

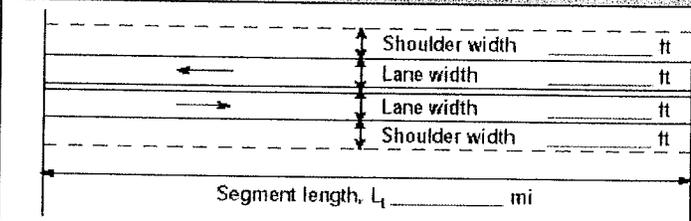
**MODIFIED LEVEL OF SERVICE CRITERIA
LEVEL OF SERVICE CALCULATION WORKSHEETS
YEAR 2030 "WITHOUT FOREST RANCH" SCENARIO**

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level <input type="checkbox"/> Rolling	
Grade Length 4.00 mi	Up/down -3.0
Peak-hour factor, PHF 0.88	
No-passing zone 88%	
% Trucks and Buses, P _T 2%	
% Recreational vehicles, P _R 2%	
Access points/ mi 2	

Analysis direction vol., V_d 888veh/h
 Opposing direction vol., V_o 253veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 20-9 or 20-15)	1.1	7.5
Passenger-car equivalents for RVs, E _R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/(1+P _T (E _T -1)+P _R (E _R -1))	0.998	0.885
Grade adjustment factor ¹ , f _G (Exhibit 20-7 or 20-13)	1.00	0.94
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV} *f _G)	1011	346
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S _{FM} mi/h	Base free-flow speed ³ , BFFS _{FM} 60.0 mi/h	
Observed volume ³ , V _f veh/h	Adj. for lane width and shoulder width ³ , f _{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS _d FFS=S _{FM} +0.00776(V _f /f _{HV}) mi/h	Adj. for access points ³ , f _A (Exhibit 20-5) 0.5 mi/h	
Adjustment for no-passing zones, f _{np} (Exhibit 20-19) 3.1 mi/h	Free-flow speed, FFS _d (FSS=BFFS-f _{LS} -f _A) 59.5 mi/h	
	Average travel speed, ATS=FFS-0.00776V _o -f _{np} 45.8 mi/h	

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 20-10 or 20-16)	1.0	1.5
Passenger-car equivalents for RVs, E _R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/(1+P _T (E _T -1)+P _R (E _R -1))	1.000	0.990
Grade adjustment factor ¹ , f _G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate ² , v _i (pc/h)=V _i /(PHF*f _{HV} *f _G)	1009	290
Base percent time-spent-following ⁴ , BPTSF(%)=100(1-e ^{-av_d^b})	71.7	
Adj. for no-passing zone, f _{np} (Exhibit. 20-20)	24.1	
Percent time-spent-following, PTSF(%)=BPTSF+f _{np}	90.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, v/c=V _p /1,700	0.59
Peak 15-min veh-miles of travel, VMT ₁₅ (veh-mi)=0.25L ₁ (V/PHF)	2725
Peak-hour vehicle-miles of travel, VMT ₈₀ (veh-mi)=V*L ₁	9590
Peak 15-min total travel time, TT ₁₅ (veh-h)=VMT ₁₅ /ATS	59.4

Notes

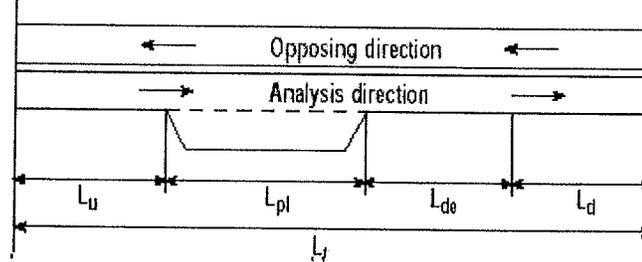
1. If the highway is extended segment (level) or rolling terrain, f_G=1.0.
2. If v_i(V_d or V_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch
Project Description: Foresthill Divide Community Plan			

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	10.8
Length of two-lane highway upstream of the passing lane, L_u (mi)	4.8
Length of passing lane including tapers, L_{pl} (mi)	1.5
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	45.8
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	90.4
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	2.80
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	46.9

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	3.60
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	0.90
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}(\%)$ $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	79.9

Level of Service and Other Performance Measures⁴

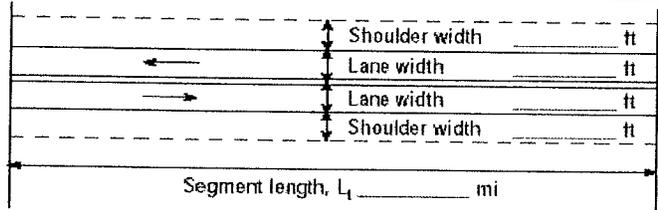
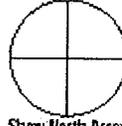
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15} / ATS_{pl}$	58.1

Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mtig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch
Project Description: Foresthill Divide Community Plan			

Input Data	
 <p>Shoulder width _____ ft Lane width _____ ft Lane width _____ ft Shoulder width _____ ft</p> <p>Segment length, L_1 _____ mi</p> <p>Analysis direction vol., V_d 605veh/h Opposing direction vol., V_o 328veh/h</p>	<div style="text-align: center;">  Show North Arrow </div> <p> <input checked="" type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway Terrain <input type="checkbox"/> Level <input type="checkbox"/> Rolling Grade Length 1.70 mi Up/down -3.4 Peak-hour factor, PHF 0.88 No-passing zone 100% % Trucks and Buses, P_T 2% % Recreational vehicles, P_R 2% Access points/ mi 5 </p>

Average Travel Speed		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)		1.1	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)		1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$		0.998	0.915
Grade adjustment factor ¹ , f_G (Exhibit 20-7 or 20-13)		1.00	0.98
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$		689	415
Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM}	mi/h	Base free-flow speed ³ , $BFFS_{FM}$ 60.0 mi/h	
Observed volume ³ , V_f	veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$	mi/h	Adj. for access points ³ , f_A (Exhibit 20-5) 1.3 mi/h	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19)	2.8 mi/h	Free-flow speed, FFS_d ($FSS=BFFS \cdot f_{LS} \cdot f_A$) 58.8 mi/h	
		Average travel speed, $ATS=FFS-0.00776v_p \cdot f_{np}$ 47.4 mi/h	

Percent Time Spent Following		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)		1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)		1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$		1.000	1.000
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)		1.00	0.94
Directional flow rate ² , v_i (pc/h)= $V_i/(PHF \cdot f_{HV} \cdot f_G)$		688	395
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-v_d^b})$			59.9
Adj. for no-passing zone, f_{np} (Exhibit 20-20)			33.1
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$			80.9

Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1,700$	0.41
Peak 15-min veh-miles of travel, VMT_{15} (veh- mi)= $0.25L_1(V/PHF)$	292
Peak-hour vehicle-miles of travel, VMT_{60} (veh- mi)= $V \cdot L_1$	1029
Peak 15-min total travel time, TT_{15} (veh-h)= VMT_{15}/ATS	6.2

- Notes**
1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
 2. If $v_i(v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
 3. For the analysis direction only.
 4. Exhibit 20-21 provides factors a and b.
 5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mtg.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch
Project Description: Foresthill Divide Community Plan			

Input Data

Class I highway Class II highway

Show North Arrow

Total length of analysis segment, L_t (mi)	1.7
Length of two-lane highway upstream of the passing lane, L_u (mi)	1.0
Length of passing lane including tapers, L_{pl} (mi)	0.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	47.4
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	80.9
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.20
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	49.2

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	5.80
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-5.30
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}(\%)$ $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	68.7

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	5.9

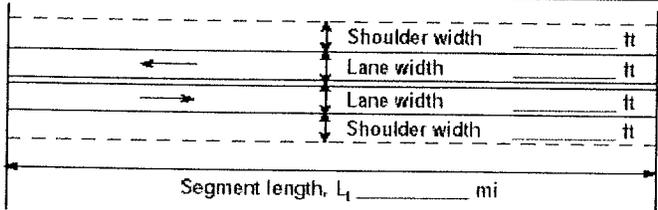
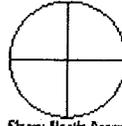
Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data	
 <p style="text-align: center;">Segment length, L_1 _____ mi</p>	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">  <p>Show North Arrow</p> </div> <div> <input checked="" type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway Terrain <input type="checkbox"/> Level <input type="checkbox"/> Rolling Grade Length 4.00 mi Up/down -3.0 Peak-hour factor, PHF 0.76 No-passing zone 88% % Trucks and Buses, P_T 4% % Recreational vehicles, P_R 2% Access points/ mi 2 </div> </div>
Analysis direction vol., V_d	341 veh/h
Opposing direction vol., V_o	899 veh/h

Average Travel Speed		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV} = 1 / (1 + P_T(E_T - 1) + P_R(E_R - 1))$	0.992	0.842
Grade adjustment factor f_G (Exhibit 20-7 or 20-13)	1.00	0.95
Directional flow rate ² , v_i (pc/h) $v_i = V_i / (PHF * f_{HV} * f_G)$	452	1479
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} mi/h	Base free-flow speed ³ , $BFFS_{FM}$ 60.0 mi/h	
Observed volume ³ , V_f veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS_d $FFS = S_{FM} + 0.00776(V_f / f_{HV})$ mi/h	Adj. for access points ³ , f_A (Exhibit 20-5) 0.5 mi/h	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) 0.8 mi/h	Free-flow speed, FFS_d ($FSS = BFFS - f_{LS} - f_A$) 59.5 mi/h	
	Average travel speed, $ATS = FFS - 0.00776 v_p - f_{np}$ 43.7 mi/h	

Percent Time Spent Following		
	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV} = 1 / (1 + P_T(E_T - 1) + P_R(E_R - 1))$	0.996	1.000
Grade adjustment factor f_G (Exhibit 20-8 or 20-14)	1.00	0.97
Directional flow rate ² , v_i (pc/h) $v_i = V_i / (PHF * f_{HV} * f_G)$	450	1219
Base percent time-spent-following ⁴ , $BPTSF(\%) = 100(1 - e^{-a v_d^b})$	56.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	22.4	
Percent time-spent-following, $PTSF(\%) = BPTSF + f_{np}$	62.8	

Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c = V_p / 1,700$	0.27
Peak 15-min veh-miles of travel, $VMT_{15} (\text{veh} \cdot \text{mi}) = 0.25 L_1 (V / PHF)$	1211
Peak-hour vehicle-miles of travel, $VMT_{60} (\text{veh} \cdot \text{mi}) = V * L_1$	3683
Peak 15-min total travel time, $TT_{15} (\text{veh} \cdot \text{h}) = VMT_{15} / ATS$	27.7

- Notes**
1. If the highway is extended segment (level) or rolling terrain, $f_G = 1.0$.
 2. If $v_i (v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
 3. For the analysis direction only.
 4. Exhibit 20-21 provides factors a and b.
 5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

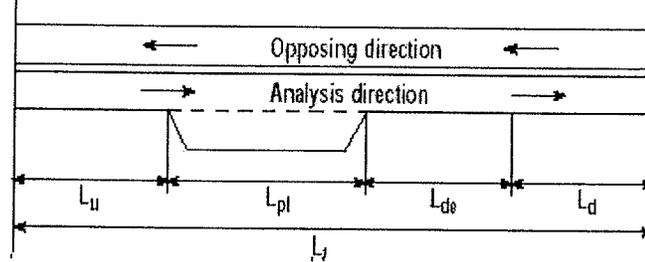
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	10.8
Length of two-lane highway upstream of the passing lane, L_u (mi)	4.8
Length of passing lane including tapers, L_{pl} (mi)	1.5
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	43.7
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	62.8
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	2.80
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	44.6

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	7.70
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-3.20
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane ³ , $PTSF_{pl}(\%)$ $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	52.2

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	27.1

Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

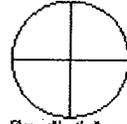
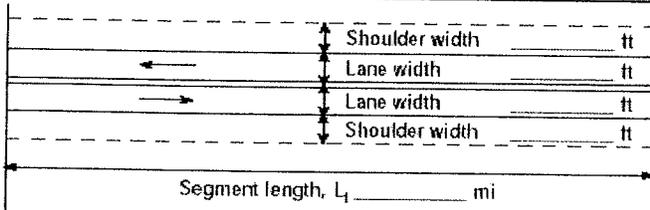
Analyst: MKL
 Agency or Company: MRO Engineers, Inc.
 Date Performed: 2/27/07
 Analysis Time Period: PM Peak Hour

Site Information

Highway / Direction of Travel: Foresthill Road - WB - Mitig.
 From/To: Spring Garden to Todd Valley W
 Jurisdiction: Placer County
 Analysis Year: Year 2030 Without Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



Class I highway Class II highway
 Terrain: Level Rolling
 Grade Length: 1.70 mi Up/down: -3.4
 Peak-hour factor, PHF: 0.88
 No-passing zone: 100%
 % Trucks and Buses, P_T : 3%
 % Recreational vehicles, P_R : 2%
 Access points/ mi: 5

