Final Report

Mineral Freight Forecasts for the

Alberta to Alaska Rail Link Project

By

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Executive Summary

This report is in support of a larger project to examine the economic feasibility of a proposed rail link between Fort McMurray, Alberta and Delta Junction Alaska. The primary function of the proposed rail link is the transport of product from the oil sands projects in the Fort McMurray area to an existing deepwater supertanker port with an operating oil terminal. This supporting document examines potential mineral freight revenue that would provide additional cash flows to support the multi-billion rail project.

Within a 100 mile (160 kilometer) wide corridor for the rail link, there are 1717 known metallic mineral occurrences. There is a much larger potential tonnage of industrial minerals and coal within the corridor; however, these resources are less well defined. The metallic mineral resources are primarily in a 1100 mile (1760 kilometer) section of the corridor from Fort Nelson, B.C. to Delta Junction, Alaska. The combined mineral and solid fuel resources are estimated to provide 43 million tons of freight per year to proposed rail system. It is estimated that such a freight load would provide positive cash flows over a 30 year project life that would significantly increase the economic feasibility of the proposed rail link. It would also reduce the project risk due to multiple sources of freight.

The expected gross metal value of only the metallic mineral resources is estimated in a range of $333 to $659 billion as a function of expected metal commodity prices. Estimated future metal prices are projected to be within the range of metal prices over the last decade. These gross metal values are equivalent to the gross metal value of one or two large porphyry copper mines. These mines would provide significant economic benefits to communities with the mine areas as well as to the provincial or state governments in which they are located.

Introduction

This investigation is in support of a study commissioned by Alberta Provincial Government to examine the potential economic feasibility of a rail link between Fort McMurray, Alberta and Delta Junction, Alaska for the transport of oil sands products to the deepwater port at Valdez, Alaska. The initial concept is to inject the bitumen from the Fort McMurray area oil sands projects into the Trans-Alaska Pipeline (TAPS) at Delta Junction for final transport to the existing oil terminal at the Port of Valdez. Alyeska Pipeline Service Company, which operates the pipeline, is owned by a consortium of Alaska North Slope Oil Field producers. Alyeska has reconfigured the pipeline to accommodate the current reduced production from the Alaska North Slope (ANS), which is below 600,000 barrels per day (bpd). The original pipeline operational capacity as constructed was 1.6 million bpd although it operated for a very short time at a peak capacity 2.1 million bpd. The current operational capacity is approximately 1.1 million bpd. Thus, the pipeline could theoretically transport 500 to 600 thousand bpd of product from the Fort McMurray area.

As an alternative to injection of oil sands products into the TAPS or to supplement the current excess capacity of TAPS, a parallel pipeline could be constructed in the Transportation Corridor from Delta Junction to Valdez, Alaska. This alternative would not change mineral freight forecast for the rail link from Fort McMurray to Delta Junction, Alaska. The supplemental pipeline alternative would allow much larger volumes for oil sands products to be transported through the Port of Valdez and thus providing significant economies of scale for the rail link project.

The focus of this investigation is an estimation of potential mineral and solid fuel freight that may be transported by the Alberta to Alaska Rail Link. This potential freight load would affect the economics of the rail link and would provide economic benefits to the various jurisdictions that the rail link transects and to the mineral and energy industries with resources along the route.

Background and Previous Investigations

Connecting the Alaska Railroad with the North American railway grid in Canada has been an objective since the original authorization of the federally owned and operated railroad by the U.S. Congress in 1914. With the completion of the railroad construction from Seward to Fairbanks, Alaska, the original appropriations were exhausted. During World War II, a planning effort examined a railroad right-of-way from the Canadian Railway System in northern British Columbia to Fairbanks and on to Port Clarence near Nome, Alaska. This proposed railroad extension was replaced by the Alaska Highway alternative. Connecting Alaska to the North American rail grid has been the focus of several planning efforts since the Alaska Railroad Corporation was acquired by the State of Alaska in 1986. The most recent effort was federal legislation sponsored by Alaska Senator Frank Murkowski and signed into law by President Clinton at the end of his term in 2000. The “Rails to Resources” legislation provided for a 24 Member Bi-lateral Commission from Canada and the U.S. to examine the feasibility of an Alaska Canada Rail Link.

With the failure of the Commission to be seated by 2002, Senator Murkowski requested that a portion of the funding for the feasibility study be transferred to the University of Alaska Fairbanks to begin the effort. The request included a mandate that the University partner with a Canadian organization to jointly undertake the investigation. The University of Alaska Fairbanks had an existing co-operative research agreement with the University of Calgary and entered into a more definitive agreement with the Van Horne Institute for Transportation and Regulatory Affairs, which is a privately funded institute located at the University of Calgary industrial park.

In 2003, the U.S. Army Alaska contracted with the University of Alaska to examine modes surface access to the one million acre training grounds between Fort Wainwright, Eielson, AFB, and Fort Greely, Alaska. The study was completed in 2005, recommended rail access to the training grounds and installations, and provided for a preliminary design and economic analysis of an 80 mile railroad extension from Eielson, AFB to Fort Greely at Delta Junction, Alaska (Metz and Others, 2005). The Environmental Impact Statement for that extension was undertaken by the U.S. Surface Transportation Board (STB) and a Finding of No Significant Impact was received at the end of 2010. Construction on this railroad extension continues to date.

