

ALASKA – CANADA RAIL LINK STUDY

PHASED MULTIMODAL INTEGRATION WORK PACKAGE B3(d) LIFE-CYCLE OPERATING EXPENSES ESTIMATION

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1.0 Introduction

This study is part of The Alaska Canada Rail Link (ALCAN Rail Link) Feasibility Study Project. One of the primary functions of a proposed rail link through Northern British Columbia, the Yukon and Alaska (**Figure 1.1**) would be to lower transportation costs throughout the region. As the economies of this region are largely resource based, rail traffic projections are composed of outbound resources traveling to market and re-supply materials for consumption by the domestic and resource economies.

The development of the region's rich natural resources is dependent on the ability to move resources, in a cost effective way, from their origins to market. These markets, in some cases, will be within North America and can be transported to the larger North American rail network via the ALCAN Rail Link. Many other markets, however, are located off-shore and resources moving to these destinations will travel via deep sea ship.

This document, work package B3(d), reports the life-cycle operating expenses for a series of rail-port scenarios developed to serve these ocean based trips in constant US\$ 2006 prices over a 50 year analysis period. Under separate cover, work package B3(b) Life-Cycle Capital Cost Estimation and work package B3(f) Life-Cycle Cost of Service Estimation provide similar estimates of capital costs and unit costs of service. Data used to estimate the capital cost, operating expenses and unit costs of service were provided by the ALCAN Rail Link Project Team.

All rail-port scenarios include the ALCAN Rail Link mainline, spurs to access ports or resources and a destination port facility. Rail-port scenarios are consistent between the reports on work packages B3(b/d/f). A map of all rail network and port facilities considered is provided below in **Figure 1.2**.

Traffic projections from the project team were used to estimate rail traffic volumes throughout the entire rail network and traffic bound for the destination port. Port facility concepts were then developed to reflect the volume of projected traffic. In some scenarios rail traffic from the Crest Iron Ore Mine was included, owing to the large volume of traffic generated by this mine development, it has a significant impact on the port facilities proposed. A more complete description of projected traffic is provided in Section 2.0 the work package B3(b) report, entitled Life-Cycle Capital Cost Estimation.

The following ten scenarios were analyzed in the B3(b/d/f) work packages, a more complete description of each scenario is provided in Section 3.0 of the report on work package B3(b).

- Scenario 1 Skagway (without Crest)
- Scenario 2 Port Mackenzie – Anchorage via Beaver Creek (with Crest)
- Scenario 2a Port Mackenzie – Anchorage via Beaver Creek (without Crest)
- Scenario 3 Port Mackenzie – Anchorage via Ladue River (with Crest)
- Scenario 3a Port Mackenzie – Anchorage via Ladue River (without Crest)
- Scenario 4 Haines (with Crest)
- Scenario 4a Haines (without Crest)
- Scenario 5 Hyder-Stewart (without Crest)
- Scenario 6 Prince Rupert (with Crest)
- Scenario 6a Prince Rupert (without Crest)

Operating expenses for each of the assessed scenarios were developed from two sources. Rail network operating expenses, including rail traffic destined for both the port and other segments of the network, were extracted from the rail cost model developed by Innovative Scheduling under work package B3(c/e). As part of the Innovative Scheduling rail cost model a set of three management strategies were developed that resulted in differing operating expenses. A description of these management strategies is provided in the Alaska Canada Rail Link Feasibility Study Cost Analysis Report as part of work package B3(c/e).

Port terminal operating expenses were estimated by Banjar Management based on projected traffic volumes, engineering judgment and work completed by Banjar Management in work packages B2(a/d/g).



