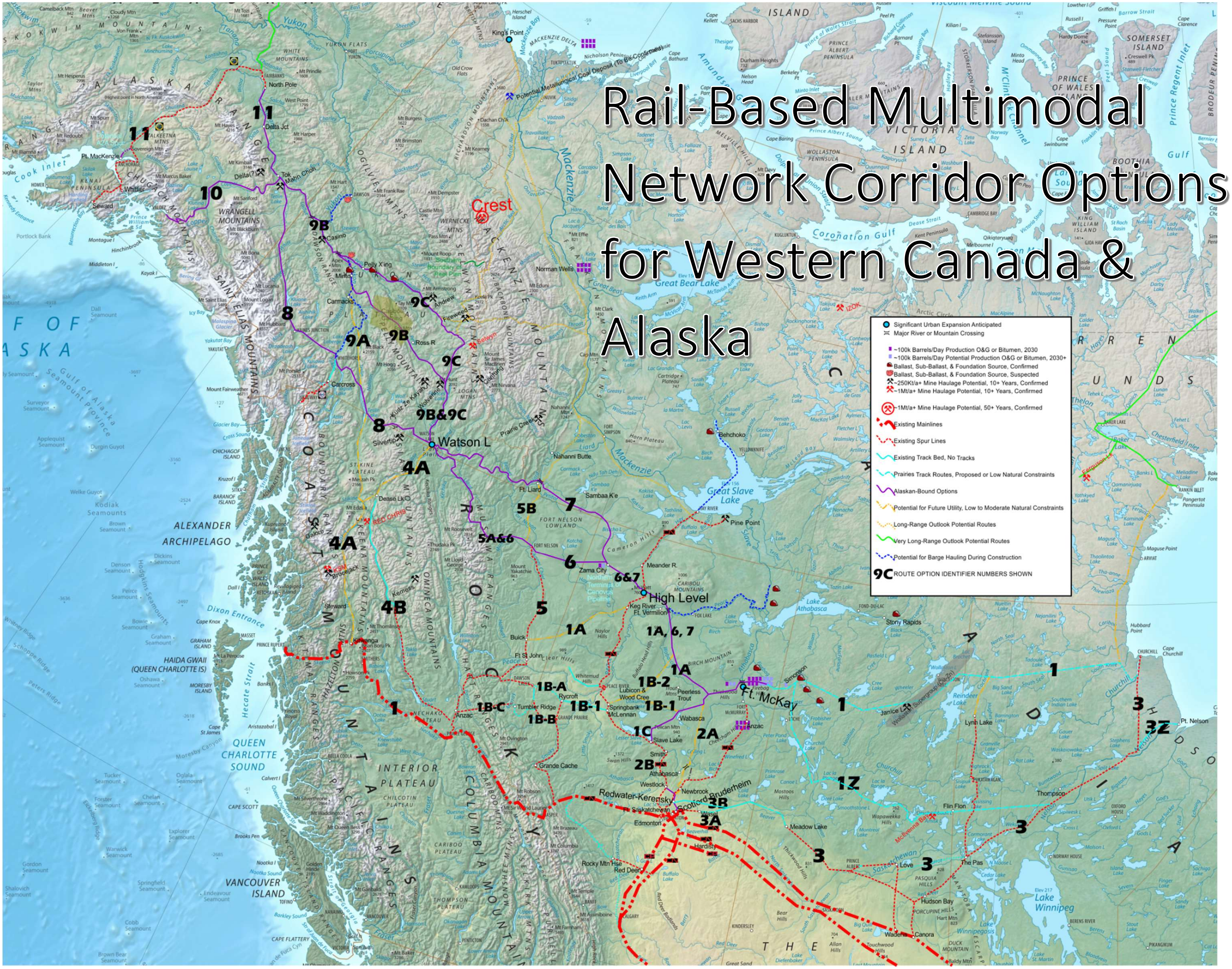
Rail-Based Multimodal Network Corridor Options for Western Canada & Alaska



1 Arguments for Rail as a Benchmark for Multimodal

The routes under consideration are only those that could host a railway. There are three primary reasons to use rail as a benchmark in designing a multimodal network.

The first is physical. Rail is the mode most limited by topographic constraints, so, if a corridor if suitable for rail, geographic space permitting, the corridor will automatically also be suitable to all other modes. In general, routes for heavy haul railways are limited to gradients of ~2% for very short (<5km) distances, ~1% up to about 20km, and the maximum gradient for longer runs is about 0.7% average. This last gradient translates into 7m per 1km, so a drop into a 200m deep valley to cross a river or from a mountain pass (of which there are many!) means about 29km of track distance. Double that for the other side of the valley or pass. Capital costs aside, we must also factor the energy and mechanical costs of slowing down or pushing up a mile-long train of 315,000lbs railcars. While pipelines can drop down cliff faces and powerlines can be strung between mountain peaks, by pulling all modes into a single transportation and utility corridor (TUC), distances for the powerlines and pipelines may be extended slightly, but they are then packaged in a readily-accessible corridor where all the aesthetic and environmental impacts are in one place and they can be easily accessed for maintenance, upgrades, and repairs.