In 2006, the State of Alaska, the Yukon Territorial Government, the University of Alaska Fairbanks, and the Van Horne Institute began a Phase I Feasibility Study for the Alaska Canada Rail Link from Delta Junction Alaska to several locations in northeastern British Columbia. The Executive Report was released in July 2007 (Staff, Alaska Canada Rail Link Project, 2006). The investigation demonstrated a business case for the rail link and examined alternatives for financing the project. In late 2006, the Alaska Department of Transportation and Public Facilities provided additional funding to the University of Alaska Fairbanks to refine the cost estimates and revenue projections from the Phase I Feasibility Study. This Phase II work is on-going (Metz, 2006; Metz, 2007a; Metz, 2007b; Metz, 2007c; Metz, 2007d; Metz and Others, 2008; Metz, 2011).

Mineral Freight Forecast Model

The site selection, preliminary design, and cost estimation for an 1100 mile (1760 kilometer) railroad is a major task. Equally challenging is estimating what sources of rail freight and freight revenues will accrue over the 30 plus year project life to recapture the multi-billion dollar capital investment.

The Phase I Feasibility Study relied on a single major freight source, the Crest Iron Ore occurrence in east-central Yukon Territory. The single source of major freight from a mineral occurrence with limited mineral exploration and evaluation expenditures created significant uncertainties in revenue projections and thus significant financial risk to the proposed rail link project. At the same time, public data bases contained mineral source information on nearly 23,000 mineral occurrences in northeastern British Columbia, Yukon Territory and Alaska that would be potentially impacted by a bulk transportation system.

Metz and Dixon (1988) developed a methodology for appraising mineral resources without proven mineral reserves. This methodology is in part dependent on quantitative mineral deposit models and associated tonnage and grade data (Cox and Singer, 1986). The mineral deposit models combined with assumed mining and mineral processing methods and metal prices are used to provide a probabilistic in-place gross metal value and recoverable tonnage of mineral concentrates. Two major problems must be addressed to provide confidence in the methodology. The estimation of probabilities that a given mineral occurrence is developed and that mineral deposit models were correctly assigned to each mineral occurrence in the public data bases. Metz and Li (2008) first applied the methodology to mineral occurrences for the Alaska Canada Rail Link corridor. Only mineral occurrences with validated mineral deposit models were included in the analysis. Probabilities of development were based on past surveys of major mineral exploration firms by various Canadian federal and provincial agencies collecting and disseminating mineral industry data. For mineral occurrences outside of historic mining districts, rates of discovery and development were found to be approximately one for each four hundred mineral occurrences examined. Within historic mining areas, the probability is reduced to approximately 1/100 and within the vicinity of a producing mine further reduction to 1/10.

For the Phase II Feasibility Study for the Alaska Canada Rail Link, the Michigan Tech Research Institute at Michigan Technological University was retained to merge the methodology development by Metz and Dixon (1988) with geographic information systems (GIS) technology. The resulting product is referred to as the Mineral Occurrence Revenue Estimation and Visualization (MOREV) Tool. The development of the tool is discussed by Brooks and Others (2011).

Metallic Mineral Rail Freight Estimates

The Mineral Occurrence Revenue Estimation and Visualization Tool has been run by Michigan Tech Research Institute for a 100 mile (160 kilometer) wide transportation corridor defined for the subject investigation (see Appendix A, Map of Mineral Occurrences in Transportation Corridor from Fort McMurray, Alberta to Delta Junction Alaska). The model was run at published metal prices for years 2005, 2007, 2009, 2011, and 2013 to examine changes in expected in-place gross metal values over the period of the Global Financial Crisis (GFC). The model was run with tonnage and grade curves for the known metallic mineral occurrences in the corridors at the 10^{th}, 50^{th}, and 90^{th} percentiles of the worldwide occurrences reported in the U.S Geological Survey Bulletin entitled Mineral Deposit Models (Cox and Singer,1986). Input data for the runs included published data in the British Columbia Mine File System, the Yukon Territory Mine File System, and the Alaska Resource Data Files System.

The 100 mile (160 kilometer) wide corridor includes 1717 known metallic mineral occurrences that have all been assigned metallic mineral deposit model numbers. The output from the model includes both expected rail freight tonnages and expected in-place gross metal values for known metallic mineral occurrences (see Appendix B, MOREV Tool eGMV Analysis of Mineral Occurrences within Proposed Rail Corridor). The ‘expected values’ are calculated on probabilities of development of one occurrence in one hundred occurrences explored and identified (1/100). The assigned probabilities are based on data published by the Canadian government as a result of surveys of Canadian mining companies on exploration activities known mining districts over extended time periods. The expected values do not reflect the potential for mineral development as a consequence of new exploration activities that are likely to occur after a bulk transportation system is operational.

The expected in-place gross metal values for the 1717 known metallic mineral occurrences within the 100 mile (160 kilometer) wide corridor at the upper 90^{th} percentile range from \$333-\$659 billion. This is equivalent to the gross metal value of one to two large porphyry copper deposits. By comparison, the Pebble Porphyry Copper Project in south central Alaska has a measured in-place gross metal value of \$350 billion. The expected rail freight concentrate tonnage is approximately 296 million tons. This would be equivalent to five medium to large size base-metal mines operating over a 30 year time period.