Figure 1.1 - Study Area

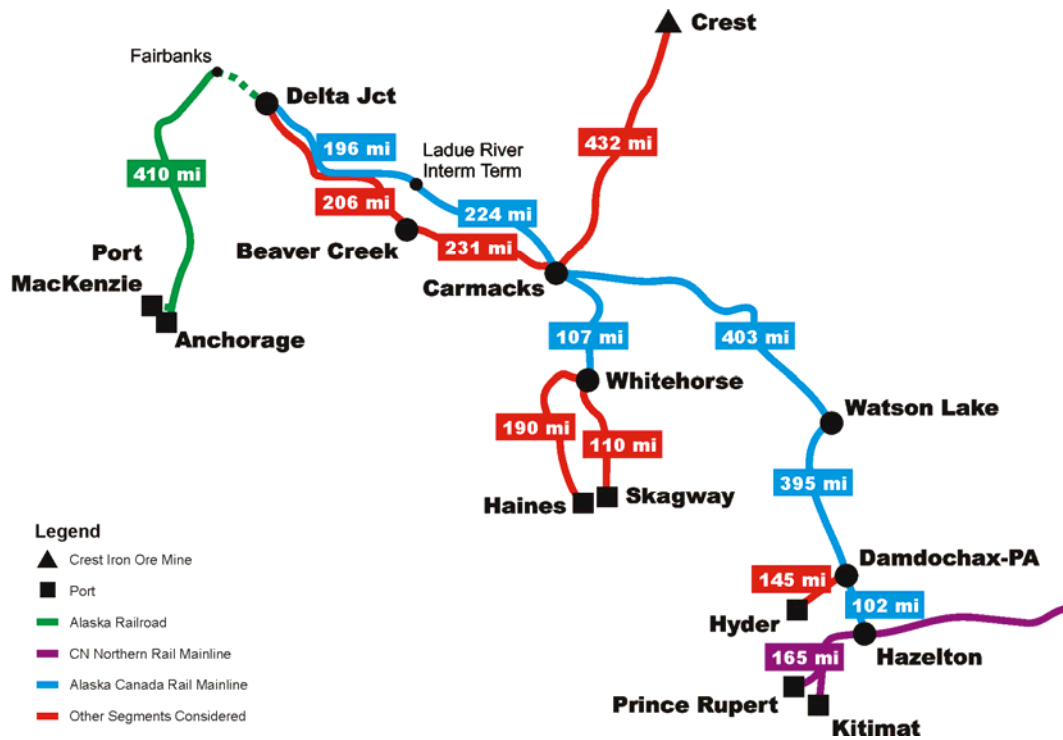


Figure 1.2 – Rail/Port Network Segments Analyzed

2.0 Rail - Port Scenarios

The following section reports the rail and port operating expenses for each of the scenarios assessed as part of this work package. Rail operating expenses have been broken down into a series of sub-accounts to provide insight into their allocation, including:

- Maintenance of Way
- Maintenance of Equipment
- Labor
- Locomotive Costs
- Car Hire
- Other Transportation Expenses
- General & Administration

Port operating expenses are also reported for the port or by terminal if multiple terminals are proposed. Issues that could significantly influence the operating expenses of the proposed terminals are commented upon. Operational expenses at bulk terminals (coal/iron ore/mineral concentrates) generally are composed of labour, operating and maintenance expenses, and terminal overhead including management.

From experience with other port cost models it is estimated that operating expenses make up in the range of 30% to 40% of the total unit cost of marine terminal activity. This range was used in conjunction with the estimated capital costs and the level of operating traffic volume to derive the estimated unit operating cost of each terminal considered in each of the scenarios. These estimates were applied on a port - by - port and terminal specific basis in the comparative economic analysis.

In the case of the short lived pipe traffic, it was assumed that existing infrastructure would be used and operational expenses would comprise largely of port handling changes.

2.1 Scenario 1 - Skagway

In Scenario 1, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse and then to Skagway via an upgraded White Pass Railway. To accommodate the projected 3-5m tons of non-Crest traffic forecasted as part of this scenario, a significant port facility would be required at Skagway.

Total undiscounted operating expenses, for the entire rail network have been estimated for Scenario 1 and are presented below in **Table 2.1**.

Table 2.1 – Total Life-Cycle Rail Operating Expenses (Skagway - No Crest)

Skagway Operating Expenses without Crest			
(in US\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,283	\$2,372	\$2,463
Maintenance of Equipment	\$238	\$293	\$278
Labor	\$434	\$806	\$902
Locomotive Fuel	\$1,442	\$1,832	\$2,256
Car Hire & Locomotive Purchases	\$832	\$803	\$732
Other Transportation Expenses	\$236	\$394	\$568
General & Administration	\$254	\$282	\$293
Total Operating Expenses	\$5,718	\$6,782	\$7,492

As reported in Work Packages B2(d) and B2(g) the Port of Skagway has limited expansion potential due to the lack of incremental back up land and berthing areas, conflicts with the passenger cruise business and the issues of environmental approval for industrial facilities at the mouth of the Skagway River.

No port scenario was envisioned that could handle 3-5 million tones of bulk and pipe traffic through the Port of Skagway without significant impacts on adjacent port uses. Therefore, the reduced volume scenario presented in 3.1.2 of the “Life-Cycle Capital Cost Estimation” report was used to estimate undiscounted life-cycle port operating expenses in the magnitude of US\$ 500 million.

2.2 Scenario 2 – Port-Mackenzie – Anchorage via Beaver Creek (with Crest Iron Ore)

In Scenario 2, the ALCAN Rail Link mainline would be developed via Beaver Creek and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse but no connection to the existing White Pass Railway route would be developed. A second spur, also from Carmacks, would head north to the Crest Iron Ore Mine. From Delta Junction west, rail traffic would use the Alaska Railroad network to connect to Anchorage, development of a short spur to Port Mackenzie would be required. At Port Mackenzie a port facility would be developed to handle approximately 28m tons of projected Crest Iron Ore. An additional 3-5m tons of non-Crest traffic would be shared between existing port sites in Port Mackenzie and Anchorage. Proposed port facility improvements would be as per Scenario 2 in work package B3(b).

2.2.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire, other transportation expenses, general and administration have been estimated for Scenario 2 and are presented below in **Table 2.2**.

