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8. ALTERNATIVES

8.1 BACKGROUND

The complete preferred Project arrangement is presented in detail in Section 6.4. To arrive at this preferred overall arrangement, numerous alternatives such as plant layouts, plant sizing, localized Project components, and in particular transmission line routing have been studied. Some of the alternatives evolved early in the conceptual development stage of the Project, and were dealt with through the options studies of the preliminary design phase. High-level technical, environmental, and economic comparisons were used to screen these alternatives and move forward with more detailed studies of preferred options. In some cases, such as plant sizing, the most suitable arrangement would only be defined at the final design stage, and the preferred configuration discussed here still encompasses a range of plant sizes that would be equally feasible.

For the transmission line routing, where a large number of options would appear to be available, specific alternative corridors have been chosen that characterize the main approaches of routing that could be used for the Project. Because the transmission line is a large component of the Project, and transmission line route alternatives present fundamental differences in such things as geographic location, construction methodology, costs, benefits, and land use effects, a formalized comparative procedure has been used for ranking these alternatives. The key alternatives assessments made in the course of developing the preferred concept are described in more detail in the following sections.

8.2 PLANT SITING AND LAYOUT

Using as much of the existing facility infrastructure as possible and minimizing the incremental footprint of any expansion has been an over-reaching goal of the Project's design development. Therefore, the design effort has focused on means to enhance the control of Nonacho Lake through the upgrade of existing control concepts there and to develop additional generation from the existing Forebay. As there are significant physical constraints to what can be located at the existing Nonacho Lake dam site, no alternatives to the proposed siting have been studied in detail.

At the Forebay area, two arrangements for connecting the Forebay to the Taltson River downstream of Elsie Falls appeared feasible from initial study: the North Gorge layout and the Janine Lake layout. Both were brought through a pre-feasibility assessment (Klohn Crippen 2004). The North Gorge option has become the preferred arrangement.

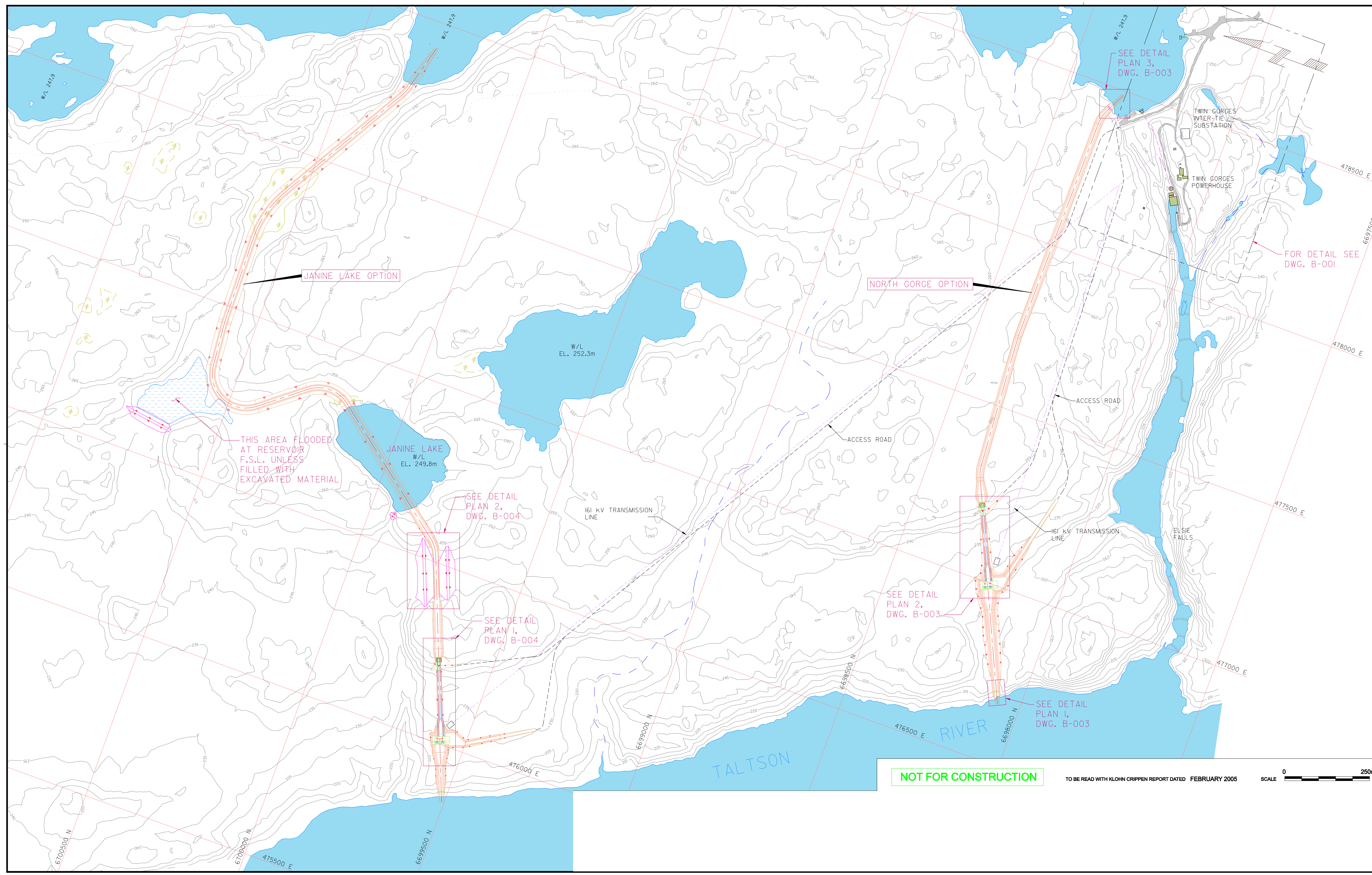
The Janine Lake option considered a water conveyance canal interconnecting a series of small lakes, one named Janine Lake, located approximately 2 km north of the existing Twin Gorges facility. The layout is shown in Figure 8.2.1. As with the preferred concept, a canal connecting into the existing Forebay would convey flows to an intake structure at the grade break in terrain above the Taltson River. Penstocks would convey the water from an intake structure at the end of this canal system to the powerhouse, located close to the river. A short tailrace canal would connect the powerhouse to the Taltson River. The study of this alternative concluded that the Project sizing and energy production would be the same as the North Gorge option. The cost estimate for the Janine Lake option was approximately 10% higher at the pre-feasibility level than the North Gorge option. The primary comparisons made between the Janine Lake alternative and the North Gorge layout are presented in Table 8.2.1.

Table 8.2.1 — Comparison of Janine Lake Alternative and North Gorge Plant Siting

Component	Comparison to North Gorge Siting
Economic Evaluation	The Janine Lake alternative was anticipated to cost approximately 10% more than the North Gorge alternative.
Risk	The Janine Lake alternative was viewed as having significant geotechnical risk in comparison with the North Gorge alternative.
Construction Effect and In-stream Works	The Janine Lake alternative would require draining the small lakes, including Janine Lake, for construction. Therefore, the alternative had a much higher in-stream works requirement and environmental effect relative to the North Gorge alternative.
Land Use Footprint	The water conveyance canal for the Janine Lake alternative was circuitous, and encompassed the disturbance of substantially more terrain than the North Gorge alternative. The Janine Lake alternative, at 2 km from the existing facility, would leave a much larger section of terrain both disturbed by access and isolated between the existing and new generation facilities.
Spoil Quantity and Disturbed Area	Approximately equal volumes of spoil and waste rock were forecast from the two locations. The Janine Lake alternative did not appear to provide a benefit in excavation quantities or in disturbed area.

Component	Comparison to North Gorge Siting
Potential Downstream Effect	The Janine Lake alternative would leave a much longer section of the Taltson River exposed to ramping flow variations between the existing and new plants.
Convenience	The Janine Lake alternative, at 2 km from the existing facility, would require additional road maintenance, snow clearing, and travel time for operation.

The conclusion reached on the basis of the above key comparatives was that the North Gorge option offered a reduced Project footprint than the Janine Lake site at essentially the same cost. No further work has been undertaken on the Janine Lake alternative.



TALTSON
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Janine Lake Canal and Plant Layout

Figure 8.2.1

8.3 PLANT SIZING

8.3.1 General Methodology

Plant sizing here refers to the total installed capacity that would be developed for the Expansion Project, and therefore defines the new plant capacity to be installed in addition to the existing 18 MW plant. A final decision on plant sizing would be made at the final design stages, and would fall within the range of plant sizes considered in the optimization study. The determination of the appropriate study range is itself an alternatives analysis that involves the following key assessment parameters:

- Site capacity assessment and evaluation of hydrologic constraints,
- Hydrologic trend analysis,
- Incremental benefit/cost assessment,
- Customer load forecast and contract opportunities,
- Hydrological effect,
- Other potential effects, and
- Overall resource development optimization.

A synopsis of these individual assessments is provided in the following sections.

8.3.2 Site Capacity and Energy Output

A plant sizing assessment covering a range from 40 MW to 90 MW of total installed capacity has been carried out using the hydrological generation model developed for evaluation of Project performance. As discussed in Chapter 6, this generation model includes all of the important operational strategies and constraints included in the preliminary design. The Project performance is evaluated using inflows developed from the available historic WSC database for the Taltson Basin extending from 1962 to 2007 (45 complete water years). A summary of several of the key assessment parameters including spill percentages and energy generation assessments is shown in Table 8.3.1.

The range of plant sizes that appear attractive on the basis of overall spill volumes, energy output, and associated capacity factors as normally sought in hydropower design is highlighted in Table 8.3.1. Within this range, no significant deviations from the preferred concept design would be required, other than slightly larger water conveyance facilities (wider canal, larger gates) and powerhouse size (larger generation machines and slightly larger building). No alterations to the Nonacho Lake facilities would be required, nor would operations strategy change, other than that the necessary flow releases from Nonacho Lake would be increased for the larger plants.

Table 8.3.1 — Key Variables of Project Performance for Various Plant Sizes

1962 TO 2007 DATASET								1985 TO 2007 DATASET	
Installed Total Capacity	Spill % of Flow	GWh Total Project	GWh New Plant	GWh Existing Plant	CF Total Project	CF New Plant	CF Existing Plant	GWh Total Project	CF Total Project
40	28.5	340	193	147	0.97	1.0	0.93	350	1.0
50	17.3	414	278	136	0.94	0.99	0.86	437	0.99
54	13.5	440	309	131	0.93	0.98	0.83	467	0.99
60	9.0	471	351	120	0.90	0.95	0.76	503	0.96
70	4.7	506	407	99	0.82	0.89	0.63	543	0.89
74	3.5	516	425	91	0.80	0.86	0.58	557	0.86
80	2.2	528	450	78	0.75	0.83	0.50	573	0.82
86	1.5	540	475	65	0.72	0.80	0.41	591	0.78
90	1.0	546	490	56	0.69	0.78	0.35	597	0.76

Notes:

1. CF (Capacity Factor): fraction of time plant is operating at full capacity.
2. GWh: Gigawatt hour (unit of energy production) values are average annual production.

