St to US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB West of US 61 North Overpass

Flow Inputs and Adjustments

Volume, V	1174	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	326	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.8*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.833	
Driver population factor, fp	1.00	
Flow rate, vp	783	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	783	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	12.0	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst: Sorrell
Agency/Co.: Neel-Schaffer Inc.
Date performed: 2/18/09
Analysis time period:
Freeway/Dir of Travel: I-20 EB
Junction:
Jurisdiction:
Analysis Year: 2040 Alt C
Description: I-20 EB at C-D Road On Ramp east of US61N

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1174	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1116	vph
Length of first accel/decel lane	325	ft
Length of second accel/decel lane	975	ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1174	1116		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	326	310		v
Trucks and buses	25	7		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.8*	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.833	0.966		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	1565	1283		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)
P_{FM} = 1.000 Using Equation 0
$v_{12} = v_F (P_{FM})$ = 1565 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2848	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1565	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.9 pc/mi/ln
Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.275
Space mean speed in ramp influence area, S_R = 58.7 mph
Space mean speed in outer lanes, S_0 = N/A mph
Space mean speed for all vehicles, S = 58.7 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 EB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 EB east of US 61 North

Flow Inputs and Adjustments

Volume, V	2290	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	636	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1425	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1425	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.9	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Mark Sorrell
Neel-Schaffer Inc

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	East of US 61 North
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB east of US 61 North

Flow Inputs and Adjustments

Volume, V	2226	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	618	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	1385	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	1.00	interchange/mi
Number of lanes, N	2	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	2.5	mi/h
Number of lanes adjustment, fN	4.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1385	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	21.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Major Diverge Areas

Location: Major Diverge of I-20 WB and US 61 N / Clay St Collector-Distributer Rd

Equation 25-12:

$$D = 0.0109 \times \frac{v_F}{N}$$

D = Average density across all freeway lanes for a distance of 1500 ft upstream of diverge (pc/mi/ln)

v_F = Freeway flow rate approaching diverge area (pc/h)

N = Number of lanes on freeway segment approaching diverge area

Given:

Volume	2226 vph
P_T	24%
PHF	0.90
f_p	1.00
N	3 lanes

Calculated:

f_{HV}	0.89
v_F	2771 pc/h
D	10.1 pc/mi/ln

LOS B

(Analysis performed as described on pages 25-16 through 25-17 of the HCM 2000)

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	After C-D Rd Exit
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB West of US 61 North Overpass

Flow Inputs and Adjustments

Volume, V	1156	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	321	v
Trucks and buses	25	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.889	
Driver population factor, fp	1.00	
Flow rate, vp	723	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	65.0	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	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	723	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	11.1	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Lane Addition Capacity Check

Location: I-20 WB at C-D Road on ramp with resulting lane addition

This analysis follows the guidelines described on pages 25-9 and 25-10 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the downstream of the lane addition, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway after the lane addition are the best indicators to the likely operation. Summarized below is the capacity of the ramp roadway as well as the downstream capacity. A freeway analysis for the resulting number of lanes was performed using HCS.

RAMP ROADWAY CAPACITY CHECK

Given:

Ramp Roadway Volume	1973 vph
P_T	5%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Two-Lane
Estimated Ramp FFS	45 mph

Calculated:

f_{HV}	0.98
v_F	2248 pc/h
Ramp Capacity	4100 pc/h
Percentage of Ramp Capacity	***55%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

DOWNSTREAM FREEWAY CAPACITY CHECK

Given:

Volume	3129 vph
P_T	17%
PHF	0.90
f_p	1.00
Free-Flow Speed	65 mph
Number of Lanes	3

Calculated:

f_{HV}	0.92
v_F	3773 pc/h
Downstream Capacity	7050 pc/h
Percentage of Downstream Capacity	***54%***

Exhibit 25-7. Capacity Values for Merge Areas

Freeway Free-Flow Speed (mi/h)	Maximum Downstream Freeway Flow, v (pc/h)				Max Desirable Flow Entering Influence Area, V_{R12} (pc/h)
	Number of Lanes in One Direction				
	2	3	4	>4	
≥ 70	4800	7200	9600	2400/ln	4600
65	4700	7050	9400	2350/ln	4600
60	4600	6900	9200	2300/ln	4600
55	4500	6750	9000	2250/ln	4600

Source: Highway Capacity Manual 2000

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	C-D Rd On Ramp to Indiana Off
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB between C-D Rd On Ramp and Indiana Off Ramp

Flow Inputs and Adjustments

Volume, V	3129	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	869	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1257	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1257	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: Sorrell
Agency/Co.: Neel-Schaffer Inc
Date performed: 2/17/09
Analysis time period:
Freeway/Dir of Travel: I-20 WB
Junction: Indiana Ave
Jurisdiction:
Analysis Year: 2040 Alt C
Description: I-20 WB at Indiana Ave off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3129	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	363	vph
Length of first accel/decel lane	975	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	1973	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2380	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3129	363	1973	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	869	101	548	v
Trucks and buses	16	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	0.00 %	0.00 %	0.00 %	
Length	0.00 mi	0.00 mi	0.00 mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.926	0.990	0.976	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3755	407	2247	pcph

Estimation of V12 Diverge Areas

L_{EQ} = 17772.26 Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 6

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3755 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3755	7050	No
$v_{FO} = v_F - v_R$	3348	7050	No
v_R	407	2000	No
v_{av34}	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3755	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.465

Space mean speed in ramp influence area, S_R = 54.3 mph

Space mean speed in outer lanes, S_0 = 71.3 mph

Space mean speed for all vehicles, S = 54.3 mph

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Indiana Ave
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB at Indian Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2766	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	235	vph
Length of first accel/decel lane	925	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	493	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2805	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2766	235	493	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	768	65	137	v
Trucks and buses	17	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.922	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3335	264	553	pcph

Estimation of V12 Merge Areas

L_{EQ} = 2651.32 (Equation 25-2 or 25-3)

P_{FM} = 0.603 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2012 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3599	7050	No
$v_{3\ or\ av34}$	1323 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2012	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.294
Space mean speed in ramp influence area,	S_R = 58.2 mph
Space mean speed in outer lanes,	S_0 = 62.0 mph
Space mean speed for all vehicles,	S = 59.6 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	Indiana Ave to Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB between Indiana Ave and Halls Ferry Rd

Flow Inputs and Adjustments

Volume, V	3001	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	834	v
Trucks and buses	17	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.922	
Driver population factor, fp	1.00	
Flow rate, vp	1206	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1206	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.6	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/16/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Halls Ferry Rd
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB at Halls Ferry Rd off ramp

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3001	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	493	vph
Length of first accel/decel lane	300	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	235	vph
Position of adjacent ramp	Upstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2805	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3001		493		235		vph
Peak-hour factor, PHF	0.90		0.90		0.90		
Peak 15-min volume, v15	834		137		65		v
Trucks and buses	17		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	1.5		1.5		1.5		
Recreational vehicle PCE, ER	1.2		1.2		1.2		
Heavy vehicle adjustment, fHV	0.922		0.990		0.990		
Driver population factor, fP	1.00		1.00		1.00		
Flow rate, vp	3618		553		264		pcph

Estimation of V12 Diverge Areas

L_{EQ} = 2353.23 (Equation 25-8 or 25-9)

P_{FD} = 0.644 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2527 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3618	7050	No
$v_{FO} = v_F - v_R$	3065	7050	No
v_R	553	2000	No
$v_{3\ or\ av34}$	1091 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2527	4600	No

!

