



Analysis and Report  
to the  
Clean Environment Commission  
on  
Manitoba Minnesota  
Transmission Project (MMTP)  
Route Selection Criteria, Routes,  
and Impacts.

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Our File: 16-2631



May 17, 2017

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Attention: Mr. Kevin D. Toyne

Dear Sir:

Re: Manitoba Minnesota Transmission Project (MMTP) Our File 2631

Further to your instructions and my analysis, I am pleased to provide the attached report. In it I have reviewed the Manitoba Hydro (MH) EPRI-GTC (E-G) for route selection through southeastern Manitoba. The review is based upon tested criteria originating from different jurisdictions and numerous proceedings and applications dealing specifically with the issue of power line routing from over 30 plus years ago right up to the current time. Numerous citations will be provided to allow the Clean Environment Commission (CEC) to directly evaluate the criteria and findings by other administrative tribunals. Much of the routing criteria review will flow from my work on Bipole III. However, as none of the current CEC panel was on the Bipole III, it bears repeating.

With that background, I have conducted a review and critique of the routing evaluation as set forth in the various documents provided by Manitoba Hydro dealing with this Manitoba Minnesota Transmission project (MMTP). Further, as part of that effort, I have rather extensively considered many of the matters outlined in the other Technical Reports and Appendices. I have especially reviewed the E-G Technical Paper (2006) referenced by, and utilized by MH.

Following these sections, I have provided a series of findings, conclusions, and recommendations.

I am happy to attend a hearing on this matter and to discuss and defend the contents of this report.

Yours truly,

A handwritten signature in black ink, appearing to read 'R. Berrien', written in a cursive style.

Robert A. Berrien, DAC  
Licence #0361-16

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3. Copy of an Extract from Decision 80-A, 500 kV Transmission Line, Keephills – Ellerslie
4. Copy of an Extract from Decision 76-F, Environmental Evaluation by Alberta Environment
5. Copy of an Extract from Decision 81-D, 500 kV Transmission Line, Keephills – Ellerslie
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7. Copy of an Extract from Decision 80-A, 500 kV Transmission Line, Keephills – Ellerslie
8. Copy of an Extract from the Edmonton – Calgary 500kV Transmission Development, Needs Application
9. Copy of Southwest Alberta 240 kV Transmission Development Application, 2007
10. Copy of an Extract from the Analysis and Report to the Alberta Energy and Utilities Board
11. Copy of an Extract from Decision 2009-049, Construct Updike Substation
12. Copy of an Extract from the Eastern Alberta DC Transmission Line Application, Volume 2
13. Testimony from Chief AltaLink Route Planner in Heartland Project
14. Copy of an Extract from AUC Decision 2013-369, Foothills Area Transmission Development
15. Copy of an Extract from AUC Decision 21030-D02-2017, Fort McMurray West 500 kV Transmission Project
16. Copy of the Hydro Quebec Agreement on the Siting of Power Transmission Lines on Farms and in Woodlands, December 2000
17. A. Copy of the Report of the Solandt Commission, April 1975;  
 B. Environmental Assessment Report – Bruce to Milton Transmission Reinforcement Project List of Study Area Criteria and Indicators;  
 C. Supply to Essex County Transmission Reinforcement Project, Final Workshop Report, Nov 2009
18. A. Copy of the Poplar River to Pasqua 230 kV Transmission Line Environmental Impact Statement, SaskPower, April 2009;  
 B. Reasons for Decision; Environmental Assessment Approval  
 C. Saskatoon Area Reinforcement Projects, March 2012
19. Copy of an Extract from the Environmental Assessment Certificate Application, May 2006
20. Copy of an Extract from Minnesota Power submission on MMTP
21. Copy of the Kentucky EPRI-GTC Modified criteria
22. Copies of Aerial Photos of Tower Placements

## 1.0 BACKGROUND

### 1.1 Purpose

The purpose of the first portion of the review is to identify the key routing issues that have been addressed in previous applications for high voltage transmission lines (HVTL), and to characterize, as we read it, how the various review agencies or applicants have considered or weighted these issues after consultation or input from interveners. This analysis will assist us in our review of the Manitoba Hydro (MH) MMTP route selection and evaluation process, and the impact assessment of the route alignment.

### 1.2 Review of Previous Decisions, Applications, and Environmental Impact Statements

As part of our ongoing work on HVTL route issues, we regularly review the practices from other jurisdictions, as well as Decisions related to HVTL applications, with a particular view to how the decision maker weighed or considered route alternatives presented.

The following sections of this report detail a number of examples from across Canada. It is up to date, and includes a recent (February 2017) decision from the Alberta Utilities Commission (AUC) on a 500 kV AC power line from Fort McMurray to the Edmonton area over 500 km long. It also references the Minnesota Power approach on the other end of this MMTP line, and the process used in Kentucky.

## 2.0 ROUTING CRITERIA

### 2.1 Alberta Cases

Given our home base, we have the greatest direct familiarity with the cases from this jurisdiction. Therefore, they will constitute the first and largest component of this section on routing principles. In the following discussion, I use the term “the Board” to refer to any of a series of quasi-judicial panels that have dealt with these matters in Alberta over the years. It is worthwhile to note that the Alberta panels have the jurisdiction to approve, modify, or deny an application for a power line project or route. It is also fair to say that the AUC has probably the greatest level of experience in Canada, given the numerous hearings flowing from the many HVTLs that have been built in the last few years.

#### 2.1.1 Routing Principles – Detailed Discussions in Board Decisions

The earliest Decision we have located that attempted to specifically discuss “*routing principles*” was Decision 77-G (Appendix 2: 240 kV Transmission Line Proposed by Calgary Power Ltd., Between Calgary and Lethbridge). This discussion included a number of potential options regarding route and/or design, that might have reduced impacts. All decisions on power lines deal with the concept of impact evaluation, but here it was tackled head-on. The routing evaluation considered the four following issues. It is noteworthy that each of the four is an Existing Linear Disturbance (ELD) of one type or another.