Analysis direction vol., V_d : 383 veh/h
 Opposing direction vol., V_o : 573 veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	4.3
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.994	0.909
Grade adjustment factor f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	438	716
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} (mi/h)	Base free-flow speed ³ , $BFFS_{FM}$: 60.0 mi/h	
Observed volume ³ , V_f (veh/h)	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5): 0.0 mi/h	
Free-flow speed, $FFS_d = FFS_{FM} + 0.00776(V_f / f_{HV})$ (mi/h)	Adj. for access points ³ , f_A (Exhibit 20-5): 1.3 mi/h	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19): 1.6 mi/h	Free-flow speed, FFS_d ($FSS=BFFS_{FM} \cdot f_{LS} \cdot f_A$): 58.8 mi/h	
	Average travel speed, $ATS=FFS_d \cdot 0.00776 V_p \cdot f_{np}$: 48.2 mi/h	

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.997	1.000
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	437	690
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-a v_d^b})$	49.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	33.7	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	62.8	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1,700$	0.26
Peak 15-min veh-miles of travel, VMT_{15} (veh-mi) $=0.25L_1(V/PHF)$	185
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $=V \cdot L_1$	651
Peak 15-min total travel time, TT_{15} (veh-h) $=VMT_{15}/ATS$	3.8

Notes

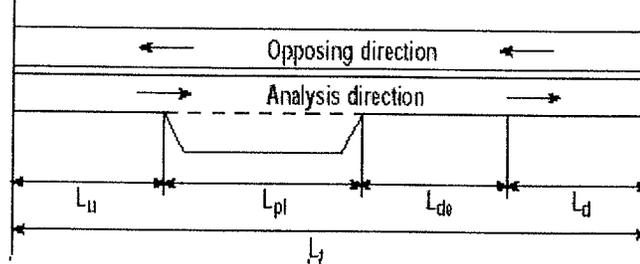
- If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
- If $v_i(v_d$ or $v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
- For the analysis direction only.
- Exhibit 20-21 provides factors a and b.
- Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - WB - Mitig.
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 Without Forest Ranch
Project Description: Foresthill Divide Community Plan			

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	1.7
Length of two-lane highway upstream of the passing lane, L_u (mi)	1.0
Length of passing lane including tapers, L_{pl} (mi)	0.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	48.2
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	62.8
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.20
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	49.8

Percent Time Spent Following

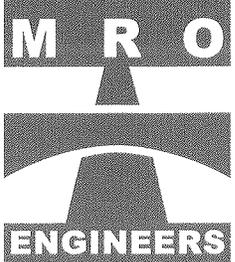
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	7.80
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-7.30
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane ³ , $PTSF_{pl}(\%)$ $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	52.9

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15} / ATS_{pl}$	3.7

Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.



ATTACHMENT C

TWO-LANE HIGHWAY

LEVEL OF SERVICE CALCULATION WORKSHEETS

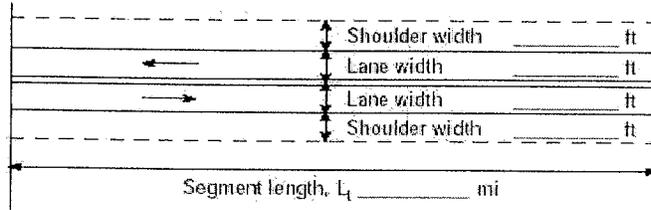
YEAR 2030 "WITH FOREST RANCH" SCENARIO

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level	<input type="checkbox"/> Rolling
Grade Length 4.00 mi	Up/down 3.0
Peak-hour factor, PHF 0.88	No-passing zone 55%
% Trucks and Buses, P_T 6%	% Recreational vehicles, P_R 2%
Access points/ mi 2	

Analysis direction vol., V_d 347veh/h
 Opposing direction vol., V_o 993veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	7.5	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.719	0.994
Grade adjustment factor f_G (Exhibit 20-7 or 20-13)	0.94	1.00
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	583	1135
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} mi/h	Base free-flow speed ³ , $BFFS_{FM}$ 60.0 mi/h	
Observed volume ³ , V_f veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$ mi/h	Adj. for access points ³ , f_A (Exhibit 20-5) 0.5 mi/h	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) 0.8 mi/h	Free-flow speed, FFS_d ($FSS=BFFS \cdot f_{LS} \cdot f_A$) 59.5 mi/h	
	Average travel speed, $ATS=FFS \cdot 0.00776 V_p \cdot f_{np}$ 45.3 mi/h	

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate ² , v_i (pc/h) $=V_i/(PHF \cdot f_{HV} \cdot f_G)$	394	1128
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-av_d^b})$	51.8	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	22.8	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	57.7	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	C
Volume to capacity ratio, $v/c=V_p/1,700$	0.34
Peak 15-min veh-miles of travel, $VMT_{15}(\text{veh} \cdot \text{mi})=0.25L_t(V/PHF)$	1065
Peak-hour vehicle-miles of travel, $VMT_{60}(\text{veh} \cdot \text{mi})=V \cdot L_t$	3748
Peak 15-min total travel time, $TT_{15}(\text{veh} \cdot \text{h})=VMT_{15}/ATS$	23.5

Notes

1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
2. If $v_i(v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

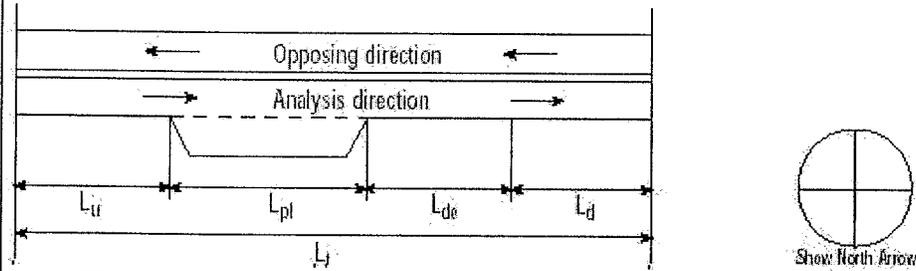
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	10.8
Length of two-lane highway upstream of the passing lane, L_u (mi)	3.0
Length of passing lane including tapers, L_{pi} (mi)	4.9
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	45.3
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	57.7
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	C

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pi} + L_{de})$	1.20
Adj. factor for the effect of passing lane on average speed, f_{pi} (Exhibit 20-24)	1.10
Average travel speed including passing lane ² , $ATS_{pi} = (ATS_d * L_t) / (L_u + L_d + (L_{pi}/f_{pi}) + (2L_{de}/(1+f_{pi})))$	47.7