For base-metal and ferro-alloy metal mines, the inbound freight loads range from 5-10% of the outbound freight. The range reflects the need for larger quantities of fuel and materials for remote mines without grid power and without a local labor force. Thus, the total rail freight requirements for the 100 mile (160 kilometer) wide corridor is estimated at 326 million tons (296 x 1.1) over a 30 year time period or approximately 11 million tons per year.

Industrial Mineral and Coal Rail Freight Estimates

The above analysis is an estimate of rail freight requirements for metallic mineral deposits only. These are the only mineral resource types with published deposit models that include tonnage and grade data. On a worldwide basis metallic minerals only constitute 25% of total mineral resource value produced annually. Industrial minerals (non-metallic minerals) and coal account for 75% of the value of annual mineral resource production (petroleum and natural gas excluded). These are generally low unit value commodities that must be transported on rail or on water.

As communities develop along the rail corridor there will be increased demand for energy and industrial minerals locally. The rail transportation corridors will also allow for the efficient transport of these materials to export markets. Estimating the tonnages of non-metallic minerals and coal is based on this proportionate gross metal value. Tonnages of metallic minerals would provide a minimum tonnage of rail freight as the metallic mineral concentrates have proportionately higher unit values than industrial minerals and coal. Using a 4 to 1 ratio for total expected rail freight tonnages to metallic mineral freight loads, the total estimated rail freight for the 100 mile (160 kilometer) wide corridor is 1.3 billion tons (4 x 326 million) over a 30 year time period.

Thus the expected annual metallic and industrial minerals and coal rail freight load is 43 million tons (1.3 billion / 30 years). Assuming that the mineral resources are evenly distributed over the rail link that transects the mining districts from Fort Nelson, B.C. to Delta Junction, Alaska, the annual rail freight revenues can be based on half this distance of 1100 miles (1760 kilometers).

As stated above, these estimates do not include the potential rail freight tonnages from new mineral discoveries within in the transportation corridor. The estimates also do not include the potential freight from very large mineral occurrences outside the corridor that could sustain the development cost of longer infrastructure to the transportation corridor. The Crest Iron Ore occurrence in central Yukon Territory is one such example. The estimated resource at Crest is 5.5 billion tons. Operating at 50 million tons per year, the resource could provide this rail freight load for 100 years.

The probability of development of the 1717 metallic mineral occurrences is a conservative estimate as it applies to mineral prospects in a mining district that are in the early stage of exploration and evaluation. Known mineral occurrences with measured or drill indicated reserves have a higher probability of development. Appendix C is a tabulation of mineral occurrences in Alaska and Northeastern British Columbia with measured or drill indicated reserves. Similarly, Appendix D includes known mineral occurrences in the Yukon Territory with measured and drill indicated reserves. The probabilities of the development of these occurrences have not been increased in the MOREV Tool. Thus, the above mineral and energy rail freight estimates are considered conservative.

The metallic mineral freight forecast also does not include the shipment of low grade bog iron deposits from northwestern Alberta via the Alberta-Alaska Rail Link. The Bog Iron Ore deposit type has not been a major source of iron ore since the discovery of the Lake Superior Banded Iron Formation type in the late 1800’s. The firm that is attempting the development of the Alberta Bog Iron Ores has indicated that it has plans to transport the material through the Prince Rupert Port to mills in China.

Calculation of Expected Mineral and Solid Fuel Rail Freight Revenues and Cash Flows

Based on an expected annual mineral and coal freight load of 43 million tons, the expected annual rail freight revenue can be estimated based on a single or range of freight rates. **As an example,** assuming that the average haulage distance for mineral and coal transport is 550 miles (880 kilometers) and at a freight rate of $0.06 per ton-mile applied to these commodities, the expected annual gross revenue would be $1.42 billion. Assuming an operating cost of $0.03 per ton-mile, the expected annual cash flow before taxes would be $710 million. The freight rate and the operating cost are based on current rates and costs for the Alaska Railroad Corporation (ARRC).

By comparison with the work completed to date by AECOM, the all-inclusive estimated Rail Cost is similar to the operating cost reported by the ARRC. The Shipper Costs and Rail Costs estimated by AECOM have been converted to costs per ton-mile to be compatible with the ARRC costs. The calculated costs per ton-mile are based on a rail haul of 2440 kilometers or 1,464 miles and a density of bitumen on 1 gm/cc. At a transport rate of 1.5 mbpd, the Rail Costs are essentially equivalent to the ARRC costs. The estimated Shipper Costs are significantly less than the tariffs on transported mineral commodities levied by the ARRC. The unit value of the mineral concentrates however are several times greater than the unit value of bitumen. For instance, at the current price of copper of $3.00/lb, a low grade copper concentrate (chalcopyrite at 34% Cu) would have a gross metal value of approximately $2,040.00/short-ton. At the current oil price of $92/barrel, a short-ton of bitumen would have a gross value of $552.00. Thus the mineral commodity could support a slightly higher tariff. A tariff of $0.07 per ton-mile applied to the mineral commodities under the same quantity and distance assumptions as discussed above would generate expected annual gross revenues of $1.65 billion. Assuming an operating cost of $0.031 per ton-mile, the expected annual cash flow before taxes would be $917 million ($1,650 – $733 million).