Level of Service Determination (if not F)

Density, D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D = 23.3 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.478

Space mean speed in ramp influence area, S_R = 54.0 mph

Space mean speed in outer lanes, S_0 = 71.0 mph

Space mean speed for all vehicles, S = 58.2 mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date Performed:	2/16/09
Analysis Time Period:	
Freeway/Dir of Travel:	I-20 WB
Weaving Location:	Halls Ferry Rd to US 61 South
Jurisdiction:	
Analysis Year:	2040 Alt C
Description:	I-20 WB from Halls Ferry Rd to US 61 South

Inputs

Freeway free-flow speed, SFF	65	mph
Weaving number of lanes, N	4	
Weaving segment length, L	2500	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	C	
Volume ratio, VR	0.46	
Weaving ratio, R	0.14	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	161	1393	201	1115	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	45	387	56	310	v
Trucks and buses	2	19	2	19	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.913	0.990	0.913	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	180	1694	225	1356	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.30	6.00
c (Exhibit 24-6)	0.80	1.10
d (Exhibit 24-6)	0.60	0.60
Weaving intensity factor, Wi	0.39	0.30
Weaving and non-weaving speeds, Si	54.60	57.38

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.97
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.00
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	56.07	mph
Weaving segment density, D	15.40	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	7555	pc/h
Capacity as a 15-minute flow rate, c	7480	pc/h
Capacity as a full-hour volume, ch	6732	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1581	3500	a
Average flow rate (pcphpl)	863	2350	b
Volume ratio, VR	0.46	0.50	c
Weaving ratio, R	0.14	0.40	d
Weaving length (ft)	2500	2500	e

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.

HCM Lane Addition Capacity Check

Location: I-20 WB at US 61 South on ramp with resulting lane addition

This analysis follows the guidelines described on pages 25-9 and 25-10 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the downstream of the lane addition, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway after the lane addition are the best indicators to the likely operation. Summarized below is the capacity of the ramp roadway as well as the downstream capacity. A freeway analysis for the resulting number of lanes was performed using HCS.

RAMP ROADWAY CAPACITY CHECK

Given:

Ramp Roadway Volume	234 vph
P_T	4%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.98
v_F	266 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***13%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

DOWNSTREAM FREEWAY CAPACITY CHECK

Given:

Volume	1828 vph
P_T	20%
PHF	0.90
f_p	1.00
Free-Flow Speed	65 mph
Number of Lanes	4

Calculated:

f_{HV}	0.91
v_F	2235 pc/h
Downstream Capacity	9400 pc/h
Percentage of Downstream Capacity	***24%***

Exhibit 25-7. Capacity Values for Merge Areas

Freeway Free-Flow Speed (mi/h)	Maximum Downstream Freeway Flow, v (pc/h)				Max Desirable Flow Entering Influence Area, V_{R12} (pc/h)
	Number of Lanes in One Direction				
	2	3	4	>4	
≥ 70	4800	7200	9600	2400/ln	4600
65	4700	7050	9400	2350/ln	4600
60	4600	6900	9200	2300/ln	4600
55	4500	6750	9000	2250/ln	4600

Source: Highway Capacity Manual 2000

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	US 61 S to Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB between US 61 South and Washington Ave

Flow Inputs and Adjustments

Volume, V	1828	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	508	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	559	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	4	
Free-flow speed:	Measured	
FFS or BFFS	65.0	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	1.5	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	559	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	4	
Density, D	8.6	pc/mi/ln
Level of service, LOS	A	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/18/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	US 61 S to Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB between US 61 South and Washington Ave

Flow Inputs and Adjustments

Volume, V	1828	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	508	v
Trucks and buses	20	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.909	
Driver population factor, fp	1.00	
Flow rate, vp	745	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	65.0	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	3.0	mi/h
Free-flow speed, FFS	65.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	745	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	11.5	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

HCM Lane Drop Capacity Check

Location: I-20 WB Off Ramp at Washington Ave - Single lane drop

This analysis follows the guidelines described on page 25-16 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the ramp roadway itself, and no Level of Service is available. The capacity of the ramp roadway and the level of service on the freeway prior to the lane drop are the best indicators to the likely operation of a ramp resulting from a lane drop.

Given:

Ramp Roadway Volume	427 vph
P_T	2%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.99
v_F	480 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***24%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer Inc.
Date performed:	2/17/09
Analysis time period:	
Freeway/Dir of Travel:	I-20 WB
Junction:	Washington Ave
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB at Washington Ave on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	65.0	mph
Volume on freeway	1401	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	25.0	mph
Volume on ramp	195	vph
Length of first accel/decel lane	700	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	427	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	1200	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	1401	195	427	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	389	54	119	v
Trucks and buses	25	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.889	0.990	0.990	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	1751	219	479	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1751 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1970	4700	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1751	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.4 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, M_S = 0.314

Space mean speed in ramp influence area, S_R = 57.8 mph

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

Space mean speed for all vehicles, S = 57.8 mph

HCS+: Basic Freeway Segments Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency or Company:	Neel-Schaffer Inc.
Date Performed:	2/17/09
Analysis Time Period:	
Freeway/Direction:	I-20 WB
From/To:	MS River Bridge
Jurisdiction:	
Analysis Year:	2040 Alt C

Description: I-20 WB at MS River Bridge

Flow Inputs and Adjustments

Volume, V	1596	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	443	v
Trucks and buses	24	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.893	
Driver population factor, fp	1.00	
Flow rate, vp	993	pc/h/ln