Table 2.2 - Total Life-Cycle Rail Operating Expenses (Port Mackenzie via Beaver Creek – with Crest)

Port MacKenzie via Beaver Creek Operating Expenses with Crest			
(in US\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$4,396	\$4,568	\$4,744
Maintenance of Equipment	\$745	\$1,026	\$1,007
Labor	\$1,619	\$3,335	\$3,966
Locomotive Fuel	\$7,437	\$9,449	\$11,636
Car Hire & Locomotive Purchases	\$3,553	\$3,441	\$3,318
Other Transportation Expenses	\$1,176	\$1,943	\$2,825
General & Administration	\$400	\$514	\$562
Total Operating Expenses	\$19,326	\$24,277	\$28,058

The longer distance required to access Port Mackenzie, particularly for the large volumes of Crest Iron Ore traffic, results in comparatively higher rail operating expenses relative to closer port locations. Locomotive fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up 70-80% of total rail operating expenses.

2.2.2 Port Facility Operating Expenses

Based on projected combined dry bulk traffic (coal + iron ore + other minerals) of 1.35 billion tons at Port Mackenzie over the 50 year analysis period, total undiscounted life-cycle operating expenses are projected at US\$ 5.7 billion. At Anchorage, based on a small projected volume of pipe traffic in years 3-4, total undiscounted life-cycle operating expenses are projected at US\$ 7 million. Operating expenses at Anchorage reflect the port's throughput tariff charges, and thus would include operating expenses and capital recovery. Total operating expenses for Scenario 2 are projected at US\$ 5.7 billion.

2.2.3 Operating Expense Summary

The analysis of Scenario 2 projects undiscounted life-cycle operating expenses at US\$ 24.9-33.7 billion.

Table 2.3 – Total Estimated Undiscounted Life-Cycle Operating Expenses (Port Mackenzie via Beaver Creek – with Crest)

Port Mackenzie via Beaver Creek (with Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (US\$ millions)	Management Strategy 2 (US\$ millions)	Management Strategy 3 (US\$ millions)
Rail Network Operations			
Maintenance of Way	\$4,396	\$4,568	\$4,744
Maintenance of Equipment	\$745	\$1,026	\$1,007
Labor	\$1,619	\$3,335	\$3,966
Locomotive Fuel	\$7,437	\$9,449	\$11,636
Car Hire & Locomotive Purchase	\$3,553	\$3,441	\$3,318
Other Transportation Expenses	\$1,176	\$1,943	\$2,825
General & Administration	\$400	\$514	\$562
Sub Total	\$19,326	\$24,277	\$28,058
Port Facility Operations			
Port Mackenzie (Bulk)		\$5,659	
Port of Anchorage (Pipe)		\$7	
Sub Total		\$5,667	
Total Operating Expenses	\$24,993	\$29,944	\$33,724

2.3 Scenario 2a – Port-Mackenzie – Anchorage via Beaver Creek (without Crest Iron Ore)

In Scenario 2a, the ALCAN Rail Link mainline would be developed via Beaver Creek and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse but no connection to the existing White Pass Railway route would be developed. From Delta Junction west, rail traffic would use the existing Alaska Railroad network to connect to Anchorage. 3-5m tons of non-Crest traffic would be handled at the existing port sites at Port Mackenzie and Anchorage. Proposed port facility improvements would be as per Scenario 2a in work package B3(b).

2.3.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire, locomotive purchase, other transportation expenses, general and administration have been estimated for Scenario 2a and are presented below in **Table 2.4**.

Table 2.4 - Total Life-Cycle Rail Operating Expenses (Port Mackenzie via Beaver Creek – without Crest)

Port MacKenzie via Beaver Creek Operating Expenses without Crest			
(in U\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,283	\$2,372	\$2,463
Maintenance of Equipment	\$205	\$248	\$248
Labor	\$453	\$783	\$929
Locomotive Fuel	\$1,605	\$2,040	\$2,512
Car Hire & Locomotive Purchases	\$729	\$698	\$664
Other Transportation Expenses	\$259	\$424	\$617
General & Administration	\$254	\$280	\$294
Total Operating Expenses	\$5,789	\$6,845	\$7,728

The longer distance required to access Port Mackenzie results in comparatively higher rail operating expenses relative to closer port locations. Locomotive fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up around 80% of total rail operating expenses.

2.3.2 Port Facility Operating Expenses

Based on projected combined dry bulk traffic (coal + other minerals) of 82 million tons at Port Mackenzie over the 50 year analysis period, total undiscounted operating expenses are projected at U\$ 1.1 billion. At Anchorage, based on a small projected volume of pipe traffic in years 3-4, total undiscounted operating expenses are projected at U\$ 7 million. Operating expenses at Anchorage reflect the port's throughput tariff charges, and thus would include operating expenses and capital recovery. Total operating expenses for Scenario 2a are projected at U\$ 1.1 billion.

2.3.3 Operating Expense Summary

The analysis of Scenario 2a projects undiscounted life-cycle operating expenses at U\$ 6.9-8.8 billion.