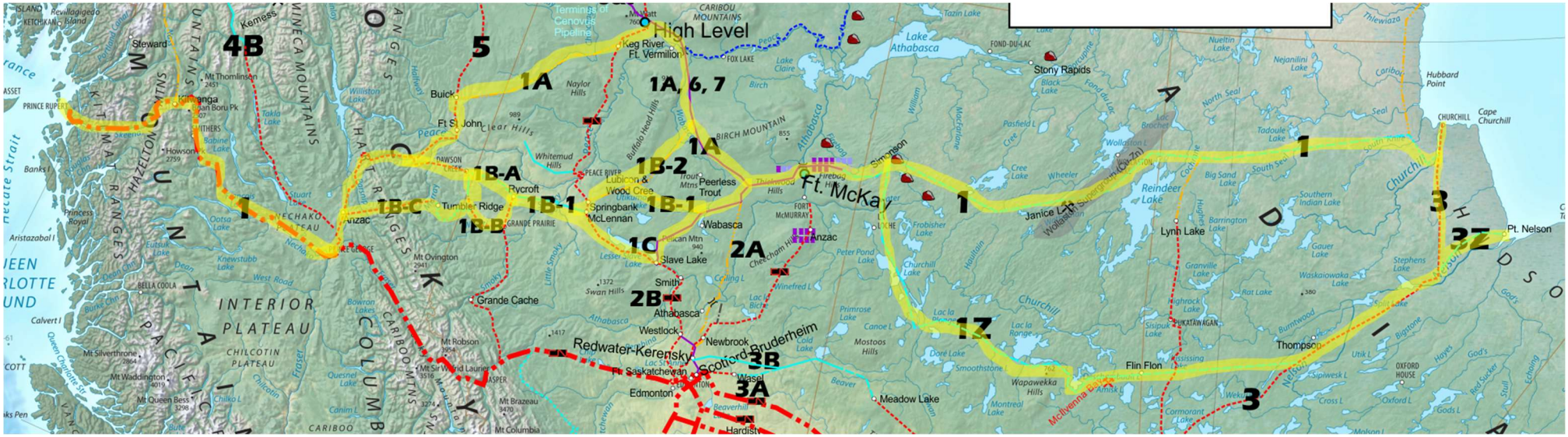
The second is cultural. Communities served by scheduled passenger rail or 'land ferry' service seem to do a better job of holding onto their people. Consider air- and sea-access communities in remote jurisdictions. In each of the three regions of Nunavut, the largest town has about 1/3 of the total population. In Greenland, with many communities, the capital Nuuk has about a quarter of the total population. In the Alaska Panhandle about a third of the region's population is in Juneau. Alternatively, Yukon, with an extensive highway network, has 85% of its population in Whitehorse. Half of NWT's population lives in Yellowknife, but in terms of the communities in southern NWT connected to roads, that proportion is about 75%. About 70% of Alaska's population in the portion of the state served by highways lives in the Anchorage area. The other communities are villages, except for Fairbanks. But remote Bethel and Barrow push 3,000 each, while Kodiak Island has a spaceport. We are discussing a major coordinated infrastructure expansion in Canada's Middle North and Alaska, and there are many small communities. It seems that where there is a choice, rail access is better for maintaining local cultures.

The third is economic. When a rail mainline is built through a place…not a dead-end spur, but a route going from one coast to another coast, that place is forever transformed. Communities founded along mainline rail stations rarely become ghost towns.

A sidenote. Passenger services by rail are often dismissed out-of-hand as uneconomic. Bad schedules, dirty rail cars, and unreliable punctuality on many existing services do not assist with changing that perception. However, with the transcontinental network extension we are discussing, becomes possible the second-longest passenger rail service on earth: Miami to Anchorage, 8000km. This could be promoted as a rite of passage for Americans. This could bring a market of 400 million people.

With that, here is the high-level view of the network options for the future of the Middle North, how Alberta and the rest of the Prairies shall find their permanent egress solution(s). These options need to be reviewed and compared in a transparent, objective, and reproducible way to help make final decisions and informed decisions about infrastructure investment.

2 Hudson Bay To North BC Coast



2.1 Option 1: Northern Route

All options require Churchill or Port Nelson to ~100km west of Ft. McKay. Generally gentle terrain, start with deciding whether Churchill or Port Nelson are preferable as ports and build west from there. This option opens the heavy ore, electricity, timber, and oilsands of northern Saskatchewan and Manitoba.

OPTIONS FOR 100km WEST OF FT. MCKAY TO PRINCE GEORGE

Option 1A: Stay North

Option 1A: NW to High Level, south on existing line to Keg River, SW to Buick BC area, south on existing tracks to Ft. St John and Pr. George. It's additional length probably renders this option non-competitive.

