ALASKA CANADA RAIL LINK PROJECT

FEASIBILITY STUDY REPORT

ALTERNATE ROUTE SEGMENT ASSESSMENT

WORK PACKAGE B1(g)

April 2006
*REVISION * June 2006*

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1.1. Introduction

The purpose of this work package is to evaluate the alternate rail routes in British Columbia and Yukon that would connect the Alaska Railroad at Delta Junction to the CN mainline in Northern British Columbia.

The alternate route corridors 1 through 7 were specified in the proposal issued by the Alaska Canada Rail Committee. Corridors 8 and 9 were added later. These specific rail corridors were identified as follows:

1. Fort Nelson, BC to Watson Lake, Yukon.
2. Minaret, BC to Watson Lake, Yukon, via Dease Lake(along former BCR route).
3. Watson Lake, Yukon to Carmacks, Yukon along Robert Campbell Highway and Tintina Trench.
4. Carmacks, Yukon to Alaska Border via Ladue River.
5. Carmacks, Yukon via Nisling River to Alaska Border near Beaver Creek.
6. Watson Lake, Yukon to Whitehorse, Yukon via Alaska Highway.
7. Whitehorse, Yukon to Alaska Border near Beaver Creek along Alaska Highway.
8. MacKenzie, BC to Watson Lake, Yukon via the Rocky Mountain Trench.
9. Hazelton, BC to Watson Lake, Yukon along Skeena , Nass and Klappen Rivers and via Dease Lake.

Evaluation of routes No. 1 through 7 were based on the preliminary route alignment and grade profile information generated from work packages B1(d), B1(e) and B1(g). Routes No. 8 and 9 were evaluated using general information available from previous Rail Access Studies conducted in 1969 and then compared to Routes No.1 through 7.

National topographic series maps 1:50,000 scale, covering Yukon and British Columbia, were used in projecting route locations and generating grade profiles.

There was no aerial reconnaissance or field examination of any routes nor has there been any aerial photographic interpretation carried out of the surficial soils and geology along the various proposed route corridors.

1.2. Railway Location and Construction Standards

The construction standards adopted in this study can provide a long distance railway with capacity to support heavy tonnage and passenger speeds, over the long term, and be compatible to link with an existing major rail route in northern British Columbia. Speed and long term reliable service are critical factors in the determination of a railway route location, which in turn drives the long term financial health of a railway.

The present CN mainline from Jasper to Prince Rupert constructed in 1915 has a maximum ruling gradient of 0.7% and curvature limited to 6°.

Present location practice demands limiting alignment curvature to 3° and gradients to 0.5%. This design criteria can often be achieved, but cannot be met consistently in mountainous terrain. In this study, curvature is limited to 6° and compensated gradients to 0.7% or 1.0% in most instances. In two of the route segments studied, a maximum compensated gradient of 1.5% and 2.5% was reached.

Selection of ruling gradients and curvature along a given route corridor demands considerable good judgment. UMA has been consistent in the route location work by applying the same judgment for all of the routes studied. There has been only one projection of each route segment. No refinements have been considered at this time. Further revisions to route alignment in the next phases of future engineering study, could produce a more economical project within the confines of the standards set out.

A standard track section, typical roadbed sections through different terrain conditions, typical bridge structures, a typical tunnel, a typical rock shed, etc. are described in work package B 1(d) and B 1(e).

1.3. Physical Features Affecting Alternate Routes

Because a railway requires low gradients, alignments in mountainous terrain generally follow major river systems to reach destinations. Long and gentle sloping valleys are the most desirable for railway location. This gives rise to major physical features being encountered along the routes which have an affect on the integrity, safety and economics of the railway line. The following physical features play a major role in the selection of a rail route:

(a) Grade (profiles) and alignment (curvature).
(b) Major river crossings.
(c) Debris flow locations.
(d) Surfical and bedrock geology.
(e) Landslide areas.
(f) Locations of seismic activity.
(g) Snow avalanche and rock fall locations.
(h) Tunnel locations.
(i) Conflict with major highways.
(j) Alignments parallel to rivers and lakes that are subject to erosion.

1.4. Highlights - Rail Route from Fort Nelson to Watson Lake

This segment is about 336 miles long with a multi summit profile and maximum compensated gradients of 0.7% against westbound traffic and 1.0% against eastbound traffic. About 34% of the line is on curves over 1° with 10% being between 1° and 3°,

and 24% being between 3° and 6°. The line has a significant number of major river crossings with erosion rip rap protection, a 2 mile long rock tunnel and minor highway conflicts with the Alaska Highway. Under moderate to heavy tonnage traffic, the rail wear will be high; fuel consumption and operating costs will be moderate.