Table 2.5 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Beaver Creek – without Crest)

Port Mackenzie via Beaver Creek (without Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$2,283	\$2,372	\$2,463
Maintenance of Equipment	\$205	\$248	\$248
Labor	\$453	\$783	\$929
Locomotive Fuel	\$1,605	\$2,040	\$2,512
Car Hire & Locomotive Purchase	\$729	\$698	\$664
Other Transportation Expenses	\$259	\$424	\$617
General & Administration	<u>\$254</u>	<u>\$280</u>	<u>\$294</u>
Sub Total	\$5,789	\$6,845	\$7,728
Port Facility Operations			
Port Mackenzie (Bulk)		\$1,104	
Port of Anchorage (Pipe)		<u>\$7</u>	
Sub Total		\$1,111	
Total Operating Expenses	\$6,900	\$7,956	\$8,839

2.4 Scenario 3 – Port-Mackenzie – Anchorage via Ladue River (with Crest Iron Ore)

In Scenario 3, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). As in Scenario 2, a spur at Carmacks would head south to Whitehorse but no connection to the existing White Pass Railway route would be developed. A second spur would head north from Carmacks to the Crest Iron Ore Mine. From Delta Junction west, rail traffic would use the Alaska Railroad network to connect to Anchorage, development of a short spur to Port Mackenzie would be required. At Port Mackenzie a port facility would be developed to handle approximately 28m tons of projected Crest Iron Ore. An additional 3-5m tons of non-Crest traffic would be handled at the existing port sites at Port Mackenzie and Anchorage. Proposed port facility improvements would be as per Scenario 3 in work package B3(b).

2.4.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire & locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 3 and are presented below in **Table 2.6**.

Table 2.6 - Total Life-Cycle Rail Operating Expenses (Port Mackenzie via Ladue River – with Crest)

Port MacKenzie via Ladue River Operating Expenses with Crest			
(in US\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$4,274	\$4,442	\$4,613
Maintenance of Equipment	\$670	\$961	\$962
Labor	\$1,468	\$3,335	\$3,966
Locomotive Fuel	\$7,207	\$9,157	\$11,276
Car Hire & Locomotive Purchases	\$3,387	\$3,354	\$3,257
Other Transportation Expenses	\$1,134	\$1,896	\$2,759
General & Administration	\$387	\$509	\$557
Total Operating Expenses	\$18,528	\$23,654	\$27,390

The longer distance required to access Port Mackenzie results in comparatively higher rail operating expenses relative to closer port locations. Locomotive fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up 70-80% of total rail operating expenses.

2.4.2 Port Facility Operating Expenses

Port facility operating expenses for Scenario 3 are the same as Scenario 2 and are projected at US\$ 5.7 billion.

2.4.3 Operating Expense Summary

The analysis of Scenario 3 projects undiscounted life-cycle operating expenses at U\$ 24.2-33.1 billion.

Table 2.7 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Ladue River – with Crest)

Port Mackenzie via Ladue River (with Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$4,274	\$4,442	\$4,613
Maintenance of Equipment	\$670	\$961	\$962
Labor	\$1,468	\$3,335	\$3,966
Locomotive Fuel	\$7,207	\$9,157	\$11,276
Car Hire & Locomotive Purchase	\$3,387	\$3,354	\$3,257
Other Transportation Expenses	\$1,134	\$1,896	\$2,759
General & Administration	<u>\$387</u>	<u>\$509</u>	<u>\$557</u>
Sub Total	\$18,528	\$23,654	\$27,390
Port Facility Operations			
Port Mackenzie (Bulk)		\$5,659	
Port of Anchorage (Pipe)		<u>\$7</u>	
Sub Total		\$5,667	
Total Operating Expenses	\$24,194	\$29,320	\$33,056

2.5 Scenario 3a – Port-Mackenzie – Anchorage via Ladue River (without Crest Iron Ore)

In Scenario 3a, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). As in Scenario 3, a spur at Carmacks would head south to Whitehorse but no connection to the existing White Pass Railway route would be developed. From Delta Junction west, rail traffic would use the Alaska Railroad network to connect to Anchorage, and Port Mackenzie via a currently undeveloped spur line. 3-5m tons of non-Crest traffic would be handled at the existing port sites in Port Mackenzie and Anchorage. Proposed port facility improvements would be as per Scenario 3a in work package B3(b).

2.5.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire, locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 2a and are presented below in **Table 2.8**.

Table 2.8 - Total Life-Cycle Rail Operating Expenses (Port Mackenzie via Ladue River – without Crest)

Port MacKenzie via Ladue River Operating Expenses without Crest			
(in US\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,188	\$2,372	\$2,463
Maintenance of Equipment	\$198	\$245	\$246
Labor	\$423	\$783	\$929
Locomotive Fuel	\$1,545	\$1,964	\$2,418
Car Hire & Locomotive Purchases	\$698	\$681	\$656
Other Transportation Expenses	\$249	\$412	\$600
General & Administration	\$252	\$280	\$294
Total Operating Expenses	\$5,554	\$6,737	\$7,607

The longer distance required to access Port Mackenzie results in comparatively higher rail operating expenses relative to closer port locations. Locomotive fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up around 80% of total rail operating expenses.

2.5.2 Port Facility Operating Expenses

Port facility operating expenses for Scenario 3a are the same as Scenario 2a and are projected at US\$ 1.1 billion.

2.5.3 Operating Expense Summary

The analysis of Scenario 3a projects undiscounted life-cycle operating expenses at U\$ 6.7-8.7 billion.