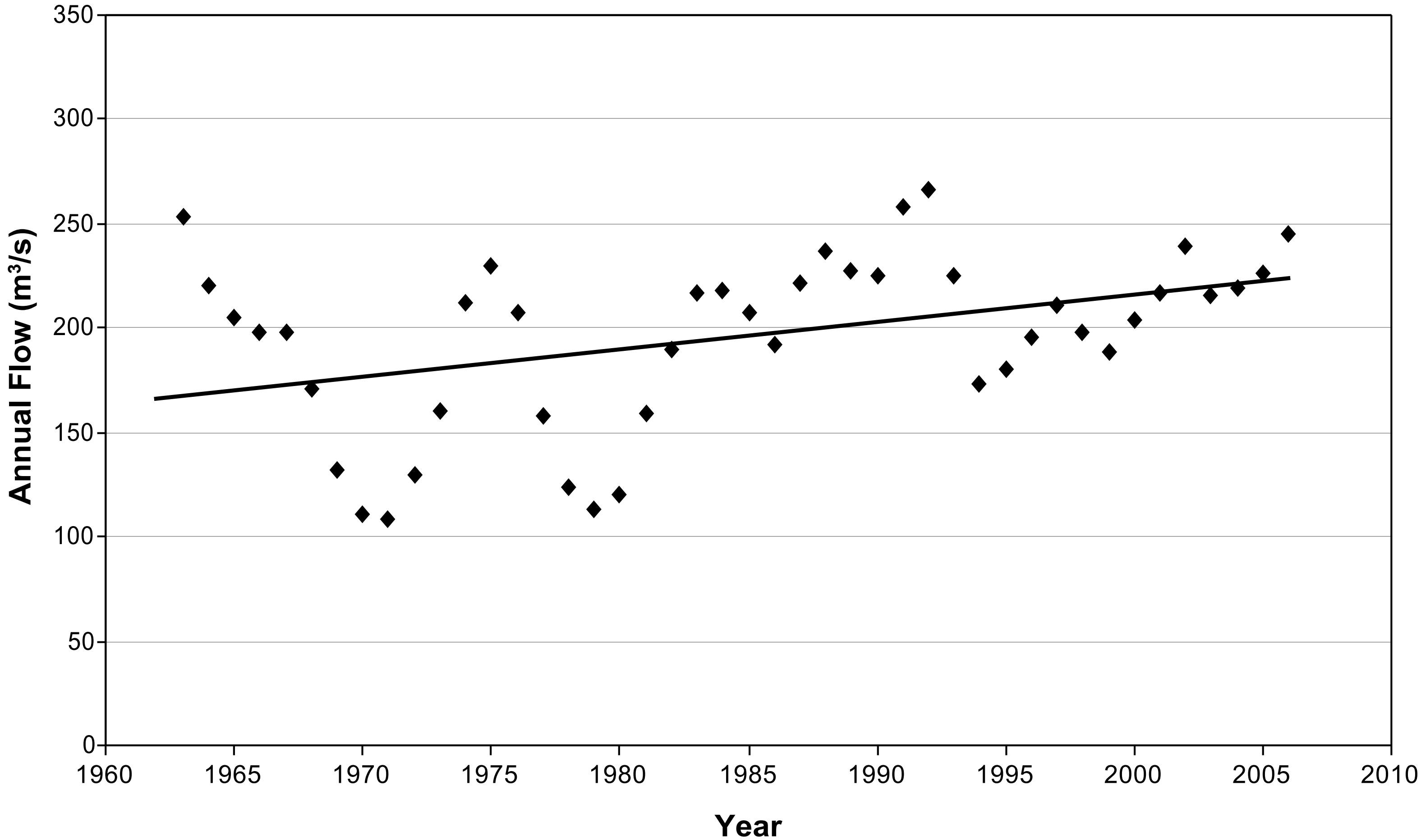
The important hydrologic constraints for this site are the average annual volume of water available in the system above Twin Gorges and the regulation of the flows that is available in the system (in this case with controlled regulation only at Nonacho Lake). Within those broader constraints, existing operational constraints such as minimum water levels in Nonacho Lake and minimum releases at the control structure must be maintained.

Water usage can be illustrated by total spill volumes over the period of record, as shown in Table 8.3.1 for the various plant sizes. These results show that a very small percentage of water is not used for generation in the larger plant sizes considered, and the plant size would be considered optimized in terms of water use. The same result is shown by the decreasing incremental energy available from the larger plant sizes (see Table 8.3.2).

8.3.3 Hydrologic Trends

Long-term hydrologic trends are very important to consider in hydropower development. Significant trends are often difficult to discern clearly because of a lack of data at many sites. In this case there is a long-term gauging record on both Nonacho Lake and on the Lower Taltson River. The 45-year database used for the energy assessments shows an upward trending mean annual flow below Twin Gorges, as shown in Figure 8.3.1. It is also significant that no events like the multi-year dry seasons noted early in the record have occurred since the early 1980s. Whether this points to a more stable trend in run-off in the future is not known, but the basin has been wetter since the 1980s than it was in the 1960 to 1980 period.

The effect of the higher mean annual flow in the more recent 20-year record is shown in the final two columns of Table 8.3.1, where energy output and capacity factor are shown for the same plant size for this shorter period. Typically, average annual output forecasts would increase by approximately 6% to 7% for the range of plant sizes under study. While the full record is used for economic and financial analysis, the significant difference in output forecast for the more recent period must be considered in plant sizing decisions, and supports a move toward a slightly larger plant size than a decision made on the 45-year record.



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Three Year Rolling Average of Mean Annual Discharge
Near Twin Gorges (1962-2007)

FIGURE
8.3.1

8.3.4 Incremental Benefit/Cost Assessment

Incremental benefit/cost analysis is the next stage of assessment once the energy output forecasts are defined for the various plant sizes. Using a detailed cost assessment of the 54 MW Project configurations, incremental costs are estimated from this baseline to move toward a smaller or a larger plant. The costs are typically developed at a high level on a unit basis, in this case on a cost/MW of new installed capacity. Incremental costs include all affected items, such as increased canal excavation, larger gates, larger turbines/generators etc. Plant capacity below 54 MW does not seem optimal based on industry design methodology and smaller sizes have not been considered. No alteration of the Nonacho Lake facility would be required, and therefore no increased costs for this work are included.

The incremental costs associated with moving to a different plant capacity are then compared to the incremental benefits that accrue from the facility. Here, this benefit is the revenue difference over the life of the Project available from the different plant sizes. In the current analysis, a relatively simple approach is used to assess such benefits, with the stream of annual revenue converted to Net Present Value (NPV) using the Project finance term (here taken as 15 years) and predicted Project Internal Rate of Return (IRR) as the discount rate for the NPV calculation. The result of this assessment for a slightly finer range of plant sizing is shown in Table 8.3.2. The baseline is taken as the 54 MW total installed capacity (36 MW new plant) for which the detailed cost estimate has been developed.

Table 8.3.2 — Incremental Benefit/Cost Assessment for Various Plant Sizes

New Installed Capacity (MW)	Annual Average Energy (GWh)	Capacity Factor (Overall)	Incremental Energy	Energy Value/Year ($M)	Net Present Value	Incremental Cost ($M)	Incremental Benefit/Cost
36	440	0.92	0	$ -	$ -	0	
40	461	0.90	21	$ 4.62	$ 35.14	$ 10.77	3.3
44	479	0.87	18	$ 3.96	$ 30.12	$ 10.77	2.8
48	494	0.84	15	$ 3.30	$ 25.10	$ 10.77	2.3
52	506	0.81	12	$ 2.64	$ 20.08	$ 10.77	1.9
56	516	0.78	10	$ 2.20	$ 16.73	$ 10.77	1.6
60	525	0.75	9	$ 1.98	$ 15.06	$ 10.77	1.4
64	533	0.72	8	$ 1.76	$ 13.39	$ 10.77	1.2
68	540	0.70	7	$ 1.54	$ 11.71	$ 10.77	1.1
72	546	0.67	6	$ 1.32	$ 10.04	$ 10.77	0.9

Notes:

Energy value taken as $0.22/kWh (for illustrative purposes only)

Net Present Value for 15 years at discount rate of 10% is 7.606

Annual energy value from energy model - actual numbers may vary due to random factor

Analysis assumes minimum release = 4 m^3/s

Within these assumptions, which are considered reasonable and conservative, this assessment indicates attractive incremental benefit/cost ratios moving from the 54 MW capacity to larger plant sizing. The low-risk, high-benefit range extends to approximately 80 MW total installed capacity, which accords with the general findings based on optimized capacity factor limits shown in Table 8.3.1.

8.3.5 Customer Load Forecast and Contract Opportunities

The customer load forecast and contract opportunities play a major role in defining the final plant size. This topic is covered in greater detail in Chapter 5 – Purpose and Rationale. Initial forecasts from mine customers were used in defining the 54 MW Expansion Project configuration. In more recent negotiations, it is evident that additional power demand has developed and continues to develop at the mines. While not generally adding to the available firm power in the plant size range considered, a larger hydropower plant offers the opportunity to provide substantial additional energy on a non-firm basis to the customers. Since fully adequate diesel generation is present at all existing mines to support operations when this additional energy may not be available (for example, during transient lower flow periods), it is likely that lower cost, non-firm hydropower would be an attractive alternative to diesel power. As an example of scale, the energy increment available on an average annual basis from a 74 MW installation over a 54 MW installation, estimated at 76 GWh, would displace the consumption of approximately 16 million litres of diesel fuel in diesel generation requirements at the mines.

The specific contract provisions regarding energy sales to customers are confidential, but are expected to support the purchase of non-firm energy by the mines at attractive rates to the Project. Therefore, the best plant sizing to meet customer demand would continue to evolve until final design, but would very likely be bracketed by the range in plant sizes currently under consideration (54 MW to 74 MW total installed capacity).

8.3.6 Hydrological Effects of Plant Sizing

The hydrologic effects of plant sizing are covered in detail in Chapters 13 and 14 of this submission. That analysis has considered the specific effects of plant sizes of 54 MW and 74 MW total installed capacity (36 MW and 56 MW Expansion), the range in which the final sizing of the Project would be defined, and the normal range of operation of an Expansion Project.

A small but not insignificant potential benefit of installing a slightly larger plant at Twin Gorges than required would be its ability to absorb small flow fluctuations in the Forebay. This capability would require a variable power consumption rate by the customers and can likely be accommodated when both diesel and hydroelectric power are being used at any particular mine. Flow fluctuations at the Forebay would occur from two main sources: prediction errors in releases from Nonacho Lake to balance Tazin River inflows at Twin Gorges and small changes in flow from the Tazin system itself. It is anticipated that the flow variations would typically be in the range from 5 m^3/s to 20 m^3/s. To avoid spilling of these flows, the output of a larger plant operating normally at slightly below capacity could be ramped up temporarily to use the water and control Forebay fluctuations. This type of more gradual operation limits the use of open/closed spill facilities and associated rapid ramping of flows downstream of these facilities.

8.3.7 Other Environmental and Social Effects

No other significant effects are considered to be associated with a change in plant size in the range considered. The transmission line itself is capable of carrying over 100 MW of power and no changes in the line or substations would be required to transmit the range of power output available from the plant sizes considered.

No significant changes to the Project footprint would occur, other than a small increase in area of canal and volume of spoil. As the spoil areas defined for potential use are somewhat larger than required for the 54 MW expansion configuration, the incremental spoil volumes and small increment in disturbed areas can all be accommodated within the areas noted.

A small increase in manpower may be required to construct the larger plant in the same schedule. As the camps are sized conservatively, no additional footprint of temporary works is required to construct the larger plant sizes.

8.3.8 Resource Optimization

While the Expansion Project is being developed as a specific business opportunity defined by the current customer base, a Project with a lifetime of 40 years or longer would have future business opportunities that currently can only be speculated upon. Regarding resource optimization, it is usually preferable to install a hydropower generation facility with the capability of using the hydrologic resource to the best extent possible, even if the current, shorter-term forecast does not appear to require such a plant. It is always feasible to operate plants at a lower capacity once constructed, but rarely economic to install additional capacity into an existing plant. The Expansion Project is a rare occasion arising from the unique opportunity of a completely new customer base.

In the future, Taltson could be connected to a southern electrical grid and/or to other systems in the Northwest Territories. In that case, it is likely that all output could be sold without limitation. Were the plant developed for that market, the best overall plant sizing would typically be predicated on hydrologic optimization, that being defined by the upper ranges of plant size considered in this alternative assessment.

8.3.9 Conclusions on Plant Sizing

A summary of findings from the above assessments is provided in Table 8.3.3.

Table 8.3.3 — Summary of Plant Sizing Alternative Assessment

Component	Assessment
Site Capacity	Project site would support plant total capacity up to 80 MW range with normally optimized capacity factors.
Hydrological Constraints	Reasonable simple water management plans meeting operational constraints such as minimum water levels and flows can be retained through a range of plant sizes up to approximately 80 MW.
Hydrological Trends	Reasonable certainty that overall runoff has increased through the period of record. Use of historic record only may lead to underrating site capacity and plant size.