1.5. Highlights – Rail Route from Minaret to Watson Lake Along Old BCR Route via Dease Lake

This segment is about 392 miles long, with a multi summit grade profile. The maximum north and southbound compensated grades are 2.5% in both directions. Nearly 38% of the line is on curve with 23% being between 1° and 3° and 15% between 3° and 6°. A large percentage of the line encounters very heavy grading and rock cuts requiring rock sheds and five tunnels, totalling 16.5 miles. The grades could be somewhat reduced and the tunnels avoided with some alignment revisions. This route has a significant number of bridges that are likely high with considerable erosion protection needed for the embankments. The alignment has a number of highway conflicts with the Cassiar Highway. This line segment is the most expensive of the nine route segments studied with very high capital, maintenance and operating costs. This is a high energy consumption line and the right-of-way would have a high risk of exposure to natural disasters.

1.6. Highlights – Rail Route from Watson Lake to Carmacks via Robert Campbell Highway and Tintina Trench

This segment is about 403 miles long, with a single summit grade profile with a gradual rise and fall. Both east and westbound have maximum compensated gradients of 0.7%. Nearly 28% of the line is on curves, with 22% being between 1° and 3°, and 6% between 3° and 6°. This line traverses organic and permafrost terrain and encounters heavy to very heavy grading with rock cuts. No major rivers are encountered along the route but a significant number of high bridges are required. There are no rock tunnels along this corridor but there are numerous locations of highway conflict. This could be mitigated with some minor realignment of either road or rail. This is a low maintenance and operating cost route with low fuel consumption.

1.7. Highlights – Rail Route from Carmacks to Alaska Ladue River Border

This segment is about 223 miles with a gentle decline in grade from Carmacks to the Alaska border. The compensated grades are maximum 0.7% in both east and westbound direction. Nearly 35% of line is on curves with 22% between 1° and 3° and 13% between 3° and 6°. The route traverses some organic terrain and includes heavy to very heavy

grading. Major river crossings are encountered with some high bridge structures. A section of the railway grade along the Yukon River will require significant protection against river erosion. This is a low maintenance and operating cost route with low fuel consumption.

1.8. Highlights – Rail Route from Carmacks to Beaver Creek Alaska Border via Nisling River

This segment is about 233 miles long. The grade rises to 1.5% immediately outside Carmacks and runs through a 8.4 mile long rock tunnel. The profile has one long summit run and gradually descending to Beaver Creek via Nisling River at a compensated 1.5% gradient. 22% of the line is curves, with 16% between 1° and 3° and 6% between 3° and 6°. The line traverses a long section of organics and permafrost terrain and substantially encounters heavy and very heavy construction. An 8.4 mile long tunnel and several long major river crossings will be required. There are limited highway conflicts along this route. The rail wear would be low for moderate to heavy tonnage traffic but the fuel consumption and operating costs would be high.

1.9. Highlights – Rail Route from Watson Lake to Whitehorse via Alaska Highway

This segment is about 314 miles long. The grade profile is multi summit with a gentle rise and fall at 0.7% compensated gradients in both east and westbound directions. About 34% of the line is on curves with 24% between 1° and 3° and 10% between 3° and 6°. The line traverses some lengths of organic terrain and encounters heavy and very heavy construction along a majority of the route. It encounters a 2.5 mile long rock tunnel, long bridge lengths over major rivers, rock and snow sheds and extensive highway conflicts. The rail wear would be moderate with moderate fuel consumption and operating costs over the life of the railway.

1.10. Highlights – Rail Route from Whitehorse to Beaver Creek Alaska Border via Alaska Highway

This segment is 328 miles long. The grade profile is multi summit, with maximum compensated grades of 1.0% in both east and westbound directions. About 21% of the line is on curves, with 17% between 1and 3° and 4 % between 3° and 6°. The line traverses long sections of heavy, very heavy, permafrost and organics construction. A short rock tunnel of 0.5 mile in length and moderate highway conflicts are encountered. The rail wear would be low with moderate fuel consumption and operating costs over the life of the railway.

Alternate BC Routes Studied In 1969

1.11. Rocky Mountain Trench Route from MacKenzie, BC to Watson Lake, Yukon

The information in this report has been obtained from the Yukon Railway Feasibility Reconnaissance Summary Report completed in 1969 for the Federal Government. The provided estimate represents a "*best conjectured evaluation*", as access to the original route location drawings and detailed engineering data was not possible.