##### 2.1.1.1. Use of Railway Lines

Locating HVTL Right of Way (ROW) along existing railway lines was an option. For the route considered, the Board found that there were numerous bends in the railway line route that made it less than a desirable linear route for a HVTL. They also noted that in the subject area there were a number of small towns located adjacent to the railway line that introduced a further issue. The railway ROW is generally 100 ft. wide, so could not provide the entire ROW required for a 240 kV line. Furthermore, there may have been some issues with having the HVTL too close to the railway tracks. The Board acknowledged that additional ROW would have to be acquired even if the railway line ROW was considered.

In my view, if a railway ROW provides a straight alignment for any distance in a locale that follows the basic route of the HVTL under consideration, the railroad ROW may be an ELD that a transmission line could parallel. But it is a site specific situation.

#### 2.1.1.2 Following Natural Severances

This Calgary Power proposal considered using river valleys, or other such physical or landscape characteristics to route HVTLs. The Board was of the view that because of the meandering nature of rivers and major creeks, plus the environmental impacts associated with construction in river valleys (erosion, impact on habitat, slope stability, etc.) that this offered little opportunity. Furthermore, the Board recognized that recreational facilities were often located within or adjacent to rivers or in the river valley.

We agree that with the environmental sensitivity today, using a river valley as a route for a HVTLs is not optimal. In today's routing practices, river valleys are typically crossed in the shortest and minimally impacting manner. The basis for considering natural severances is however, a sound one. Whenever an existing linear disturbance may be followed, it minimizes impacts on adjacent land uses.

#### 2.1.1.3 Adjacent to Existing HVTL

One route option considered at the hearing into the 240 kV transmission line proposed by Calgary Power Ltd., between Calgary and Lethbridge was to run the proposed line parallel to an existing 240 kV line for a portion of the route. The Board found that the amount of ROW required and the impacts on farming were similar to the proposed route, which was through "virgin" territory. Furthermore, the applicant (Calgary Power) stated that one reason supporting its proposed route was that it was not adjacent to an existing line, and therefore not vulnerable to the same storm damaging both lines. The Applicant indicated that a separation of 20 to 40 miles from the existing line was optimal.

A similar issue was raised in Decision 80-A (Appendix 3: 500 kV Transmission Lines Keephills – Ellerslie, Feb. 1980, Sec 5.0). Here again, the Applicant (Calgary Power) indicated that it was not desirable to locate the two proposed 500 kV lines in the same ROW, due to system reliability issues. Only within the Restricted Development Area (RDA), (now Transportation Utility Corridor (TUC), was this deemed to be acceptable.

In an earlier Decision (Appendix 4: In the Matter of 240 kV Transmission Line Facilities of Calgary Power Ltd. in the Calgary Area, ERCB Report 76-F, August 1976) the Board noted, with approval, the corridor concept. Indeed, their decision was based, in part, on not precluding a corridor that might arise. Multiple 240 kV, HVTLs were conceived as occupying the corridor. The issue of risks from close by lines did not arise in this hearing.

It is clear that the thinking in respect of existing Power Line Linear Disturbances (PLDs), has evolved largely due to the understanding of incremental versus new impacts. This issue can be viewed very differently depending on the risk presented to the electric system if both lines were to be taken down at the same time.

#### 2.1.1.4 Unused Road Allowances

The fourth ELD considered in the Calgary to Lethbridge hearing dealt with unopened or undeveloped road allowances. For a number of reasons, it was not practical to situate large steel lattice HVTLs within road allowances which are typically only 66 feet wide. Road allowances are in place to provide public access. As a principle, this warranted no further consideration for lattice HVTLs, other than to acknowledge that placing towers within road allowances is not appropriate, whether the road allowance is developed or undeveloped. This issue of towers immediately beside road allowances was never canvassed at this hearing.

#### 2.1.2 Implied Routing Principles

In addition to the specific discussions on routing principles in Decision 77-G set out above, the Board has addressed and opined on other “principles” in various other Decisions.

##### 2.1.2.1 Conflict with Urban Lands

Again referencing Decision 80-A (See Appendix 3), the Board discussed at length the issue of Utility Corridors. The entire extract of their comments is appended to this Report.

To quote from that Decision, the Board noted the following at pg. 5-1:

*“The Board agrees that utility corridors represent a desirable alternative where a well-defined need exists for utility services between two areas, such as the generating area at Wabamun and Keephills and the load centre in Edmonton. In this respect the Board uses the term “utility corridor” to mean a properly established and officially designated corridor that would properly protect the rights of landowners affected by it.”*

The Board was looking for true corridor status and actually urged the Government to establish such pathways (See pg. 8-1, Appendix 3). Notwithstanding this situation, one cannot help but see a preference for co-locating power lines when a line must be run from a generating site to a common load site. But again, the risk of losing multiple lines at the same time can govern how the corridor concept is viewed.



In Decision 81-D, (Appendix 5: 500 kV Transmission Lines Keephills to Ellerslie, April 1981, pg. 11) the Board dealt with the corridor issue 36 years ago. A number of the Board's findings from that Decision will provide guidance on the issue of power lines in proximity to one another. A multipage extract from that Decision is appended to this Report so the reader may see an unedited version. In my view, the Board recognized that when lines were grouped together the impact could be reduced. What is not stated is the underlying basis for the description of "reduced" impacts – compared to what? In my view, it could only be a comparison to multiple power lines in different locations.

The Board, after some evaluation of matters specific to the Application before it, goes on to state at pg. 12:

*"In several of its decision reports, the Board has indicated that it subscribes to the corridor concept and believes it to be in the long-term public interest for utilities such as transmission lines to be located in designated corridors whenever reasonable and practical, in order to reduce impact on residents."*

In this Decision, the Board reaffirmed its preference for corridor development on linear facilities, and the use of existing corridors like the TUC's that exist around Edmonton and Calgary. These Decisions, both of which deal with the corridor concept, provide me with significant guidance that use of corridors, defined, or de facto, will generally generate lower impacts than greenfield, and obviously, multiple routings. To the extent that a corridor may also arise from other linear facilities, these must also be kept in mind as routing opportunities. Indeed, all the foregoing discussion around corridors is really just a refinement of the concept of using Existing Linear Disturbances (ELD) as a focus for routing, rather than creating new disturbances.