Component	Assessment
Incremental Benefit/Cost	With current assumptions, results show strong returns for incremental increases in installed capacity up to approximately the 80 MW range.
Load Forecast and Balance	Mines are likely to take all energy provided by the Expansion Project at attractive rates. Plant sizing not limited to a capacity match between load and installed generation.
Effects of plant size range	Hydrological Effects: no significant effects Other Effects: Significant positive GHG reduction benefit with larger plant sizes if the energy is used to displace diesel generation. No significant other negative effects
Resource Optimization and Future Use	Should the facility ever be grid-connected, classic resource optimization would lead to plant sizes in the 70 to 80 MW range.

The conclusions suggest a plant installed capacity of a minimum of 54 MW and a maximum in the range of 75 MW would be an optimized Project. The specific sizing within this range would require further development and commitment on Power Purchase Agreements (PPA) terms.

8.4 TRANSMISSION LINE ROUTING ALTERNATIVES

8.4.1 Routing Alternatives Description

The transmission line routing from the generation plants at Twin Gorges to the four mine sites (Ekati, Diavik, Gahcho Kué, and Snap Lake) was the focus of a separate and formalized alternatives study. This work involved a significant program of phased desktop evaluation and field work to develop technically feasible routing concepts, to define electrically feasible systems in terms of power delivery and reliability to the mines, to develop appropriate construction methodology for each line route, and finally to develop reasonably accurate costing and scheduling for the various routes.

Within this study, four main alternatives to the preferred route and three alternatives within the general preferred route were studied. These alternatives are as follows:

- West Arm Route: a line route from Twin Gorges around the west arm of Great Slave Lake, through Ft. Providence, Yellowknife, on to Snap Lake, and northward to Ekati.
- Submarine Route: a line route north from Twin Gorges to a marine crossing of Great Slave Lake, on to Snap Lake, and northward to Ekati.
- Island Crossing Route: a line route north from Twin Gorges to the Simpson Islands, and an island-hopping and short section of submarine cable crossing of Great Slave Lake, on to Snap Lake, and northward to Ekati.
- East Arm Route: a line route northeast from Twin Gorges around the East Arm of the Lake to Gahcho Kué. Three options investigated from this point are:
    - East Arm Northeast: north from Gahcho Kué to Ekati, with a branch line to Snap Lake,
    - East Arm Northwest: west from Gahcho Kué to Snap Lake, and on to Ekati, and
    - East Arm Southern: Lockhart River direct to Snap Lake.

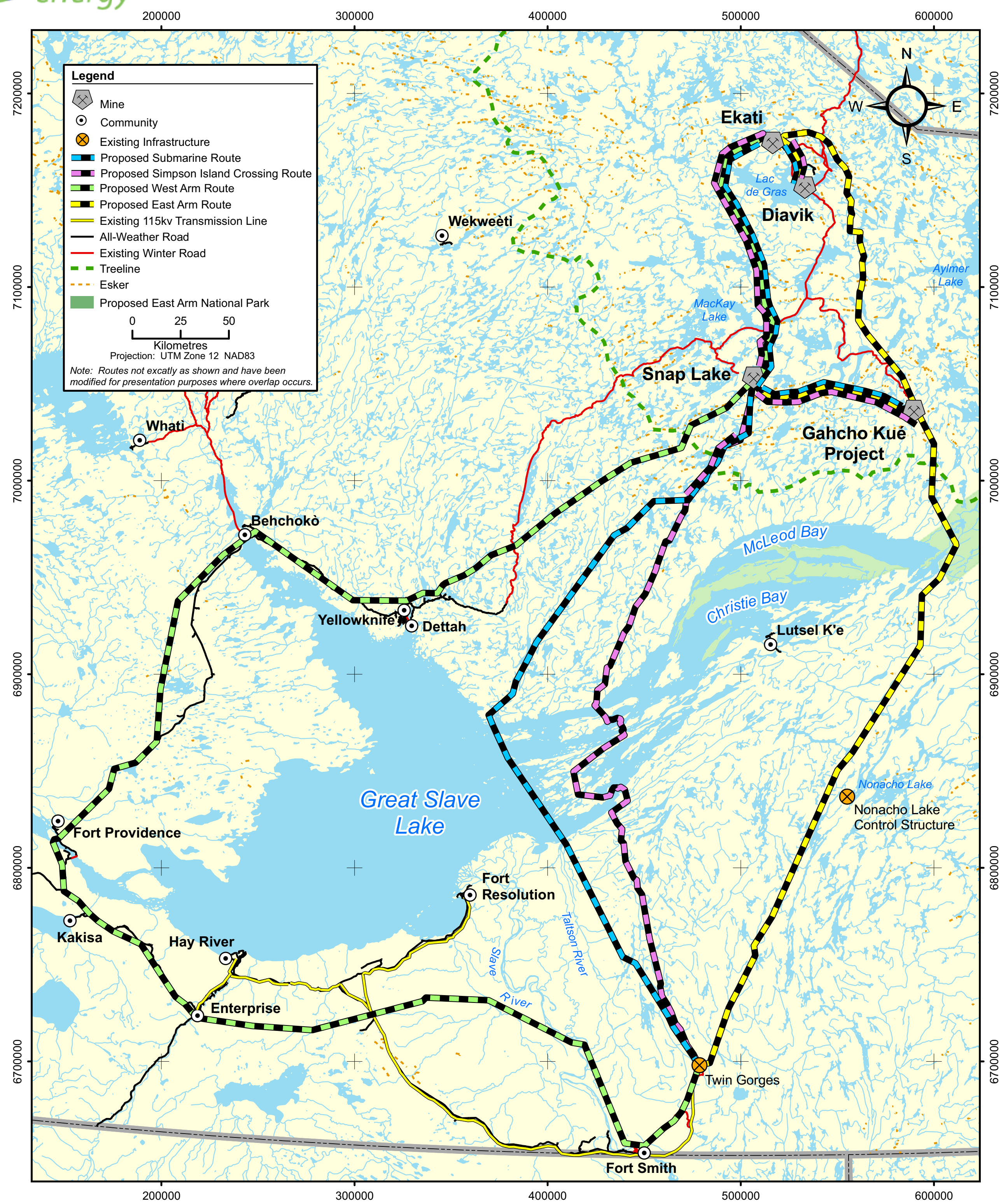
These routes and their general characteristics are presented below. The routes are shown in Figure 8.4.1, with the exception of the East Arm Southern Option: Lockhart River direct to Snap Lake, which is discussed in Section 8.4.1.4.3 – Southern Option.

Once the line routes were finalized, the important physical characteristics of these corridors, including such parameters as terrain, vegetation, water crossings etc., were compiled. These basic features were then used both to assess broader scale effects such as land use and wildlife interaction and to develop key risk assessments relating to line construction and operation. The four routing alternatives were then ranked relative to each other to determine the best overall route.

The Trans-island Option is the second most feasible alternative, with line length comparable to the Baseline Option. Crossing Great Slave Lake over a series of islands with an overhead line creates significant environmental impact in this environmentally sensitive region. Two submarine cable crossings would also be required to cross Hearne Channel and the channel between Blanchet and Eaton Islands. Due to the depth of Great Slave Lake, these would be some of the deepest cable crossings in the world. Combined with the uncertainty of the configuration of the lake bottom and difficulties in transporting, installing and maintaining the cables in remote and extreme climate areas, this option is less attractive than the Baseline Option.

The Submarine Cable Option assumes crossing Great Slave Lake with a 60 to 70 km long cable, and is more expensive than the Trans-Island alternative. Comments made for cable crossings of the Trans-Island Option also apply for this option. Additionally, in case of cable failure, the repair time in these extreme weather conditions would be approximately six months to a year, resulting in low reliability of the scheme. This alternative is not recommended.

The West Route Option is the longest alternative, with line length at the limit of technical feasibility. Intermediate series and shunt compensation would be required to maintain operating parameters stable and within limits. These intermediate stations would need to be accessible for maintenance and during forced outages. As this is the longest alternative, it would be most expensive for construction, operation and maintenance, and is therefore not recommended.



TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Transmission Line Route Alternatives	Figure 8.4.1

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8.4.1.1 WEST ARM ROUTE

The West Arm route is an alternative line routing around the west end of Great Slave Lake that would potentially allow connection of the line from Taltson Twin Gorges to existing communities. This route is shown in more detail in Figure 8.4.2. The line has a total length of 1,250 km. At this time, the alternatives study has considered the line independent of interconnection to other loads. On this basis, the line route has been shown to be technically feasible, but has relatively high line losses and would require additional substations and additional voltage control equipment over the other alternatives.

The West Arm route would run eastward somewhat north of the existing line to a point close to the Slave River, and then northward down the Slave River to avoid Wood Buffalo National Park. (Alternatively, the existing line could be upgraded to 161 kV, and used for the initial line route as far as the northern end of the Park; this option is not shown on Figure 8.4.2, but does not affect the assessment). The West Arm route would then turn west, passing through Enterprise and along a corridor near the highway to a crossing of the Mackenzie River near Ft. Providence. The terrain in this first major section would be mixed, but require primarily soil and wetland foundations, with little rock available. Overland winter access roads are considered feasible in much of this sector.

The Mackenzie River crossing is considered feasible, but would require high tower structures to support the significant spans. The line would then run northwest across primarily wetland terrain to Behchoko. This sector is considered difficult for construction because of the wetland terrain and poor foundation conditions.

The line would route along the highway to just north of Yellowknife, and then overland to Snap Lake. The terrain in this major sector is mixed, with significantly more rock available for foundation, but with a fair amount of relief and water crossings requiring longer spans. There is no winter road access considered feasible to this sector of the line, and a major portion of this sector would require helicopter construction.

From Snap Lake, the line would use the northwest corridor to Ekati, with branch lines from Ekati to Diavik and Snap Lake to Gahcho Kué.

The key advantages of this route are:

- The proximity that the line would have to existing communities, including Yellowknife, and
- Avoiding the proposed East Arm Park and Lockhart River crossing.

The key disadvantages of this route are:

- The very long line length and associated line losses,
- The land use provisions that would be required,
- The complexity of multi-load use for an interconnected system,
- The difficult access and increased cost associated with construction of certain sectors because of anticipated poor ground conditions, and
- The increased cost and schedule duration.

Dezé energy

TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	West Arm Transmission Line Route Overview	Figure 8.4.2

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8.4.1.2 SUBMARINE ROUTE

The Submarine route transmission corridor alternative runs northward from Twin Gorges and involves a 70 km to 80 km long underwater crossing of Great Slave Lake, then an overland connecting sector to Snap Lake. The line has a total length of 750 km. The route is shown in Figure 8.4.3. The line has been shown to be technically and electrically feasible, but would be at the limit of marine cable length and depth possible for the lower cost type of conductor used in the study. Significant additional information on lake-bottom conditions and bathymetry would need to be obtained to complete a final feasibility assessment of this line route. That work is considered beyond the scope of study required for the alternatives assessment.

The first 135 km of the line route runs parallel but northeast of the Taltson River to stay on the shield rock. This terrain is variable, with considerable wetland and numerous small- and medium-sized water body crossings. Road access to this section of the line is not considered feasible except quite close to Great Slave Lake and extensive helicopter construction would be required. The initial section of overhead line would terminate at a small substation on the shore of Great Slave Lake near Taltson Bay.

The single circuit and likely single cable marine transmission cable would be trenched into the lakeshore and run northwest across the open lake slightly west of the Simpson Islands. Depths of up to 120 m are anticipated, although existing bathymetry is not sufficient to make final conclusions regarding lakebed characteristics. The total marine cable length is estimated to be between 70 and 80 km.

The marine cable would exit the lake in a trench along the shore to another small substation near Gros Cap. The line would then run 259 km overland to Snap Lake mine. The terrain in this section is mixed until the treeline, with some relief and significant wetland. Road access is not considered feasible much below the treeline on this section and helicopter construction methodology would be required.

Above Snap Lake, the northwest corridor would be used for the 161 kV line route to Ekati, crossing Mackay Lake and the Coppermine River. Branch lines at 69 kV on the baseline corridor would connect Snap Lake to Gahcho Kué and Ekati to Diavik.

