Appendix A

Capacity Analyses

Malahat Capacity Calculations

Highway Characteristics

Highway Classification		Rural Arterial Divided
Design Speed		80 km/h
Posted Speed		70 km/h (assume ave speed = 75 km/h)
Lane Widths		3.5 m
Distance of Obstructions to Edge of Travelled Way		1 m
Rural or Suburban Environment		rural
Commuter/Regular Users vs Recreation/Non-regular Users		Summer: non-regular
Grades	Goldstream to Tunnel Hill	6 km between 0% and 7% (3 km between 3% and 7%)
	Tunnel Hill to Summit	8 km between 0% and 5% (2 km between 3% and 5%)
	Summit to Mill Bay	11 km between 0% and 6.8% (2 km of 6.8%)
Proportion of Heavy Trucks		1.8%
Proportion of Buses		0.2%
Proportion of RV's		0.1%

1 Existing Highway - 2 lane Divided Rural Highway

Use FHWA Rural One-Lane Capacity

One Lane Capacity = (1600pch x PHF x f_G x f_{HV}) - V_{NP}

Step 1: Determine PHF (Peak Hour Factor)

At capacity PHF = 1.0

Step 2: Determine f_G (Grade Adjustment Factor)

At capacity two way flow rate will be > 1200 pch
Mountainous Terrain

From FHWA Table 6: f_G = 0.99

Step 3: Determine f_{HV} (Heavy Vehicle Factor)

$f_{HV} = 1/(1 + P_T(E_T - 1)$

Where P_T = 2% trucks and buses
ET = 7.2 (from FHWA Table 7)

$f_{HV} = 0.89$

Step 4: Determine V_{NP} (Volume Adjustment for No Passing Zones)

$V_{NP} = f_{NP} / 0.00776$

to get f_{NP} we need two way demand flow rate V_P

$$V_P = \frac{\text{Volume}_{\text{at capacity}}}{PHF \times f_G \times f_{HV}} = \sim 2400 / (.88 \times .99 \times .89) = 3095$$

From FHWA Table 8 @ 100% no passing, f_{NP} =0.8

V_{NP} = 0.8 / 0.00776= 103

One Lane Capacity = (1600 pch x PHF x f_G x f_{HV}) - V_{NP}
= (1600 x 1.0 x 0.99 x 0.89) - 103
= 1307 pch in one direction

2 Multilane Highway – 4-lane divided

Step 1: Calculate Free Flow Speed

FFS = BFFS - f_{LW} - f_{LC} - f_M - f_A

BFFS = speed limit + 11 for speed limit 70 km/h = 81 km/h

f_{LW} = 1.0 km/h (from Exhibit 21-4)

f_{LC} = 2.0 km/h (from Exhibit 21-5)

f_M = 0.0 km/h (from Exhibit 21-6)

f_A = 0.0 km/h (from Exhibit 21-7)

FFS = 78 km/h (49 mph)

Step 2: Calculate Base Capacity (BaseCap)

BaseCap = 1000 + 20xFFS; for FFS<=60 mph

= 2200 for FFS > 60 mph

BaseCap = 1000 + 20 x 49

1980 pcphpl

Step 3: Determine Peak Capacity (PeakCap)

PeakCap = BaseCap x PHF x N x f_{HV} x f_P

PHF = Peak Hour Factor = 0.95 @ rural capacity (Table 5 FHWA)

N = 2 for 4-Lane Divided

3 for 4-Lane Divided with Climbing Lane

f_P = 0.95 for mixture of regular and non-regular users (summer)

f_{HV} = 1 / (1 + P_T(E_T - 1))

P_T = Proportion of trucks and buses (RV's ignored)

= 2%

E_T = grade dependent

<u>Peak Capacity per Direction:</u>

4 Lane Divided			
Grade	**E_T**	**f_{HV}**	**PeakCap (vph)**
1%	4	0.94	3372
3%	10	0.85	3029
5%	14	0.79	2836
7%	17	0.76	2708

4 Lane Divided with Passing Lane			
Grade	**E_T**	**f_{HV}**	**PeakCap (vph)**
1%	4	0.94	5057
3%	10	0.85	4543
5%	14	0.79	4255
7%	17	0.76	4061