Table 2.9 – Total Estimated Undiscounted Life-Cycle Costs (Port Mackenzie via Ladue River – without Crest)

Port Mackenzie via Ladue River (without Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$2,188	\$2,372	\$2,463
Maintenance of Equipment	\$198	\$245	\$246
Labor	\$423	\$783	\$929
Locomotive Fuel	\$1,545	\$1,964	\$2,418
Car Hire & Locomotive Purchase	\$698	\$681	\$656
Other Transportation Expenses	\$249	\$412	\$600
General & Administration	<u>\$252</u>	<u>\$280</u>	<u>\$294</u>
Sub Total	\$5,554	\$6,737	\$7,607
Port Facility Operations			
Port Mackenzie (Bulk)		\$1,104	
Port of Anchorage (Pipe)		<u>\$7</u>	
Sub Total		\$1,111	
Total Operating Expenses	\$6,665	\$7,848	\$8,718

2.6 Scenario 4 – Haines (with Crest Iron Ore)

In Scenario 4, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse and then on to Haines; no connection to the White Pass Railway route would be provided. A second spur, also from Carmacks, would head north to the Crest Iron Ore Mine. At Haines port facilities would be developed to handle approximately 28m tons of projected Crest Iron Ore (Tanani Point) and 3-5m tons of mixed non-Crest traffic (Lutak Inlet). Proposed port facility improvements would be as per Scenario 4 in work package B3(b).

2.6.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire and locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 4 and are presented below in **Table 2.10**.

Table 2.10 - Total Life-Cycle Rail Operating Expenses (Haines – with Crest)

Haines Operating Expenses with Crest			
(in U\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,884	\$2,997	\$3,112
Maintenance of Equipment	\$443	\$626	\$628
Labor	\$982	\$2,005	\$2,708
Locomotive Fuel	\$4,778	\$6,071	\$7,477
Car Hire & Locomotive Purchases	\$2,944	\$2,904	\$2,848
Other Transportation Expenses	\$773	\$1,271	\$1,889
General & Administration	\$314	\$384	\$433
Total Operating Expenses	\$13,118	\$16,258	\$19,095

The shorter distance required to access Haines, particularly for the large volumes of Crest Iron Ore traffic, results in comparatively lower rail operating expenses relative to farther port locations. Locomotive fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up around 80% of total rail operating expenses.

2.6.2 Port Facility Operating Expenses

Based on projected combined dry bulk traffic (coal + iron ore) of 1.29 billion tons at the proposed Tanani Point bulk terminal over the 50 year analysis period, total undiscounted operating expenses are projected at U\$ 6.3 billion. At the Lutak Inlet site, with approximately 3.5 million tons of mineral concentrates and a small projected volume of pipe traffic in years 3-4, total undiscounted operating expenses are projected at U\$ 1.2 billion. Total operating expenses for Scenario 4 are projected at U\$ 7.5 billion.

2.6.3 Operating Expense Summary

The analysis of Scenario 4 projects undiscounted life-cycle operating expenses at U\$ 20.6-26.6 billion.

Table 2.11 – Total Estimated Undiscounted Life-Cycle Costs (Haines – with Crest)

Haines (with Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$2,884	\$2,997	\$3,112
Maintenance of Equipment	\$443	\$626	\$628
Labor	\$982	\$2,005	\$2,708
Locomotive Fuel	\$4,778	\$6,071	\$7,477
Car Hire & Locomotive Purchase	\$2,944	\$2,904	\$2,848
Other Transportation Expenses	\$773	\$1,271	\$1,889
General & Administration	\$314	\$384	\$433
Sub Total	\$13,118	\$16,258	\$19,095
Port Facility Operations			
Tanani Point (Iron Ore + Coal)		\$6,345	
Lutak Inlet (Minerals + Pipe)		\$1,151	
Sub Total		\$7,496	
Total Operating Expenses	\$20,614	\$23,755	\$26,591

2.7 Scenario 4a – Haines (without Crest Iron Ore)

In Scenario 4a, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse and then on to Haines; no connection to the White Pass Railway route would be provided. At Haines port facilities would be developed to handle approximately 3-5m tons of projected non-Crest mixed traffic at Tanani Point. Proposed port facility improvements would be as per Scenario 4a in work package B3(b).

2.7.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire & locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 4a and are presented below in **Table 2.12**.

Table 2.12 - Total Life-Cycle Rail Operating Expenses (Haines – without Crest)

Haines Operating Expenses without Crest			
(in U\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,188	\$2,372	\$2,463
Maintenance of Equipment	\$192	\$235	\$237
Labor	\$399	\$739	\$904
Locomotive Fuel	\$1,462	\$1,857	\$2,287
Car Hire & Locomotive Purchases	\$680	\$657	\$636
Other Transportation Expenses	\$236	\$391	\$573
General & Administration	\$251	\$277	\$292
Total Operating Expenses	\$5,408	\$6,527	\$7,393

Locomotive Fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up around 80% of total rail operating expenses.