	ShipperCo	RailCo	ShipperCo	RailCo
	$/Barrel Cost	$/Barrel Cost	$/Ton-mile	$/Ton-mile
Scenario 1,0 mbpd	$9.96	$9.49	$0.040	$0.038
Scenario 1.5 mbpd	$8.14	$7.66	$0.033	$0.031

Expected Net Present Value of Mineral and Solid Fuel Freight Cash Flows

For the above example, the impact of mineral and coal freight revenues on the project feasibility can be estimated assuming a given minimum rate of return on capital. The ARRC which is owned by the State of Alaska has had discussion in recent years with the financial industry. A current cost of capital to ARRC is estimated at 5% (five percent). At an interest rate of 5% (five percent) and an assumed project life of 30 years, the expected net present value of the cash flow at the ARRC costs and tariffs would be approximately $10.9 billion ($710 million x uniform series present worth factor for i = 5%, n = 30 years which is 15.372). The estimated weighted cost of capital used in AECOM's business case, is 8.2% (eight and two tenths percent). Using this rate, a Rail Cost of $0.031/short ton-mile and a tariff of $0.07/ short ton-mile, the net present value of the expected annual cash flow for a 30 year period is $10.1 billion ($917 million x uniform series present worth factor for i = 8.2%, n =30 years which is 11.05). For this level of analysis, the amounts are comparable. Thus mineral and coal freight revenues could have a significant positive impact on project feasibility.

Socio-Economic Benefits of the Rail Link Related to Mineral and Coal Development

Mineral development can have major positive economic impacts on local communities as well as provincial or state governments. In multiple studies of the economic impact of mining on local communities in Alaska, the McDowell Group found large revenue streams accruing to local communities through wages, salaries, supply purchases, and taxes. In particular, a 2011 analysis of the impact of the Fort Knox Mine on the Fairbanks North Star Borough showed returns to the community that approximated in-place gross metal values since the commencement of operations in1996 (Staff, McDowell Group, 2011).. These large returns reflect the multiplier effect of mining on the local economy. Similar results were found for other operational mines in Alaska.

Summary and Conclusions

A 100 mile (160 kilometer) wide transportation corridor from Fort McMurray to Delta Junction contains 1717 known metallic mineral occurrences that are included in the Mine File records for British Columbia and Yukon Territory and the Resource Data Files for Alaska. Review of the data in these files allowed validation and or assignment of mineral deposit models and associated tonnage and grade curves to each mineral occurrence. These data provided input to the MOREV Tool to provide estimates of expected gross metal values and expected tonnage of metallic mineral concentrates to be transported on an Alberta to Alaska Rail Link over a 30 time period. The expected in-place gross metal values range from $333 to $659 billion depending on estimated commodity price levels. The expected annual tonnage of metallic mineral concentrates is 11 million tons per year. Adding to this estimate, the potential coal and industrial minerals in the corridor, the total expected annual rail freight load is 43 million tons.

It is assumed that the mineral freight load will come primarily from mineral occurrences in the 1100 mile sector of the corridor from the Fort Nelson, B.C. area to Delta Junction, Alaska. It is further assumed that the freight load will be evenly distribute along the route. Thus mineral freight revenues can be estimated based on an average haul distance of 550 miles (880 kilometers. Assuming even relatively low tariffs, the mineral freight revenues have the potential to provide a significant portion of the positive cash flow to support this large capital intensive project.

Based on expected in-place gross metal values, the development of the mineral resources in the transportation corridor will have significant positive economic impacts on the communities along the route. The positive impacts on the mineral producers and the communities will provide strong incentives for increase mineral exploration and the development of newly discovered resources.