Options for 1B: Tie Together Northern Ends of Multiple Spurlines

Option 1B-1: Southern side of Trout Mountains, to existing line at Springbank, south to McLennan, along new track on existing track bed to Rycroft.

Option 1B-2: As above, but along northern side of Trout Mountains

Option 1B-A: from Rycroft along existing track to Spirit River, then west on newly-built track to Dawson Creek, connecting on existing track to Pr. George. This route was mapped in detail c. 1920 but never built.

Option 1B-B: from Rycroft south on existing track to Grande Prairie, then west on existing track to Lymburn and on new track on existing track bed to Dawson Creek, connecting on existing track to Pr. George.

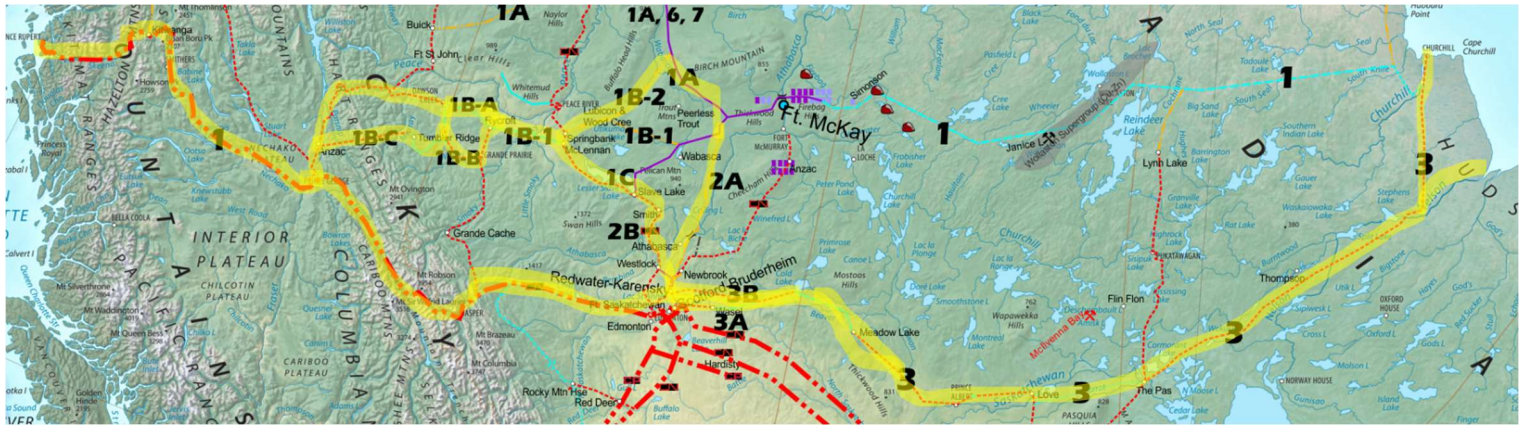
Option 1B-C: As for 1B-B, but on new track west of Lymburn to Tumbler Ridge, then on upgraded existing rail tunnels to Anzac and then south to Pr. George.

<u>Option 1C (Preferred):</u> The Original 1900s Concept: Lesser Slave Lake to Hudson Bay

Option 1C: From 100km west of Ft. McKay, head southwest to Slave Lake, Alberta. Connect with existing line to Falher. New track on existing track bed to Rycroft, then as for 1B Options. Connects with Option 2B.

Option 1Z: Pioneering a new route from the Thompson Manitoba area to Ft. McKay via La Loche. Would tie in well with northern routes and encourage mineral and timber development.