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	8.25
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $= L_t - (L_u + L_{pi} + L_{de})$	-5.35
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pi} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane ³ , $PTSF_{pi}$ (%) $PTSF_{pi} = PTSF_d [L_u + L_d + f_{pi} L_{pi} + ((1+f_{pi})/2)L_{de}] / L_t$	42.5

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pi} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15}/ATS_{pi}$	22.3

Notes

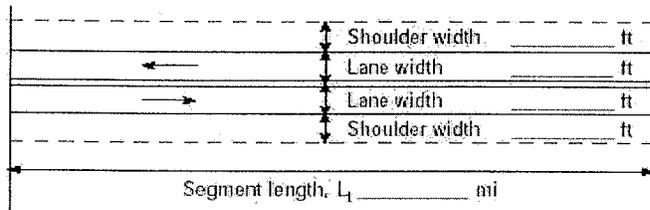
1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level <input checked="" type="checkbox"/> Rolling	
Grade Length	4.00 mi
Up/down	-3.0
Peak-hour factor, PHF	0.88
No-passing zone	88%
% Trucks and Buses, P _T	2%
% Recreational vehicles, P _R	2%
Access points/ mi	2

Analysis direction vol., V_d 993veh/h
 Opposing direction vol., V_o 347veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 20-9 or 20-15)	1.1	7.5
Passenger-car equivalents for RVs, E _R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/(1+P _T (E _T -1)+P _R (E _R -1))	0.998	0.885
Grade adjustment factor ¹ , f _G (Exhibit 20-7 or 20-13)	1.00	0.94
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV} *f _G)	1131	474
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S _{FM} mi/h	Base free-flow speed ³ , BFFS _{FM}	60.0 mi/h
Observed volume ³ , V _i veh/h	Adj. for lane width and shoulder width ³ , f _{LS} (Exh 20-5)	0.0 mi/h
Free-flow speed, FFS _d FFS=S _{FM} +0.00776(V _i /f _{HV}) mi/h	Adj. for access points ³ , f _A (Exhibit 20-5)	0.5 mi/h
Adjustment for no-passing zones, f _{np} (Exhibit 20-19) 2.5 mi/h	Free-flow speed, FFS _d (FSS=BFFS-f _{LS} -f _A)	59.5 mi/h
	Average travel speed, ATS=FFS-0.00776V _p -f _{np}	44.6 mi/h

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E _R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/(1+P _T (E _T -1)+P _R (E _R -1))	1.000	1.000
Grade adjustment factor ¹ , f _G (Exhibit 20-8 or 20-14)	1.00	1.00
Directional flow rate ² , v _i (pc/h)=V _i /(PHF*f _{HV} *f _G)	1128	394
Base percent time-spent-following ⁴ , BPTSF(%)=100(1-e ^{-av_id})	76.4	
Adj. for no-passing zone, f _{np} (Exhibit 20-20)	20.4	
Percent time-spent-following, PTSF(%)=BPTSF+f _{np}	91.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, v/c=V _p /1,700	0.67
Peak 15-min veh-miles of travel, VMT ₁₅ (veh-mi)=0.25L _t (V/PHF)	3047
Peak-hour vehicle-miles of travel, VMT ₆₀ (veh-mi)=V*L _t	10724
Peak 15-min total travel time, TT ₁₅ (veh-h)=VMT ₁₅ /ATS	68.3

Notes

1. If the highway is extended segment (level) or rolling terrain, f_G=1.0.
2. If v_i(V_d or V_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

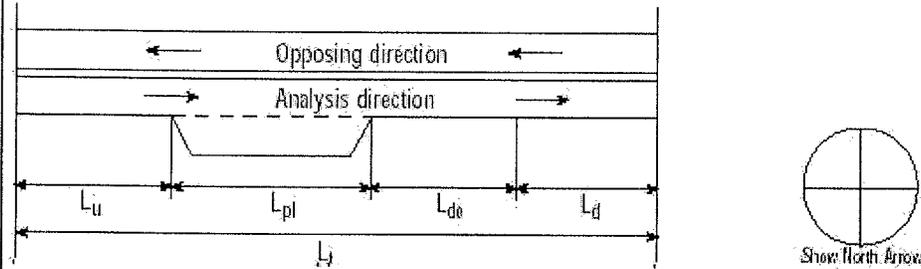
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	10.8
Length of two-lane highway upstream of the passing lane, L_u (mi)	4.8
Length of passing lane including tapers, L_{pl} (mi)	1.3
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	44.6
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	91.5
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	3.00
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	45.5

Percent Time-Spent-Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	3.60
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	1.10
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}$ (%) $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	81.5

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	E
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	67.0

Notes

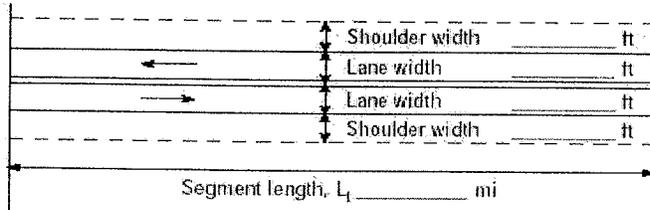
1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/28/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level <input checked="" type="checkbox"/> Rolling	
Grade Length 1.70 mi	Up/down 3.4
Peak-hour factor, PHF 0.75	
No-passing zone 29%	
% Trucks and Buses, P_T 3%	
% Recreational vehicles, P_R 2%	
Access points/ mi 4	

Analysis direction vol., V_d 405veh/h
 Opposing direction vol., V_o 684veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.876	0.997
Grade adjustment factor f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	616	915
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} _____ mi/h	Base free-flow speed ³ , $BFFS_{FM}$	60.0 mi/h
Observed volume ³ , V_i _____ veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_i/f_{HV})$ _____ mi/h	Adj. for access points ³ , f_A (Exhibit 20-5)	1.0 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) _____ 0.7 mi/h	Free-flow speed, FFS_d ($FFS=BFFS-f_{LS}-f_A$)	59.0 mi/h
	Average travel speed, $ATS=FFS-0.00776v_p \cdot f_{np}$	46.5 mi/h

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)	0.94	1.00
Directional flow rate ² , v_i (pc/h)= $V_i/(PHF \cdot f_{HV} \cdot f_G)$	572	912
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-av_d^b})$	60.3	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	19.5	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	67.8	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_p/1,700$	0.36
Peak 15-min veh-miles of travel, $VMT_{15}(\text{veh} \cdot \text{mi})=0.25L_t(V/PHF)$	230
Peak-hour vehicle-miles of travel, $VMT_{60}(\text{veh} \cdot \text{mi})=V \cdot L_t$	689
Peak 15-min total travel time, $TT_{15}(\text{veh} \cdot \text{h})=VMT_{15}/ATS$	5.0