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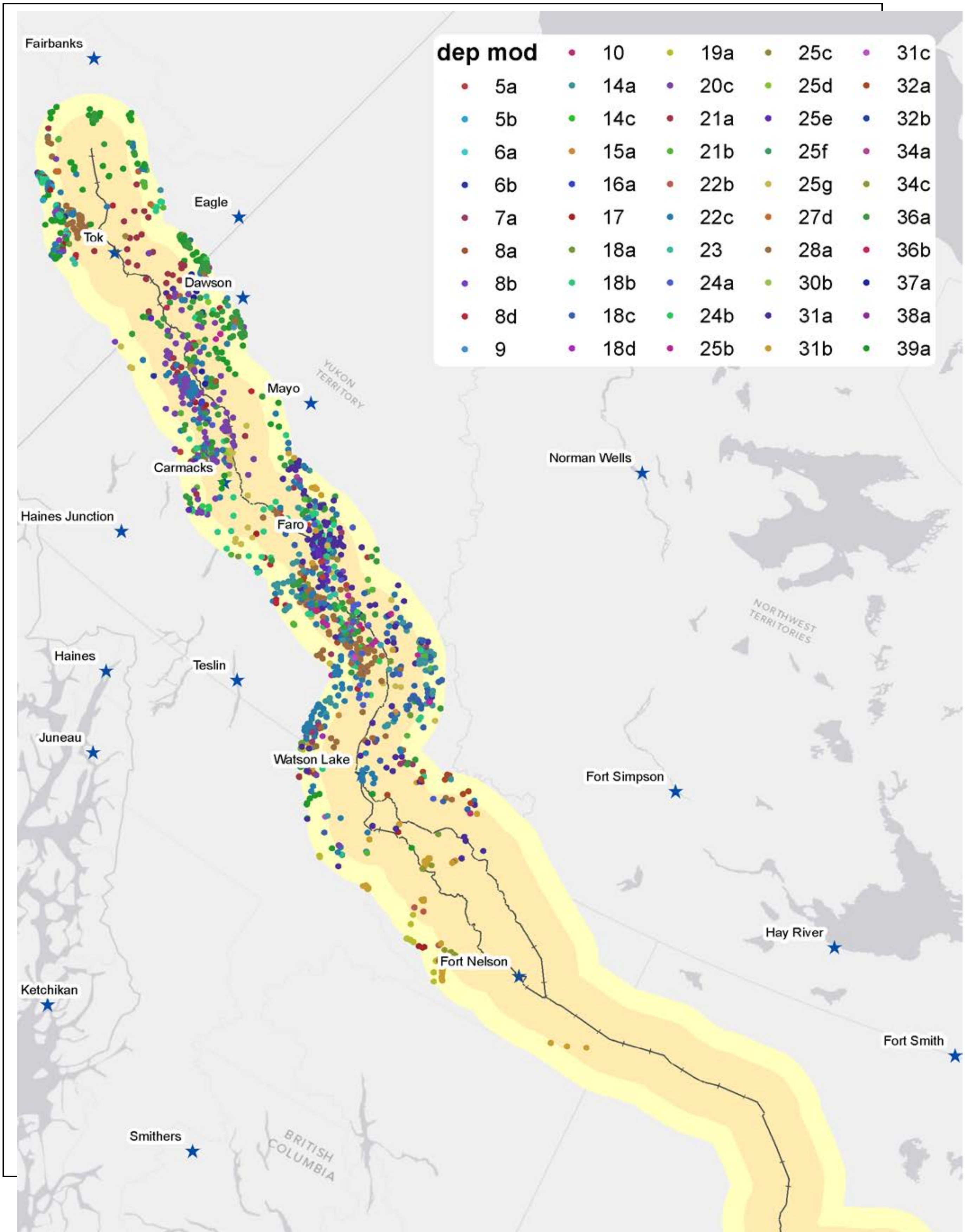
APPENDIX A - Location Map of the Proposed Rail Link Corridor and Known Metallic Mineral Occurrences in the Corridor



APPENDIX B

Table of MOREV Tool Expected Gross Metal Values and Mineral Concentrate Tonnage for Metallic Mineral Occurrences within the Proposed Corridor

Concentrate Tonnage by Deposit Model Type (Alberta Energy 100 mi rail corridor)