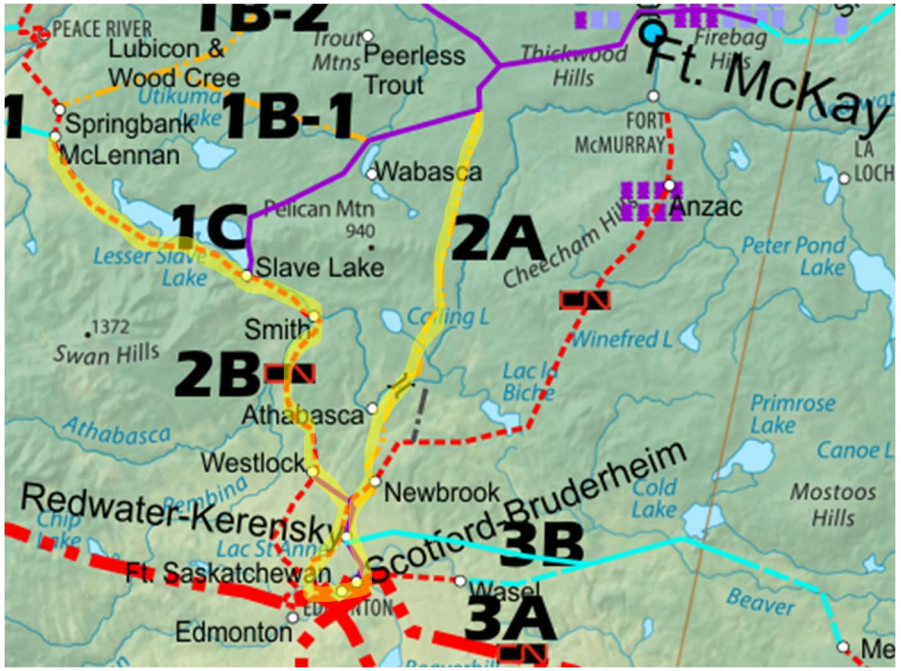
2.2 Option 2: Middle Northern Route



All options require upgrading existing Hudson Bay Railway line from either Churchill or Port Nelson to The Pas. From The Pas, new line westward to Love Saskatchewan, follow existing lines to Meadow Lake, then pioneer new route (generally gentle terrain along the northern limits of the agricultural zone) to Cold Lake. Existing track beds exist from there to the lines near Edmonton. Most of this route is a “fill-in-the-gap” route.

2.2.1 OPTIONS FOR SCOTFORD-BRUDERHEIM OR REDWATER-KERENSKY TO PRINCE GEORGE

While these options ignore the ability to simply use the existing CNR mainline, the idea is to create a mid-provincial east-west link for Alberta and BC.



Option 2A: Cross the North Saskatchewan at Vinca, connect with existing line at Redwater AB, head north to Newbrook, then follow east side of Wabasca Hills to 100km west of Ft. McKay. From there, see 1B and 1C Options.

<u>Option 2B (Preferred):</u> Use existing track through Edmonton to Westlock or build a new line from Westlock to Scotford. Uses existing line from Westlock to McLennan. Connects with Option 1C at Slave Lake, meaning this route could serve both Alaska and Hudson Bay. Smith has a rail bridge at the most mellow crossing point available over the Athabasca River.

Option 3A: Uses existing track and track beds to the Bonnyville-Smoky Lake area of Alberta, and then strike southwest, crossing the North Saskatchewan near Wasel to connect directly to the existing railway exchange system at Scotford-Bruderheim.

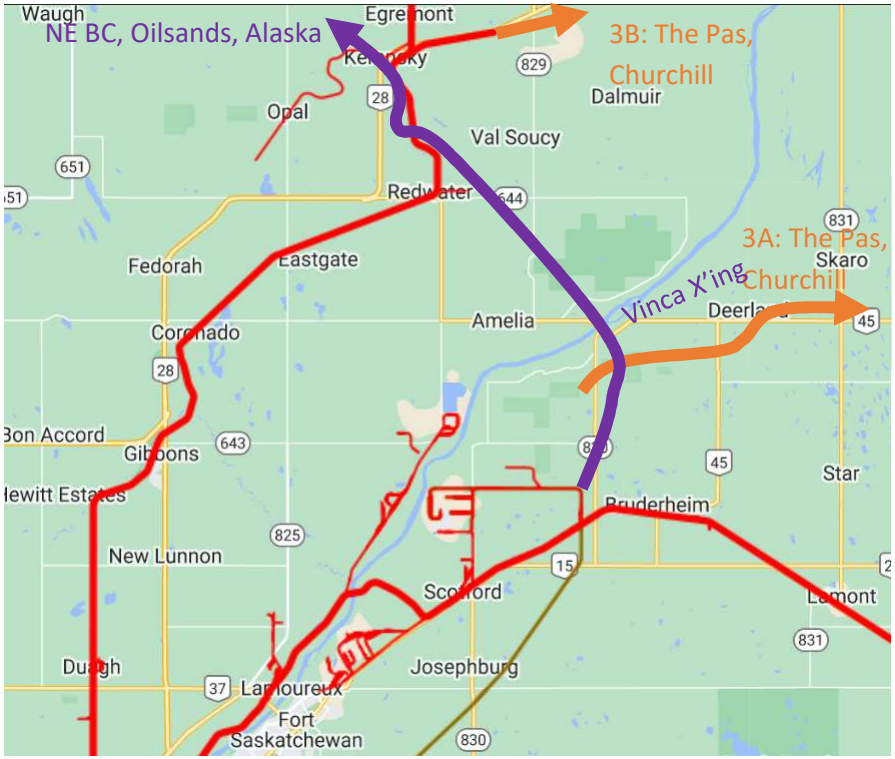
Option 3B: As for 3A, uses existing track and track beds past the Bonnyville-Smoky Lake area of Alberta. This option would stay north of the North Saskatchewan, and connect to a new rail interchange at Kerensky-Redwater. Note the RoW from Cold Lake to Kerensky was sold to a community trails group in 1999.

