Appendix F

Opinion of Probable Costs

Supporting Notes for review of costs by Paul Agate 27 April, 2006

Review of Rail Infrastructure Costs

Assumed track from Victoria to Shawnigan - 45km

	Major	Med	Minor	Total
Bridges	9	9	3	
Culverts to 36"	231			
Concrete Arch	12			
Subway	1			
Repair costs per bridge $m	$3	$2	$1	
Total Bridge repairs	$27	$14	$3	$44
Repair costs per culvert $10,000 each				$2
Track replacement/$3m/km*45km				$135
Total				$181

General

Result of general overview inspection by Andrew Rushforth. Not a detailed review
In general consider that CPR had a great deal and got rid of a major liability
Track is worn out and needs replacing. Contemplated a call to Rail Safety Board
Ties are worn out 3 out of 4, probably all need replacing
Niagara Bridge records indicate last maintenance done in 1968
Minimum work required, removal of old lead paint, repaint
Estimated at $3m/bridge for major; $1.5m for med and $1.0m small

Review of Costs for VIHP Sections

	VIHP Estimate Year		ENR Cost Index				Add BC cost	Add 20% traffic	Add 20% Contingency	Add MoT Costs			Check
	Mar-94	Dec-94	Mar-94	Dec-94	Apr-06	Inflated cost	20%	20%	20%	30%	Total	Length	$/km
	m$					m$	m$			m$	m$	m$	m$
Tunnel Hill to Summit	$24		5381		7695.1	$35	$7	$7	$7	$10	$66	7.76	$9
Summit to Bamberton		$18		5439	7695.1	$25	$5	$5	$5	$7	$47	4.96	$9

Notes for VIHP costs
Add BC Cost - A 20% premium has been added to allow for the anticipated extra costs of working in BC
Add 20% due to increased traffic management costs since 1994, but less that in the Goldstream Park as there is more room for diversions etc.
Add 20% contingency
Add 30% MoT costs (admin etc)
Minimal saving in dropping lane at this level of estimating

Tunnel Hill
Uprade at Tunnel Hill based on 190m structure @ $3500/m2 and retaining walls, total of $15m plus 50% traffic impact = $23m

Couplet
Reduces Option H4 Near West by two lanes (2X3.7m), all other costs the same
Reduces width by 7.4m, approx from 24m to 16m ie 30%, estimated total cost saving 20%

Counterflow
Same costs as Option H1b for first section reduced to 75%. Reduction limited to reduced width but increased by ITS required.

Sea to Sky DB2
Discussion with Rob Ahola

	Total	Length	ENR	ENR	Inflated to ENR	Add BC costs	Add Cont	Per km
	2004		2004	2006		20%	30%	
	m$	km						
Total costs	47	6.7	6900	7700	$52	$63.00	$82.00	$12

Notes on the use of S2S costs

The major difference between S2S and Malahat is S2S is mainly structure with reduced traffic impact, Malahat is rock cut and more traffic impact.
Malahat is rock excavation above road more traffic impact. Requires double Traffic mgt? Plus loss of production. Add say 25%. Use m$15/km
Traffic mgt on S2S DB 2 was m$2.6 (7% of total contract at $36m) This is considered low for Malahat with above road cut
Use figures derived from "Highway Estimate" sheet for most Options as noted in Summary Table.
These are in excess of S2S #'s but derived from quantity take offs and can be considered conservative but suitable for this study.

Summary of General Costs/km

For heavy rock sections	Based on New Highway Cost sheet
For VIHP sections	$9m/km
Upgrade to Pat Bay	$5m/km
Intersections	$20m each from Hwy 17 study (including land)
Land Acquisition	Shown seperately
MoT Management Costs	Included at 30%

Summary of Options

1) The following costs should be considered as a "Best Opinion of Probable Costs" and have been generated based on available data as noted below.
2) Should any of these options be considered further significant additional analysis will be required.
3) Quantity estimates are based on very preliminary data and have been generated to provide a comparison of probable costs only and should not be relied upon for
4) The figures noted have been incorporated into a range of costs to allow for contingencies and to reflect the level of confidence that should be applied.

Roadway Options	Length of New Road	Unit Cost	New Construction	Tunnel Hill 1.15 km[1]	Tunnel Hill to Summit 7.76 km[2]	Summit to Existing 4 Lanes 4.96km[2]	Subtotal	Land Costs[3]	Total	Rounded Totals
	km	m$/km	m$	m$	m$	m$	m$	m$	m$	m$
					m$9/km	m$9/km				
H1a - Widen Existing Alignment	6.11	11 [8]	$ 69	$ 23	$ 70	$ 45	$ 206	$ 1	$ 207	$210
H1b - Improve Existing Alignment	6.11	29 [4]	$ 180	$ 23	$ 70	$ 45	$ 317	$ 1	$ 318	$320
H2 - Double Deck	6.16	51 [4]	$ 316	$ 23	$ 70	$ 45	$ 453	$ 1	$ 454	$460
H3 - Counterflow	6.20	8 [5]	$ 52	$ 23	$ 70	$ 45	$ 190	$ 1	$ 191	$200
H4 - Near West	6.41	18 [4]	$ 113	$ 23	$ 70	$ 45	$ 250	$ 2	$ 252	$250
H5 - E & N	14.23	18 [9]	$ 251			$ 45	$ 295	$ 1	$ 296	$300
H6 - Niagara Main	14.77	19 [4]	$ 277			$ 45	$ 322	$ 2	$ 324	$325
H7 - Couplet	14.77	15 [7]	$ 222			$ 45	$ 266	$ 2	$ 268	$270
H8 - Shawnigan	26.24	18 [9]	$ 463				$ 463	$ 2	$ 464	$470
H9 - Far West	79.50	18 [9]	$ 1,401				$ 1,401	$ 23	$ 1,424	$1,430