#### 2.1.2.2 Conflict with Rural Residences

In virtually all its HVTL Decisions, the Board has had regard for the number of rural residences that are located proximal to the route. Through dry land agricultural areas, the convention has been to locate HVTLs through the middle of sections, to encounter as little property boundary area as possible adjacent to developed road allowances. Reducing the length of ROW beside a developed road minimizes the number of residences that may be encountered, as well as minimizing the potential conflict with future rural residential sites.

It is apparent that the Board acknowledges that it may be impossible and impractical to “thread” a HVTL through an area to avoid all conflict with existing rural residences, and has some tolerance for this conflict. However, there is no doubt that it remains one of its top priority routing considerations.

#### 2.1.2.3 Public vs. Private Land Use

Following from the points above, if a suitable area of public land is available, the Board would prefer that be used. That said, the Board has not indicated that the use of public land is automatically the preferred routing option, unless the public land is designated for use as a transportation and utilities corridor. All other factors need to be considered. (This is very similar to the CEC admonition expressed in Bipole III).

In theory, using public land would avoid the potential of conflict with rural residences. That said, if the public land is used for the purpose of a developed recreation area, or designated as a natural area for environmental reasons, then use of public land may not be an option. Furthermore, the Board has approved routes on private land, rather than on public land simply because the route on private land was shorter.

It appears that this is not an over-riding factor, except where a transportation and utility corridor exists. The policy appears to be, all else being equal, public land is preferred over private land.

#### 2.1.2.4 Conflict with Irrigation Land Use

In Decision 77-G, (Appendix 2) the Board made a considerable effort to examine the conflict between HVTLs and irrigation operations. Needless to say, a great deal of detailed information is required about the irrigation development along prospective routes before these matters can be properly considered. It was deemed reasonable to place towers at the edge of fields to avoid compromising the pivot circle area.

#### 2.1.2.5 Agricultural Impact – Dry Land

Most of the sub-factors under this category refer to items that form the basis for the amount of annual compensation for towers under the Alberta Surface Rights Act. For the purposes of relating this discussion to the Manitoba situation, we recognize that the compensation policy has been set under the Manitoba Expropriation Act, and that it is a single payment, based on capitalizing the annual impacts.

The Board recognizes that locating the route through an area with poor soils may result in reduced agricultural impacts, as that route would more likely be on pasture land as opposed to cultivated land.

However, the Board has not approved route alternatives that use poorer agricultural land or pasture lands, if that route alternative is significantly longer than a route through cultivated land. As in most such things, the proper balance is what the Board is seeking to achieve. In any event, when routing lines through agricultural lands, it is a priority that the structures be carefully placed to minimize their impacts. Such careful consideration of structure locations can frequently lead to route alteration. While the strip of land associated with the ROW has many impacts on land uses, it is the tower placements, and the towers themselves that, in my experience, invariably attract the most concern. This is of specific concern in the MMTP situation where the line is planned to route through agricultural land.

#### 2.1.2.6 Decrease of Property Values

This is a sub-factor under the “residential impact” category, but is raised over and over again by landowners. Generally speaking, on dry land agricultural property, based on our own analysis, we have not seen a measurable impact on land value because of the presence of a single or twin HVTLs. We are not aware of any study that has considered whether properties with an agricultural highest and best use with HVTLs take longer to sell. It is worthwhile to note that our study was in Alberta where there are annual payments for each transmission tower on the property. There may be differences in Manitoba where only a one-time payment is available.

Work that we have done with pipelines and sour gas facilities indicates that land value may be impacted if the highest and best use of the property is not agriculture. Recent work in Alberta, in conjunction with the Critical Infrastructure power lines, has seen the same effect due to HVTLs. As well, land value may be impacted as a property moves out of agriculture into a higher use, such as a recreational or country residential property. HVTL ROWs restrict the amount of land that can be developed, as well as potentially affecting esthetics, the development design and servicing costs.

With recreational or country residential properties, view and proximity can be major factors in property value. For example, properties fetch a premium if they have a superior mountain or river valley view. If the location of the HVTL deteriorates the view, it would be logical to expect a decrease in property value. Or, if a tower is so close to a homesite that noise or safety concerns generate a stigma, that too can negatively impact values.

### 2.1.2.7 Visual Impact

In Decision 77-G, the Board appears to be conflicted in their views on corridors. While expressing concern about the impacts of the second line in relation to the first lines impacts, they also recognized there can be benefits flowing from HVTLs in corridors or when placed beside an existing HVTL. By the 1980's the Board appears to have sorted out its views on multiple lines.

In Decision 80-D (Appendix 6: 500 kV Transmission Line Langdon – Phillips Pass, June 1980), the Board stated the following unequivocal view at pg. 6-19:

*“Generally, the Board believes that a single transmission line on the prairies produces a moderate visual impact near the line which diminishes rapidly as the distance increases to 3 to 5 km. An advantage of paralleling an existing line is that the second line does not result in double visual impact.”*

In Decision 81-D (Appendix 5) the Board noted the following at pg. 11:

*“Visual and aesthetic impact were also matters of concern to the interveners. The Board believes the judgment of visual impact to be somewhat subjective and the assigning of quantitative values to compare visual impact on residents difficult, particularly for future urban development. The Board, in its analysis of visual impact, considered such items as the length of line, its location with regard to existing residences, the configuration of the line (number of corners in the alignment), and conflict with future development.”*

The Board went on to compare two competing alignments that were all, to a greater or lesser degree, in an urban, or future urban setting. In this, as well as other situations, line length is an important consideration. The longer the line, the greater the overall visual impact. The pre-existing visual environment and the degree of change that will result from the new line are also important.

Another visual factor is scenic views. If there are superior views that would be adversely impacted by a HVTL route, these were a consideration.

In view of the foregoing, the guidance from the Board is that where one or two lines already exist, visual impacts will be less than in a situation where a new line is placed in a greenfield setting. Also, the impacts on view can be seen as a subset of impacts due to proximity to homesites.