Notes

1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
2. If $v_i(v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

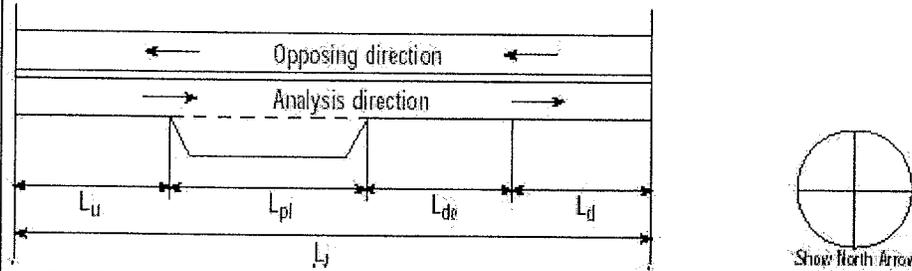
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	12/28/06	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	1.7
Length of two-lane highway upstream of the passing lane, L_u (mi)	0.3
Length of passing lane including tapers, L_{pl} (mi)	1.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	46.5
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	67.8
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.50
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	50.6

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	6.72
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-6.52
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane ³ , $PTSF_{pl}(\%)$ $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	46.1

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	B
Peak 15-min total travel time, $TT_{15}(\text{veh-h})$ $TT_{15} = VMT_{15}/ATS_{pl}$	4.5

Notes

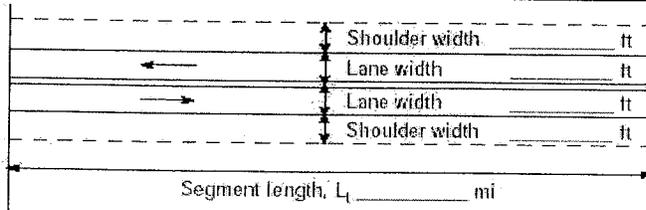
1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level <input type="checkbox"/> Rolling	
Grade Length 1.70 mi	Up/down -3.4
Peak-hour factor, PHF 0.88	
No-passing zone 100%	
% Trucks and Buses, P_T 2%	
% Recreational vehicles, P_R 2%	
Access points/ mi 5	

Analysis direction vol., V_d 684veh/h
 Opposing direction vol., V_o 405veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.1	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.998	0.915
Grade adjustment factor ¹ , f_G (Exhibit 20-7 or 20-13)	1.00	0.98
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	779	512
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} mi/h	Base free-flow speed ³ , $BFFS_{FM}$	60.0 mi/h
Observed volume ³ , V_i veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5)	0.0 mi/h
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_i/f_{HV})$ mi/h	Adj. for access points ³ , f_A (Exhibit 20-5)	1.3 mi/h
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) 2.4 mi/h	Free-flow speed, FFS_d ($FSS=BFFS-f_{LS}-f_A$)	58.8 mi/h
	Average travel speed, $ATS=FFS-0.00776V_p \cdot f_{np}$	46.4 mi/h

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.0	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	1.000
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate ² , v_i (pc/h)= $V_i/(PHF \cdot f_{HV} \cdot f_G)$	777	488
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-av_d^b})$	65.7	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	29.9	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	84.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1,700$	0.46
Peak 15-min veh-miles of travel, VMT_{15} (veh- m)= $0.25L_1(V/PHF)$	330
Peak-hour vehicle-miles of travel, VMT_{60} (veh- m)= $V \cdot L_1$	1163
Peak 15-min total travel time, TT_{15} (veh-h)= VMT_{15}/ATS	7.1

Notes

1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
2. If $v_i(v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

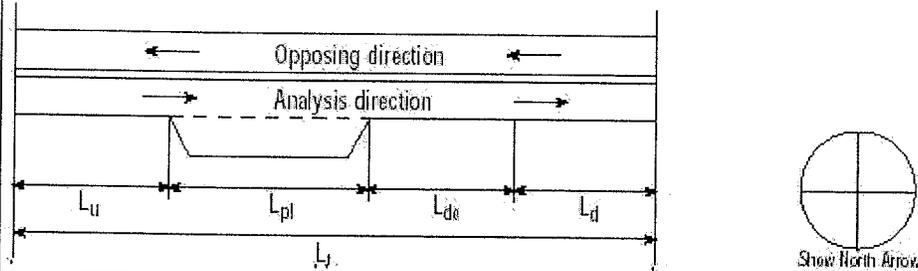
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	1.7
Length of two-lane highway upstream of the passing lane, L_u (mi)	1.7
Length of passing lane including tapers, L_{pl} (mi)	0.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	46.4
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	84.1
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.70
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	5.16
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-5.16
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}$ (%) $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	84.1

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	

Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKP	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct
Date Performed	10/22/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

Class I highway Class II highway

L_u L_{pl} L_{de} L_d
 L_t

Show North Arrow

Total length of analysis segment, L_t (mi)	1.2
Length of two-lane highway upstream of the passing lane, L_u (mi)	0.1
Length of passing lane including tapers, L_{pl} (mi)	1.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	44.1
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	82.0
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.60
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl} / f_{pl}) + (2L_{de} / (1 + f_{pl})))$	48.5

Percent Time-Spent-Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	4.13
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-4.03
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}$ (%) $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl} L_{pl} + ((1 + f_{pl}) / 2) L_{de}] / L_t$	53.4

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15} / ATS_{pl}$	5.3

Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

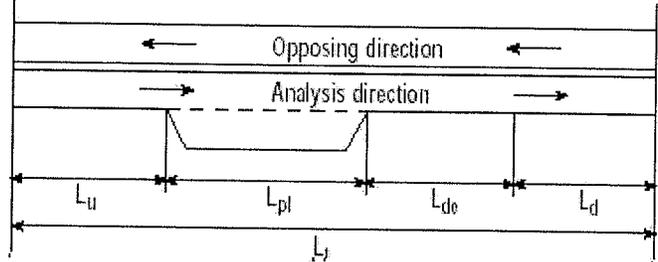
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKP	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Todd Valley W to Owl Hill Ct.
Date Performed	10/22/07	Jurisdiction	Placer County
Analysis Time Period	AM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	1.2
Length of two-lane highway upstream of the passing lane, L_u (mi)	1.2
Length of passing lane including tapers, L_{pl} (mi)	0.0
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	46.4
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	79.7
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.70
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d + L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	