The key advantages of this route are:

- the proximity that the line would reach to Yellowknife (within 80 km), and
- avoiding the proposed East Arm Park and Lockhart River crossing.

The key disadvantages of this route are:

- the difficult access and increased cost associated with construction, and
- the increased cost and risk of the marine cable segment.

TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Submarine Transmission Line Route Overview	Figure 8.4.3

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8.4.1.3 SIMPSON ISLAND CROSSING ROUTE

The Simpson Island Crossing route alternative runs northward from Twin Gorges and comprises a combination of overland, high tower crossings and short marine cables between the islands from the south shore of Great Slave Lake to an exit point near McKinley Point, then connects to Snap Lake. The line has a total length of 740 km. The overall route is shown in Figure 8.4.4. A larger scale view of the island crossing section is shown in Figure 8.4.5. Typical terrain through the island crossing sections is shown in Plates 8.4.1 and 8.4.2. The line has been shown to be technically and electrically feasible under the current assumptions of lake conditions and routing. Significant additional information on lake-bottom conditions and bathymetry would need to be obtained to complete a final feasibility assessment of this line route. That work is considered beyond the scope of study required for the alternatives assessment.

The first 142 km of the line route runs parallel but northeast of the Taltson River to stay on the shield rock. This terrain is variable, with considerable wetland and numerous small- and medium-sized water body crossings. Road access to this section of the line is not considered feasible except quite close to Great Slave Lake, and extensive helicopter construction would be required. Near the south shore of Great Slave Lake, the line would turn east along the lakeshore to reach a point of feasible overhead crossing from Hornby Channel to Preble Island. Tower heights required on this crossing are estimated to be 80 m high. The line then traverses Preble Island and on to the Simpson Islands, heading northeast to Seton Island with a possible overhead crossing to Blanchet Island. Field review of this crossing indicates that a marine crossing may be required, as the spans required are too large unless significant enhancement of small intermediate islets is possible. From the crossing to Blanchet Island, the line would traverse this island to a terminus on its north shore to connect to the marine segment. To reach this point, it is anticipated that a minimum of 10 large tower structures would be required. All of the island route would require helicopter construction, likely staged from barge camps.

A marine cable crossing of the Hearne Channel near McKinley Point, where the channel width is smallest at 5 km, would require an estimated cable length of 8,000 m. The depth of the lake at this crossing is estimated at 320 m, although bathymetric information is limited. This large depth requires the use of double sheathed cable. Entry and exit points for the cable would require significant trenching and burial to protect the cable against ice damage. The total line length to cross the 50 km wide lake at this point is estimated at 101 km.

From McKinley Point, the line would run northwest 195 km overland to Snap Lake mine. The terrain in this section is mixed until the treeline, with some significant relief and wetlands in between the ridges. Road access is not considered feasible much below the treeline on this section and helicopter construction methodology would be required.

Above Snap Lake, the northwest corridor would be used for the 161 kV line route to Ekati, crossing Mackay Lake and the Coppermine River. Branch lines at 69 kV on the baseline corridor would connect Snap Lake to Gahcho Kué and Ekati to Diavik.

The key advantages of this route are:

- the proximity that the line would reach to Yellowknife (within 100 km), and
- avoiding the proposed East Arm Park and Lockhart River crossing.

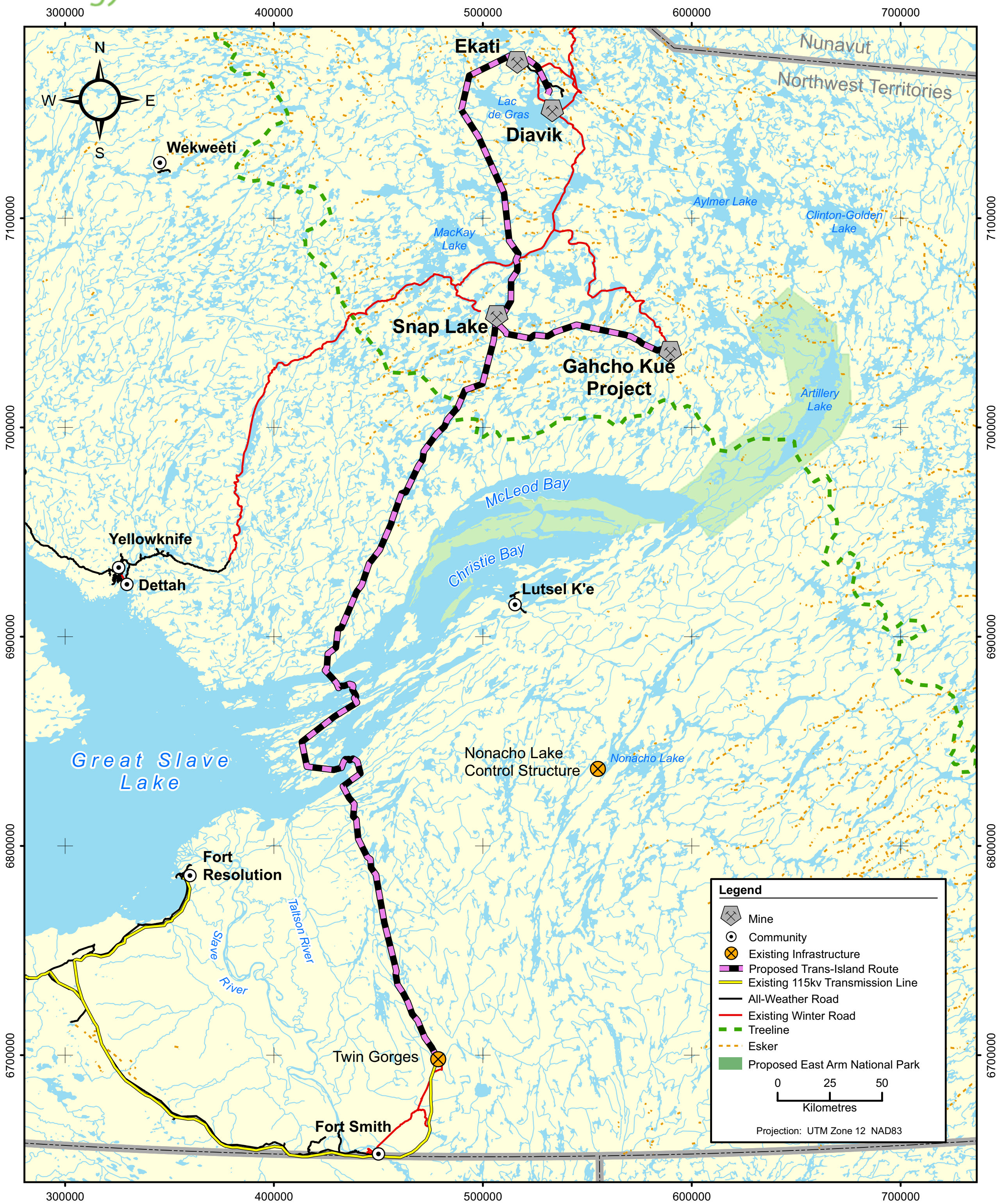
The key disadvantages of this route are:

- the difficult access and increased cost associated with construction of some sectors,
- the increased cost and risk of the marine cable segment, and
- the visual effect of the overland sections on the Simpson Islands and channel crossings.

Plate 8.4.1 — Typical Terrain Features in the Simpson Islands: Southern Section

Plate 8.4.2 — Typical Terrain Features in the Simpson Islands: Northern Section

Dezé energy



TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Simpson Island Transmission Line Route Overview	Figure 8.4.4

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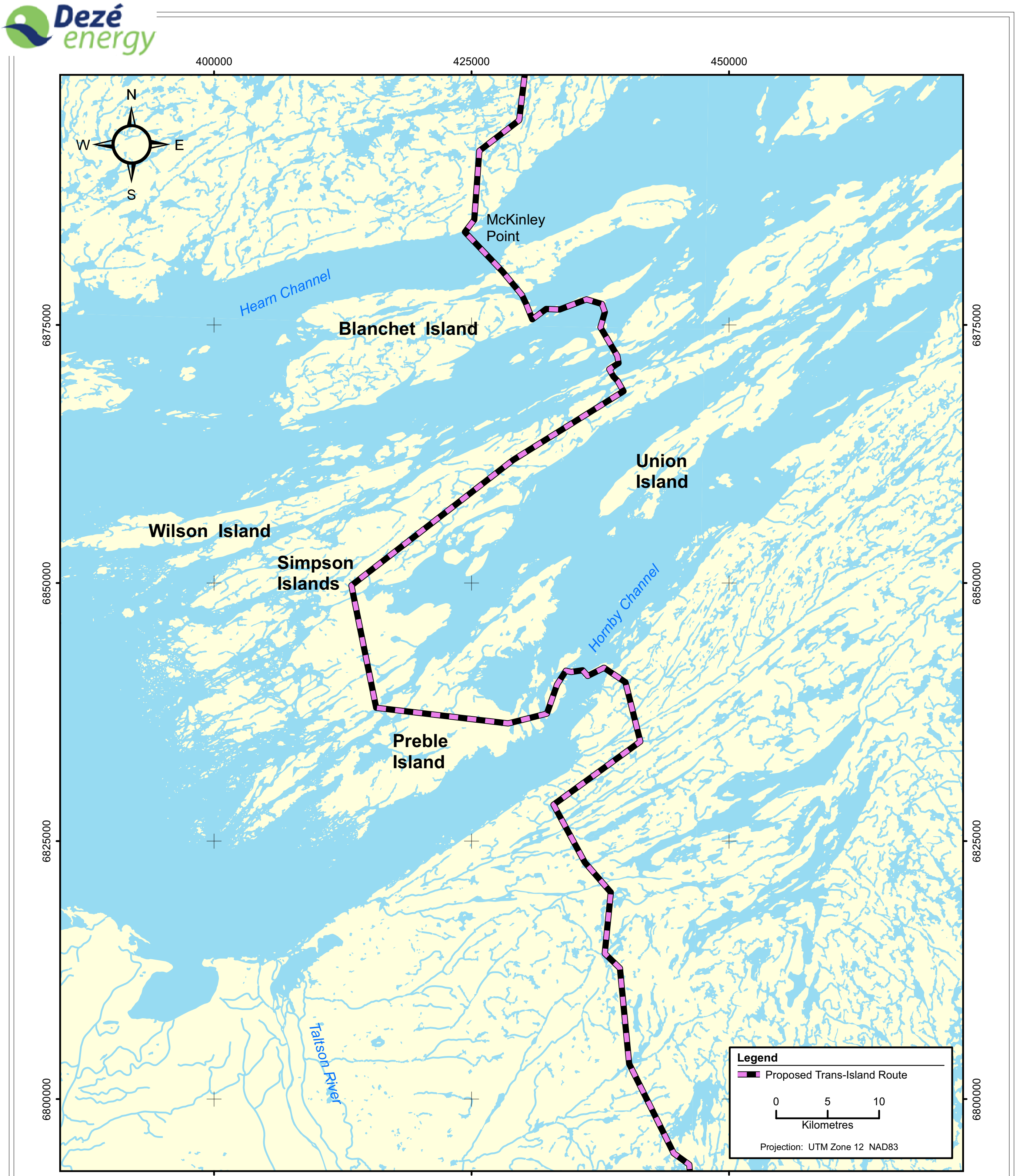

TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Simpson Island Transmission Line Route Details	Figure 8.4.5

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8.4.1.4 EAST ARM ROUTE

The baseline arrangement for the transmission route alternatives study is the East Arm route running northeast from Twin Gorges to the Lockhart River, northward to Gahcho Kué, and with one of two possible routes from Gahcho Kué northward. This route is described in detail in Section 6.3.5.