			Conc. Tonnage (individual)			Conc. Tonnage (total)		
dm	name	#	10th	50th	90th	10th	50th	90th
22c	POLYMETALLIC VEINS	272	13.5	1633.3	161285.9	3,660	444,244	43,869,759
36a	LOW-SULFIDE Au-QUARTZ VEINS	160	0.0	0.3	29.5	1	55	4,714
28a	KUROKO MASSIVE SULFIDE	151	2615.4	239839.0	12301214.7	394,923	36,215,682	1,857,483,423
39a	PLACER Au-PGE	125	0.0	0.2	23.6	0	25	2,950
20c	PORPHYRY Cu-Au	123	150469.2	860012.3	5005073.6	18,507,714	105,781,513	615,624,047
31a	SEDIMENTARY EXHALATIVE Zn-Pb	116	127787.1	2786665.9	60344708.6	14,823,307	323,253,242	6,999,986,195
14a	W SKARN	94	208.8	9054.0	378378.0	19,631	851,080	35,567,532
18b	Cu SKARN	85	409.3	16370.1	633408.2	34,786	1,391,460	53,839,698
18c	Zn-Pb SKARN	71	9822.1	211747.5	4524970.9	697,367	15,034,069	321,272,936
31b	BEDDED BARITE	56	58752.0	1211760.0	20563200.0	3,290,112	67,858,560	1,151,539,200
NA	NON-METALLIC COAL	49	0.0	0.0	0.0	-	-	-
21a	PORPHYRY Cu-Mo	40	551431.5	3749661.0	26195470.5	22,057,262	149,986,442	1,047,818,818
21b	PORPHYRY Mo, LOW-F	35	9313.9	84566.2	770515.2	325,987	2,959,816	26,968,032
25g	EPITHERMAL Mn	32	319.2	4987.5	72618.0	10,214	159,600	2,323,776
5b	NORIL'SK Cu-Ni-PGE	26	18307094.4	18307094.4	18307094.4	475,984,454	475,984,454	475,984,454
24a	CYPRUS MASSIVE SULFIDE	23	482.0	20808.0	782054.4	11,085	478,584	17,987,251
25b	CREEDE EPITHERMAL VEINS	23	629.2	40714.0	2439858.4	14,472	936,423	56,116,743
17	PORPHYRY Cu	19	83408.3	1070571.6	15114460.1	1,584,758	20,340,860	287,174,742
7a	SYNOROGENIC-SYNVOLCANIC Ni-Cu	18	954.7	19920.6	379357.3	17,185	358,571	6,828,432
25e	EPITHERMAL QUARTZ-ALUNITE Au	18	0.9	560.1	366832.6	17	10,082	6,602,987
23	BASALTIC Cu	17	7752000.0	7752000.0	7752000.0	131,784,000	131,784,000	131,784,000
32a	SOUTHEAST MISSOURI Pb-Zn AND APPAL	15	52962.1	2931001.9	144872534.6	794,432	43,965,028	2,173,088,019
24b	BESSHI MASSIVE SULFIDE	15	169.8	7295.8	310931.7	2,547	109,437	4,663,976
19a	POLYMETALLIC REPLACEMENT	14	4821.3	164850.6	5699998.2	67,499	2,307,909	79,799,975
8d	SERPENTINE-HOSTED ASBESTOS	12	89417.8	861060.2	8639400.0	1,073,013	10,332,722	103,672,800
5a	DULUTH Cu-Ni-PGE	10	22018688.0	22018688.0	22018688.0	220,186,880	220,186,880	220,186,880
18a	PORPHYRY CU, SKARN-RELATED	10	175394.1	1348264.8	10582980.1	1,753,941	13,482,648	105,829,801
18d	Fe SKARN	9	130769.1	3962700.0	110955600.0	1,176,922	35,664,300	998,600,400
8a	PODIFORM CHROMITE	8	2.0	42.5	743.8	16	340	5,950
25c	COMSTOCK EPITHERMAL VEINS	8	0.6	64.4	21931.2	4	515	175,449
34c	UPWELLING TYPE PHOSPHATE	7	2983500.0	63112500.0	1028160000.0	20,884,500	441,787,500	7,197,120,000
25d	SADO EPITHERMAL VEINS	7	0.1	8.8	38485.5	1	61	269,399
27d	Simple Sb	6	1.2	62.7	3216.3	7	376	19,298
37a	UNCONFORMITY U-Au	5	9.0	1152.2	173644.8	45	5,761	868,224
22b	Au-Ag-Te VEINS	5	0.0	0.0	0.0	-	-	-
6b	DUNITIC Ni-Cu	4	10710.0	221850.0	4294304.9	42,840	887,400	17,177,220
NA	JADE-NON-METALLIC	4	0.0	0.0	0.0	-	-	-
NA	NON-METALLIC LIMESTONE/DOBOSTONE	4	0.0	0.0	0.0	-	-	-
10	CARBONATITE	3	20492.6	247619.4	3522172.5	61,478	742,858	10,566,518
14c	REPLACEMENT Sn	2	4331.6	32177.6	250614.0	8,663	64,355	501,228
31c	EMERALD VEINS	2	0.0	0.0	0.0	-	-	-
15a	W VEINS	2	350.1	6608.2	127081.5	700	13,216	254,163

36b	HOMESTAKE Au	2	0.3	6.2	190.4	1	12	381
16a	CLIMAX MO	2	66808.6	424536.0	2883493.2	133,617	849,072	5,766,986
30b	SEDIMENT-HOSTED Cu	1	11475.0	353430.0	11971936.4	11,475	353,430	11,971,936
34a	SUPERIOR Fe	1	3632475.0	99235584.5	1748079060.0	3,632,475	99,235,585	1,748,079,060
9	ALASKAN PGE	1	460810.4	460810.4	460810.4	460,810	460,810	460,810
32b	SOUTHEAST MISSOURI Pb-Zn AND APPAL	1	52962.1	2931001.9	144872534.6	52,962	2,931,002	144,872,535
8b	PODIFORM CHROMITE	1	432.0	5355.0	61880.0	432	5,355	61,880
6a	KOMATIITIC Ni-Cu	1	7278.2	130720.8	3280659.7	7,278	130,721	3,280,660
25f	VOLCANOGENIC U	1	7.4	271.3	9310.0	7	271	9,310
38a	LATERITIC Ni	1	55500.9	438314.8	3497268.3	55,501	438,315	3,497,268
						919,968,982	2,207,784,643	25,969,579,816

APPENDIX C - Alaska and British Columbia Advanced Mineral Projects

ALASKA DEPOSITS

Name	Company	Description	Deposit Type	Within Corridor	ARDF #	USGS Model #	Commodities	Tons (proven + probable)	weighted ave Au g/t	Ag g/t (min, ave, max)	Cu % (min, ave, max)			Lattitude (DD)	Longitude (DD)	Miles to proposed rail
Rolling Thunder	FGMI	Producer	Intrusion-related Au	NO	FB115	---	Au	262,068,000	0.44					64.992	-147.361	~ 25 miles to existing rail
Rolling Thunder	Sumitomo Metal Mining Co. ltd	Producer	Intrusion related, mesothermal, porphyry Au	YES	BD033	---	Au	13,594,000	11.38					64.453	-144.914	Within corridor
Rolling Thunder	Contago ORE Inc.	Significant Project	Polymetallic veins?	YES	TC040	22c?	Au, Ag, Cu	N/A	0.002, 12.53, 81.10	0.90, 44.08, 343	0.03, 0.99, 7.26			63.1795	-142.9162	Within corridor
Rolling Thunder	Freegold Ventures Ltd	Significant Project	Schist-hosted shaer zones w/discrete and/or crushed gold-arsenic-antimony-quartz veins	NO	L6119	---	Au	280,580,000	0.63					65.067	-147.439	~ 25 miles to existing rail
Rolling Thunder	Full Metal Minerals	Significant Project	structuraly controlled quartz-pyrite stockwork, vein and vein breccias hosted in Gneissic and amphiblite facies rocks.	NO	---	---	Au	14,832,093	3.0							Within corridor
									Highest values based upon limited drilling							
									Cu% (up to)	Au g/t (up to)	Ag g/t (up to)	Mo ppm (up to)				
Chisna	Corvus Gold Inc	Significant Project	Porhyry Cu, Skarn related?	YES	MH365	18a	Cu, Au, Ag, Mo, W	N/A	17	127	198	1,270		63.150	-144.799	Within corridor