Option 3Z: Construction of the 1910s surveyed route to Port Nelson. While Churchill is generally preferably for smaller vessels, Port Nelson is more suitable for Panamax-size vessels. Churchill has a small rocky harbour that tends to be desilted by the flow of the Churchill River. Port Nelson is a silty port but with the strong flow of the Nelson River, good breakwater design could create self-clearing.

2.3 The Importance of Scotford-Bruderheim and Redwater-Kerensky

This location would be the primary interchange where the existing infrastructure networks meet the new northern network.

Scotford-Bruderheim is a rail hub. It is at the juncture of Canadian Pacific (CP) and Canadian National (CN) mainlines, next to a mellow crossing point of the North Saskatchewan River (with an existing bridge), it contains multiple existing rail sorting yards, it has direct access to the oilsands and multiple major industrial areas, is near a source of tradespeople (Ft. Saskatchewan), and has a great deal of available land. Redwater-Kerensky is a potential alternative Arctic rail hub as it is where existing track bed from the east connects.



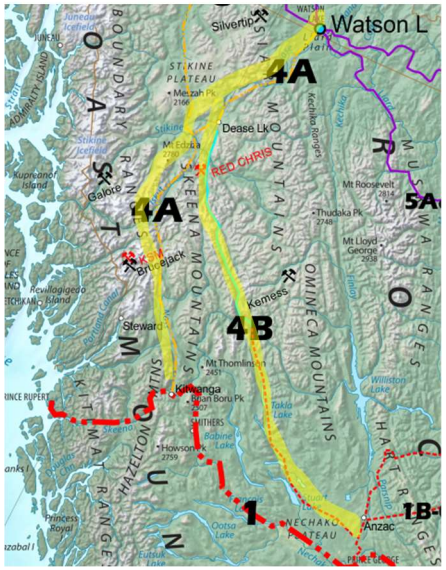
In this screencapture from the CN website, red are CN lines, brown is CP. Alberta's main hydrogen facility is near the centre of the map. The blue line is the North Saskatchewan. Added to the image are spurlines in orange. 3A is still partially tracked and leads to Lloydminster. 3B is no longer tracked, and goes to Cold Lake.

While early phases of Arctic routes would use the existing CN lines and bridge, it is envisioned a new mainline would eventually come in from the North, cross at Vinca. This would carry the main tonnages to and from the Alaskan and Hudson Bay ports. This is shown in purple. The options of what links and rail yards are built when would be decisions based on movement assessments.

2.4 North BC Coast To Watson Lake

2.4.1 Option 4: NW BC

All options share the same route between Dease Lake and Watson Lake, and will require new track bed.



Option 4A: Kitwanga to Watson Lake

Entire route requires new track. Stays close to the coast, provides optional spur to Stewart.

Option 4B: Summit Lake to Watson Lake

There is existing track bed most of the route, but needs new track for about half of it. The distance for the North BC Coast to Watson Lake is much longer than for 4A.

2.4.2 Option 5: NE BC

Upgrade existing track from Prince George through Ft. St. John, up to Ft. Nelson. This option perhaps negates the need for a route in NW BC, unless major commodity deposits are founded that are unsuitable to shipment by road.

Option 5A: Ft. Nelson to Watson Lake via Alaska Highway Corridor

Effectively parallels the highway. Some gradient concerns near Muncho Lake and Stone Mountain that will likely require difficult engineering.