Percent Time-Spent-Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	5.54
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-5.54
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}$ (%) $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	79.7

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15} / ATS_{pl}$	

Notes

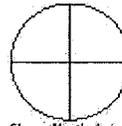
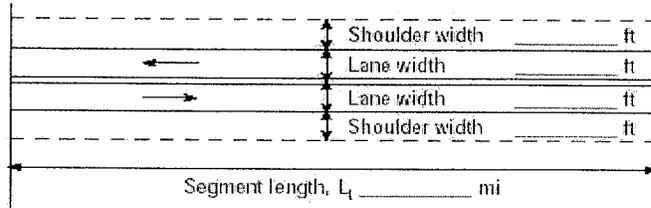
1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level	<input type="checkbox"/> Rolling
Grade Length 4.00 mi	Up/down 3.0
Peak-hour factor, PHF 0.88	No-passing zone 55%
% Trucks and Buses, P_T 1%	% Recreational vehicles, P_R 2%
Access points/ mi 2	

Analysis direction vol., V_d 1009veh/h
 Opposing direction vol., V_o 405veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	5.7	1.2
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.955	0.998
Grade adjustment factor ¹ , f_G (Exhibit 20-7 or 20-13)	0.95	1.00
Directional flow rate ² , v_i (pc/h) $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	1264	461
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} mi/h	Base free-flow speed ³ , $BFFS_{FM}$ 60.0 mi/h	
Observed volume ³ , V_i veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_i/f_{HV})$ mi/h	Adj. for access points ³ , f_A (Exhibit 20-5) 0.5 mi/h	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) 2.1 mi/h	Free-flow speed, FFS_d ($FFS=BFFS-f_{LS}-f_A$) 59.5 mi/h	
	Average travel speed, $ATS=FFS-0.00776v_p \cdot f_{np}$ 44.0 mi/h	

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	1.000	0.999
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)	0.97	1.00
Directional flow rate ² , v_i (pc/h)= $V_i/(PHF \cdot f_{HV} \cdot f_G)$	1182	461
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-av_d^b})$	78.8	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	17.1	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	91.1	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, $v/c=V_p/1,700$	0.74
Peak 15-min veh-miles of travel, $VMT_{15}(\text{veh} \cdot \text{mi})=0.25L_1(V/PHF)$	3096
Peak-hour vehicle-miles of travel, $VMT_{60}(\text{veh} \cdot \text{mi})=V \cdot L_1$	10897
Peak 15-min total travel time, $TT_{15}(\text{veh} \cdot \text{h})=VMT_{15}/ATS$	70.4

Notes

1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
2. If $v_i(v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

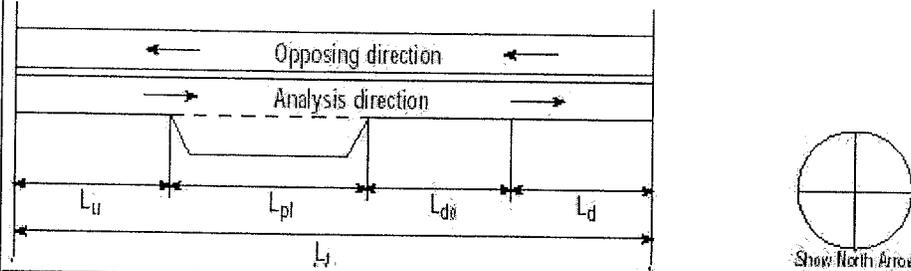
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: *Foresthill Divide Community Plan*

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	10.8
Length of two-lane highway upstream of the passing lane, L_u (mi)	3.0
Length of passing lane including tapers, L_{pl} (mi)	4.9
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	44.0
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	91.1
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E
Average Travel Speed	
Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	1.20
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	46.5
Percent Time Spent Following	
Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	3.60
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $= L_t - (L_u + L_{pl} + L_{de})$	-0.70
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}(\%)$ $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	69.8
Level of Service and Other Performance Measures⁴	
Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15} / ATS_{pl}$	66.6

Notes

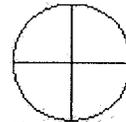
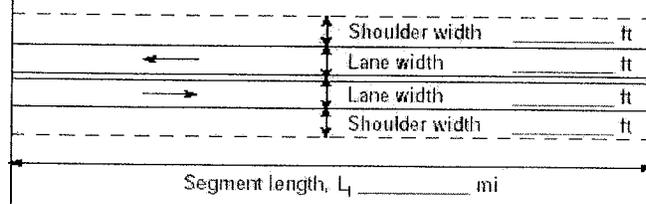
1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level	<input checked="" type="checkbox"/> Rolling
Grade Length	4.00 mi
Up/down	-3.0
Peak-hour factor, PHF	0.76
No-passing zone	88%
% Trucks and Buses, P_T	4%
% Recreational vehicles, P_R	2%
Access points/ mi	2

Analysis direction vol., V_d 405veh/h
 Opposing direction vol., V_o 1009veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	5.7
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.992	0.842
Grade adjustment factor ¹ , f_G (Exhibit 20-7 or 20-13)	1.00	0.95
Directional flow rate ² , $v_i(\text{pc/h})$ $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	537	1660
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} mi/h	Base free-flow speed ³ , $BFFS_{FM}$ 60.0 mi/h	
Observed volume ³ , V_f veh/h	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_f/f_{HV})$ mi/h	Adj. for access points ³ , f_A (Exhibit 20-5) 0.5 mi/h	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) 0.7 mi/h	Free-flow speed, FFS_d ($FFS=BFFS \cdot f_{LS} \cdot f_A$) 59.5 mi/h	
	Average travel speed, $ATS=FFS \cdot 0.00776 v_p \cdot f_{np}$ 41.8 mi/h	

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.996	1.000
Grade adjustment factor ¹ , f_G (Exhibit 20-8 or 20-14)	1.00	0.97
Directional flow rate ² , $v_i(\text{pc/h})=V_i/(PHF \cdot f_{HV} \cdot f_G)$	535	1369
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-av_d^b})$	63.2	
Adj. for no-passing zone, f_{np} (Exhibit. 20-20)	18.6	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	68.5	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	D
Volume to capacity ratio, $v/c=V_f/1,700$	0.32
Peak 15-min veh-miles of travel, $VMT_{15}(\text{veh} \cdot \text{mi})=0.25L_1(V/PHF)$	1439
Peak-hour vehicle-miles of travel, $VMT_{60}(\text{veh} \cdot \text{mi})=V \cdot L_1$	4374
Peak 15-min total travel time, $TT_{15}(\text{veh} \cdot \text{h})=VMT_{15}/ATS$	34.5