### 2.1.3 Listed Routing Criteria

There have been a number of power line cases before the Alberta Board where routing criteria have been listed with greater detail to help understand the components the Board may consider.

In both Decision 80-A and Decision 81-D, the Board included an Appendix that set out the “six major aspects” used to consider alternative routes, plus a “special constraints” factor. (See Appendices 5 and 7 for these extracts).

In these earlier decisions, these “major aspects” included the following:

#### 1. Agricultural Impact

- *Shared use with other utilities and transmission lines.*
- *Loss of shelter belts.*
- *Loss of crops. This would include short-term loss caused by construction, longer-term losses possible from soil erosion, rutting, drainage disturbance, soil mixing, and permanent loss of crop under or adjacent to the tower base.*
- *Short-term disruption of farming and livestock grazing resulting from construction.*
- *Risk of collision with tower; damage to equipment, lost time, liability for damage to tower, and secondary liabilities.*
- *Visual impact – a daily fact of life, no choice of viewing it.*
- *Psychological impact of line.*
- *Restrictions on use of aircraft and high-pressure irrigation systems*
- *Impact of height restrictions on equipment during field operations.*
- *Reduced efficiency of field operations.*
- *Reduction in yield adjacent to towers due to overlapping farming operations and added soil compaction.*
- *Added cost and inconvenience of weed control under towers.*
- *Impact on tree farms*

#### 2. Residential Impact

- *Decrease in property values.*
- *Visual impact, alteration of the visual character of the area.*
- *Loss of developable land, and constraints on development.*
- *Relocation or removal of residents.*
- *Psychological impact of line.*
- *Biological effects.*

- *Noise and T.V. interference.*
- *Windbreak and other vegetation removal.*
- *Conflict with recreation use of acreages.*

3. *Environmental Impact*

- *Increased public accessibility to wildlife areas.*
- *Reduction of habitat's winter carrying capacity due to depletion of cover and woody browse.*
- *Alteration of natural areas and sanctuaries and interferences with outdoor educational opportunities.*

4. *Cost*

- *The cost of each route is shown in Table 7.1 and discussed in section 7.2.1.*

5. *Electrical Considerations*

- *Separation of the two lines to ensure maximum reliability.*
- *Proximity of future substations.*
- *Ease of connection to future generating stations.*

6. *Special Constraints*

- *Electrical interferences with radio transmitting and receiving stations and satellite receiving stations.*
- *Physical conflict with private and commercial airstrips.*
- *Electrical/biological effects on The University of Alberta's research station.*
- *Inductive co-ordination with communication systems.*

It is important to note the Board has never put these individual components of the major aspects under a microscope, nor have they accorded specific weights or values in an attempt to generate numerical scoring for route alternatives. The Board recognizes it is an exercise in judgment, and that different segments can require individualized evaluations involving variable criteria as one moves through a route.

In the Edmonton to Calgary - Needs Application (Appendix 8), the Alberta Electric System Operator set forth the following criteria.

*"The assessment criteria found in the Board decision for the Keepphills-Ellerslie-Genesee 500 kV lines and the Langdon to Phillips Pass 500 kV tie line were used for the high level corridor assessment. Under each of the primary criteria the EUB provided a list of evaluation factors it considered significant for each. The primary assessment criteria and the significant evaluation factors are summarized as follows:*

- a) *Agricultural Impact - Includes evaluation factors related to the effect on field operations, crop yield reduction, weed control, height restriction of equipment, risk of collision with towers, visual and psychological impact of lines, loss of shelter belts, and impacts on tree farms.*
- b) *Residential Impact - Includes evaluation factors related to the decrease in property values, loss of or constraints to developable land, relocation or removal of residents, visual and psychological impact of lines, biological effects, noise and TV interference, removal of windbreak and other vegetation, conflict with recreational land use, and public versus private land.*
- c) *Environmental Impact - Includes evaluation factors related to increased public access to wildlife areas, alteration of natural areas, erosion effects, unique ecological areas, use of restricted development areas, and reduction of habitat winter carrying capacity.*
- d) *Cost - Includes evaluation factors related to construction and land acquisition costs.*
- e) *Electrical Considerations - Includes evaluation factors related to ease of connection for future facilities, proximity to future substations, reliability, reparability, access for construction and maintenance, and separation of circuits.*
- f) *Visual Impact - Includes evaluation factors related to visual impacts of tree removal, dispersed recreational users, and towers and lines seen from residences, farms, roads, and recreational installations.*
- g) *Special Constraints - Includes evaluation factors related to electrical interference, conflict with private and commercial airstrips, inductive interference, conflict with historical sites, effects on recreational installations, and electrical/biological effects on research stations.*

These factors are the precursor to the current criteria, which are now termed "major factors" and employed by all Alberta Transmission Facility Operators (TFO's).



In its recent application for the Western Alberta Transmission Line, the TFO, AltaLink, set out (at pg. 126) of its Application, what they termed “AUC (*Alberta Utilities Commission*) Rule 007 also provides guidance on route selection”. In paragraph S15 they listed the items, and called them “comparative metrics”. They are quoted below.

### AUC Rule 007

NID12) *In those cases where ISO is identifying, as part of its application, a particular area in which the TFO should attempt to ultimately locate the proposed transmission facilities (e.g. a preferred “corridor”), ISO is expected to examine alternatives, and elaborate on the rationale for recommending the preferred option, having regard for the following major aspects, where applicable:*

#### 1. Agricultural Impact

- a) *Loss of crops. This would include short-term loss caused by construction; longer-term losses possible from soil erosion, rutting, drainage, disturbance, and soil mixing; and permanent loss of crop under or adjacent to the tower base.*
- b) *Short-term disruption of farming and livestock grazing resulting from construction.*
- c) *Reduced efficiency of field operations.*
- d) *Restrictions on use of aircraft and high-pressure irrigation systems.*
- e) *Risk of collision with tower; damage to equipment, lost time, liability for damage to tower and secondary liabilities.*
- f) *Reduction in yield adjacent to towers due to overlapping farming operations and added soil compaction.*
- g) *Added cost and inconvenience of weed control under towers.*
- h) *Impact of height restrictions on equipment during field operations.*
- i) *Psychological impact of line.*
- j) *Loss of shelter belts.*
- k) *Shared use with other utilities and transmission lines.*
- l) *Interference with citizen band radios.*