This route starts at MacKenzie, BC about 115 miles north of Prince George on the CN Mackenzie Spur, and traverses along the Williston Reservoir, climbing to Sifton Pass and then gradually descending into Watson Lake. The route is about 435 miles long, with a single summit and maximum compensated gradients of 0.5% in both the north and south directions. About 25% of the line is on curved alignment, with 20% between 1° and 3° and 5% between 3° and 6°. A majority of the line traverses through average grading conditions and requires several bridge crossings due to its vicinity to the Williston Reservoir. Tunnels are not needed and a limited number of highway conflicts are encountered near Watson Lake. Rail wear, maintenance, fuel consumption and operating cost are expected to be low.

1.12. Hazelton, BC to Watson Lake, Yukon via Dease Lake

The information in this report has been obtained from the Yukon Railway Feasibility Reconnaissance Summary Report completed in 1969 for the Federal Government. The provided estimate represents a "*best conjectured evaluation*" as access to the original route location drawings and detailed engineering data was not possible.

This route begins at Hazelton, BC (New Hazelton on CN Line), crosses the Skeena river, and follows the Kispiox, Nass, and Klappen River's, Cassiar Highway and Dease Lake, terminating at Watson Lake. The projected grade has a multi summit profile with maximum compensated grades of 1.0% both north and southbound. About 35% of the line is on curves, with 24% between 1° and 3° and 11% between 3° and 6°.

The corridor is in mountainous terrain and traverses heavy and very heavy grading conditions. Several bridge crossings over major rivers are required. Moderate highway conflicts are encountered along the route at the north end. Rail wear will be moderate and fuel consumption and operating costs likely moderate as well.

1.13. General Comments on all of the Alternate Route Segments.

This engineering review has been a desk stop study without any field validation. Each of the route segments poses its own engineering and construction challenges. The route that is to be selected should be evaluated based on several factors, including strategic location for long-term growth, revenue possibilities, transit time of premium traffic to markets, access to ports and regional development, low capital costs and low long term operating costs. Prior to the commitment to construct such an undertaking, a preliminary engineering feasibility and environmental impact studies with field support and validation should be conducted of the selected routes. This process should lead to the final field engineering and environmental investigation and the design and construction of the final selected route.

The present technical information at hand suggests that the preferred routes, would be:

1. Alaska Ladue River Border to Carmacks to Watson Lake, Yukon and on to Mackenzie near Prince George, B.C.;
2. Alaska Ladue River Border to Carmacks to Watson Lake, Yukon and on to Hazelton, B.C.;
3. Alaska Beaver Creek Border to Whitehorse to Watson Lake, Yukon and on to Mackenzie, B.C.;
4. Alaska Beaver Creek Border to Whitehorse to Watson Lake, Yukon and on to Hazelton, B.C.

Tables

Table 1

ALCAN Rail Link - Route Segment Curvature and Grade Profile Summary								BC Route Segments Not in Study	
Route / Curves and Grades	Fort Nelson to Watson Lake	Watson Lake to Carmacks	Carmacks to Alaska Border at Ladue River	Minaret to Watson Lake via Dease Lake	Watson Lake to Whitehorse via Alaska Hwy.	Whitehorse to Alaska Border at Beaver Creek	Carmacks to Alaska Border via Nisling River	Mackenzie to Watson Lake via Rocky M. T.	Hazelton to Watson Lake via Dease Lake
Route Miles	**336.0 Mi**	**403.0 Mi**	**223.0 Mi**	**392.0 Mi**	**314.0 Mi**	**328.0 Mi**	**233.0 Mi**	**435.0 Mi**	**497.0 Mi ***
Miles of Curves									
1 Degree	0.30	0.00	0.20	25.40	0.00	1.10	0.00		
2 Degree	9.40	62.40	34.65	43.50	42.75	36.25	23.90		
3 Degree	22.50	25.50	13.50	21.40	31.15	17.55	12.80		
4 Degree	22.40	21.15	20.00	26.70	24.20	13.05	10.80		
5 Degree	14.80	1.80	0.50	2.80	0.20	0.00	1.00		
6 Degree	41.80	1.50	8.40	27.20	6.45	0.00	3.20		
Total Miles of Curves	**111.20 Mi**	**112.35 Mi**	**77.25 Mi**	**147.00 Mi**	**104.75 Mi**	**67.95 Mi**	**51.70 Mi**	**110.00 Mi**	**173.95 Mi ***
% of All Curves	**33.10%**	**27.88%**	**34.64%**	**37.50%**	**33.36%**	**20.72%**	**22.19%**	**25.29%**	**35%**
% of 1 to 3 deg. Curves	9.58%	21.81%	21.68%	23.04%	23.54%	16.74%	15.75%	20%	24%
% of 4 to 6 deg. Curves	**23.51%**	6.07%	**12.96%**	**14.46%**	9.82%	3.98%	6.44%	5%	11%
Profile Grades	Multi Summit	Single Summit	Gentle Decline	Multi Summit	Multi Summit	Multi Summit	Single Summit	Single Summit	Multi Summit
	WB max. 0.7%	WB max. 0.7%	WB max. 0.7%	**NB max. 2.5%**	WB max. 0.7%	**WB max. 1.0%**	**WB max. 1.5%**	NB max. 0.5%	NB max. 1.0%
	EB max. 1.0%	EB max. 0.7%	EB max. 0.7%	**SB max. 2.5%**	EB max. 0.7%	**EB max. 1.0%**	EB max. 0.7%	SB max. 0.5%	SB max. 1.0%