ALASKA DEPOSITS								Inferred Tons (subject to changes)	Drill Assays (Subject to changing values)							
Name	Company	Description	Deposit Type	Within Corrido?	ARDF #	USGS Model #	Commodities		Ni %	Pt (ppb)	Pd (ppb)	Cu %	Au (ppb)	Lattitude (DD)	Longitude (DD)	Miles to proposed rail
MAN	Pure Nickel Inc.	Significant Project	Ni-Cu-PGE in differentiated ultramafic sill	YES	MH168-MH177; MH104 & 105	---	Ni, Pt, Pd, Cu, Au	80,950,000	0.25	106	174	0.17	35	63.244	-146.141	within corridor
								Tons (indicated + inferred)	weighted ave Cu%							
Bornite Ruby Creek	NovaCopper Inc.	Significant Project	polymetallic/carbonate hosted copper cobalt	NO	AR018	32c?	Cu	60,100,000	0.883677205					67.062	-156.948	---
								inferred Tons	inferred Cu%							
Bornite South Reef	Nova Copper	Significant Project	???	NO	???	---	Cu	47,509,618	2.54							
									Averages derived from indicated and inferred values							
								Tons (indicated + inferred)	Ave Cu%	Ave Pb%	Ave Zn%	Ave Au g/t	Ave Ag g/t	Lattitude (DD)		
Sun	Andover Mining Corp.	Significant Project	Kuroko Massive sulfide	NO	SP039	28a	Cu, Pb, Zn, Ag, Au	15,226,226	1.18	1.32	3.94	0.21	66.94	67.070	-155.043	
								Tons (measured + indicated)	weighted ave Au g/t					Lattitude (DD)		
Money Knob	International Tower Hills	Significant Project	Intrusion-related gold	NO	LG202	---	Au	884,053,671	0.55					65.509	-148.534	

BC DEPOSITS

										Averaged from indicated and inferred						
Name	Description	Deposit Type	Within Corridor	B.C Mine File #	B.C Profile #	USGS Model #	Commodities	Tons (indicated + inferred)	Cu %	Pb%	Zn%	Au (g/t)	Ag (g/t)	Lattitude (DD)	Longitude (DD)	Miles to proposed rail
Silvertip	Significant project	Polymetallic Manto Ag-Pb-Zn /SEDEX Zn-Pb-Ag	NO (~75 road miles)	104O 038	J01/E14	19a/31a	Zn, Ag, Pb, Au, Sn, Cu	2,573,210		7.63	10.46	0.48	363	59.927	-130.342	~ 75 road miles to Watson Lake YT via Stewart Cassiar Hwy 37N
Cassiar Gold (Table Mountain)	Proposed Mine	Au-quartz veins	NO (~90 road miles)	104P 070	I01	36a	Au	96,152				20.64		59.239	-129.668	~ 90 road miles to Watson lake via Stewart Cassiar Highway (Hwy 37N)
								Reserve Tons								
Kutcho Creek	Proposed Mine	Polymetallic veins/Norando/Kuroko massive sulfide	NO (~230 road miles)	104I 072	IO5/GO6	22c, 25b/24a	Cu, Zn, Au, Ag	11,509,232	2.01	3.19				58.199	-128.524	~ 230 miles to Watson Lake
								Inferred Tons								
Engineer	Significant project	Epithermal Au-Ag, low sulfidation	No (~275 road miles)	104M 014	H05	25c	Au	45,195				17.24		59.487	-134.235	~ 275 miles of road via Klondike hwy and Alaska Hwy
								Results from two drill holes								
								Indicated Tons								
Gnat Pass (Galaxie)	Significant project	Porphyry Cu-Mo-Au	No (~175 road miles)	104I 001	L04	17,20,21a	Cu, Zn, Au, Ag	33,697,454	0.389					58.254	-129.827	~ 175 miles to Watson Lake via Dease lake Hwy, Cassiar Hwy, Alaska & Yukon Hwy