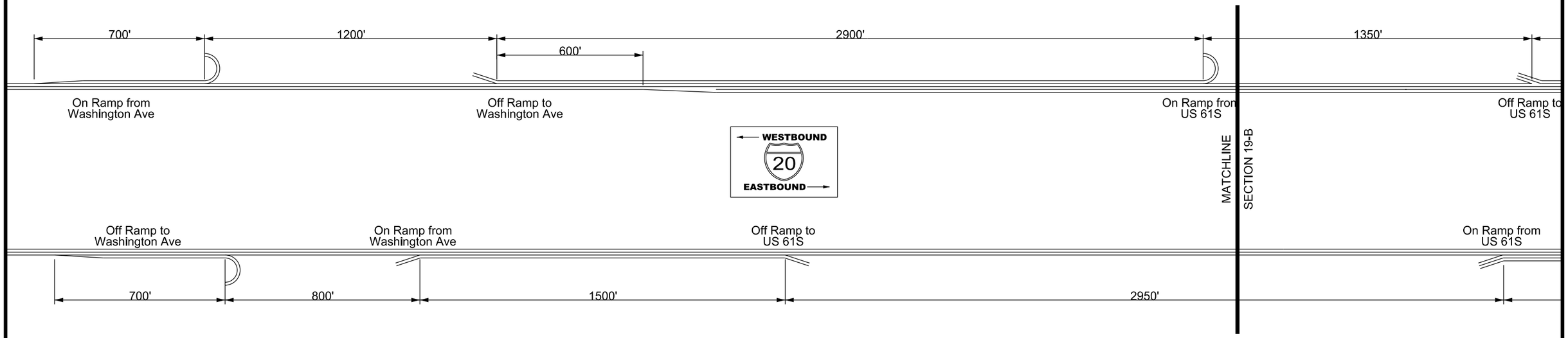
Speed Inputs and Adjustments

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	65.0	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	65.0	mi/h
	Urban Freeway	

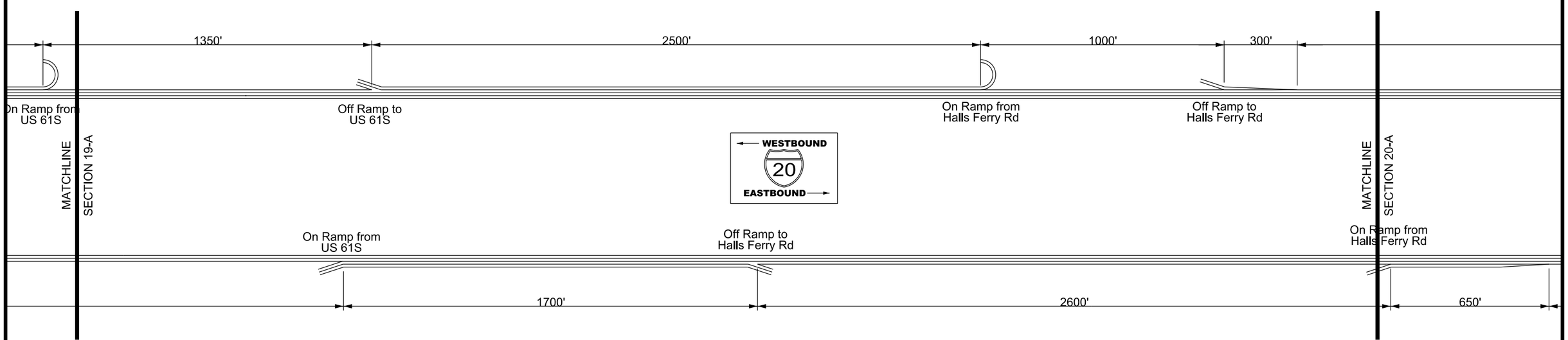
LOS and Performance Measures

Flow rate, vp	993	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	2	
Density, D	15.3	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.



SECTION 19-A



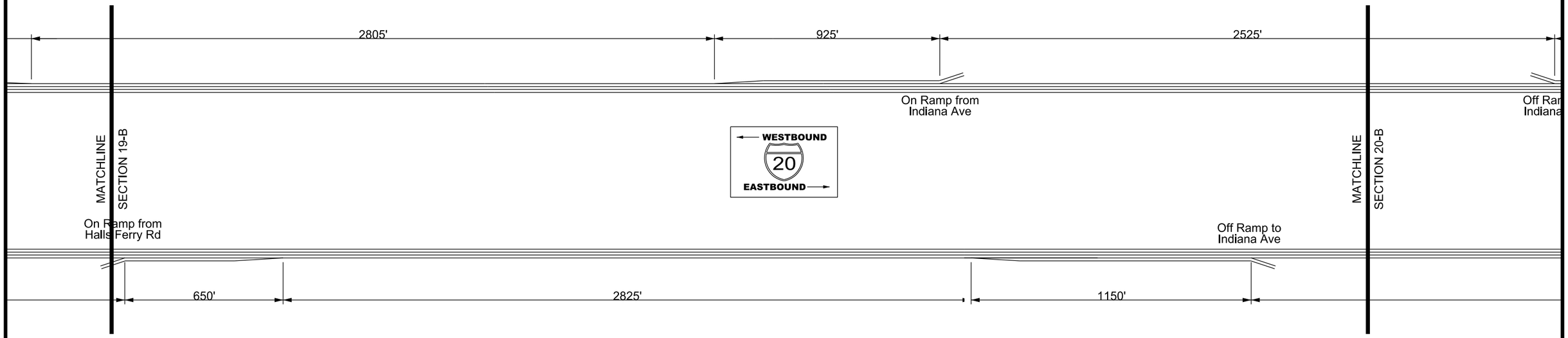
SECTION 19-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