Notes

1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
2. If $v_i(V_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

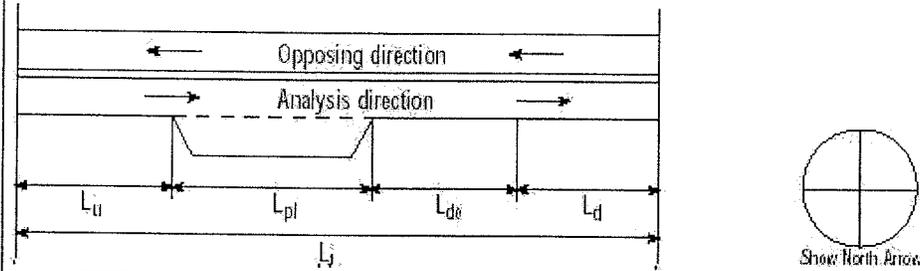
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Westbound
Agency or Company	MRO Engineers, Inc.	From/To	Bridge to Spring Garden Road
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	10.8
Length of two-lane highway upstream of the passing lane, L_u (mi)	4.8
Length of passing lane including tapers, L_{pl} (mi)	1.3
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	41.8
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	68.5
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	D

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	3.00
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.10
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl}/f_{pl}) + (2L_{de}/(1+f_{pl})))$	42.5

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	7.02
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-2.32
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.61
Percent time-spent-following including passing lane ³ , $PTSF_{pl}$ (%) $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl}L_{pl} + ((1+f_{pl})/2)L_{de}] / L_t$	57.5

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	D
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15}/ATS_{pl}$	33.8

Notes

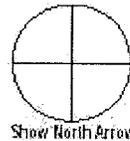
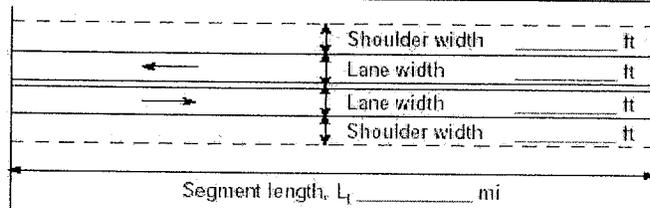
1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway / Direction of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data



<input checked="" type="checkbox"/> Class I highway	<input type="checkbox"/> Class II highway
Terrain <input type="checkbox"/> Level <input type="checkbox"/> Rolling	
Grade Length 1.70 mi	Up/down 3.4
Peak-hour factor, PHF 0.88	
No-passing zone 29%	
% Trucks and Buses, P _T 2%	
% Recreational vehicles, P _R 2%	
Access points/ mi 4	

Analysis direction vol., V_d 676veh/h
 Opposing direction vol., V_o 455veh/h

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 20-9 or 20-15)	4.3	1.2
Passenger-car equivalents for RVs, E _R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/(1+P _T (E _T -1)+P _R (E _R -1))	0.937	0.996
Grade adjustment factor ¹ , f _G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate ² , v _i (pc/h) v _i =V _i /(PHF*f _{HV} *f _G)	819	519
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S _{FM} mi/h	Base free-flow speed ³ , BFFS _{FM} 60.0 mi/h	
Observed volume ³ , V _f veh/h	Adj. for lane width and shoulder width ³ , f _{LS} (Exh 20-5) 0.0 mi/h	
Free-flow speed, FFS _d FFS=S _{FM} +0.00776(V _f /f _{HV}) mi/h	Adj. for access points ³ , f _A (Exhibit 20-5) 1.0 mi/h	
Adjustment for no-passing zones, f _{np} (Exhibit 20-19) 1.4 mi/h	Free-flow speed, FFS _d (FSS=BFFS-f _{LS} -f _A) 59.0 mi/h	
	Average travel speed, ATS=FFS-0.00776v _p -f _{np} 47.3 mi/h	

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E _T (Exhibit 20-10 or 20-16)	1.0	1.1
Passenger-car equivalents for RVs, E _R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, f _{HV} =1/(1+P _T (E _T -1)+P _R (E _R -1))	1.000	0.998
Grade adjustment factor ¹ , f _G (Exhibit 20-8 or 20-14)	0.94	1.00
Directional flow rate ² , v _i (pc/h)=V _i /(PHF*f _{HV} *f _G)	814	518
Base percent time-spent-following ⁴ , BPTSF(%)=100(1-e ^{-av_d^b})	67.5	
Adj. for no-passing zone, f _{np} (Exhibit 20-20)	21.1	
Percent time-spent-following, PTSF(%)=BPTSF+f _{np}	80.3	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	E
Volume to capacity ratio, v/c=V _p /1,700	0.48
Peak 15-min veh-miles of travel, VMT ₁₅ (veh-mi)=0.25L ₁ (V/PHF)	326
Peak-hour vehicle-miles of travel, VMT ₆₀ (veh-mi)=V*L ₁	1149
Peak 15-min total travel time, TT ₁₅ (veh-h)=VMT ₁₅ /ATS	6.9

Notes

1. If the highway is extended segment (level) or rolling terrain, f_G=1.0.
2. If v_i(V_d or V_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.

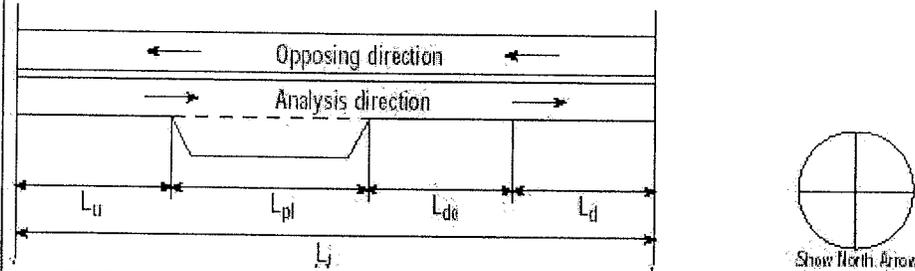
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET WITH PASSING LANE WORKSHEET

General Information		Site Information	
Analyst	MKL	Highway of Travel	Foresthill Road - Eastbound
Agency or Company	MRO Engineers, Inc.	From/To	Spring Garden to Todd Valley W
Date Performed	2/27/07	Jurisdiction	Placer County
Analysis Time Period	PM Peak Hour	Analysis Year	Year 2030 With Forest Ranch