*** Revised June 2, 2006**

Table 2

ALCAN Rail Link Alternate Route Segment Assessment Summary and Ranking

Corridor Description / Issues	Watson Lake to Carmacks via Rob.Campbell	Carmacks to Alaska Border via Yukon and Ladue R.	Carmacks to Beaver Creek via Nisling River	Watson Lake to Whitehorse along Alaska Hwy.	Whitehorse to Beaver Creek along Alaska Hwy.	Fort Nelson to Watson Lake	Minaret to Watson Lake via (BCR grade)	MacKenzie to Watson Lake	Hazelton to Watson Lake
Construction Miles	**403**	**223**	**233**	**314**	**328**	**336**	**392**	435	497
Tunnels	None	None	8.4 miles	2.2 miles	0.5 mile	None	16.5 miles	None	None
Highway conflict	High	Low	Low	Very high	Moderate	Moderate	Moderate	Low	Moderate
Profile Grades									
General Grade	Low	Low	Steep	Low	Moderate	Low/Moderate	Very Steep	Gentle	Moderate
Max. Grade	0.7% EB & WB	0.7% EB & WB	**1.5%WB** 0.7% EB	0.7% EB & WB	**1.0% EB & WB**	0.7% WB **1.0% EB**	**2.5% NB & SB**	0.5% EB & SB	1.0% EB & WB
Alignment Curves									
1° to 3° Curves	88 miles - 22 %	48 miles - 22%	37 miles - 16%	74 miles - 24%	55 miles - 17%	32 miles - 10%	90 miles - 23%	89 miles - 20%	118 miles - 24%
4° to 6° Curves	24 miles - 6%	29 miles - 13%	15 miles - 6%	31 miles - 10%	13 miles - 4%	**79 miles - 24%**	**57 miles - 15%**	21 miles - 5%	55 miles - 11%
All Curves	112 miles - 28%	77 miles - 35%	52 miles - 22 %	105 miles - 34%	68 miles - 21%	111 miles - 33%	147 miles - 38%	110 miles - 25%	174** miles - 35%
Track/Train Dynamics Outcome									
Rail Wear	Low	Moderate	Low	Moderate	Low	**Very High**	**High**	Low	Moderate
Fuel Consumption	Low	Low	**High**	Low	Moderate	Moderate	**Very High**	Low	Moderate
Operating Cost	Low	Low	**High**	Medium	Medium	Medium	**Very High**	Low	Medium
Risk Ranking									
Seismic Activity	Moderate	Moderate	Moderate	Low	Low	Low	Low	Low	Low
Natural Disasters	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High	Moderate	Moderate
***Permafrost**									
(in miles)	28 miles	None	2.5 miles	1 mile	32 miles	None	None	None	None
Technical Ranking	1	1	3	2	2	3	5	1	2

NOTE: Best Ranking is 1 and 5 is the Lowest

*** Revised May 17, 2006**

**** Revised June 2, 2006**

Table 3

ALCAN Rail Link
Preliminary Route Miles and Transit Time

Preliminary Transit Time to Chicago, IL			Ladue - Carmack - Watson Lake			B Creek - Carmacks - Watson Lake			B Creek - Whitehorse - Watson Lake		
Route Segment	Route Miles	Average Speed	**Hazelton**	**R. Mtn Trench**	**Nelson**	**Hazelton**	**R. Mtn Trench**	**Nelson**	**Hazelton**	**R. Mtn Trench**	**Nelson**
Fairbank to Ladue River Border	295	20	14.8	14.8	14.8						
Fairbank to Beaver Creek Border	305	20				15.3	15.3	15.3	15.3	15.3	15.3
Ladue Border - Carmack	224	20	11.2	11.2	11.2						
B Crk Border - Whitehorse - Watson Lake	591	20							29.5	29.5	29.5
B Crk Border - Carmacks	231	15				15.4	15.4	15.4			
Carmack - Watson Lake	403	20	20.2	20.2	20.2	20.2	20.2	20.2			
Watson Lake to Fort Nelson	334	20			16.7			16.7			16.7
Watson L. - R.M. Trench - MacKenzie	435	25		17.4			17.4			17.4	
Watson Lake to Hazelton	497	20	24.9			24.9			24.9		
MacKenzie to Prince George	116	25		4.6			4.6			4.6	
Fort Nelson to Chetwynd	320	15			21.3			21.3			21.3
Chetwynd to Prince George	196	20			9.8			9.8			9.8
Hazelton to Prince George	290	25	11.6			11.6			11.6		
Total Transit Hours to Prince George			**82.6**	**68.1**	**93.9**	**87.3**	**72.8**	**98.6**	**81.2**	**66.8**	**92.6**
Prince George to Edmonton	489	25	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6
Edmonton to Winnipeg	792	30	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
Winnipeg to Chicago	852	25	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1
Total Transit Hours - Fairbank to Chicago			**162.6**	**148.2**	**174.0**	**167.3**	**152.9**	**178.7**	**161.3**	**146.9**	**172.6**