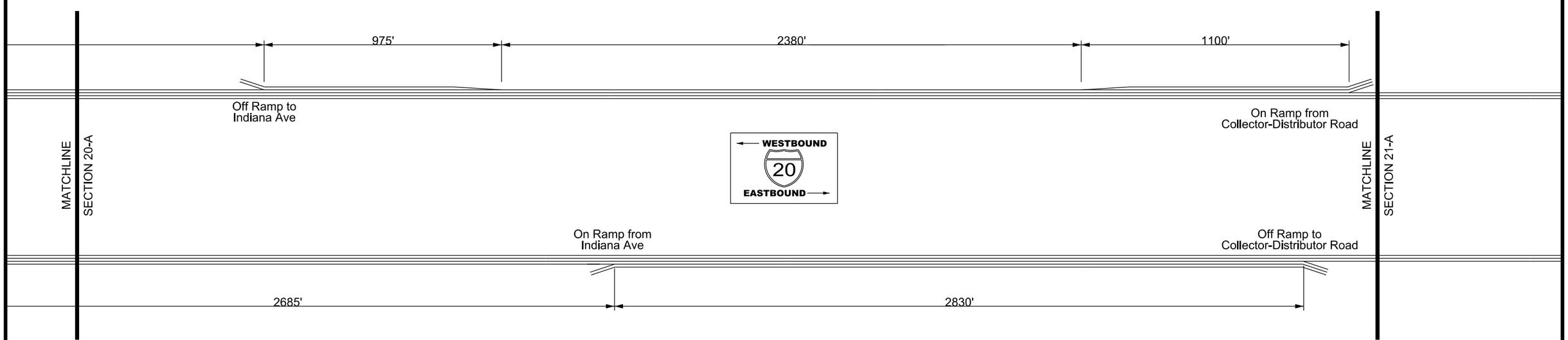
NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR ALTERNATE C
INTERSTATE 20, VICKSBURG, MS

FIGURE
19



SECTION 20-A



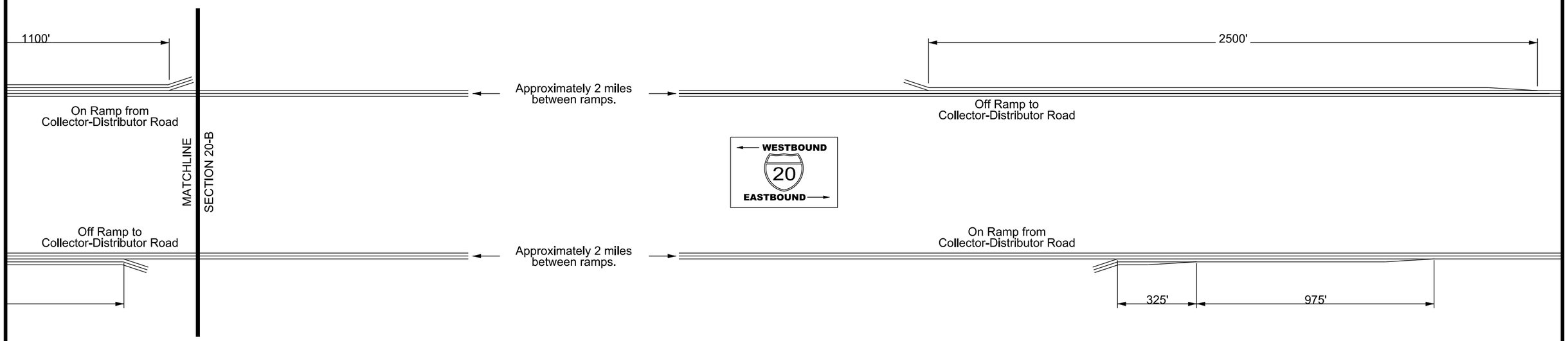
SECTION 20-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR ALTERNATE C
INTERSTATE 20, VICKSBURG, MS