[1] Upgrade at Tunnel Hill based on 190m structure and retaining walls @ $3500/m2, total $15m plus 50% traffic impact = $23m
[2] Inflated from 1994 project estimates added MoT costs
[3] See Appendix F for derivation of land costs
[4] Cost/km derived from New Highway Cost spreadsheet (attached)
[5] Cost/km of new road 75% of Option H1a - Widen Existing Alignment due to reduced width and increased ITS required
[6] Cost/km derived from $10m/km for general sections, $18m/km for heavy rock sections, and average $15m/km check against Kicking Horse Canyon costs
[7] Cost/km for new two lane construction taken as 80% the cost of four lane construction of Option H6 - Niagara Main
[8] Use cost for Tunnel Hill to Summit cost @m$9/km plus 25% due to additional traffic problems
[9] Costs for H5, H8 and H9 based on H4

Bridge Options	Bridge Costs								Land Costs	Total	Range including contingency
	m$									m$	m$
Bridge Option B1	$ 799								$ 90	$ 889	$700-1000
Bridge Option B2	$939								$ 50	$ 989	$900-1200

Bridge Capital Cost Estimates

Bridges	Length, Width 22m	Cost of Bridge /m^2	m^2	Cost of Bridge	Approach Lengths	Cost/km See Second Sheet	Approach Road Costs	Pat Bay Upgrade	Cost/km	Number of Interchanges	Cost per Interchange	Pat Bay Costs	Total Costs	Range including contingency
				m$	km	m$/km	m$	km	m$		m$	m$	m$	
														m$
Bridge Crossing #1	3240	$7,500	71,280	$535	11	$9	$104	24	$5	2	$ 20	$160	$799	$700-1000
Bridge Crossing #2	1400	$20,000	30,800	$616	14.9	$18	$263			3	$ 20	$60	$939	$900-1200

Notes:
The following are to be considered as a best opinion of probable costs and have been generated using the following data
1) Engineering New Record (ENR) ratings
2) Bridge Crossing #1 can be compared to Port Mann as similar total length (Port Mann 2.2km, Crossing #1 - 3.24km) Similar width 25m. Crossing #1 in deeper water but spans could be similar. Both are navigation channels.
3) Bridge Crossing #2, a single span of 1.4km is similar to Rion-Antiron Greece as the closest we could find to length (total 2883m), width (27.2m), water depth (65m), location (seismic zone, although likely a higher zone), construction method (DBFO), and of recent construction (completed August 2004),
4) Another comparison to new data on Harbinger Fiord bridge in Norway, 1380m span 20m deck, and navigation clearance of 55m, costs are very similar. Estimated cost.
5) New highway for Crossing #2 used $18m/km as very difficult terrain
6) The figures noted have been incorporated into a range of costs to allow for contingencies and to reflect the level of confidence that should be applied.
7) Should any of these options be considered further significant additional analysis will be required.

Summary of Bridge Costs

	Year	Capital - US	CDN to 2005	ENR for Estimate Year	ENR for 2006	Inflated to 2006	Length	Deck Area	Cost/m^2	Add 20% Contingency	Plus 30% MoT costs	Use
		m$	m$				m	m2	$/$m^2$	$/$m^2$	$/$m^2$	$/$m^2$
Bridge Crossing #1												
Port Mann			$330						$5,600	includes 20%	$7,280	$7,280
Previous Estimate	1995		$500	5500	7695	$700	3240	71280	$9,800	$11,760	$15,300	$15,300
Use for Bridge Crossing #1												$7,500
Bridge Crossing #2												
Rion-Antiron Greece	2004	$750	$984					78420	$12,553	$15,100	$19,630	$19,630
Hardanger Fiord - Norway	2006 est	$271	$339					26200	$12,929	$15,500	$20,150	$20,150
Previous Estimate	2003		$350	6700	7695	$402	1400	30800	$13,051	$15,700.00	$20,410	$20,410
Use for Bridge Crossing #2												$20,000

New Highway Cost

Notes

1) The following costs should be considered as a "Best Opinion of Probable Costs" and have been generated based on available data as noted below.
2) Should any of these options be considered further significant additional analysis will be required.
3) Quantity estimates are based on very preliminary data and have been generated to provide a comparison of probable costs only and should not be relied upon for further work.
4) The figures noted have been incorporated into a range of costs to allow for contingencies and to reflect the level of confidence that should be applied.
5) The costs are calculated and rounded for estimateing the cost/km of new construciotn as noted.