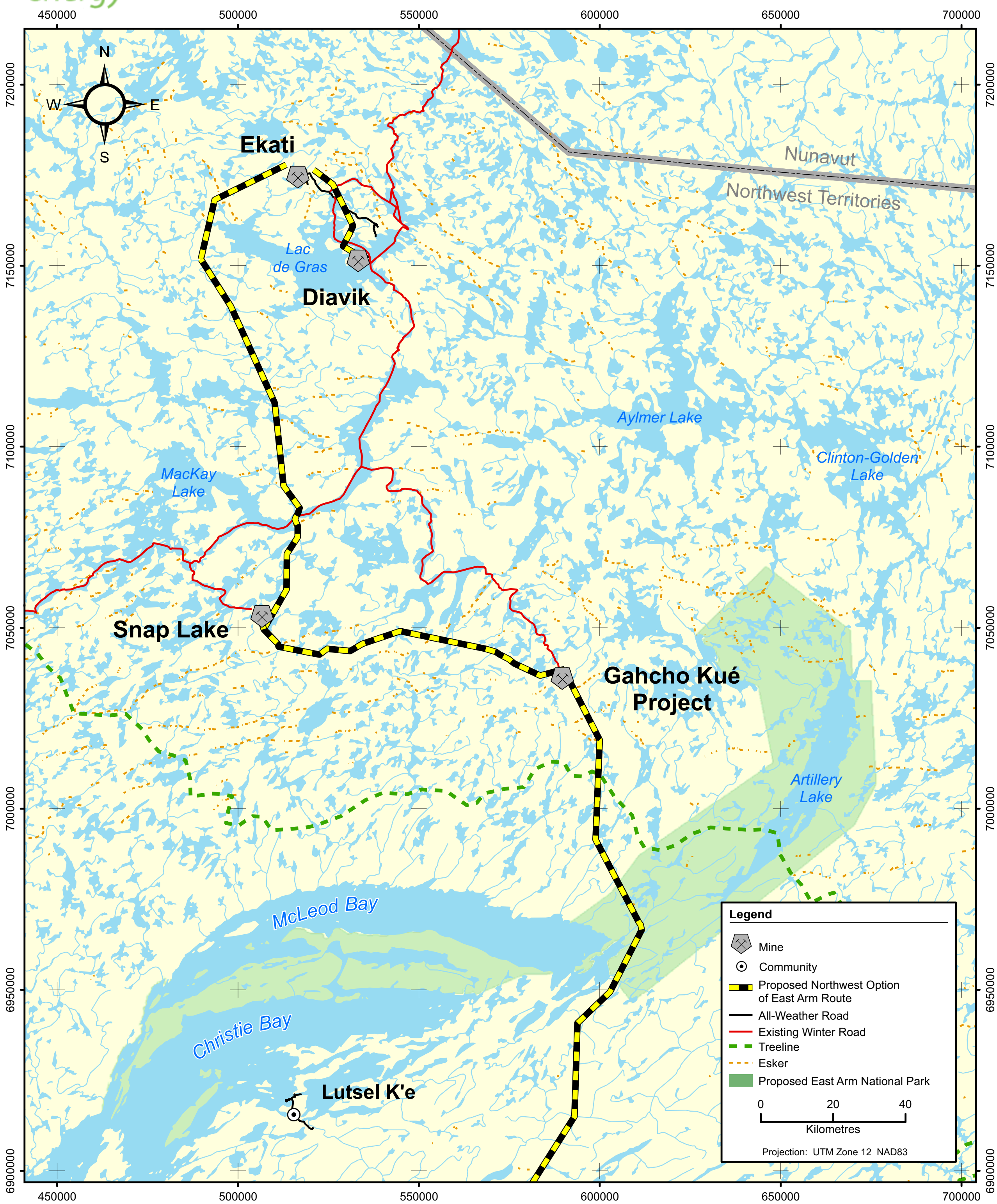
The East Arm routes were the focus of significant initial study and additional desktop and field work in 2008, with a number of deviations from the original corridor now adopted as a result of wildlife and access considerations. Two routes beyond Gahcho Kué are considered effectively equivalent, with the preferred baseline taken as the northeast routing to avoid a highly visible crossing of Mackay Lake that would exist on the northwest option, and because access to the line for construction is considered slightly better on the northeast route. The alternatives that have been studied within the basic East Arm route are described briefly in the following sections.

8.4.1.4.1 Northwest Option

The Northwest route option is shown in Figure 8.4.6. This route continues the 161 kV line from Gahcho Kué to Snap Lake, and from Snap Lake northward to Ekati. The only branch line is then a short spur from Ekati mine to Diavik mine. The section from Gahcho Kué to Snap Lake would follow the same corridor as any of the routes previously discussed. North of Snap Lake, the line would require crossing Mackay Lake close to the Mackay Lake Lodge. A feasible crossing point exists on a line of small rocky islets. (Plate 8.4.3), on which towers would be founded. To provide protection against ice damage, each of the islets would require armouring with additional rock to raise their height by several metres. Spans would require self-supporting towers approximately 75 m high.

Plate 8.4.3 — Northwest Option of East Arm Route with Small Rocky Islets Showing Crossing Points

North of the Mackay Lake crossing, terrain is very similar on either the northeast or northwest routes, with a significant fraction of permafrost existing in the lightly rolling and rocky terrain interspersed with many smaller lakes. A crossing at the very early stages of the Coppermine River as it exits Lac de Gras would be required.



TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Northwest Option of East Arm Transmission Line Route Overview	Figure 8.4.6

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8.4.1.4.2 Northeast Option

The Northeast route is the preferred Project line route and is discussed in detail in Section 6.4. The route is shown in Figure 8.4.7. This route continues the 161 kV line from Gahcho Kué northward to Ekati, with branch lines from Gahcho Kué to Snap Lake and Ekati to Diavik. The section from Gahcho Kué to Snap Lake would follow the same corridor as all of the routes previously discussed. This route is used in the alternatives ranking study described below as the East Arm route.

The Northeast Option route presented in Figure 8.4.7 is not the original route. A modification was made to the Northeast Option in July 2008. Originally, the Northeast route intercepted the Lockhart River at the outflow of MacKay Lake, and proceeded north towards a crossing of the Coppermine River at the narrows between Lac de Gras and Lac du Sauvage. This was disadvantageous for several reasons. First, high densities of caribou trails were observed to pass around the eastern end of MacKay Lake near the outflow. MacKay Lake likely acts as a geographic barrier to caribou during the post-calving migration, funnelling caribou towards a crossing of the Lockhart River in this area. Similarly, the narrows between Lac de Gras and Lac du Sauvage is a known crossing point for caribou.

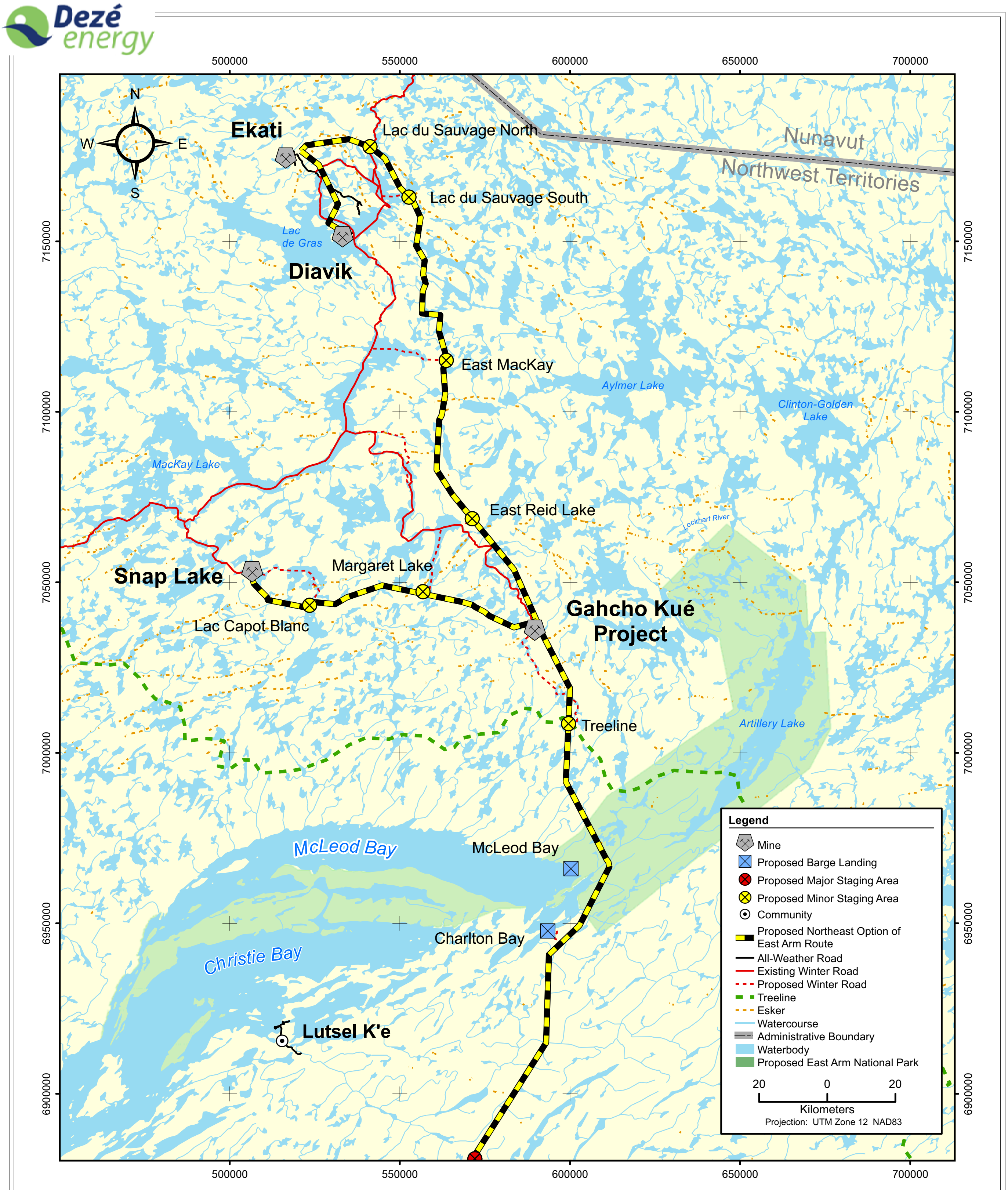
Where there are caribou, there are people. Both the Lockhart River at the outflow of MacKay Lake and the narrows between Lac de Gras and Lac du Sauvage have high densities of archaeological sites. Further, there is currently hunting and fishing activity at both sites, originating from the MacKay Lake Lodge, and the Lac de Gras Hunting Camp. A transmission line near these areas would lead to effects to the wilderness character of these sites. As such, it was decided to move the transmission line east by up to 12 km to avoid effects to caribou, to heritage resources, and to current use of these areas by tourists.

8.4.1.4.3 Southern Option

Routing the transmission line from the Lockhart River area to Snap Lake was originally investigated and proposed as an alternative to the preferred route directly from Lockhart River to Gahcho Kué. This route has been discarded as an alternative for reasons of environmental and visual effect as it would involve a long corridor within the proposed East Arm Park. No further work has been carried out on this route and it is not considered further as an alternative in this study.

8.4.1.5 SUMMARY OF LINE ROUTE CHARACTERISTICS

A summary table of the four main alternatives' characteristics, including the baseline route, is provided in Table 8.4.1. These data characteristics have been compiled from a combination of both broad and detailed assessments of the geographical and environmental setting of each route, terrain and vegetation types along the route, other route requirements such as water body crossings, feasible access that could be developed, construction methodology, risk assessment, and costs. These basic characteristics are then used as input into the comparative assessment, as described below.