2.7.2 Port Facility Operating Expenses

Based on projected combined, largely bulk, traffic (coal + mineral concentrates + pipe) of 83 million tons at the proposed Tanani Point terminal over the 50 year analysis period, total undiscounted operating expenses are projected at U\$ 1.6 billion.

2.7.3 Operating Expense Summary

The analysis of Scenario 4a projects undiscounted life-cycle operating expenses at U\$ 7.0-9.0 billion.

Table 2.13 – Total Estimated Undiscounted Life-Cycle Operating Expenses (Haines – without Crest)

Haines (without Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$2,188	\$2,372	\$2,463
Maintenance of Equipment	\$192	\$235	\$237
Labor	\$399	\$739	\$904
Locomotive Fuel	\$1,462	\$1,857	\$2,287
Car Hire & Locomotive Purchase	\$680	\$657	\$636
Other Transportation Expenses	\$236	\$391	\$573
General & Administration	<u>\$251</u>	<u>\$277</u>	<u>\$292</u>
Sub Total	\$5,408	\$6,527	\$7,393
Port Facility Operations			
Tanani Point (Coal/Pipe/Minerals)		<u>\$1,606</u>	
Sub Total		\$1,606	
Total Operating Expenses	\$7,014	\$8,134	\$8,999

2.8 Scenario 5 – Hyder-Stewart (without Crest Iron Ore)

In Scenario 5, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse, no connection to the White Pass Railway route would be provided. One hundred miles north of Hazelton, at Damdochax-Pa, a spur would be developed, heading west, providing access to Hyder-Stewart. At Hyder-Stewart a port facility would be developed to handle approximately 3-5m tons of mixed non-Crest traffic. Proposed port facility improvements would be as per Scenario 5 in work package B3(b).

2.8.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire and locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 5 and are presented below in **Table 2.14**.

Table 2.14 - Total Life-Cycle Rail Operating Expenses (Hyder-Stewart – without Crest)

Hyder-Stewart Operating Expenses without Crest			
(in U\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,188	\$2,372	\$2,463
Maintenance of Equipment	\$192	\$234	\$237
Labor	\$394	\$758	\$893
Locomotive Fuel	\$1,478	\$1,877	\$2,312
Car Hire & Locomotive Purchases	\$679	\$654	\$639
Other Transportation Expenses	\$238	\$396	\$576
General & Administration	\$250	\$278	\$292
Total Operating Expenses	\$5,419	\$6,570	\$7,412

Locomotive Fuel, Locomotive Purchases & Car Hire and Maintenance of Way expenses make up around 80% of total rail operating expenses.

2.8.2 Port Facility Operating Expenses

Based on projected combined, largely bulk, traffic (coal + mineral concentrates + pipe) of 83 million tons at the proposed Hyder terminal over the 50 year analysis period, total undiscounted operating expenses are projected at U\$ 1.5 billion.

2.8.3 Operating Expense Summary

The analysis of Scenario 5 projects undiscounted life-cycle operating expenses at U\$ 6.9-8.9 billion.

Table 2.15 – Total Estimated Undiscounted Life-Cycle Operating Expenses (Hyder-Stewart – without Crest)

Hyder-Stewart (without Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$2,188	\$2,372	\$2,463
Maintenance of Equipment	\$192	\$234	\$237
Labor	\$394	\$758	\$893
Locomotive Fuel	\$1,478	\$1,877	\$2,312
Car Hire & Locomotive Purchase	\$679	\$654	\$639
Other Transportation Expenses	\$238	\$396	\$576
General & Administration	<u>\$250</u>	<u>\$278</u>	<u>\$292</u>
Sub Total	\$5,419	\$6,570	\$7,412
Port Facility Operations			
Hyder (Coal/Pipe/Minerals)		<u>\$1,487</u>	
Sub Total		\$1,487	
Total Operating Expenses	\$6,906	\$8,057	\$8,899

2.9 Scenario 6 – Prince Rupert (with Crest Iron Ore)

In Scenario 6, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse, no connection to the White Pass Railway route would be provided. A second spur, also from Carmacks, would head north to the Crest Iron Ore Mine. From the southern terminus of the ALCAN Rail Link at Hazelton rail traffic would make use of the existing CN Northern Mainline to connect to port facilities at Prince Rupert. At Prince Rupert, approximately 28 million tons of Crest Iron Ore would be processed through an expanded Ridley Island Terminal. Non-Crest mixed traffic would be processed through a combination of expansion to the bulk terminal capacity at Ridley Island and the development of a new multi – purpose bulk terminal at South Kaien Island. In this scenario the pipe traffic would be routed through the under-utilized EuroCan Terminal at Kitimat.

Proposed port facility improvements would be as per Scenario 6 in work package B3(b).

2.9.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire and locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 6 and are presented below in **Table 2.16**.

Table 2.16 - Total Life-Cycle Rail Operating Expenses (Prince Rupert – with Crest)

Prince Rupert Operating Expenses with Crest			
(in US\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$6,972	\$7,246	\$7,524
Maintenance of Equipment	\$932	\$1,289	\$1,294
Labor	\$1,700	\$3,544	\$4,228
Locomotive Fuel	\$8,912	\$11,324	\$13,945
Car Hire & Locomotive Purchases	\$3,571	\$3,550	\$3,443
Other Transportation Expenses	\$1,377	\$2,257	\$3,274
General & Administration	\$474	\$599	\$653
Total Operating Expenses	\$23,939	\$29,809	\$34,361

Locomotive fuel, Locomotive Purchases & Car Hire and Maintenance of Way expenses make up 70-80% of total rail operating expenses.