APPENDIX D - Yukon Territory Advanced Mineral Projects

YUKON DEPOSITS

Name	Production (PRO) Deposit (DEP)	Deposit Type	Within Corridor	OBJECTID/SITE	Mine File #	Yukon Profile #	USGS Model #	Commodity	Reserve Tonnage (short tons)
Minto Mine	PRO	Alkalic Pophyry Cu-Au	Yes	9160/MINTO	115I 021	L03	20c	Cu, Au, Ag	66,947,775
Wolverine Mine	PRO	Volcanic associated	Yes	9741/FETISH	105G 072	G06	28a	Pb, Zn, Cu, Au, Ag	4,917,411
Bellekeno Mine	PRO	Vein/breccia	No (~75 road miles)		105M 001	I05	22c	Ag, Pb, Zn	592,382
Casino	DEP	Porphyry Cu +-Mo+-Au	Yes	7447/CASINO	115J 028	L04	20c	Cu	1,237,895,602
Nucleus	DEP	Porphyry Cu +-Mo+-Au	Yes	9249/NUCLEUS	115I 107	L04	20c	Au	74,483,175
Carmacks	DEP	Alkalic Pophyry Cu-Au	Yes	9145/WILLIAMS CREEK	115I 008	L03	20c	Cu, Au, Ag	17,967,680
Ketza	DEP	Polymetallic Manto	Yes	8304/Ketza	105F 019	JO1	19a	Au	5,649,345
Cash	DEP	Porphyry Cu-Au-Mo	Yes	9176/CASH	115I 037	LO4	20c	Cu-Mo	40,002,877
Fyre	DEP	Besshi Cu (-Zn)	Yes	9703/FYRE	105G 034	GO4	24b	Cu, Co, Au	7,071,327
Grizzly	DEP	SEDEX Pb, Zn, Ag, Au	Yes	8531/DY	105K 101	E14	31a	Pb, Zn, Ag, Au	19,117,644
Swim	DEP	SEDEX Pb, Zn, Ag	Yes	8474/SWIM	105K 046	E14	31a	Pb, Zn, Ag	4,739,939
Mel	DEP	Stratiform Barite	Yes	9401/MEL	095D 005		31b	Pb, Zn, Ba	7,495,717
Brewery Creek	DEP	Intrusion Related Gold	No (~170 road miles)			L02		Au	4,382,680
Dublin Gulch	DEP	Intrusion Related Gold	No (~135 road miles)		106D 025			Au	108,670,258
Howard's Pass	DEP	SEDEX	No (~150 road miles)		105I 012	E14	31a	Pb, Zn	425,370,912
Wellgreen	DEP	Gabbroid Cu-Ni-PGE	No (~85 miles NW of Haines Junction)		115G 024			Ni, PGE	7,054,792
Crest	DEP	Sediment Associated Iron Formation	No		106F 008			Iron ore	3,500,000,452
Logtung	DEP	Pophyry W	No (~210 road miles)		105B 039	L07		W, Mo	468,041,383
MacTung	DEP	Skarn W	No (~145 road miles)		105O 002	KO5	14a	W	36,408,240
Ray Gulch	DEP	Skarn W	No (~155 road miles)		106D 027	KO5	14a	W	13,999,354
Tom	DEP	SEDEX Pb, Zn, Ag	No (~135 road miles)		105O 001	E14	31a	Pb, Zn, Ag	5,489,510

	Commodity Concentration											
Name	Au (g/t)	Ag (g/t)	Cu %	Pb%	Zn%	Mo %	Ba %	Ni %	Pd (ppm)	Pt (ppm)	Fe%	W%
Minto Mine	0.24	2.45	0.76									
Wolverine Mine	1.87	391.14	1.16	1.58	12.14							
Bellekeno Mine	0.36	921.70		13.50	10.70							
Casino	0.22		0.21			0.02						
Nucleus	0.45											
Carmacks	0.44	4.40	0.99									
Ketza	3.89											
Cash			0.17			0.018						
Fyre	0.45		1.2									
Grizzly	0.68	64.95		4.85	6.39							
Swim		38.10		3.80	4.70							
Mel				2	7.1		54.7					
Brewery Creek	1.03											
Dublin Gulch	0.77											
Howard's Pass				1.60	4.86							
Wellgreen			0.45					0.43	0.31	0.38		
Crest											43.80	
Logtung						0.03						0.10
MacTung												0.88
Ray Gulch												0.31
Tom		43.34		4.36	6.64							

Name	Latitude	Longitude	Current Transportation	Miles to proposed rail
Minto Mine	62.61	137.24		
Wolverine Mine	61.43	130.13	Trucked to the Port	W/IN corridor
Bellekeno Mine	63.91	135.30	Concentrate trucked to Skagway	~ 45 miles from Mayo and 75 miles to Tintina Trench and Stewart Crossing via Silver Trail Road (Highway 11)
Casino	62.74	138.83		
Nucleus	62.33	137.34		
Carmacks	62.35	136.69		~ 115 miles
Ketza	61.54	132.27		W/IN Corridor
Cash	62.43	137.62		W/IN Corridor
Fyre	61.23	130.52		W/IN Corridor
Grizzly	62.23	133.13		W/IN Corridor
Swim	62.21	133.03		W/IN Corridor
Mel	60.36	127.40		W/IN Corridor
Brewery Creek	64.06	138.24		~ 170 miles via Klondike Highway (2)
Dublin Gulch	64.03	135.80		~ 135 miles via Klondike Highway (2)
Howard's Pass	62.47	129.21		~ 150 miles via Canol Road (6)
Wellgreen	61.47	139.53		
Crest	65.25	133.04		
Logtung	60.01	131.60		~ 210 miles to main rail, however, spur rail potenital to Skagway or Haines
MacTung	63.28	130.15		~ 145 miles to Ross River via Canol Road (6)
Ray Gulch	64.03	135.75		~ 155 miles via Silver Trail (2)
Tom	63.16	130.14		~ 135 miles via Canol Road to Ross River