#### 2. Residential Impact

- a) *Decrease of property values.*
- b) *Loss of developable lands and constraints on development.*
- c) *Relocation or removal of residence.*
- d) *Psychological impact of line.*
- e) *Noise and TV interference.*
- f) *Windbreak and other vegetation removal.*
- g) *Conflict with recreational use of land holdings.*
- h) *Public versus private land.*



3. Environmental Impact

- a) *Increased public accessibility to wildlife areas.*
- b) *Alteration of natural areas and interference with outdoor educational opportunities.*
- c) *Use of the Restricted Development Area.*
- d) *Effect on erosion.*
- e) *Unique ecological areas.*

4. Cost

- a) *Construction cost.*
- b) *Land acquisition costs.*

5. Electrical Considerations

- a) *Ease of connections to future load areas.*
- b) *Reliability and reparability of the line.*
- c) *Access for construction and maintenance of the line.*

6. Visual Impact

- a) *Visual impact of tree removal as seen from roads and recreational installations.*
- b) *Visual impact on dispersed recreational users such as hikers, fishermen, hunters, scenic viewers, and cross country skiers.*
- c) *Visual impact of towers and lines as seen from residences, farms, roads and recreational installations.*

7. Special Constraints

- a) *Electrical interference with radio transmitting stations, and other telecommunication equipment etc.*

The consistency of these criteria is apparent, even with 30 years of intervening events. In other proceedings, a simple listing without elaboration has been put forward.

AltaLink, an Alberta TFO, in an August 2007 Application for a 240 kV line between Pincher Creek and Lethbridge, (Appendix 9: Southwest Alberta 240 kV Transmission Development), modified and expanded these factors, and proposed the following routing criteria.

- *Follow existing linear disturbances (existing transmission line, railway, highways) as much as possible.*
- *Allow sufficient separation from other facilities such as existing 138 kV transmission lines and developed roads and well sites to maintain safe operations of all facilities in the area.*
- *Avoid or minimize effect on residences.*
- *Minimize effects on existing agricultural land uses.*
- *Minimize environmental effects.*
- *Avoid conflict with existing distribution lines.*
- *Minimize conflict with Telus facilities and pipelines to a level that can be reasonably mitigated.*
- *Avoid paralleling steep slopes and unstable areas.*
- *Minimize cost as much as practical by minimizing line length and reducing angles.*

In my own routing efforts, (Appendix 10, August 2007) I employed the following criteria in the Montana Alberta Tie Line hearing.

- *Minimize proximity to human habitation.*
- *Minimize interference with established irrigation system.*
- *Minimize line length.*
- *Minimize the number of 90° and 45° deflection structures required to build the line.*
- *Avoid urban areas.*
- *Avoid wetlands.*
- *Follow existing linear disturbances (i.e. roads and canals) where this would yield a benefit to the adjacent landowners and MATL.*
- *Keep access for maintenance as a consideration.*
- *Avoid splitting sections if possible, on land with irrigation or irrigation potential.*
- *Cross natural water bodies on the perpendicular.*

In Decision 2009-049 (Appendix 11: ATCO Electric Ltd., Construct Updike Substation 886S and 144 kV Transmission Line 7L34), the Board noted that ATCO Electric had cited the following criteria for route selection in 2008. ATCO's criteria are set out below.

- *Minimize impacts with other land uses such as residences, built-up areas and oil and gas facilities;*
- *Utilize existing linear disturbances to minimize new disturbances and clearing, following existing power lines where possible;*
- *Follow road allowances where possible, for access, to reduce new clearing and to avoid impacts to agriculture;*
- *Keep routes as straight as possible, to reduce the line length; and*
- *Avoid environmentally sensitive areas such as watercourses, recreation areas, parks, campgrounds and wildlife habitat; and*
- *Avoid wet areas and steep slopes for better access and to reduce environmental impacts.*

In its recent application to the AUC for approval of its Critical Infrastructure Eastern Alberta Transmission Line (EATL), ATCO Electric set out the following routing criteria (See Appendix 12).

#### *Transmission Line Routing Criteria*

*General criteria taken into consideration throughout the route selection process included:*

- *Minimizing impacts with other land uses such as residences, built-up areas and oil and gas facilities;*
- *Utilizing existing linear disturbances to minimize new disturbance and clearing, following existing transmission lines where practical;*
- *Keeping routes reasonably straight to reduce line length and avoid costly corner structures;*
- *Minimizing length across environmentally sensitive areas such as watercourses, recreation areas, parks, campgrounds, and wildlife habitat to the extent feasible; and*
- *Minimizing length through wet areas and steep slopes for better access and to reduce environmental impacts.*

In its 2011 application for the Heartland project, AltaLink, the largest TFO in Alberta, considered the EPRI-GTC method, but rejected the process of weighting specific factors. The major take away from a review of the original E-G is the seeking of stakeholder inputs. However, that was deemed to be a requirement under virtually all the route selection methods. (See Appendix 13) AltaLink stressed in its testimony provided by the chief route planner, a Mr. Foley, that avoiding residences was their major consideration.

In the 2013 Foothills Area Transmission Development Decision (2013-369), the AUC made its decision considering the following criteria;

*“The Commission examined the proposed Langdon to Janet transmission line siting on the basis of residential impacts, visual impacts, agricultural impacts, electrical considerations, environmental impacts, and costs.”* (Appendix 14)

The AUC restated its preference for route selection criteria in its 2017 Decision (21030-D02-2017) regarding the Fort McMurray West 500 kV Transmission Project. They stated:

*“In determining the public interest, the Commission considers the respective social, economic and environmental impacts of the routes proposed by Alberta Power Line. In doing so, the Commission assesses the following routing criteria: agricultural impacts, residential impacts, visual impacts, electrical considerations, environmental impacts and cost.”*

The AUC also noted with approval:

*“Despite the differences in opinions on proposed routes and route segments, the routing experts who appeared at the hearing all agreed on the fundamental considerations required in routing a transmission line: avoid home sites; follow existing linear disturbances; minimize impacts on agriculture, minimize impacts on the environment; minimize line length and costs.”* (Appendix 15)

#### 2.1.4 Public Input Criteria

On the few occasions we could find where the public in Alberta was specifically asked for their views and those views were presented as evidence, they hit many of the same factors.