Item	Units	Price	H1: Improve Existing Align.		H2: Double Deck[1]		H4: Near West		H6: Niagara Main	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
Overall Length of New Construction	**km**		**6.11**		**6.16**		**6.41**		**14.77**	
Clearing and Grubbing	ha	$ 12,000	15	$ 180,000		$ 180,000	23	$ 276,000	92.4	$ 1,108,800
Utility Relocations	LS			$ 200,000		$ 200,000		$ 50,000		
Bolting etc	LS			$ 1,500,000		$ 1,500,000		$ 1,500,000		$ 1,000,000
Overburden Excavation	m3	$ 8.00	33,000	$ 264,000		$ 264,000	20,000	$ 160,000	50,000	$ 400,000
Rock Excavation	m3	$ 18.00	350,000	$ 6,300,000		$ 6,300,000	757,750	$ 13,639,500	4,200,000	$ 75,600,000
Fill	m3	$ 5.00	350,000	$ 1,750,000		$ 1,750,000	1,604,000	$ 8,020,000	6,100,000	$ 30,500,000
SGSB (300mm)	tonnes	$ 12.50	70,000	$ 875,000		$ 875,000	82,000	$ 1,025,000	102,000	$ 1,275,000
25 mm base course	tonnes	$ 17.00	70,000	$ 1,190,000		$ 1,190,000	82,000	$ 1,394,000	102,000	$ 1,734,000
asphalt 150mm	tonnes	$ 70.00	41000	$ 2,870,000		$ 2,870,000	40,000	$ 2,800,000	127,500	$ 8,925,000
Structures										
Bridges Road[2]	sq m	$ 3,000	8,580	$25,740,000	7,920	$ 23,760,000	10,340	$ 31,020,000	6,440	$ 19,320,000
Bridges Rail	sq m	$ 6,000		$0		$ -		$ -	1,380	$ 8,280,000
Double Deck	sq m	$ 7,000		$0	11,440	$ 80,080,000				
Two lane Tunnel	lin m	$ 75,000	540	$40,500,000	330	$ 24,750,000		$ -		$ -
Retaining Walls	sq m	$ 500	2,000	$1,000,000		$ 1,000,000	1,000	$ 500,000		$ -
Subtotal				**$82,369,000**		**$ 144,719,000**		**$ 60,384,500**		**$ 148,142,800**
Percentage Costs										
Mobilization	LS	1.00%		$823,690		$ 1,447,190		$ 603,845		$ 1,481,428
Demobilization	LS	0.50%		$411,845		$ 723,595		$ 301,923		$ 740,714
Traffic Detours and Road Traffic Control	LS	0.25%		$205,923		$ 361,798		$ 150,961		$ 370,357
Environment	LS	0.50%		$411,845		$ 723,595		$ 301,923		$ 740,714
Design	LS	6.00%		$4,942,140		$ 8,683,140		$ 3,623,070		$ 8,888,568
Drainage (5% of total)	LS	5.00%		$4,118,450		$ 7,235,950		$ 3,019,225		$ 7,407,140
Finishing Work	LS	0.50%		$411,845		$ 723,595		$ 301,923		$ 740,714
Const Eng - Const. Mgmt	LS	10%		$8,236,900		$ 14,471,900		$ 6,038,450		$ 14,814,280
Const Eng - Gen. Eng. During Const.	LS	1%		$823,690		$ 1,447,190		$ 603,845		$ 1,481,428
Subtotal				**$102,755,328**		**$ 180,536,953**		**$ 75,329,664**		**$ 184,808,143**
Contingency	LS	20%		$20,551,066		$ 36,107,391		$ 15,065,933		$ 36,961,629
Traffic Delays for Existing Upgrade only[3]	LS	25%		$25,688,832		$ 45,134,238				
Add MoT Costs	LS	30%		$30,826,598		$ 54,161,086		$ 22,598,899		$ 55,442,443
Total				**$179,821,823**		**$ 315,939,667**		**$ 112,994,496**		**$ 277,212,215**
Probable Cost / km of new construction				**$29m/km**		**$51m/km**		**$18m/km**		**$19m/km**

[1] Double deck option as per H1: Existing Alignment with the exception of the structures
[2] Bridge areas calculated at 22m width.
[3] Upgrades on existing alignments will cause significant traffic delays and scheduling constraints. Anticipate 25% increase in costs as per Sea to Sky construction requirements.

Summary of General Costs/km

1) Upgrade to Pat Bay, potentially add 1 lane each direction. $5m/km
2) Intersections From Hwy 17 study $15-$17m plus land, use $20m
3) Use m$15/km for upgrade to Tunnel Hill to Summit to Bamberton as developed from previous estimates and inflated
4) Land Acquisition NIC are noted in summary sheet
5) Options 1 and 4 have been costed using the rates developed for the Kicking Horse Canyon DBFO bid without financing costs
6) Comparison made to KHC road costs, in rock, limited traffic delays, no financing costs. DBFO delivery. m$18/km