Project Description: Foresthill Divide Community Plan

Input Data

Class I highway Class II highway



Total length of analysis segment, L_t (mi)	1.7
Length of two-lane highway upstream of the passing lane, L_u (mi)	0.3
Length of passing lane including tapers, L_{pl} (mi)	1.2
Average travel speed, ATS_d (from Directional Two-Lane Highway Segment Worksheet)	47.3
Percent time-spent-following, $PTSF_d$ (from Directional Two-Lane Highway Segment Worksheet)	80.3
Level of service ¹ , LOS_d (from Directional Two-Lane Highway Segment Worksheet)	E

Average Travel Speed

Downstream length of two-lane highway within effective length of passing lane for average travel speed, L_{de} (mi) (Exhibit 20-23)	1.70
Length of two-lane highway downstream of effective length of the passing lane for avg travel speed, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-1.50
Adj. factor for the effect of passing lane on average speed, f_{pl} (Exhibit 20-24)	1.11
Average travel speed including passing lane ² , $ATS_{pl} = (ATS_d * L_t) / (L_u + L_d + (L_{pl} * f_{pl}) + (2 * L_{de} / (1 + f_{pl})))$	51.4

Percent Time Spent Following

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, L_{de} (mi) (Exhibit 20-23)	4.90
Length of two-lane highway downstream of effective length of the passing lane for percent-time-following, L_d (mi) $L_d = L_t - (L_u + L_{pl} + L_{de})$	-4.70
Adj. factor for the effect of passing lane on percent time-spent-following, f_{pl} (Exhibit 20-24)	0.62
Percent time-spent-following including passing lane ³ , $PTSF_{pl}$ (%) $PTSF_{pl} = PTSF_d [L_u + L_d + f_{pl} L_{pl} + ((1 + f_{pl}) / 2) L_{de}] / L_t$	55.3

Level of Service and Other Performance Measures⁴

Level of service including passing lane LOS_{pl} (Exhibit 20-3 or 20-4)	C
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = VMT_{15} / ATS_{pl}$	6.3

Notes

1. If $LOS_d = F$, passing lane analysis cannot be performed.
2. If $L_d < 0$, use alternative Equation 20-22.
3. If $L_d < 0$, use alternative Equation 20-20.
4. v/c, VMT_{15} and VMT_{60} are calculated on Directional Two-Lane Highway Segment Worksheet.

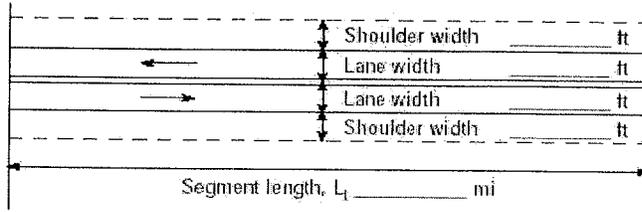
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

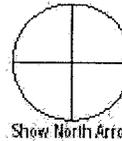
Analyst *MKL*
 Agency or Company *MRO Engineers, Inc.*
 Date Performed *2/27/07*
 Analysis Time Period *PM Peak Hour*

Site Information

Highway / Direction of Travel *Foresthill Road - Westbound*
 From/To *Spring Garden to Todd Valley W*
 Jurisdiction *Placer County*
 Analysis Year *Year 2030 With Forest Ranch*

 Project Description: *Foresthill Divide Community Plan*
Input Data


Analysis direction vol., V_d *455* veh/h
 Opposing direction vol., V_o *676* veh/h



Class I highway Class II highway
 Terrain Level Rolling
 Grade Length *1.70* mi Up/down *-3.4*
 Peak-hour factor, PHF *0.88*
 No-passing zone *100%*
 % Trucks and Buses, P_T *3%*
 % Recreational vehicles, P_R *2%*
 Access points/ mi *5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-9 or 20-15)	1.2	4.3
Passenger-car equivalents for RVs, E_R (Exhibit 20-9 or 20-17)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.994	0.909
Grade adjustment factor 1, f_G (Exhibit 20-7 or 20-13)	1.00	1.00
Directional flow rate ² , $v_i(\text{pc/h})$ $v_i=V_i/(PHF \cdot f_{HV} \cdot f_G)$	520	845
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed	
Field measured speed ³ , S_{FM} <i>mi/h</i>	Base free-flow speed ³ , $BFFS_{FM}$ <i>60.0 mi/h</i>	
Observed volume ³ , V_i <i>veh/h</i>	Adj. for lane width and shoulder width ³ , f_{LS} (Exh 20-5) <i>0.0 mi/h</i>	
Free-flow speed, FFS_d $FFS=S_{FM}+0.00776(V_i/f_{HV})$ <i>mi/h</i>	Adj. for access points ³ , f_A (Exhibit 20-5) <i>1.3 mi/h</i>	
Adjustment for no-passing zones, f_{np} (Exhibit 20-19) <i>1.3 mi/h</i>	Free-flow speed, FFS_d ($FFS=BFFS-f_{LS}-f_A$) <i>58.8 mi/h</i>	
	Average travel speed, $ATS=FFS-0.00776v_p \cdot f_{np}$ <i>46.8 mi/h</i>	

Percent Time Spent Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 20-10 or 20-16)	1.1	1.0
Passenger-car equivalents for RVs, E_R (Exhibit 20-10 or 20-16)	1.0	1.0
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	0.997	1.000
Grade adjustment factor 1, f_G (Exhibit 20-8 or 20-14)	1.00	0.94
Directional flow rate ² , $v_i(\text{pc/h})=V_i/(PHF \cdot f_{HV} \cdot f_G)$	519	814
Base percent time-spent-following ⁴ , $BPTSF(\%)=100(1-e^{-v_i})$	56.2	
Adj. for no-passing zone, f_{np} (Exhibit 20-20)	28.9	
Percent time-spent-following, $PTSF(\%)=BPTSF+f_{np}$	67.4	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 or 20-4)	<i>D</i>
Volume to capacity ratio, $v/c=V_p/1,700$	<i>0.31</i>
Peak 15-min veh-miles of travel, $VMT_{15}(\text{veh} \cdot \text{mi})=0.25L_1(V/PHF)$	<i>220</i>
Peak-hour vehicle-miles of travel, $VMT_{60}(\text{veh} \cdot \text{mi})=V \cdot L_1$	<i>774</i>
Peak 15-min total travel time, $TT_{15}(\text{veh} \cdot \text{h})=VMT_{15}/ATS$	<i>4.7</i>

Notes

1. If the highway is extended segment (level) or rolling terrain, $f_G=1.0$.
2. If $v_i(v_d \text{ or } v_o) \geq 1,700$ pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only.
4. Exhibit 20-21 provides factors a and b.
5. Use alternative Equation 20-14 if some trucks operate at crawl speeds on a specific downgrade.