2.9.2 Port Facility Operating Expenses

Based on projected combined dry bulk traffic (coal + iron ore) of 1.29 billion tons at the expanded Ridley Terminals over the 50 year analysis period, total undiscounted operating expenses are projected at US\$ 4.5 billion. At the proposed South Kaien site, with approximately 3.5 million tons per year of mineral concentrates total undiscounted operating expenses are projected at US\$ 1.2 billion. The small volume of pipe traffic in years 3-4 would be routed through Kitimat at a throughput cost of US\$ 7 million. Total operating expenses for Scenario 6 are projected at US\$ 5.6 billion.

2.9.3 Operating Expense Summary

The analysis of Scenario 5 projects undiscounted life-cycle operating expenses at US\$ 29.6-40.0 billion.

Table 2.17 – Total Estimated Undiscounted Life-Cycle Operating Expenses (Prince Rupert – with Crest)

Prince Rupert (with Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (US\$ millions)	Management Strategy 2 (US\$ millions)	Management Strategy 3 (US\$ millions)
Rail Network Operations			
Maintenance of Way	\$6,972	\$7,246	\$7,524
Maintenance of Equipment	\$932	\$1,289	\$1,294
Labor	\$1,700	\$3,544	\$4,228
Locomotive Fuel	\$8,912	\$11,324	\$13,945
Car Hire & Locomotive Purchase	\$3,571	\$3,550	\$3,443
Other Transportation Expenses	\$1,377	\$2,257	\$3,274
General & Administration	\$474	\$599	\$653
Sub Total	\$23,939	\$29,809	\$34,361
Port Facility Operations			
Expanded Ridley (Coal/Iron Ore)		\$4,461	
South Kaien (Minerals)			
+ Kitimat (Pipe)		\$1,166	
Sub Total		\$5,627	
Total Operating Expenses	\$29,566	\$35,436	\$39,987

2.10 Scenario 6a – Prince Rupert (without Crest Iron Ore)

In Scenario 6a, the ALCAN Rail Link mainline would be developed via Ladue River and Watson Lake connecting Hazelton (connection to the existing CN Rail Northern Mainline) to Delta Junction (connection to the Alaska Railroad). A spur at Carmacks would head south to Whitehorse, no connection to the White Pass Railway route would be provided. From the southern terminus of the ALCAN Rail Link at Hazelton rail traffic would make use of the existing CN Northern Mainline to connect to the existing port facilities at Prince Rupert and Kitimat. Approximately 3-5 million tons of non-Crest mixed traffic would be processed through a combination of terminals at Ridley Island, a proposed terminal at South Kaien Island and Kitimat. Proposed port facility improvements would be as per Scenario 6a in work package B3(b).

2.10.1 Rail Network Operating Expenses

Total undiscounted operating expenses, including maintenance of way, maintenance of equipment, labour, locomotive fuel, car hire and locomotive purchases, other transportation expenses, general and administration have been estimated for Scenario 6a and are presented below in **Table 2.18**.

Table 2.18 - Total Life-Cycle Rail Operating Expenses (Prince Rupert – without Crest)

Prince Rupert Operating Expenses without Crest			
(in US\$ millions 2006 over 50 years)	Management Strategy		
	1	2	3
Maintenance of Way	\$2,283	\$2,372	\$2,463
Maintenance of Equipment	\$200	\$248	\$249
Labor	\$418	\$790	\$937
Locomotive Fuel	\$1,582	\$2,010	\$2,476
Car Hire & Locomotive Purchases	\$708	\$690	\$666
Other Transportation Expenses	\$254	\$420	\$612
General & Administration	\$252	\$280	\$295
Total Operating Expenses	\$5,697	\$6,810	\$7,698

Locomotive fuel, Car Hire & Locomotive Purchases and Maintenance of Way expenses make up 70-80% of total rail operating expenses.

2.10.2 Port Facility Operating Expenses

Based on projected coal traffic of 30 million tons at Ridley Terminals over the 50 year analysis period, total undiscounted operating expenses are projected at US\$ 161 million. At the proposed South Kaien site, with approximately 3.5 million tons of mineral concentrates total undiscounted operating expenses are projected at US\$ 1.2 billion. The small volume of pipe traffic in years 3-4 would be routed through Kitimat at a throughput cost of US\$ 7 million. Total operating expenses for Scenario 6a are projected at US\$ 1.3 billion.

2.10.3 Operating Expense Summary

The analysis of Scenario 6a projects undiscounted life-cycle operating expenses at U\$ 7.0-9.0 billion.