FIGURE
20



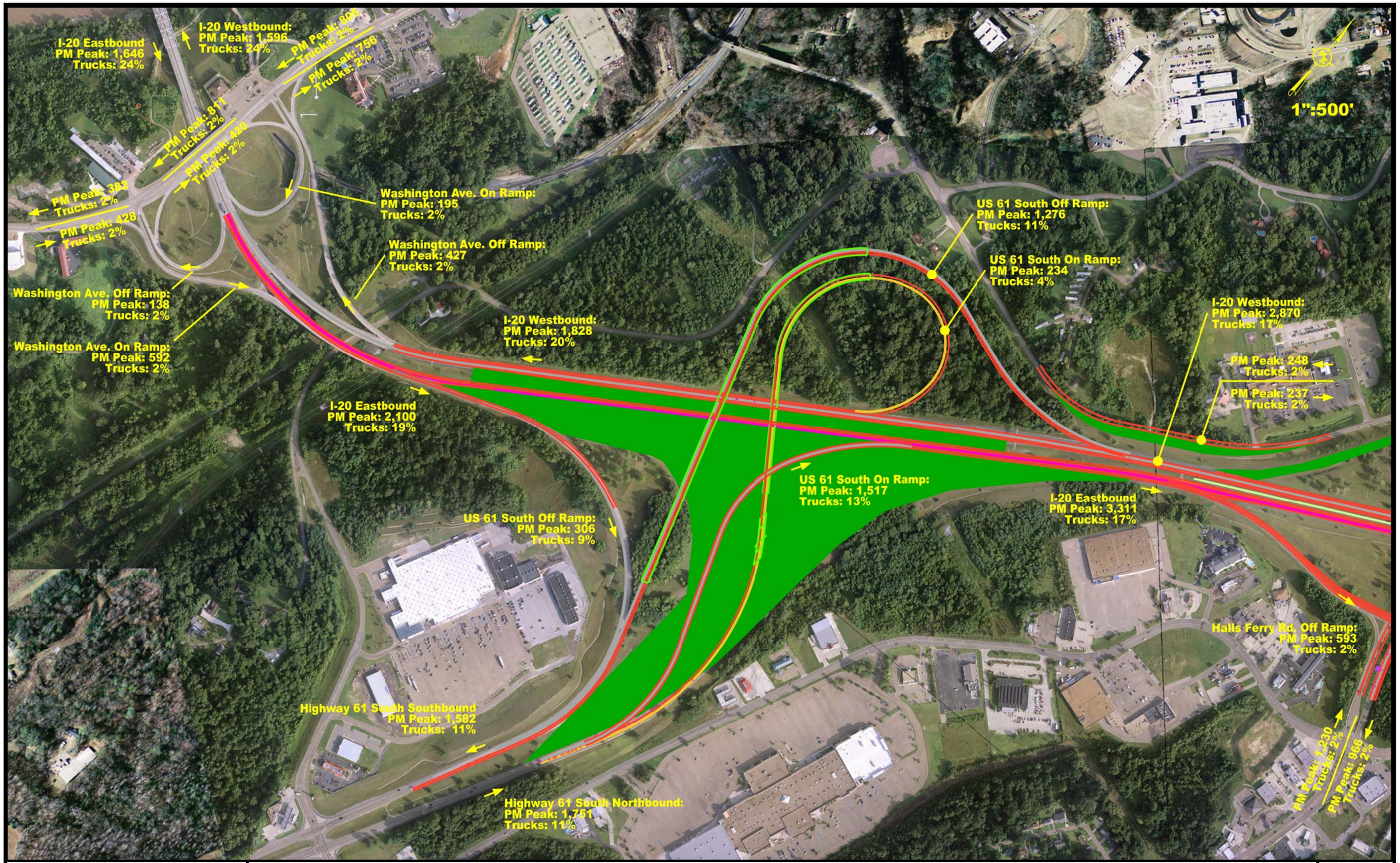
SECTION 21-A

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

NEEL-SCHAFFER
Solutions you can build upon

INTERCHANGE RAMP SPACING FOR ALTERNATE C
INTERSTATE 20, VICKSBURG, MS

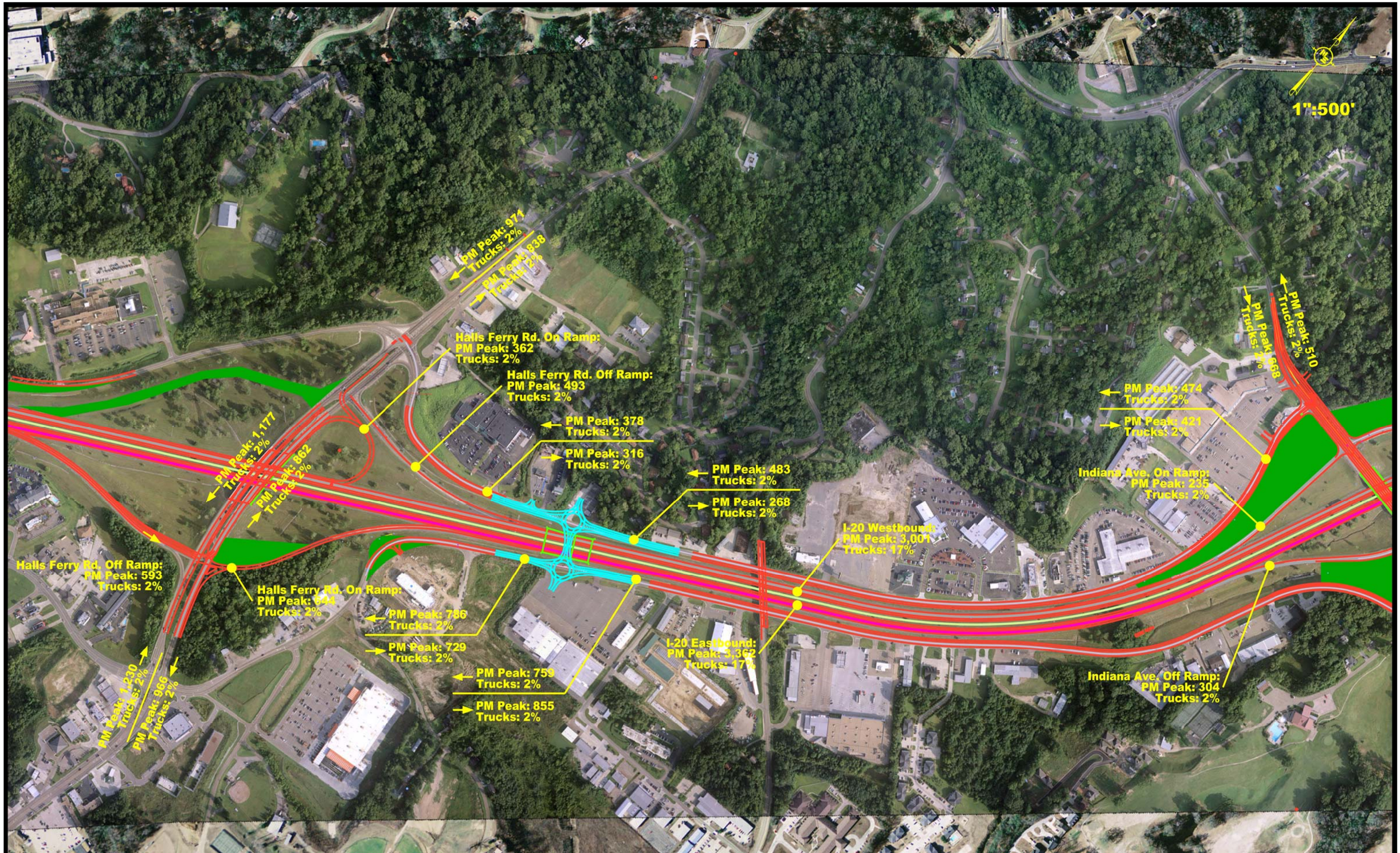
FIGURE
21



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE C TRAFFIC VOLUMES (2040)
TWO-WAY FRONTAGE ROADS