Preliminary Route Miles To Chicago, IL	Hazelton	R. Mtn Trench	Nelson	Hazelton	R. Mtn Trench	Nelson	Hazelton	R. Mtn Trench	Nelson
Route Miles Fairbank to CN Connection	1,419	1,357	1,256	1,436	1,374	1,273	1,393	1,331	1,230
Route Miles of Existing Rail Lines	2,423	2,249	2,649	2,423	2,249	2,649	2,423	2,249	2,649
Total Route Miles - Fairbank to Chicago	**3,842**	**3,606**	**3,905**	**3,859**	**3,623**	**3,922**	**3,816**	**3,580**	**3,879**

Figures

ALCAN Rail Study

UMA | AECOM

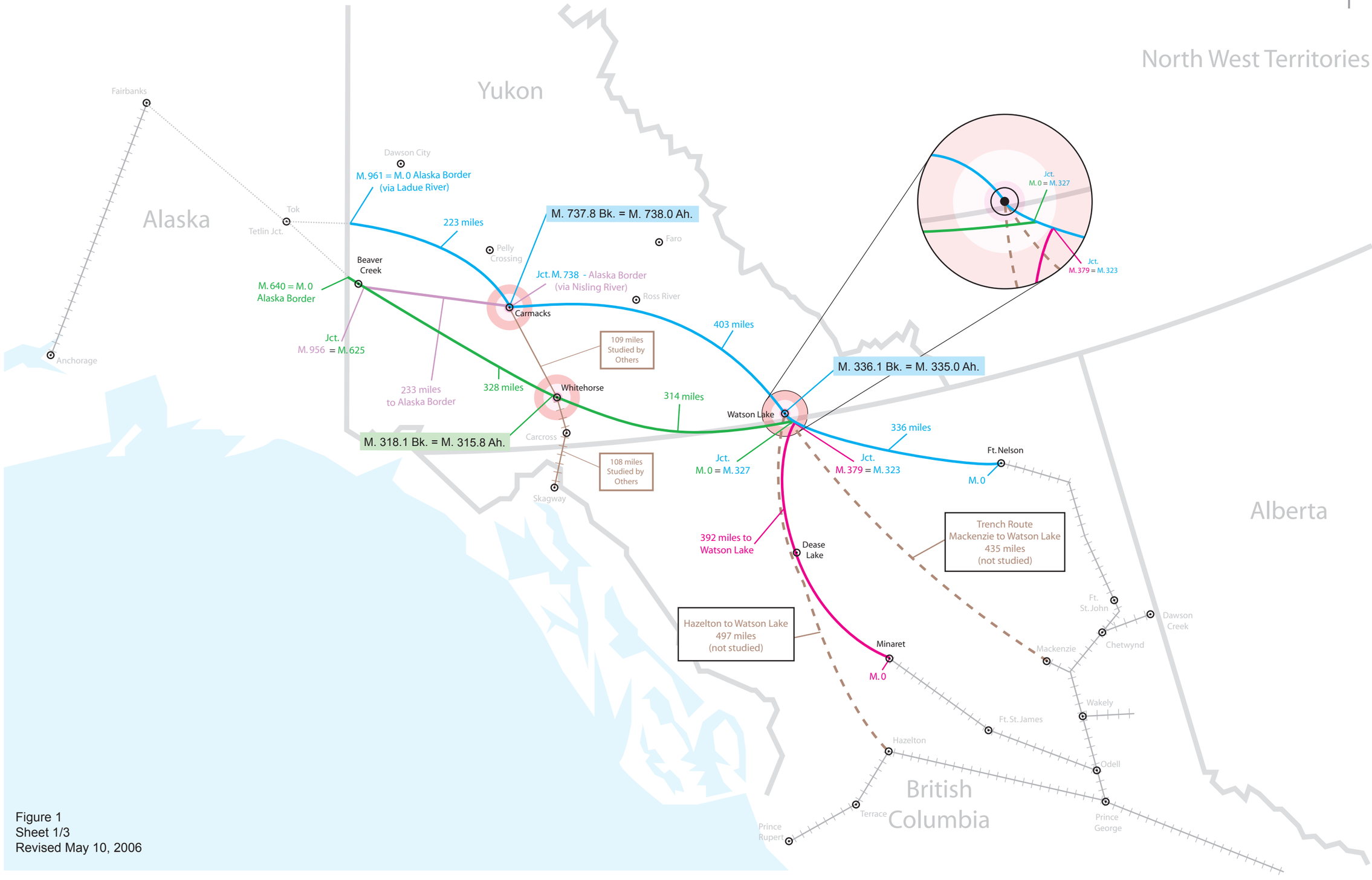


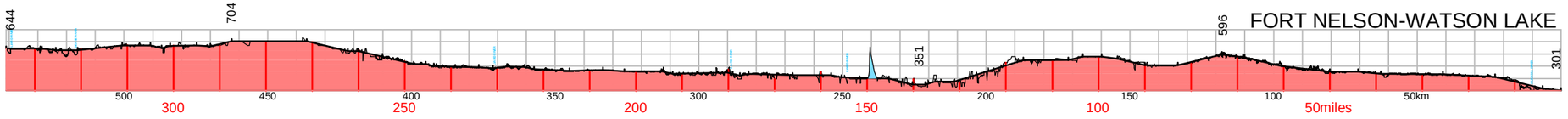
Figure 1
Sheet 1/3
Revised May 10, 2006