TALTSON **Hydroelectric Expansion Project**	**Developer's Assessment Report** **2009**	**Northeast Option of East Arm Transmission Line Route Overview**	**Figure** **8.4.7**

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Table 8.4.1 — Transmission Line Route Alternatives: Summary Information

OPTION	BASIC CHARACTERISTICS													
Line Route Description	Overall Length of line (km)	Substations Number	Vegetation Types on Corridor			Terrain Types				Major Crossing Requirements			Park/Reserve Crossings	
			Forest (%)	Tundra (%)	Burn (%)	Rock (%)	Wetland (%)	Broken Rock (%)	Permafrost (%)	Minor Rivers	Major Spans	Marine Crossings	Park km	Reserve km
East Arm East Route (Baseline)	699	5	52	48	10	55	9	36	10	4	4	0	80	0
Simpson Is. Crossing	738	5	54	46	10	59	8	33	10	5	14	2	0	0
West Arm Route	1251	6	72	28	10	28	52	20	10	5	17	0	0	0
Submarine	749	7	50	50	10	55	8	37	10	5	5	1	0	0

OPTION	CONSTRUCTION ACCESS REQ'D				CONSTRUCTION METHOD			SUBJECTIVE RISK ASSESSMENT			COST ASSESSMENT	
Line Route Description	Winter Road (km)	Tracks Spurs (km)	Clearing		Built from Track (km)	Built from Air (km)	Marine (km)	Terrain Risk low-high 1-5	Logistics and Schedule Risk 1-5	Reliability Risk 1–5	Construction Period Months	Overall Cost $M
			Line (ha)	Other (ha)								
East Arm East Route (Baseline)	410	581	1080	116	571	128	0	1.84	2.43	1.93	30	0
Simpson Is. Crossing	130	355	1182	37	372	360	6	1.79	3.04	2.45	32	+40
West Arm Route	130	921	2714	214	1251	0	0	2.55	2.58	2.61	40	+220
Submarine	130	355	1027	37	372	307	70	1.83	3.04	2.62	32	+50

8.4.2 Assessment Methodology

One of the primary goals of the alternatives assessments for the Expansion Project was to develop a simple and transparent methodology, which would clearly identify the rationale for ranking the proposed alternatives.

The rationale incorporates the technical analysis developed by Teshmont Consultants within a broader framework of assessment to consider the overall impact of routing alternatives.

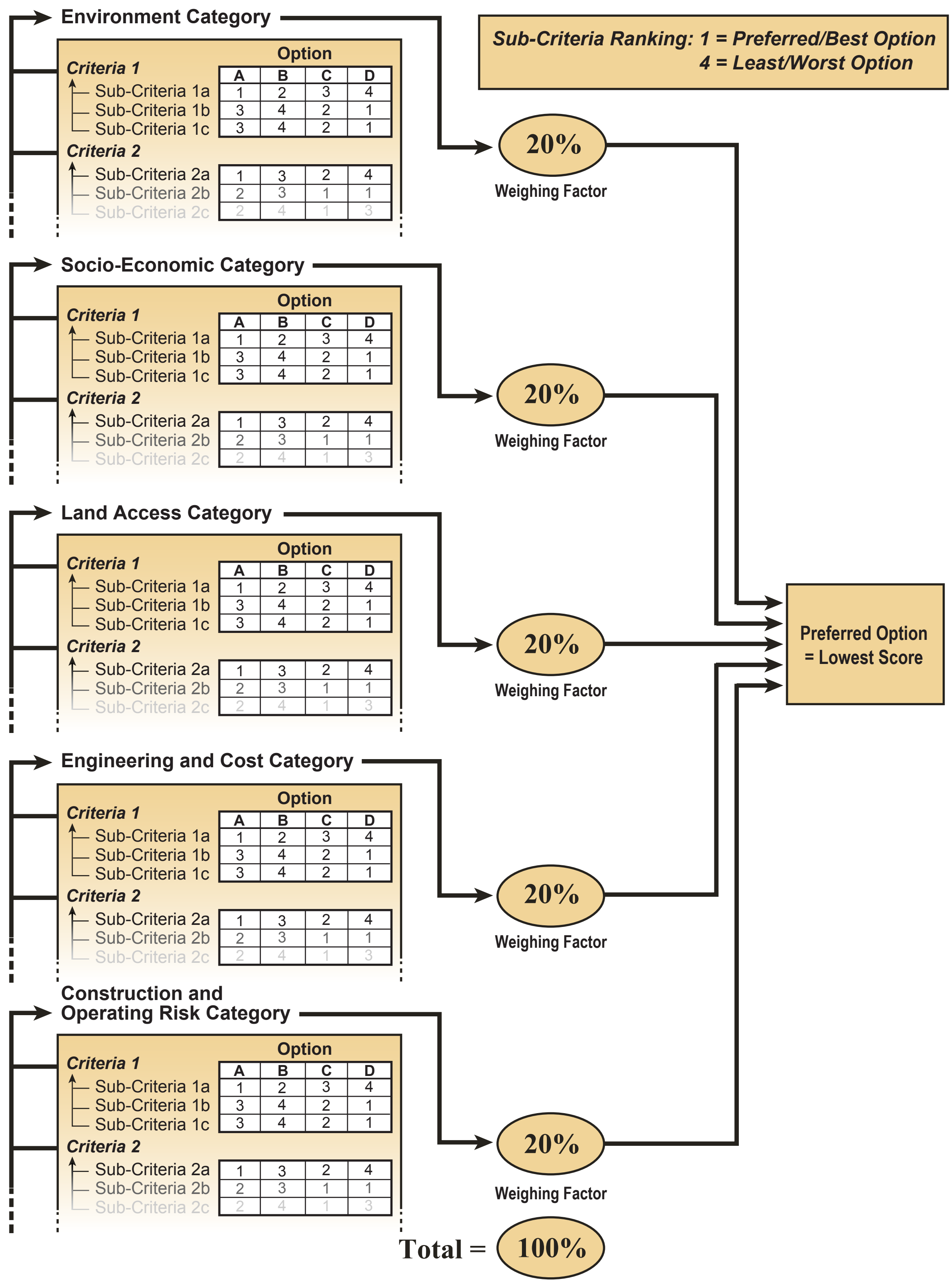
A central concept in the methodology is that the assessments are *relative*. This means that the assessment would examine the magnitude of potential effects associated with one option relative to the magnitude of potential effects associated with the other option(s). An assessment of overall/absolute effects associated with development of the Expansion Project is presented in Chapters 12 to 15.

8.4.2.1 Assessment Structure

The methodology developed for the alternatives assessments is organized in terms of *categories*, *criteria*, and *sub-criteria*. Figure 8.4.8 shows a diagram of the structure of the alternatives assessment for the transmission line routes. All components that could be affected by (or affect) the development of the proposed options were classified in terms of general categories. The following categories were defined for the transmission line route options:

- Environment
- Socio-economic
- Land access
- Engineering/costs
- Construction and operations risk

Categories consisted of several criteria, which in turn contained several sub-criteria where necessary. As an example, Table 8.4.2 shows the criteria and sub-criteria included in the Environment category. Criteria and sub-criteria associated with the other categories are described in the assessment sections.



TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Structure of Alternative Assessment for Transmission Line Routes (503-005 / a21441f)	Figure 8.4.8

Table 8.4.2 — Criteria and Sub-criteria Included in the Environment Category for the Transmission Line Route Alternatives Assessment

Environment Criteria	Environment Sub-Criteria
Air Quality	Dust
Wildlife	Habitat
	Woodland Caribou
	Waterfowl
	Moose
	Passerines
Vegetation	Rare Plants
	Forestry

8.4.2.2 CRITERIA SCREENING

A screening exercise was completed to select criteria and sub-criteria to be included in the alternatives assessment. As the first step in the screening exercise, a comprehensive list of criteria and sub-criteria was generated. The list includes all factors that, based on knowledge of the Project area and the surrounding environment, could be influenced by (or influence) the development of the Project components.

The following screening rules were applied to the proposed criteria and sub-criteria to determine whether they should be included in the final assessment:

- Rule 1: criteria and sub-criteria must be affected by (or affect) the options included in the alternatives assessments.
- Rule 2: each criterion or sub-criterion must be distinct from other criteria or sub-criteria.

Rule 1 was implemented to ensure that the assessments remain relative; Rule 2 was included to avoid double counting. For example, the sub-criterion Direct Habitat Loss was proposed under the Wildlife criterion. Because the transmission line routes are associated with different habitat and because no other criteria included this sub-criterion, it was selected for inclusion in the assessment. Conversely, the sub-criterion Total Loss of Vegetation (in the criterion Terrestrial Ecosystems) was not included in the final assessment because this is reflected in Direct Habitat Loss. However, the sub-criterion Rare Plants was included as the four routes have varying potentials to affect them.

Table 8.4.3 presents the results of the screening exercise completed for all four routes under consideration. The screening process allowed the alternative assessors to focus on criteria and sub-criteria that would be affected differently relative to the other options.

Table 8.4.3 — Transmission Line Route Criteria and Sub-Criteria Screening

Environment Criteria	Sub-Criteria	Included/ Not Included	Rationale
Air Quality	Dust	I	Each option would generate dust during construction and it differs depending on the landscape.
	Noise	N	Each option generates noise during construction but not afterwards and all are equal so not included
	Emissions	N	All options would reduce greenhouse gas
Fish/Water Quality	Winter Road Crossings	N	Transmission line construction would follow DFO guidelines, therefore not included
	Fish Habitat	N	Transmission line construction would follow DFO guidelines, therefore not included
	Transmission Line Stream Crossings	N	Transmission line construction would follow DFO guidelines, therefore not included
	Peak/Low Flows	N	The transmission line itself would not affect water flows
Wildlife	Habitat	I	The lesser amount of habitat affected the better and each route varies in length
	Waterfowl	I	Each option would expose different numbers and densities of breeding waterfowl to the transmission line
	Barren-ground caribou	N	Each option would pass through the sensitive post-calving caribou range
	Woodland caribou	I	West option would pass through woodland caribou range
	Furbearers	N	Transmission line not expected to affect furbearer abundance or distribution
	Moose	I	Moose densities and exposure would vary by option
	Raptors	N	Insufficient information on how the transmission line would affect raptors
	Passerines	I	Exposure to passerines would vary, and transmission line would lead to habitat loss
Vegetation	Rare Plants	I	Each option passes through different ecozones in which rare plants may be present.
	Forestry	I	Each option has varying lengths of line in economically viable forests

Socio-Economic Criteria	Sub-Criteria	Included/ Not Included	Rationale
Archaeology	Archaeology Impact Assessment	N	Insufficient information to assess the different routes relative to each other
	Archaeology Overview Assessment	N	Insufficient information to assess the different routes relative to each other
Access	Public desirability	I	The option with more of its ROW in desirable hunting/trapping area(s) is more likely to be accessed, and therefore is scored comparatively lower
	Change in the character of areas	I	The option that least changes the character of the area is preferred, hence the trans-island option scores lowest as it significantly changes the character of Great Slave Lake
Traditional Land Use	Trapping	I	Key traditional land use activity
	Country food consumption rate	I	Keystone cultural practice
Contemporary Land Use	Renewable resource uses	I	Tourism, guiding, fishing and forestry are examples
	Non-renewable resource uses	I	Mining, oil and gas development are examples
Nuisances (noise, aesthetics, vibration)	Vicinity to receptors	I	A function of line length and the number of receptors possibly affected
	Visibility	I	The least visible option is the most preferred
Built Heritage Features and Cultural Landscape	Vicinity to existing cabins, trails and trap lines	I	Option that has the greatest likelihood of affecting the cultural landscape and build features scored lowest
	Change in the character of areas	I	Option that would least likely change the character of the area
Economic Development	Future customers	I	The option with a higher chance of securing future customers
	Line frontage	I	The option the provides the most amount of line frontage in areas of known mineral potential are rated most desirable
Population Characteristics	Population Change	N	Project benefits may change community populations encouraging greater retention in smaller communities
	Ethnic and racial distribution	N	Changes resulting from Project effects may temporarily change the ethnic and racial makeup of communities
	Influx or outflows of temporary workers	N	Options would likely differ with respect to the flow of temporary workers

Socio-Economic Criteria	Sub-Criteria	Included/ Not Included	Rationale
Employment and Income	Aboriginal/South Slave employment	I	Routing could involve the Dehcho First Nations and possibly access fees and employment provisions
	Distribution of Project income	I	A Project goal is to increase employment and income opportunities of those in the South Slave region of the NWT
Individual and Family Changes	Perceptions of risk, health, and safety	N	Options would likely differ with respect to their perceptions of risk, health and safety
	Perception of political and economic institutions	N	Options would likely change perceptions of political and economic institutions
	Attitudes toward the Project	N	Options would likely differ with respect to public and Aboriginal attitude toward the Project
Socio-cultural Well-being	Traditional land use patterns	I	Preference to the option least likely to disrupt traditional land use patterns
	Valued cultural & spiritual places	I	All routes could affect valued cultural and spiritual places