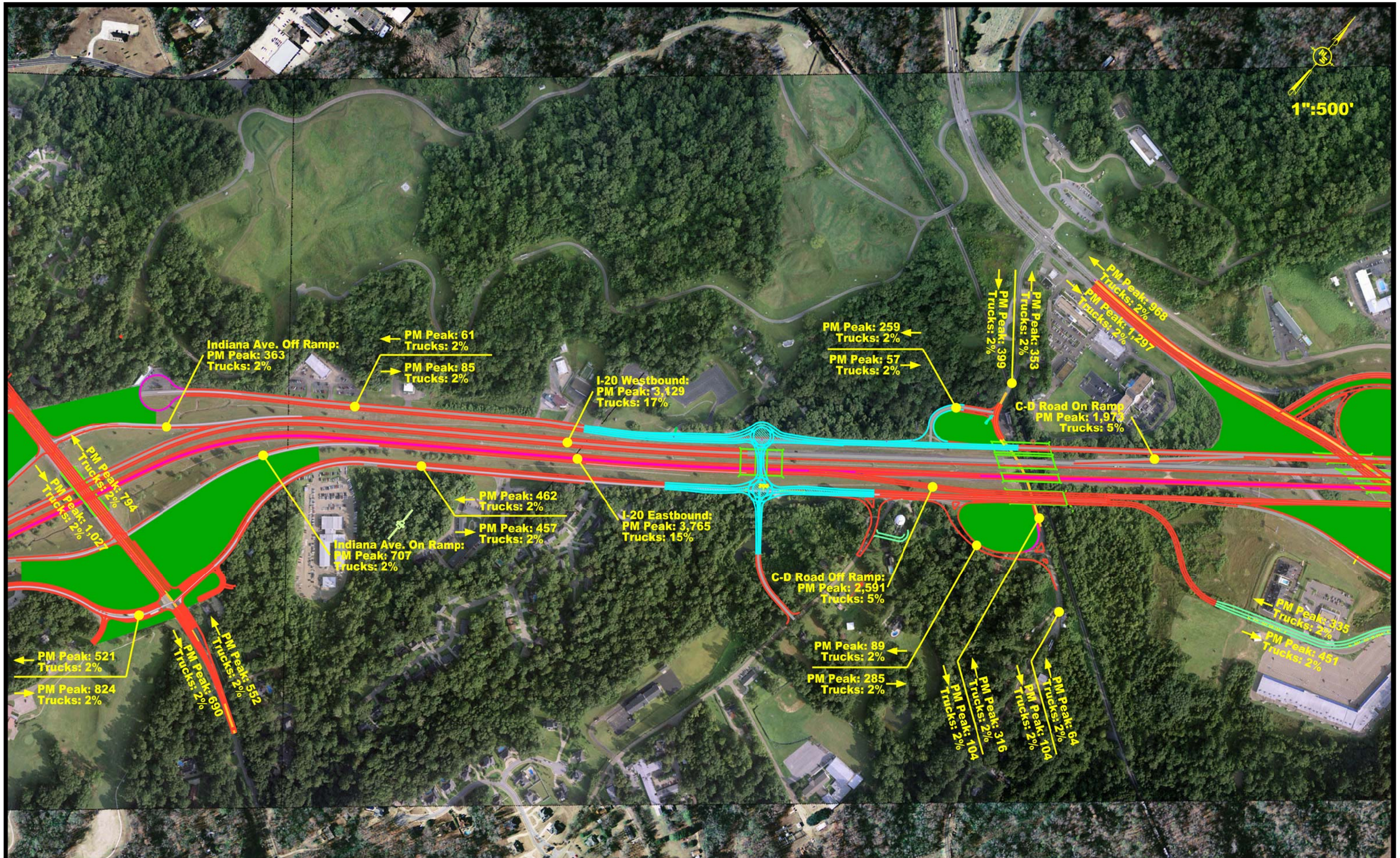
FIGURE
22



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE C TRAFFIC VOLUMES (2040)
TWO-WAY FRONTAGE ROADS

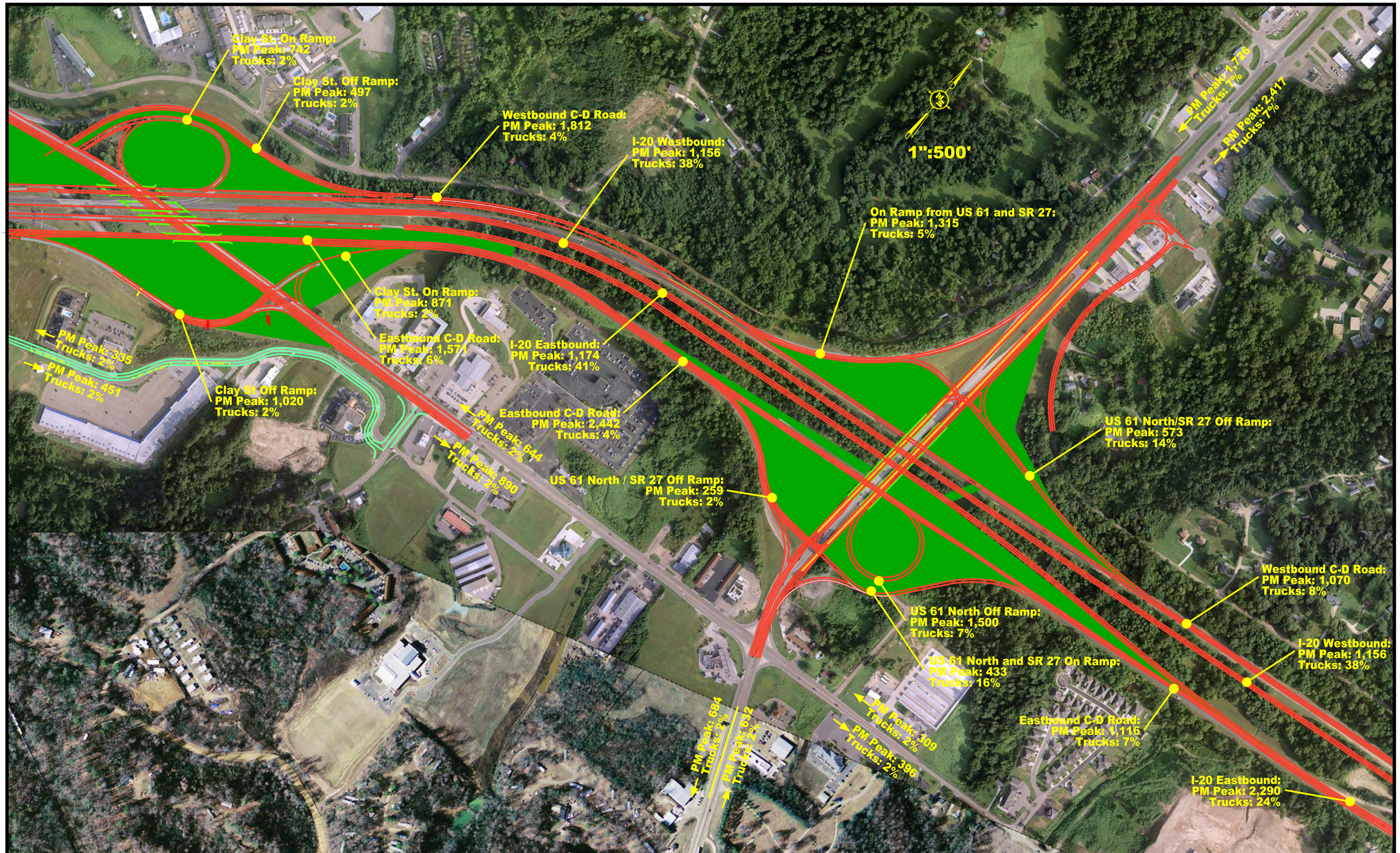
FIGURE
23



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE C TRAFFIC VOLUMES (2040)
TWO-WAY FRONTAGE ROADS

FIGURE
24



NEEL-SCHAFFER
Solutions you can build upon

ALTERNATE C TRAFFIC VOLUMES (2040)
TWO-WAY FRONTAGE ROADS

FIGURE
25

Traffic Analysis Reports:
Collector-Distributer Road for Alternates B and C

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date performed:	4/19/2011
Analysis time period:	
Freeway/Dir of Travel:	Eastbound C-D Road
Junction:	US 80
Jurisdiction:	
Analysis Year:	2040
Description:	EB CD Road off ramp to US 80

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	2591	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1020	vph
Length of first accel/decel lane	230	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2591		1020			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	720		283			v
Trucks and buses	5		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.976		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	2951		1145			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2951 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2951	4500	No
$v_{FO} = v_F - v_R$	1806	4500	No
v_R	1145	2000	No
$v_{3\ or\ av34}$	0 pc/h	(Equation 25-15 or 25-16)	
Is $v_{3\ or\ av34}$ > 2700 pc/h?		No	
Is $v_{3\ or\ av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-18)	

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2951	4600	No

!