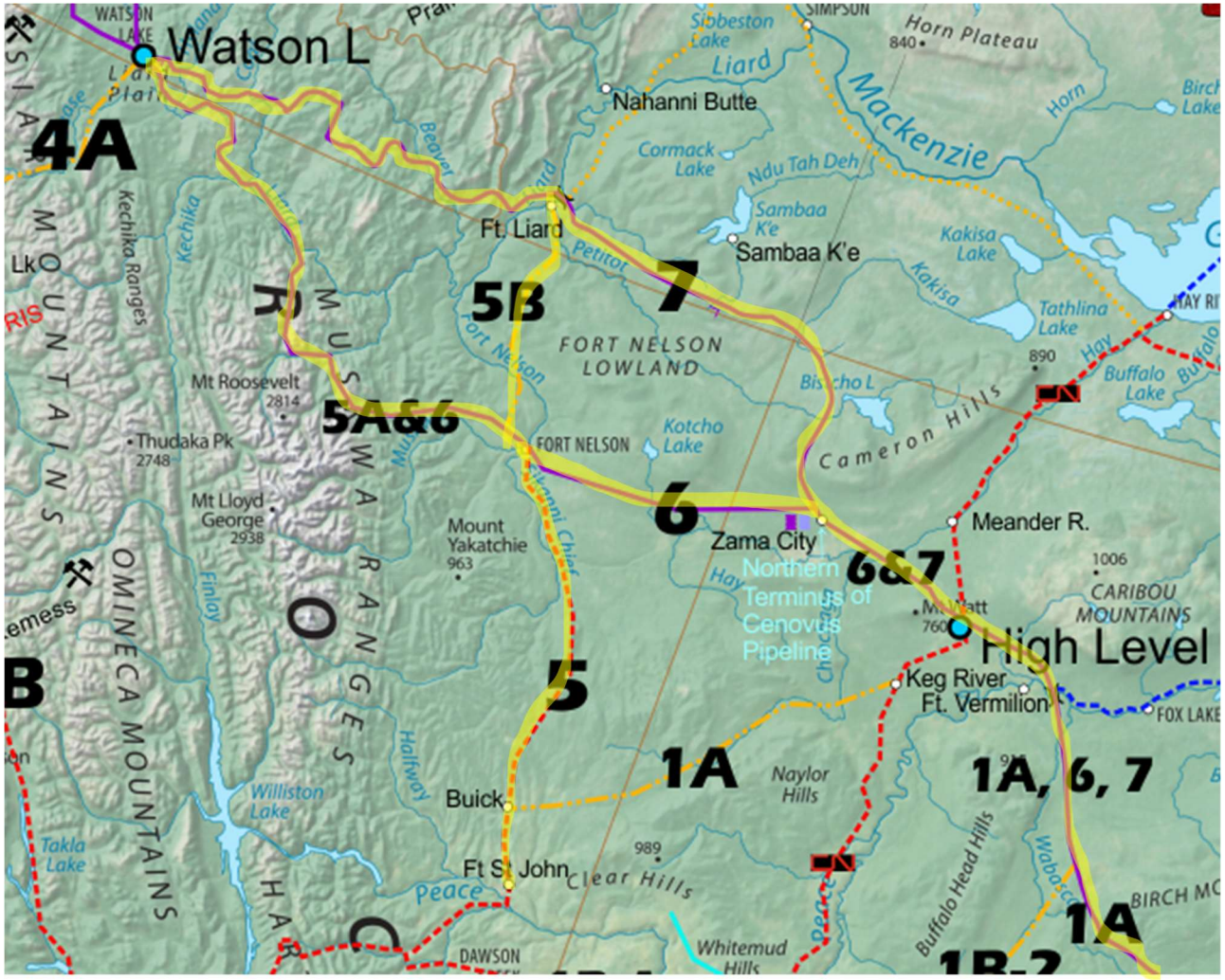
Option 5B: Ft. Nelson to Ft. Liard

New line north to Ft. Liard, where it would meet with Watson Lake-Ft. McKay. Provides access to valuable forestry lands (and potentially agricultural).

2.5 On To Alaska Part 1: 100km West of Ft. McKay To Watson Lake

All options require heading from ~100km west of Ft. McKay, northwest between the Birch Mountains and Buffalo Head Hills, to a Peace River crossing near Ft. Vermilion, onto High Level and Zama.

Note: the A2A preference of going through Meander River instead of High Level is considered void, as it involves an extra 150m elevation change and is not acceptable to the Dene Tha. It is not shown.



Option 6: Zama to Ft. Nelson

New track route but generally gentle terrain.

Option 7: Zama to Ft. Liard en route to Watson Lake

Mainly follows the A2A route, has been proven workable by engineering analysis. Of strong interest to Acho Dene Koe and Dene Tha.