Land Access Criteria	Sub-Criteria	Included/ Not Included	Rationale
Crown Land Withdrawals	Crown Land Withdrawals	I	Route options have different Crown Land withdrawals that represent different degrees of Project Risk
Areas of Recognized Importance	Areas of Recognized Importance	I	Route options have different areas of importance to NT and Aboriginal peoples
Land Tenure	Land Tenure	I	Route options have different Land Tenure issues that represent different degrees of Project Risk

Engineering/Cost Criteria	Sub-Criteria	Included/ Not Included	Rationale
Capital Costs	Design costs	I	Design requirements vary between land and marine route options
	Substation and Equipment Costs	I	Substation equipment costs vary significantly between several options
	Line and Construction Costs	I	Costs highly variable between route options
Line Loss Cost	Annual GWh loss as Net Present Value of lost income	I	Line losses vary significantly with route option
Outage/Maintenance Cost	Annual outage cost estimate	I	Sub-surface conditions vary between options
	Annual maintenance cost estimate	I	Slope stability varies between options
Engineering/Cost Criteria	**Sub-Criteria**	**Included/ Not Included**	**Rationale**
Schedule Cost	Estimated incremental construction period and cost beyond shortest duration	I	Estimated schedule durations vary between options

Construction & Operations Risk Criteria	Sub-Criteria	Included/ Not Included	Rationale
Terrain Risk	Percentage of rock for foundations	I	Percentage of rock expected to vary with route option - less risk with rock
	Percentage of wetlands for foundations	I	Percentage of wetland expected to vary with route option – slower and more risk with wetland
	Percentage of disturbed ground/fractured rock	I	Percentage of disturbed and broken ground expected to vary with route option - more risk with broken ground
	Percentage of permafrost	N	Percentage of permafrost - assumed consistent between route options as largely equal distances above treeline
Logistics/Schedule Risk	Number of major water body crossings	I	Major risk to schedule with marine options due to complex logistics for supplying and installing cable - affects several route options
	Materials delivery methodology	I	Materials delivery methods involve barge, existing road, and new road in different ratios for each route option - affects logistics risk

Construction & Operations Risk Criteria	Sub-Criteria	Included/ Not Included	Rationale
Logistics/Schedule Risk	Construction access availability	I	Construction access varies with route options and affects construction logistics
	Construction methods (air or track)	I	Air construction dependent on reasonable hours of daylight and weather - larger risk of delay for larger air component of construction
Operational Reliability Risk	Total length of line	I	Length of line directly related to exposure to lightning or other disturbances - length varies between route options
	High tower requirements on route	I	High tower crossings increase risk of exposure to storm events - varies between routes
	Materials/Technology on line components	I	Use of standard conductors and hardware vs. difficult to source equipment - marine components cannot be sourced quickly
	Estimated exposure along high lightning zone	I	Proximity to Great Slave Lake expected to be highest lightning exposure
	Estimated exposure to forest fire	I	Percentage of line through forest varies with route option
	Remoteness of line components	I	Access to line for repair varies with route option

8.4.2.3 CRITERIA RANKING

Criteria and sub-criteria included in the final assessment were assessed based on information and data available in the environmental baseline studies and engineering assessments completed for the Expansion Project. If the available information for a given criterion was insufficient to select a preferred option, rankings were not assigned.

The preferred sub-criteria was ranked 1, the least preferred ranked 4, while the in between options were assigned rankings of 2 and 3.

8.4.2.4 FINAL SELECTION OF THE PREFERRED OPTIONS

The selection of the preferred options depends critically on how categories, criteria, and sub-criteria are weighed in the final assessment. The following weighting scheme was used for this alternatives assessment:

- All *sub-criteria* were assigned equal weights.
- All *criteria* were assigned equal weights.
- *Categories* were assigned equal weights.

The weights shown in Table 8.4.4 reflect the values and priorities of the Dezé Energy Corp. Dezé recognizes that other stakeholders may prioritize categories differently.

Table 8.4.4 — Category Weights Used for the Taltson Expansion Project Transmission Line Route Alternatives Assessment

Categories	Category Weights
Environment	20%
Socio-economic	20%
Land Access	20%
Engineering/Costs	20%
Construction Risk	20%
Total	**100%**

8.4.3 Environmental Assessment of Transmission Line Routes

The results of the alternatives assessment for Environment criteria and sub-criteria are presented in Table 8.4.5. The results of the environmental assessment contributed to 20% of the overall assessment decision (see Section 8.4.7).

After screening, three criteria were carried forward to the full alternatives assessment. The Submarine route ranked as preferred, while the West Arm route was least preferred. The major disadvantage of the West Arm route is the high quality habitat through which the route traverses relative to the other routes. The East Arm was the next least preferred as it also traverses more terrestrial habitat than the Submarine and Simpson Island routes. The assessment of relative effects on woodland caribou resulted in a three-way tie for preferred, whereby the West Arm route ranked below the other three routes.

The overall preferred route for the environment category was the Submarine route. The Submarine route disturbs the least amount of terrestrial habitat. The potential aquatic effects of the Submarine route were not carried forward beyond screening as these issues are addressed by DFO operational guidelines to avoid Harmful Alterations, Disruption, or Destruction of fish habitat.

Table 8.4.5 — Assessment of Transmission Line Route Options: Environment

Criteria	Sub-Criteria	East Route	West Route	Sub-Marine	Simpson Is.	Rationale
Air Quality	Dust	1	2	1	1	West Route to be constructed by existing roads which would create dust. Other options use winter road construction methods and no dust is generated.
	Score	**1**	**2**	**1**	**1**	
	Ranking	**3**	**4**	**3**	**3**	
Wildlife	Habitat	3	4	1	2	A shorter line leads to less habitat loss. Thus, the shorter the better.
	Woodland caribou	1	2	1	1	West Route goes through Woodland Caribou habitat
	Waterfowl	2	3	1	2	West route would have greatest density and exposure to waterfowl, sub-marine route the least
	Moose	2	1	4	3	Vegetation clearing is expected to be beneficial to moose. West route is longest and goes through highest moose densities.
	Passerines	3	4	1	2	Submarine route causes the least passerine habitat loss, while the West route cases the most loss through areas of higher passerine density
	Score	**8**	**10**	**7**	**8**	
	Ranking	**3**	**4**	**1**	**3**	

Criteria	Sub-Criteria	East Route	West Route	Sub-Marine	Simpson Is.	Rationale
Vegetation	Rare Plants	3	4	1	2	West route is the worst as it goes through the Taiga Plains; other routes are ranked on their terrestrial footprint (length).
	Forestry	1	2	1	1	West route is the only route that goes through areas of economically viable forests.
	Score	**4**	**6**	**2**	**3**	
	Ranking	**3**	**4**	**1**	**2**	
Sum of Rankings		**9**	**12**	**5**	**8**	
OVERALL RANKING		**3**	**4**	**1**	**2**	

8.4.4 Socio-Economic Assessment of Transmission Line Routes

The results of the alternatives assessment for Socio-economic criteria and sub-criteria are presented in Table 8.4.6. The results of the socio-economic assessment contributed to 20% of the overall assessment decision (see Section 8.4.7).

After screening, eight criteria were carried forward to the full alternatives assessment. The East Arm route ranked as preferred, while the West Arm route was least preferred. The West Arm route ranked last for six out of eight of the sub-criteria and thus its overall ranking was least preferred. The East Arm route ranked preferred in three out of eight criteria and did not rank least preferred for any of the sub-criteria.

The second ranking route was the Submarine route. The Submarine route did rank least preferred for two out of eight of the criteria. Specifically, the sub-criteria for Economic Development deemed the Submarine route the least preferred as this route had the least opportunity to supply future customers. The key sub-criterion for the preferred route (East Arm), Access and Traditional Land Use present the merits of the East Arm route relative to the others.

Table 8.4.6 — Assessment of Transmission Line Route Options: Socio-Economic

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
Traditional Land Use	Trapping	1	4	3	2	Trapping effects scored comparatively greater for options with likely more trapping activity
	Country food consumption rate	2	1	3	4	The more likely the option affects country food consumption the less desirable it is
	Score	**3**	**5**	**6**	**6**	
	Ranking	**1**	**2**	**4**	**4**	
Contemporary Land Use	Renewable resource uses	2	4	1	3	The more likely renewable resource uses are affected the less attractive the option
	Non-renewable resource uses	2	4	3	4	The more likely non-renewable resource uses are affected the less attractive the option
	Score	4	8	4	7	
	Ranking	**2**	**4**	**2**	**3**	
Employment and Income	Aboriginal/ South Slave employment	1	3	4	3	The more Aboriginal groups possibly affected (employed) by the alternative, the more attractive the alternative
	Distribution of Project income	2	4	1	1	The more likely the Project increase employment and income opportunities in the South Slave region of the NWT the more attractive the option
	Score	**3**	**7**	**5**	**4**	
	Ranking	**1**	**4**	**3**	**2**	
Socio-cultural Well-being	Traditional land use patterns	2	4	1	1	Preference to the option least likely to disrupt traditional land use patterns
	Valued cultural & spiritual places	3	3	3	3	All routes could affect valued cultural and spiritual places
	Score	**5**	**7**	**4**	**4**	
	Ranking	**3**	**4**	**2**	**2**	
Nuisances (noise, aesthetics, vibration)	Vicinity to receptors	2	4	3	2	A function of line length and the number of receptors possibly affected

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
	Visibility	2	3	1	4	The least visible option is the most preferred. The East and marine options likely have the fewest nuisance receptors and are therefore most preferred
	Score	**4**	**7**	**4**	**6**	
	Ranking	**2**	**4**	**2**	**3**	
Built Heritage Features and Cultural Landscape	Vicinity to existing cabins, trails and trap lines	2	4	2	3	Option that has the greatest likelihood of affecting the cultural landscape and build features is the least desirable
	Change in the character of areas	3	4	2	4	Option that would least likely change the character of the area is most desirable
	Score	**5**	**8**	**4**	**7**	
	Ranking	**2**	**4**	**1**	**3**	
Economic Development	Future customers	1	2	4	4	The option with a better chance of supplying future customers is more preferred
	Line frontage	2	1	4	4	The option that provides the most amount of line frontage in areas of known mineral potential is rated most desirable
	Score	**3**	**3**	**8**	**8**	
	Ranking	**2**	**2**	**4**	**4**	
Access	Public desirability	2	4	2	2	The option with more of its ROW in desirable hunting and trapping area(s) is more likely to be accessed and therefore scored comparatively lower
	Change in the character of areas	2	3	1	4	The option that least changes the character of the area is preferred, hence the trans island option scores lowest as it significantly changes the character of Great Slave Lake
	Score	**4**	**7**	**3**	**6**	
	Ranking	**2**	**4**	**1**	**3**	
Sum of Rankings		**15**	**28**	**19**	**24**	
OVERALL RANKING		**1**	**4**	**2**	**3**	