ALCAN Rail Study - Comparative Route Profiles

UMA | AECOM

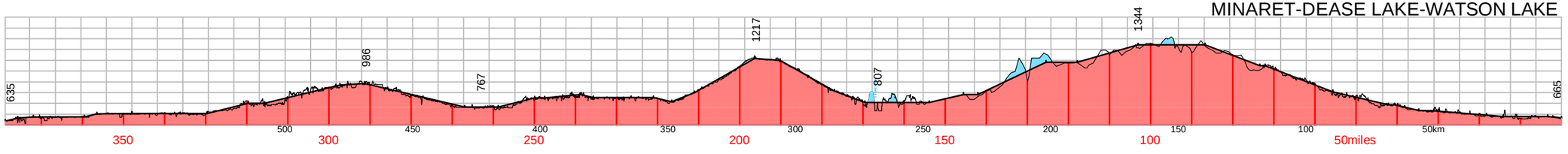
FORT NELSON-WATSON LAKE

MAX. WB GRADE 0.70% COMP.
MAX. EB GRADE 1.00% COMP.
MAX. CURVATURE 6°



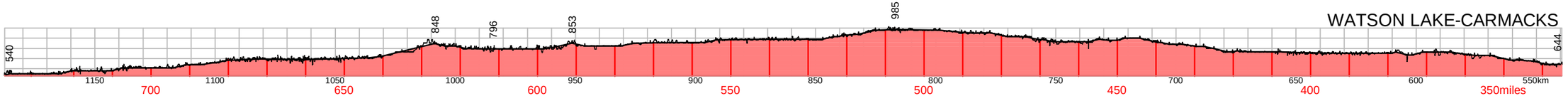
MINARET-DEASE LAKE-WATSON LAKE

MAX. NB GRADE 2.50% COMP.
MAX. SB GRADE 2.50% COMP.
MAX. CURVATURE 6°



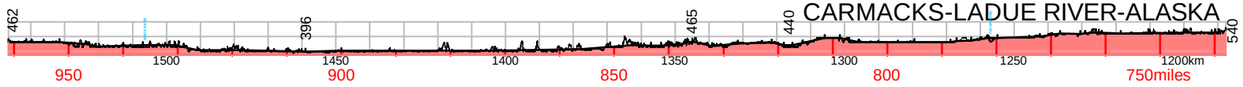
WATSON LAKE-CARMACKS

MAX. WB GRADE 0.70% COMP.
MAX. EB GRADE 0.70% COMP.
MAX. CURVATURE 6°



CARMACKS-LADUE RIVER-ALASKA

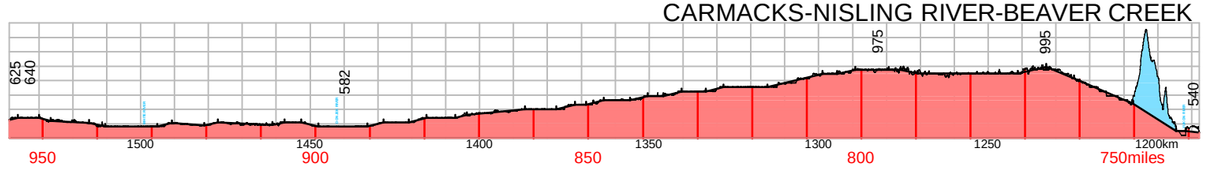
MAX. WB GRADE 0.70% COMP.
MAX. EB GRADE 0.70% COMP.