2.6 On To Alaska Part 2: Watson Lake to Tok

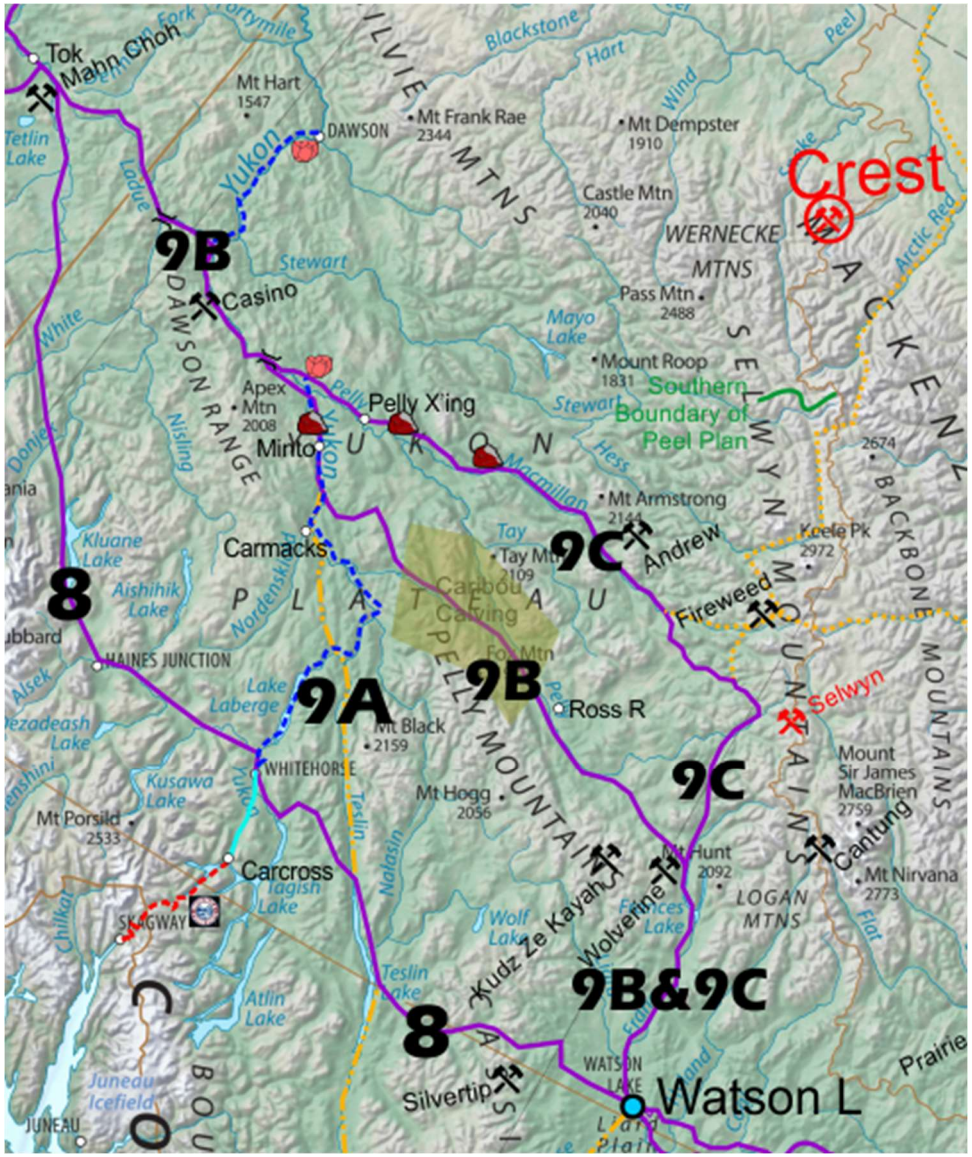
Option 8: Alaska Highway Route, Ft. Nelson to Tok

Reviewed by A2A and ruled out due to being longer than the central Yukon options. Provides the advantage of serving Whitehorse, but would not be able to serve potential heavy ore mineral deposits. The portions near Kluane National Park would be vulnerable to natural hazards (mainly earthquakes and glacial debris flows). Access to Whitehorse also means potential access to Port of Skagway.

OPTIONS THROUGH CENTRAL YUKON

Option 9A: As for Option 8, but connects from Teslin to Carcross via the Teslin River valley. Longer than the other Central Yukon Routes, and does not serve most of the potential heavy ore mineral deposits. Not considered a competitive option. However, there is a possible 'short-cut' route that follows the Teslin Valley southwards to the Dease Lake area.

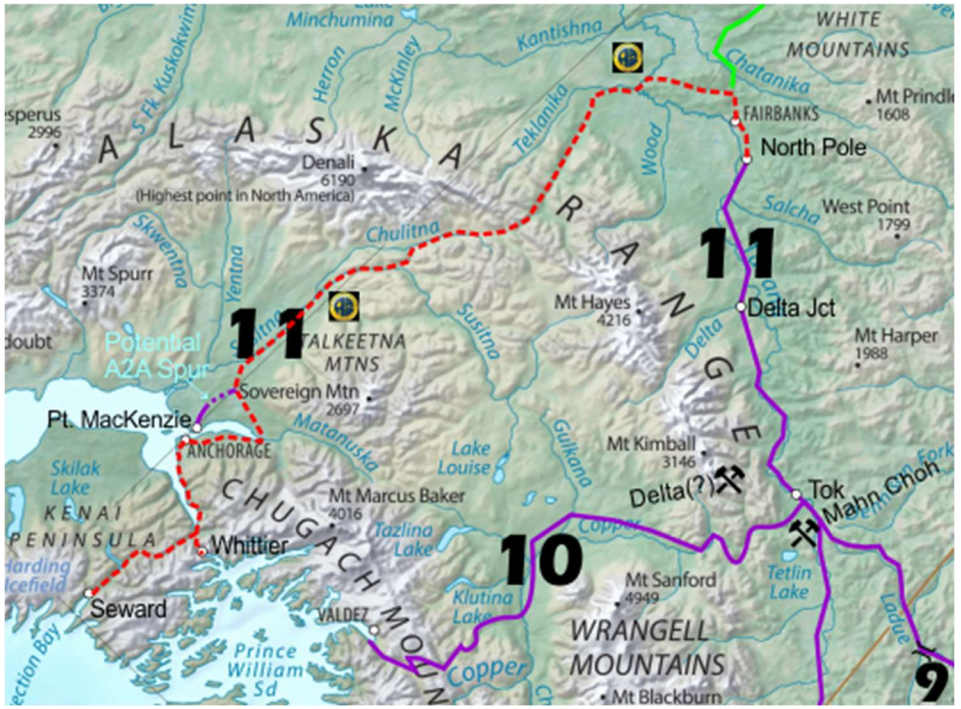
Option 9B: Robert Campbell (Highway 4) Route: Follows the highway north of Watson Lake, along the central Yukon valley (geologically, the "Tintina Trench"), to Frances Lake and then Carcross, and then follows the Yukon River past Ft. Selkirk and then connects into Alaska at the Ladue River. Major crossing of the White River required. Would provide direct access to Casino deposit. Cuts through the Yukon's most important caribou calving ground.