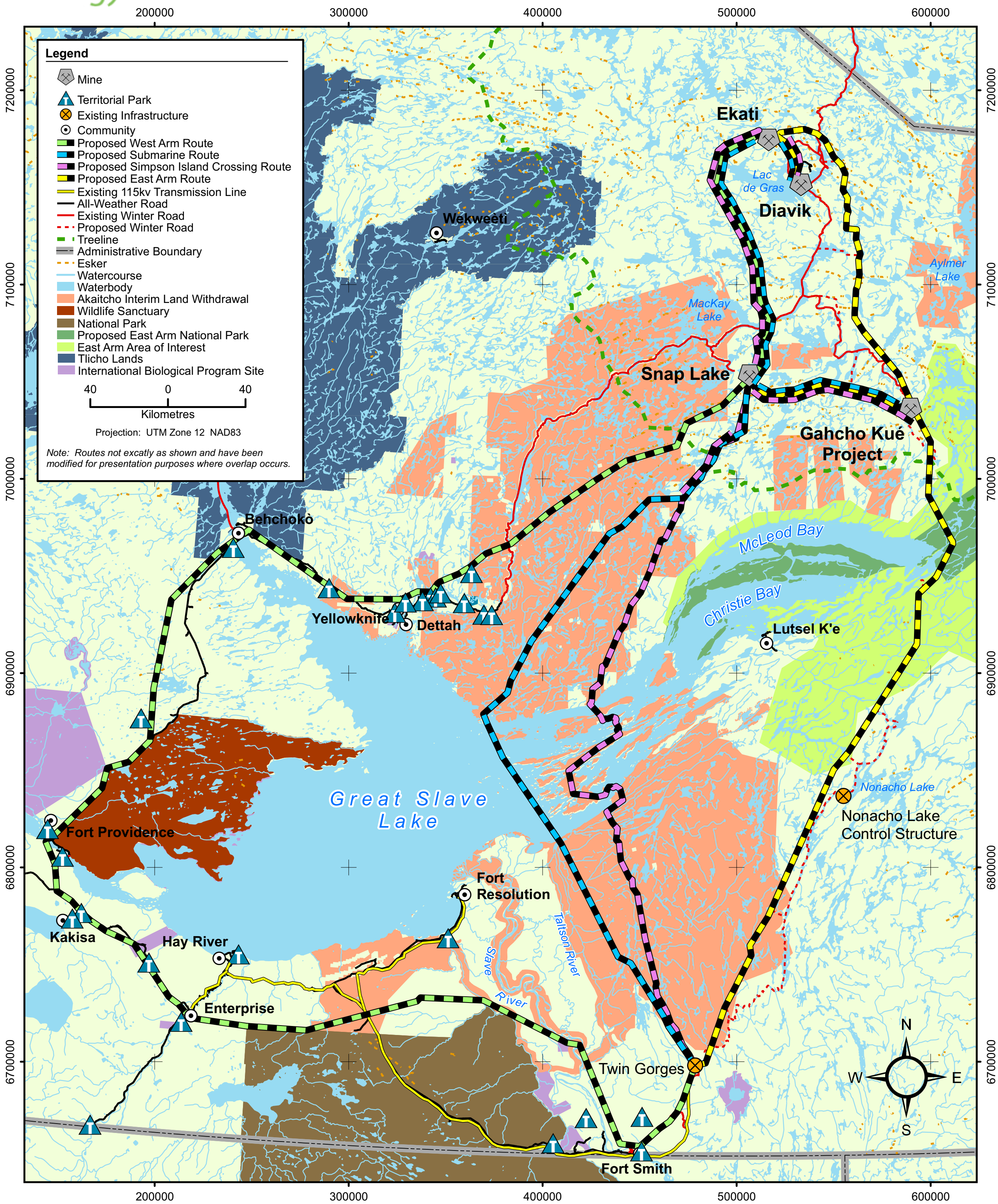
8.4.5 Land Access Assessment of Transmission Line Routes

The results of the alternatives assessment for Land Access criteria and sub-criteria are presented in Table 8.4.7. The results of the Land Access assessment contributed to 20% of the overall assessment decision (see Section 8.4.7).

After screening, three criteria were carried forward to the full alternatives assessment. The East Arm route ranked as preferred, while the West Arm route was least preferred. The West Arm route ranked least preferred for all three criteria. The East Arm route ranked preferred, but the Submarine route ranked a close second.

The West Arm route traverses important Crown Land withdrawals and areas, and areas of recognized importance, as shown in Figure 8.4.9. It is also the closest to highly-tenured land. The Submarine route, because of its shorter terrestrial nature, ranked preferred for areas of recognized importance.

Although this category is key from the Proponent's perspective, it has been accorded equal weighting among the categories to avoid biasing the alternatives assessment.



TALTSON Hydroelectric Expansion Project	Developer's Assessment Report 2009	Alternative Routes: Protected Areas and Withdrawn Lands	Figure 8.4.9

N:\Active\GIS\2008\07-1328-0013 Taltson\Mapping\MXD\DAR_Figures\YK_123_Main Alternatives& Protected Area

Table 8.4.7 — Assessment of Transmission Line Route Options: Land Access

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
Crown Land Withdrawals	Crown Land Withdrawals	2	4	3	2	Options that have the least interaction with existing Crown land withdrawals are preferred
	Score	**2**	**4**	**3**	**2**	
	Ranking	**2**	**4**	**3**	**2**	
Areas of Recognized Importance	Areas of Recognized Importance	3	4	1	2	Options that do not traverse or intersect with areas of recognized importance are preferred
	Score	**3**	**4**	**1**	**2**	
	Ranking	**2**	**4**	**1**	**3**	
Land Tenure	Land Tenure	1	4	2	3	Options with the fewest land tenure issues are preferred. For example, the West option includes land tenure issues with the Dehcho First Nations and the Tlicho Government
	Score	**1**	**4**	**2**	**3**	
	Ranking	**1**	**4**	**2**	**3**	
Sum of Rankings		**5**	**12**	**6**	**8**	
OVERALL RANKING		**1**	**4**	**2**	**3**	

8.4.6 Engineering/Cost Assessment of Transmission Line Routes

The results of the alternatives assessment for Engineering/Cost Assessment criteria and sub-criteria are presented in Table 8.4.8. The results of the Engineering/Cost assessment contributed to 20% of the overall assessment decision (see Section 8.4.7).

After screening, four criteria were carried forward to the full alternatives assessment. These criteria cover both estimated direct construction cost (capital cost and incremental schedule cost), and operating costs through line losses and anticipated outage and maintenance costs. The East Arm route ranked as preferred, while the

West Arm route was least preferred. The West Arm route ranked least preferred for all four criteria. The Simpson Island route ranked second throughout this assessment.

Direct capital costs vary significantly among the alternative routes. The second-ranked Simpson Island route is estimated to cost approximately $40 million more than the preferred East Arm route. While certain advantages to this routing have been noted, the additional cost is not in any way covered by additional tangible benefits to the Project. The Submarine route also offers similar advantages, but for the same reason cannot be justified economically. The West Arm route would not provide for an economically viable Project.

Although this category is key from the Proponent's perspective, it has been accorded equal weighting among the categories to avoid biasing the alternatives assessment.

Table 8.4.8 — Assessment of Transmission Line Route Options: Engineering/Cost

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
Capital Cost	Design Cost	1	4	3	2	Engineering and Construction Cost Estimates based on 2008 assessments for each line route
	Substation and Equipment	1	4	3	2	Engineering and Construction Cost Estimates based on 2008 assessments for each line route
	Line and Construction	1	4	3	2	Engineering and Construction Cost Estimates based on 2008 assessments for each line route
	Score	**3**	**12**	**9**	**6**	
	Ranking	**1**	**4**	**3**	**2**	
Line Loss Cost	Annual GWh Loss	1	4	3	2	Annual loss of revenue due to line losses over a 20 year term brought to Net Present Value
	Score	**1**	**4**	**3**	**2**	
	Ranking	**1**	**4**	**3**	**2**	
Outage/ Maintenance Cost	Annual Outage Cost	1	4	2	3	Estimated annual cost of outage over a 20 year operational term brought to Net Present Value

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
	Annual Maintenance Cost	3	4	1	2	Estimated annual cost of maintenance over a 20 year operational term brought to Net Present Value
	Score	**4**	**8**	**3**	**5**	
	Ranking	**2**	**4**	**1**	**3**	
Schedule Cost	Incremental Duration Cost	1	4	3	2	Incremental carried Interest During Construction due to schedule duration of each line construction
	Score	**1**	**4**	**3**	**2**	
	Ranking	**1**	**4**	**3**	**2**	
Sum of Rankings		**5**	**16**	**10**	**9**	
OVERALL RANKING		**1**	**4**	**3**	**2**	

8.4.7 Construction and Operations Risk Assessment of Transmission Line Routes

The results of the alternatives assessment for Construction and Operation Risk assessment criteria and sub-criteria are presented in Table 8.4.9. The results of the Construction and Operations Risk assessment contributed to 20% of the overall assessment decision (see Section 8.4.7).

After screening, three criteria were carried forward to the full alternatives assessment. These criteria cover the important elements of terrain-related risk (potentially leading to foundation issues and construction delay), logistics, and schedule risk caused by difficult crossings and/or significant access constraints, and the longer-term risk associated with outages and overall line reliability. All of these criteria vary with the specific line routing. For these important criteria, the East Arm route ranked as preferred, while the West Arm route was least preferred. The Submarine route ranked second throughout this assessment as high crossing risk and operational reliability issues are largely avoided in that arrangement, with the exception of repair access.

The Construction and Operations risk is provided an equal weighting among the categories to avoid biasing the alternatives assessment.

Table 8.4.9 — Assessment of Transmission Line Route Options: Construction and Operations Risk

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
Terrain Risk	Percentage Rock	3	4	1	2	Estimated percentage of rock from terrain typing and fieldwork
	Percentage Wetland	3	4	1	2	Estimated percentage of wetlands from terrain typing and fieldwork
	Percentage Disturbed	1	2	2	2	Estimated percentage of disturbed ground and broken rock from terrain typing and fieldwork
	Score	**7**	**10**	**4**	**6**	
	Ranking	**3**	**4**	**1**	**2**	
Logistics/ Schedule Risk	Water Crossings	1	2	4	3	Major water crossings add logistics complexity and foundation risk - marine crossings much more likely to have complications
	Materials Delivery	1	2	4	3	Materials delivery methodology crucial to schedule - construction of major new winter roads adds to risk, marine cable shipping adds to risk
	Construction Access	4	3	2	1	Construction access critical for schedule - dependent on terrain along route
	Construction Methods	1	2	3	4	Construction methods (air or land-based) affects logistics - air dependent on daylight and weather
	Score	**7**	**9**	**13**	**11**	
	Ranking	**1**	**2**	**4**	**3**	

Criteria	Sub-Criteria	East Arm	West Arm	Sub-Marine	Simpson Is.	Rationale
Outage/ Reliability Risk	Length of line	1	4	3	2	Line length directly related to general reliability
	High Towers	2	3	1	4	Towers increase exposure to wind, ice load and outage
	Materials Technology	1	2	4	3	Marine cable spares not readily available - outage can be major
	Lightning Exposure	2	4	1	3	Proximity to Great Slave Lake is highest zone
	Fire Exposure	3	4	1	2	Relative distance in treed zone
		2	1	4	3	Ease of access onto line would affect outage time and reliability
	Score	**11**	**18**	**14**	**17**	
	Ranking	**1**	**4**	**2**	**3**	
Sum of Rankings		**5**	**10**	**7**	**8**	
OVERALL RANKING		**1**	**4**	**2**	**3**	
OVERALL RANKING		**1**	**4**	**2**	**3**	

8.4.8 Assessment Summary

Table 8.4.10 presents the results of the transmission line route alternatives for all five categories combined. Each category was equally weighted relative to the other in that each category represents 20% of the overall assessment result. The overall preferred route is the East Arm route. The East Arm route ranked preferred for four out of five assessment categories. This route has clear advantages over the other routes for land access and tenure issues. These issues are important for moving the Project ahead at a reasonable schedule. Based on the assessment, the East Arm route is the only option that would not pose significant risks to permitting and tenure approval. Permitting and tenure approval issues associated with the other routes constitute potential danger warnings for the Project and the Project's financial backers.

The Submarine route ranked second because this alignment avoids some of the important terrestrial issues by running underwater for a length of the transmission line; it was a close second to the East Arm route for Socio-economics. However, the added costs of a submarine transmission line present economic risks.

The Simpson Island crossing ranked second or third for all categories assessed. This route's construction poses risks that could lead to unexpected costs. Environmentally, the route is preferred over the East Arm route by virtue of the reduced area requiring clearing and habitat avoidance through spanning water bodies.

Table 8.4.10 — Transmission Line Route Alternatives Assessment

Categories	Weight	East Arm	West Arm	Submarine	Simpson Is.
Land Access	20%	1	4	2	3
Socio-economics	20%	1	4	2	3
Environment	20%	3	4	1	2
Engineering/Cost	20%	1	4	3	2
Construction and Operations Risk	20%	1	4	2	3
Total	**100%**	**1.4**	**4**	**2**	**2.6**
		☑	☐	☐	☐