MAX. CURVATURE 6°



NOTE:
ELEVATIONS ARE IN METERS
NB - NORTHBOUND
SB - SOUTHBOUND
WB - WESTBOUND
EB - EASTBOUND
COMP. - COMPENSATED

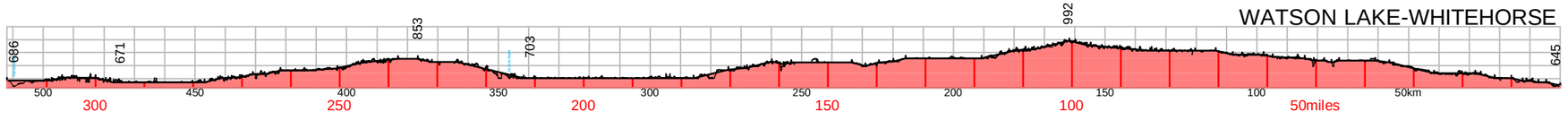
CARMACKS-NISLING RIVER-BEAVER CREEK

MAX. WB GRADE 1.50% COMP.
MAX. EB GRADE 0.70% COMP.
MAX. CURVATURE 6°



WATSON LAKE-WHITEHORSE

MAX. WB GRADE 0.70% COMP.
MAX. EB GRADE 0.70% COMP.
MAX. CURVATURE 6°



WHITEHORSE-BEAVER CREEK-ALASKA

MAX. WB GRADE 1.00% COMP.
MAX. EB GRADE 1.00% COMP.
MAX. CURVATURE 6°

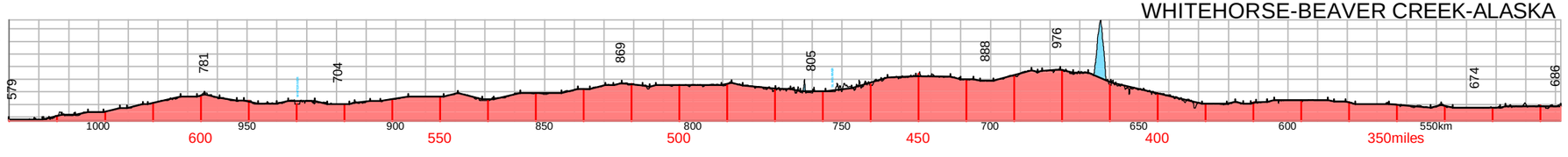
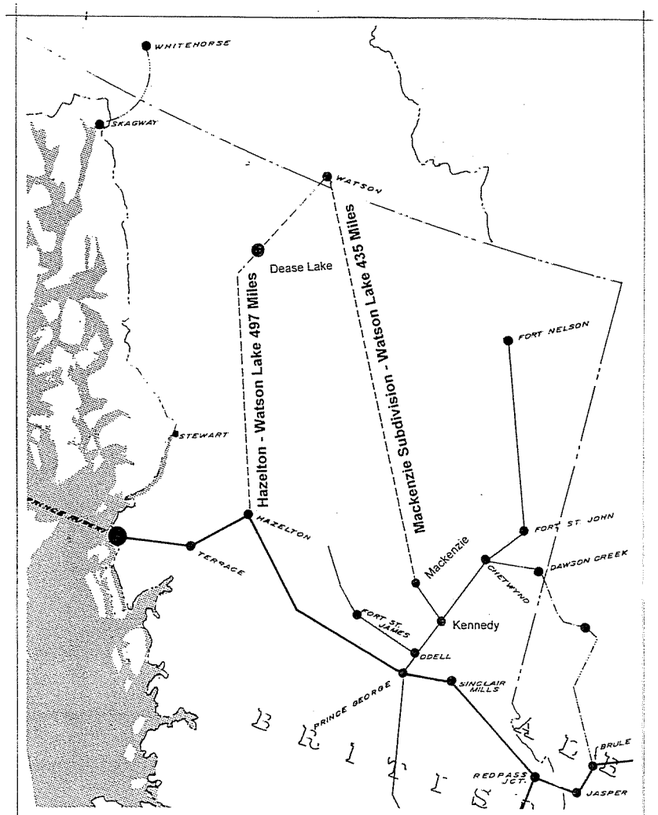
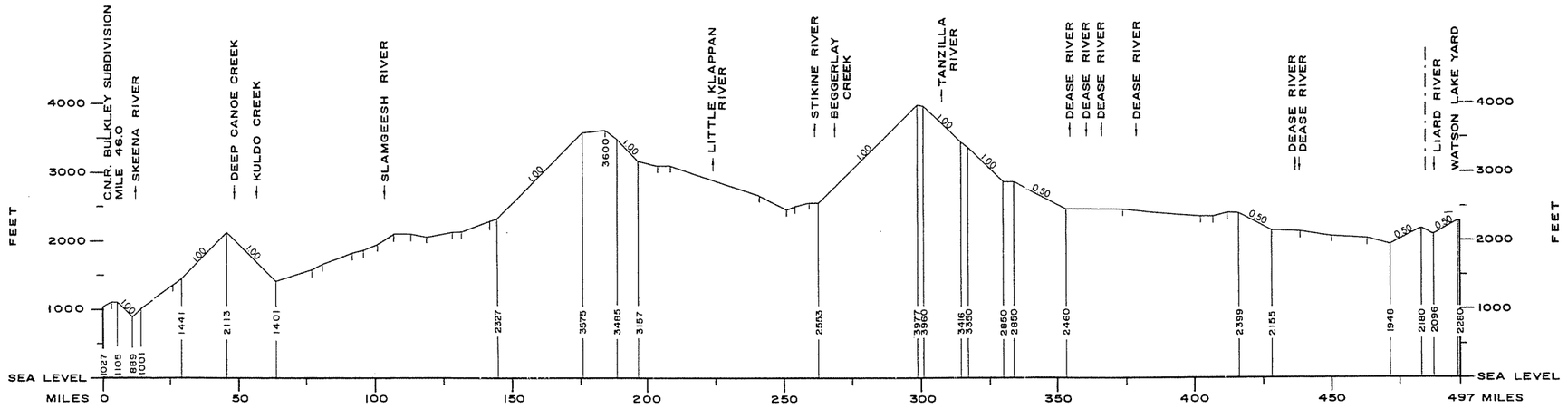