AltaLink, in its public consultation efforts on the earlier noted Pincher Creek - Lethbridge 240 kV line, identified the criteria put forth by the affected landowner's criteria. They note:

*Throughout the consultation process, AltaLink has listened to and worked with landowners and attempted to select a route which has the least overall effect and which best addresses their concerns. The general feedback from landowners was to:*

- *Minimize effects to farm operations including irrigation systems.*
- *Stay as far as possible from residences.*
- *Follow existing corridors and/or power lines.*

In a further effort to define the criteria to be used for routing in an application to the Board, ATCO submitted its findings from a questionnaire answered by those landowners it consulted during the route evaluation phase for a line proposed in Northwestern Alberta. They provided 12 prospective criteria, and asked the landowners to rate the importance of the various factors on a scale of 5 (most important) down to 1 (least important).

Upon consolidation of these criteria in descending order of importance, the landowners provided the following guidance.

1. Avoid Residences and Building Sites
2. Follow ELD's
3. Minimize Cost
4. Minimize Environmental Impacts and Habitat Loss
5. Avoid Tree Clearing
6. Minimize Agricultural Impacts

The foregoing decisions, rules, lists, and public view point's represent a wide review of routing criteria, with enough repetition of certain criteria to clearly understand the priorities of the various factors.

## 2.1.5 Route Assessment in Alberta

### 2.1.5.1 Final Selection of Criteria

Upon consideration of all the foregoing, it is my view that in Alberta the following criteria, divided into 2 tiers, should be applied to the evaluation of the routing alternatives, and route segment alternatives in agricultural areas. Tier 1 includes the more important criteria, while Tier 2 are important, but less compelling criteria. I should note these are the same criteria I put forth in route assessments that I completed dealing with the AltaLink Heartland Application, the AltaLink Western Alberta Transmission Line Application, and the 2016 Alberta Power Line Application.

#### Tier 1

- Avoid home sites.
- Follow existing linear disturbances. (ELD)
- Minimize line length and costs.

#### Tier 2

- Private versus Public Land. (Utility Corridors)
- Minimize agricultural impacts.
- Minimize environmental impacts.
- Avoid tree clearing.
- Minimize visual impacts.
- Avoid impacts on future development.
- Avoid conflicts with other power lines.
- Maintain ease of access.

## 2.2 Other Jurisdictions

We have conducted an internet search to find the nature of, and priority of (if possible), the routing criteria in use across Canada. The objective was to see if there were recurring or common elements that would provide broad based objective guidelines against which we might compare the Manitoba Hydro route selection process. Our review will go from East to West.

### 2.2.1 Quebec

We were fortunate to locate a very useful document that outlined the agreement between Hydro Quebec and the Quebec Farmers Association. This document is titled Agreement on the Siting of Power Transmission Lines on Farms and Woodlands, Dec 2000. This document identifies the impacts that the parties agree will occur, as well as the Siting Criteria Applicable to Farmland (pg. 26 of the document in Appendix 16).

The agreement notes the *“criteria are not listed in order of importance. Their application shall vary from one region to another depending on the nature of the project and the site (existing and foreseeable).”*

The factors are set out below.

- *Favor the siting of substations or power lines on the boundaries of or outside agricultural zones protected under the Act respecting the preservation of agricultural land and agricultural activities.*
- *Favor siting on agricultural land with the lowest potential in the study area, according to maps of potential prepared by the ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (Québec department of agriculture, fisheries and food, or MAPAQ).*
- *Protect sugar bushes, orchards, plantations, woodlands under development, windbreaks and other high- and average-quality woodlands in the study area, bearing in mind however that a right-of-way in this type of woodland could be developed for uses other than a right-of-way.*
- *Favor siting in poor-quality woodlands rather than on cultivated land.*
- *Where possible, favor orientation along lot, concession or any other cadastral lines and avoid running power lines diagonally across crops.*
- *Limit the number of support structures on cultivated land. Instead endeavor to locate them in residual spaces, groves or strips of woodland.*
- *Protect lands that have underground drainage or will have it in the short or medium term according to data available from the MAPAQ.*
- *Install infrastructure away from farm buildings and fish breeding ponds.*
- *Follow existing line corridors when they meet the criteria set forth above.*
- *Avoid areas subject to erosion.*

### 2.2.2 Ontario

We have located 3 different sets of information. One is an older (1975) report to the Ontario government on the process used to route a transmission line between Lennox and Oshawa. (Report of the Solandt Commission, April, 1975 (Appendix 17A)). In the context of the overall review, the report notes the criteria that were reviewed in the route selection process. The factors selected were:

- a) *Minimize damage to natural systems;*
- b) *Minimize conflict with existing land uses;*
- c) *Minimize conflict with proposed land uses;*
- d) *Minimize conflict with culturally significant features;*
- e) *Maximize potential for right-of-way sharing;*

- f) *Minimize conflict with capability analysis (proposed transmission facility should avoid those areas of high land capability as designated by the Canada Land Inventory).*

*Objective f) was to minimize visual exposure but in the final analysis this was considered to be part of objective b).*

*The variables that were considered were topography, surface hydrology, existing land use, existing road ways, communications and utilities, proposed land use, unique features, outdoor recreation capabilities, average soil capability for agriculture and capability for water fowl.*

We noted that of the many issues canvassed in the report, one item merited specific mention (see pg. 18 of the original in Appendix 17A). That factor was to, when possible, place the line “*along back lot lines*”.

We also found a List of Study Area Criteria that was applicable to the Bruce to Milton Transmission Reinforcement Project that was undertaken in 2007. The criteria are shown in Appendix 17B. There was no indication of priority; however, we note there were 14 Environmental criteria, 16 Socio-Economic criteria, and 7 more criteria related to Agriculture.