Option 9C: MacMillan Route: Same as 9B to Frances Lake, but continues north to the major mineral deposits in the MacMillan Pass area including Fireweed and especially Selwyn. Selwyn is large enough a deposit that some of the mine designs had included constructing a railway from Selwyn to Watson Lake. Also very close to Mactung and Cantung, which are tungsten deposits of strategic interest. The route turns west at the MacMillan River, following the river to just west of Ft. Selkirk, where it would cross the Yukon and join 9B near Casino. There are large igneous deposits along this route which potentially could serve the gravel needs for much of the North (they would first need to be tested for acid rock drainage). This route is 110km longer than 9B, but avoids the caribou calving area near Finlayson Lake on 9B. This option would protect the wilderness 'feel' of Ft. Selkirk. By providing access to MacMillan Pass, improves future potential for accessing Crest (one of the largest iron deposits on Earth) and/or Mackenzie Delta.

2.7 Getting Through Alaska: Tok to Coastal Access

Both coastal options would cost about the same.



OPTION 10: TOK TO VALDEZ

This option is shorter and was fully engineered by A2A, but is more vulnerable to natural hazards (earthquake, avalanche, and glacial debris flow). It does not provide the connection to Eielson Base near Fairbanks that is desired by the US Military.

OPTION 11: TOK TO SOUTH CENTRAL ALASKA

This option would pioneer a new route from Tok to North Pole, near Fairbanks. The route has some natural hazards relating to glacial debris flow. More significantly, it is considerably longer than the Valdez option and would require a retrofit to the entire existing Alaska Rail system. However, it also would provide access to 4 port facilities (Port MacKenzie, Anchorage, Seward, and Whittier), and a Miami-to-Anchorage passenger service is more likely to evolve culturally into a 'rite of passage' for Americans. It would also be a valuable military asset by providing direct heavy-lift capacity to the heart of the Alaskan defense system, which is Eielson AFB near Fairbanks.

2.8 Mackenzie Delta Options

Without a functioning icebreaker-assisted scheduled freighter convoy system in the Northwest Passage, the Mackenzie Delta is generally a non-competitive option for a port. This is not because of siltation or related depth issues, as these can be addressed by setting up the port at King's Point Yukon, which is just west of the Delta. It is because freighters arriving at the Delta will have needed to sail all the way around Alaska to get there (except for the very few ice-strengthened freighters that may come in from the east via the NW Passage). It is simply easier and shorter to dock at southern Alaska.

Having said that, there are effectively two options that may be viable multimodal routes in the long term. The first is the Mackenzie Valley, which is probably the most straightforward. The other is to head north from MacMillan Pass near Fireweed mineral deposit at the Yukon-NWT border, following isolated high alpine valleys. This latter option is only potentially viable in conjunction with initiation of mining at Crest, which is estimated to have about 10 billion tonnes+ of marketable iron ore.

The engineering for a Canol Road was built in WW2, connecting the west shore of the Mackenzie River at Norman Wells to MacMillan Pass. In theory, this route could also be used for rail.

3 What Routes are the Most Promising in the Short Term?

Leveraging the forecasted shortage of pipeline capacity (even with completion of TransCanada) as a medium-term pipeline-on-rails which can later be used for northward connectivity, linking Scotford to Fort McKay appears most worthy of detailed prefeasibility. Ideally, this would include a railbridge over the Athabasca near Ft. McKay, to provide access to the major oilsands deposits and points east in Saskatchewan, and eventually Churchill. The terrain to bridge the Athabasca is potentially suitable for a rail crossing from Ft. McKay to about 100km to the north. The author anticipates that Firebag, about 10km north of Ft. McKay, will be shown to be the most economical should a detailed engineering analysis occur.

On a grander scale, existing tracks and track beds line almost the entire route for an east-west "Neestanan" corridor from Churchill to Prince Rupert. The three new sections of rail that would be required correspond to the three provincial borders to be crossed: BC-Alberta, Alberta-Saskatchewan, and Saskatchewan-Manitoba. Such a route can use the Scotford-Ft. McKay link described above. Large portions of the existing rail line between The Pas and Churchill need to be rebuilt to a higher engineering standard.