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.6 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	D_S = 0.531
Space mean speed in ramp influence area,	S_R = 48.1 mph
Space mean speed in outer lanes,	S_0 = N/A mph
Space mean speed for all vehicles,	S = 48.1 mph

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date Performed:	4/19/2011
Analysis Time Period:	
Freeway/Dir of Travel:	Eastbound C-D Road
Weaving Location:	From US 80 to US 61N
Jurisdiction:	
Analysis Year:	2040

Description: EB CD Road - US 80 On Ramp to US 61N Off Ramp

Inputs

Freeway free-flow speed, SFF	55	mph
Weaving number of lanes, N	4	
Weaving segment length, L	2170	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	Multilane or C-D
Volume ratio, VR	0.39	
Weaving ratio, R	0.17	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	1404	92	167	779	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	390	26	46	216	v
Trucks and buses	4	2	2	4	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.990	0.990	0.980	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1591	103	187	882	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.34	0.21
Weaving and non-weaving speeds, Si	48.52	52.16

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.60
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	50.69	mph
Weaving segment density, D	13.63	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	7388	pc/h
Capacity as a 15-minute flow rate, c	7243	pc/h
Capacity as a full-hour volume, ch	6519	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1069	4000	a
Average flow rate (pcphpl)	690	2250	b
Volume ratio, VR	0.39	0.80	c
Weaving ratio, R	0.17	N/A	d
Weaving length (ft)	2170	2500	e

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.

HCM Major Diverge Areas

Location: Major Diverge of EB C-D Road at Off Loop to US 61N Northbound

Equation 25-12:

$$D = 0.0109 \times \frac{v_F}{N}$$

D = Average density across all freeway lanes for a distance of 1500 ft upstream of diverge (pc/mi/ln)

v_F = Freeway flow rate approaching diverge area (pc/h)

N = Number of lanes on freeway segment approaching diverge area

Given:

Volume	2183 vph
P_T	7%
PHF	0.90
f_p	1.00
N	3 lanes

Calculated:

f_{HV}	0.97
v_F	2511 pc/h
D	9.12 pc/mi/ln

LOS A

(Analysis performed as described on pages 25-16 through 25-17 of the HCM 2000)

HCS+: Ramps and Ramp Junctions Release 5.21

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date performed:	4/19/2011
Analysis time period:	
Freeway/Dir of Travel:	Eastbound C-D Road
Junction:	US 61 North
Jurisdiction:	
Analysis Year:	2040
Description:	EB CD Road at US61N on ramp

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	683	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	433	vph
Length of first accel/decel lane	1015	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1500	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	800	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	683	433	1500	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	190	120	417	v
Trucks and buses	2	16	7	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.926	0.966	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	766	520	1725	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 766 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1286	4500	No
$v_{3 \text{ or } av34}$	0 pc/h	(Equation 25-4 or 25-5)	
Is $v_{3 \text{ or } av34}$ > 2700 pc/h?		No	
Is $v_{3 \text{ or } av34}$ > 1.5 v_{12} /2		No	
If yes, v_{12A} =		(Equation 25-8)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	766	4400	No

!

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 8.9 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.264
Space mean speed in ramp influence area,	S_R = 51.6 mph
Space mean speed in outer lanes,	S_0 = N/A mph
Space mean speed for all vehicles,	S = 51.6 mph

HCM Ramp Capacity Check

Location: WB I-20 C-D Rd East of off ramp to US 61N/SR 27

This analysis follows the guidelines described on page 25-16 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the ramp roadway itself, and no Level of Service is available.

Given:

Ramp Roadway Volume	1070 vph
P_T	8%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	45 mph

Calculated:

f_{HV}	0.96
v_F	1237 pc/h
Ramp Capacity	2100 pc/h
Percentage of Ramp Capacity	***59%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

HCM Ramp Capacity Check

Location: WB I-20 C-D Rd off ramp to US 61N/SR 27

This analysis follows the guidelines described on page 25-16 in the Highway Capacity Manual, 2000 Edition. The analysis provides a capacity check of the ramp roadway itself, and no Level of Service is available.

Given:

Ramp Roadway Volume	573 vph
P_T	14%
PHF	0.90
f_p	1.00
Single or Two Lane Ramp	Single
Estimated Ramp FFS	35 mph

Calculated:

f_{HV}	0.93
v_F	682 pc/h
Ramp Capacity	2000 pc/h
Percentage of Ramp Capacity	***34%***

Exhibit 25-3. Approximate Capacity of Ramp Roadways

Free-Flow Speed of Ramps, S_{FR} (mi/h)	Capacity (pc/h)	
	Single-Lane Ramps	Two-Lane Ramps
> 50	2200	4400
> 40 - 50	2100	4100
> 30 - 40	2000	3800
≥ 20 - 30	1900	3500
< 20	1800	3200

Source: Highway Capacity Manual 2000

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc.
Date Performed:	3/13/2012
Analysis Time Period:	
Freeway/Dir of Travel:	Westbound C-D Road
Weaving Location:	US 61N to US 80
Jurisdiction:	
Analysis Year:	2040

Description: WB CD Road from US 61N on ramp to US 80 off ramp

Inputs

Freeway free-flow speed, SFF	55	mph
Weaving number of lanes, N	3	
Weaving segment length, L	2075	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	A	Multilane or C-D
Volume ratio, VR	0.60	
Weaving ratio, R	0.12	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	361	361	954	136	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	100	100	265	38	v
Trucks and buses	2	5	5	2	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.976	0.976	0.990	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	405	411	1086	152	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.35	0.0020
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	1.23	0.21
Weaving and non-weaving speeds, Si	35.14	52.24

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.88
Maximum number of lanes, Nw (max) (Exhibit 24-7)	1.40
Type of operation is	Constrained

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	40.39	mph
Weaving segment density, D	16.95	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	4727	pc/h
Capacity as a 15-minute flow rate, c	4680	pc/h
Capacity as a full-hour volume, ch	4212	pc/h

Limitations on Weaving Segments

	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	1238	2800	a
Average flow rate (pcphpl)	684	2250	b
Volume ratio, VR	0.60	0.45	c
Weaving ratio, R	0.12	N/A	d
Weaving length (ft)	2075	2500	e

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.