Finally, we located a Hydro One workshop report relating to the Essex County Transmission Reinforcement Project (2009). (See Appendix 17C). This is notable as it reflects direct input from the affected landowners. The factors considered most important were noted as:

- a. *Landscape and Visual Assessment,*
- b. *Proximity to Residential Dwellings, and*
- c. *Impact on Health / Noise from Transmission lines.*

These were the top considerations among the 11 factors listed. Notable was the preference to have the line “*in their backyard*”, as opposed to up by the road in “*front*” of their house, and “*as far as possible from residences*”. (See pg. 7 in Appendix 17C). It was also interesting to note that the only factors noted by the landowners related to Socio-Economic (i.e. residential issues) or Agricultural factors.



### 2.2.3 Saskatchewan

We located a number of documents that provide insight into the route (or corridor) selection process in Saskatchewan. It seems that Sask Power receives approval for a 1 mile wide corridor when it seeks to site a transmission line. Two documents reference a 160 km, 230 kV transmission line from Poplar River to Pasqua in southwestern Saskatchewan. The first is a portion of the Environmental Impact Statement proposed by Sask Power in April 2009. (See Appendix 18A). On page iv of the document, the corridor concept is noted. The Executive Summary further notes the comparison process entailed setting the route out on detailed satellite imagery maps so the most recent land use could be noted. Further extracts note that on this relatively short line, 253 individuals attended the open houses in the 4 locales where they were held. Those individuals provided feedback that helped guide the evaluation process. (see pgs. 84 and 85 of the document) Mitigation options were also devised in line with recommendations, especially in agricultural areas. Pages 193, 194, 210 and 211 of the document note the preferences for quarter section line placement of the double pole structures to be used on this line. A number of other measures are also cited as a means to get the structures out of the fields.

The second document is the approval by the Minister of the Environment of the line. (See Appendix 18B). Notable on pgs. 3 and 4 of the document is that the route with the least agricultural impact was selected. Further, the Public Consultation process revealed this was the “*principal issue*” raised. Hence, we can be sure that structure placement on field boundaries was a very important component in the overall process of reducing impacts to agriculture.

Finally, we found a Sask Power bulletin describing several projects. (March 2012, Appendix 18C). It is notable that they emphasize their preference for existing linear disturbances (ELDs), most notably quarter section lines. It is appropriate to note that these lines traversed areas that were sparsely inhabited.

### 2.2.4 British Columbia

The only information we could locate that concerned agricultural criteria in BC was related to the small agricultural areas traversed by the Vancouver Island Transmission Reinforcement Project, May 2006. (See Appendix 19). The key issues in route assessment were noted as:

- *Disturbance to agricultural land uses, including grazing and crop production during construction and operational activities;*
- *Soil disturbance and compaction during construction;*
- *Loss of crops due to construction activities on and access to the ROW;*  
*and*

- *Effects on farm worker safety during construction and operation of facilities including the potential for induced or stray voltage in wire trellis systems used to support crops.*

Given that 16 km in total of agricultural lands were affected, the document might be expected to be slim. However, 18 pages of detailed evaluation is set out in the larger Application document. A review of this section reveals that the nature of farming in these small areas is so different that the criteria were essentially inapplicable to the Manitoba situation. A short excerpt of the Application has been included to allow the reader to see the situation.

## 2.3 Assessment of Canada Wide Routing Criteria

### 2.3.1 Routing Criteria

Set forth above are samples of the criteria used to choose, compare, and select between potential transmission line routes in 5 other provinces of Canada. These are included in this report in order for the CEC to have a baseline to compare the quality and content of the routing efforts by Manitoba Hydro Application for the MMT Project.

Across Canada, the transmission facility operators (TFOs) appear to agree on a number of routing concepts in relation to routing through agricultural areas. The most common and repeated criteria include:

- Avoid residences, yards and farm buildings sites;
- Cause the least possible inconvenience to farmers;
- Use boundary or cadastral lines as the favored alignment, which is a subset of the larger goal of following Existing Linear Disturbances (ELDs); and
- Avoid high quality agricultural soils or zones.

## 2.4 United States Routing Approaches

It seemed worthwhile to review the southern end of this project to ascertain the routing methods employed by Minnesota Power. This would provide the CEC with further guidance on the process of route selection.

#### 2.4.1 Minnesota Power (MP)

Routing in Minnesota is actually governed by a set of legal principles set out in their statutes. The specific factors are set out below.

243. *The Commission's rules further specify the factors the Commission must consider in selecting a route. These factors include:*

- A. effects on human settlement, including, but not limited to, displacement, noise, aesthetics, cultural values, recreation, and public services;*
- B. effects on public health and safety;*
- C. effects on land-based economies, including, but not limited to, agriculture, forestry, tourism, and mining;*
- D. effects on archaeological and historic resources;*
- E. effects on the natural environment, including effects on air and water quality resources and flora and fauna;*
- F. effects on rare and unique natural resources;*
- G. application of design options that maximize energy efficiencies, mitigate adverse environmental effects, and could accommodate expansion of transmission or generating capacity;*
- H. use or paralleling of existing rights-of-way, survey lines, natural division lines, and agricultural field boundaries;*
- I. ...*
- J. use of existing transportation, pipeline, and electrical transmission systems or rights-of-way*
- K. electrical system reliability;*
- L. costs of constructing, operating, and maintaining the facility which are dependent on design and route;*
- M. adverse human and natural environmental effects which cannot be avoided; and*
- N. irreversible and irretrievable commitments of resources.*

The route planners at MP considered these factors as either Constraints or Opportunities, as well as Technical Limitations. (Appendix 20)

#### 2.4.2 Kentucky Legislation

The State of Kentucky considered the EPRI-GTC model, but decided it needed to be adapted to Kentucky values and factors. A copy of their Final Calibration is seen in Appendix 21. It is noteworthy that in their Built Environment category, over 60% of the criteria weighting deals with home site issues.