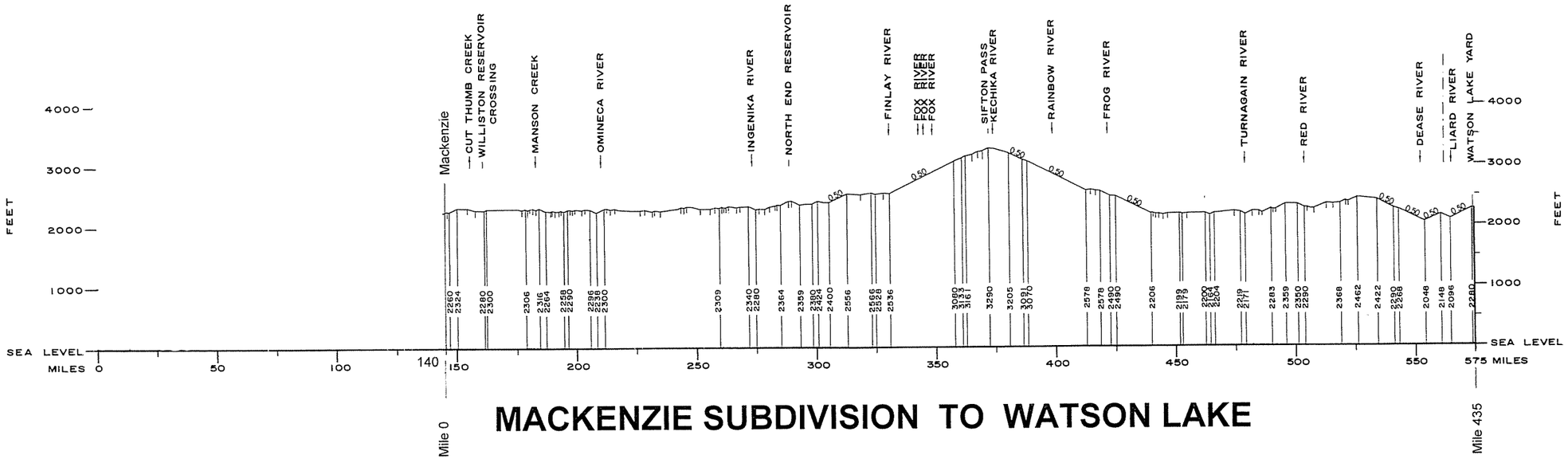
FIGURE 2
APRIL 10, 2006

Location Plan





HAZELTON TO WATSON LAKE



MACKENZIE SUBDIVISION TO WATSON LAKE

Alternate Routes In British Columbia

(Not Studied)

March 2006

Figure 3