Table 2.19 – Total Estimated Undiscounted Life-Cycle Operating Expenses (Prince Rupert – without Crest)

Prince Rupert (without Crest)	Estimated Undiscounted Life-Cycle Operating Expenses		
	Management Strategy 1 (U\$ millions)	Management Strategy 2 (U\$ millions)	Management Strategy 3 (U\$ millions)
Rail Network Operations			
Maintenance of Way	\$2,283	\$2,372	\$2,463
Maintenance of Equipment	\$200	\$248	\$249
Labor	\$418	\$790	\$937
Locomotive Fuel	\$1,582	\$2,010	\$2,476
Car Hire & Locomotive Purchase	\$708	\$690	\$666
Other Transportation Expenses	\$254	\$420	\$612
General & Administration	<u>\$252</u>	<u>\$280</u>	<u>\$295</u>
Sub Total	\$5,697	\$6,810	\$7,698
Port Facility Operations			
Expanded Ridley (Coal/Iron Ore)		\$161	
South Kaien (Minerals)			
+ Kitimat (Pipe)		<u>\$1,166</u>	
Sub Total		\$1,327	
Total Operating Expenses	\$7,024	\$8,137	\$9,025

3.0 Summary

This report on work package B3(d) estimates in constant dollars the life – cycle operating expenses of a series of scenarios of rail-port routes integrating selected ports into the Alaska Canada Rail Link. Each scenario included the ALCAN mainline, potential spurs to access resources or ports and a destination port including terminal facilities.

Using the rail cost model developed by Innovative Scheduling in work package B3(c/e) and a series of port cost models the undiscounted operating expenses of each scenario have been estimated over the 50 year analysis period and reported below.

At this stage of initial economic planning the scenarios reported herein are meant for mutually exclusive comparison and not for system network optimization.

Table 3.1 – Total Estimated Undiscounted Life-Cycle Costs by Scenario

Undiscounted Operating Expenses Summary		Estimated Undiscounted Life-Cycle Operating Expenses		
		Port Operations (US\$ millions)	Rail Operations (US\$ millions)	Total Operations (US\$ millions)
Scenario 1	Skagway (without Crest)*	\$500	\$5,000 - \$7,000	\$6,000 - \$7,000
Scenario 2	Port Mackenzie via Beaver Creek (with Crest)	\$5,700	\$19,000 - \$28,000	\$25,000 - \$34,000
Scenario 2a	Port Mackenzie via Beaver Creek (without Crest)	\$1,100	\$6,000 - \$8,000	\$7,000 - \$9,000
Scenario 3	Port Mackenzie via Ladue River (with Crest)	\$5,700	\$19,000 - \$27,000	\$25,000 - \$33,000
Scenario 3a	Port Mackenzie via Ladue River (without Crest)	\$1,100	\$6,000 - \$8,000	\$7,000 - \$9,000
Scenario 4	Haines (with Crest)	\$7,500	\$13,000 - \$19,000	\$20,000 - \$26,000
Scenario 4a	Haines (without Crest)	\$1,600	\$5,000 - \$7,000	\$7,000 - \$9,000
Scenario 5	Hyder-Stewart (without Crest)	\$1,500	\$5,000 - \$7,000	\$6,000 - \$8,000
Scenario 6	Prince Rupert (with Crest)	\$5,600	\$24,000 - \$34,000	\$30,000 - \$40,000
Scenario 6a	Prince Rupert (without Crest)	\$1,300	\$6,000 - \$8,000	\$7,000 - \$9,000

* Due to constrained port expansion capacity direct comparison not possible.

In Table 3.1 both the rail and port component of estimated operating expenses are reported. Broken down between port and rail components, port operating expenses make up 12% to 25% of total undiscounted operating expenses. Although the rail component of operating expenses dominated the port component, it was not as dominant as in the capital cost results. This reflects the relatively high operating expenses of port terminals relative to their capital costs.

For the marine terminals, operating expenses fell into two groupings: the scenarios with Crest had total life-cycle undiscounted expenses of \$U 5.6 billion to \$U 7.5 billion while without-Crest scenarios were much lower, in the range of \$U 1.1 billion to \$U 1.6 billion. Higher operating expenses at Haines and Hyder reflected the lack of existing infrastructure and more difficult terrain at the proposed port sites, leading to comparatively higher capital costs and operating expenses. Similarly, at Port Mackenzie and Prince Rupert, the use of existing infrastructure reduced operating expenses.

Rail operating expenses varied to a greater degree, both in each scenario, dependent on the management strategy selected in the rail cost model and between the specific rail-port route scenarios. Operating expenses were much lower for without-Crest scenarios, reflecting the reduced traffic levels across the rail network. Between scenarios, there was little variation within the without-Crest scenarios, due to the similar traffic patterns. In the with-Crest scenarios, significant changes in traffic patterns, particularly Crest to port traffic, resulted in much larger variation. In these scenarios, ports located far from the Crest mine site incurred significantly larger life-cycle operating expenses, with the long distance Prince Rupert scenario being 50% more expensive than the shorter Haines scenario, a difference of \$U 13 billion over the 50 year life-cycle. In general, without-Crest scenarios ranged from \$U 6 billion to \$U 7 billion. With-Crest scenarios, having much larger operating expenses, are varied from \$U 20 billion to \$U 40 billion.