HCS+: Freeway Weaving Release 5.21

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	Sorrell
Agency/Co.:	Neel-Schaffer, Inc
Date Performed:	4/19/2011
Analysis Time Period:	
Freeway/Dir of Travel:	Westbound C-D Road
Weaving Location:	US80 to N. Frontage
Jurisdiction:	
Analysis Year:	2040

Description: WB CD Road from US 80 to N. Frontage Rd

Inputs

Freeway free-flow speed, SFF	55	mph
Weaving number of lanes, N	3	
Weaving segment length, L	1025	ft
Terrain type	Level	
Grade		%
Length		mi
Weaving type	B	Multilane or C-D
Volume ratio, VR	0.37	
Weaving ratio, R	0.07	

Conversion to pc/h Under Base Conditions

	Non-Weaving V A-C	Non-Weaving V B-D	Weaving V A-D	Weaving V B-C	
Volume, V	30	1261	712	54	veh/h
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	8	350	198	15	v
Trucks and buses	2	5	2	5	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.990	0.976	0.990	0.976	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	33	1436	799	61	pc/h

Weaving and Non-Weaving Speeds

	Weaving	Non-Weaving
a (Exhibit 24-6)	0.08	0.0020
b (Exhibit 24-6)	2.20	6.00
c (Exhibit 24-6)	0.70	1.00
d (Exhibit 24-6)	0.50	0.50
Weaving intensity factor, Wi	0.53	0.32
Weaving and non-weaving speeds, Si	44.49	49.10

Number of lanes required for

unconstrained operation, Nw (Exhibit 24-7)	1.47
Maximum number of lanes, Nw (max) (Exhibit 24-7)	3.50
Type of operation is	Unconstrained

Weaving Segment Speed, Density, Level of Service and Capacity

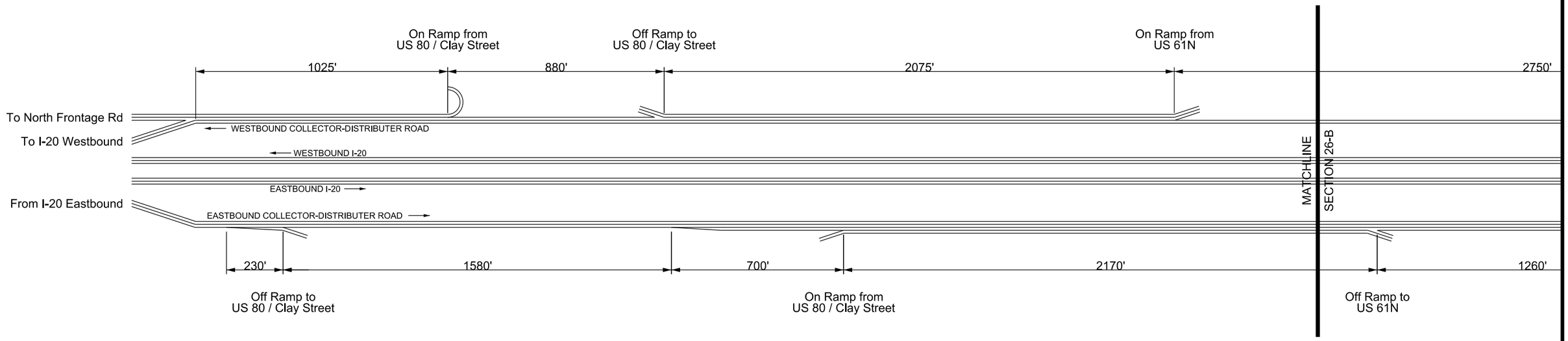
Weaving segment speed, S	47.29	mph
Weaving segment density, D	16.42	pc/mi/ln
Level of service, LOS	B	
Capacity of base condition, cb	5181	pc/h
Capacity as a 15-minute flow rate, c	5130	pc/h
Capacity as a full-hour volume, ch	4617	pc/h

Limitations on Weaving Segments

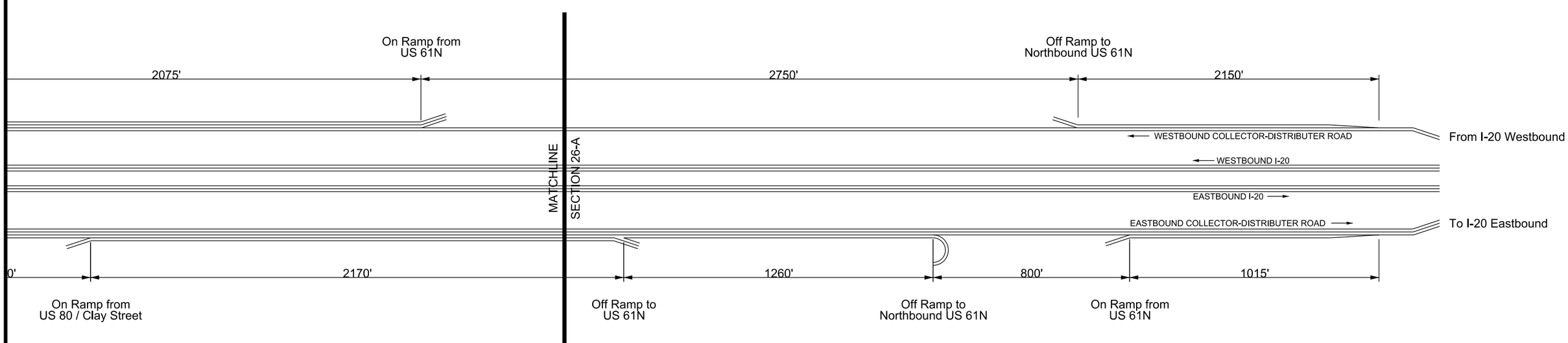
	Analyzed	If Max Exceeded Maximum	See Note Note
Weaving flow rate, Vw	860	4000	a
Average flow rate (pcphpl)	776	2250	b
Volume ratio, VR	0.37	0.80	c
Weaving ratio, R	0.07	N/A	d
Weaving length (ft)	1025	2500	e

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.



SECTION 26-A



SECTION 26-B

This figure depicts ramp spacing and the number of lanes used for traffic analysis purposes only. Not to scale.

NEEL-SCHAFFER
Solutions you can build upon

COLLECTOR-DISTRIBUTER ROAD RAMP SPACING FOR ALTERNATES B AND C
INTERSTATE 20, VICKSBURG, MS

FIGURE
26