### 2.4.3 Routing Criteria Selection and Applicability

It is noteworthy that Quebec and Ontario specifically note that the criteria used to evaluate a route be locationally specific, while other provinces appear to choose location specific comparison criteria without stating it is an objective. Kentucky purposely localized their factors. Said another way, the criteria used to evaluate a route or route segment should be chosen based on the characteristics of the area through which the line will pass.

The environmental impacts are not ignored in the criteria dealing with agricultural areas. However, in the settled agricultural areas, environmental factors are most definitely weighted lower than the agricultural, human, or socio-economic factors.

In our view, this is a correct and reasonable approach considering the human influenced nature of the “*environment*” in agricultural areas, giving that word its broadest possible meaning.

## 2.5 Understanding and Applying Routing Criteria

In my opinion, it is extremely important to understand that a ranking exists in the selection of applicable routing criteria, as various competing aspects may be in play on any given segment or between similar route alternatives. If, for example, two relatively similar and technically comparable routes are in competition, but one is directly in front of a rural home site, and the other is, say a bit more costly and through cultivated land, the greater impact to be avoided, (i.e. home sites) would push the routing preference to the more expensive route through cultivated land.

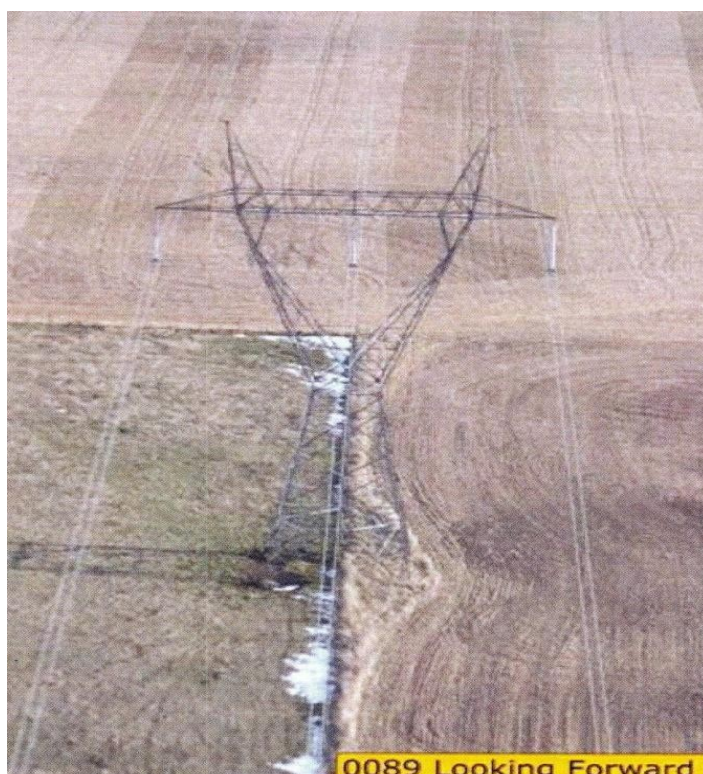
The task when applying routing criteria is to thoroughly understand not only the names of the impacts, and the concepts, but to weigh them. Then, with full understanding, selectively employ them to devise an alignment that, on an overall, as well as specific basis, is the “superior route”. And a superior route is one with the least overall negative impacts on the residents and lands through which the line will pass.

Further, and this is an important concept, the routing of transmission lines includes not only the route of the conductors in the air, but the placement of the towers that will carry those conductors.

The need for a thorough understanding of routing impacts extends to the selection of tower placements in agricultural land. With the policy of Manitoba Hydro to do “tower spotting” in the field, after approval, but before construction, the understanding of this aspect takes a heightened level of importance. The CEC can make recommendations that hopefully would guide Manitoba Hydro when they get to that point in the MMT project.

With over 35 years of power line compensation evaluation as part of my background, I have come to know that there are four possible settings. The uncultivated (UNC) bush or pasture settings are least problematic. This placement, as well as the others noted below, are all captured in a series of aerial photographs contained in Appendix 22. (See Photo 1 in Appendix 22 for an example of a UNC tower).

The headland (HL) is the next most desirable, with two legs on either side of a property line. The photo<sup>2</sup> below illustrates the minimal impact of this placement. (See Photos 2 and 3 in Appendix 22 for other examples.)



The operator farms “by” such an obstacle, on the first pass around a field, then, with some minimal overlap, is generally able to resume straight alignments in his equipment operations. The next most desirable would see a structure in a field, but near the fence, termed headland-one side (HL-OS). (See photos 4, 5, and 6 in Appendix 22). A tower five or ten meters into a field is generally similar in impact to an HL tower. Most operations still go “by” because it is generally not possible to farm “around” a tower, or between the tower and the edge of the field in this location. But the placement of an HL-OS that is 20 m to 40 m deep into a field, is much more problematic. With much of today’s larger equipment, there is not enough room to get “around” the tower base.

<sup>2</sup> Source: AltaLink Application; Western Alberta Transmission Line, Feb 28, 2011, pg. 134

These deeper H)S tower placements create a missed area in the field that is very large and that affects the farming pattern in a substantial way. This placement generates the largest Loss of Use of any tower placement.

The Midfield (MF) placement, (See photo 7 in Appendix 22) which creates the largest negative farming impacts (called Adverse Effect) of any tower placement, is an obstacle that can be approached on all sides with adequate turning room. While nobody likes to have a tower in a MF position, the overall impact is nearly the same as an HL-OS with a wide separation to the fence line.

If these impacts are not well understood, the route planner may create an alignment that sacrifices linearity, adds costs, and creates significant farming impacts, all because they perceive the priority is to stay as close to an ELD as possible.

In our experience, if a structure is HL-OS between 20 m to 40 m out into the field, but it cannot be farmed “around”, the agricultural impacts are getting to be similar to a MF tower. The only time a tower placement near an ELD would be a more desirable situation is if it is within 20 m or less (preferably much less) of the ELD, a property line in this agricultural example. And, as must be obvious, in cultivated areas, the HL placement is far and away the lowest impact placement location for an HVTL. With the foregoing understandings, a balancing of routing priorities may be achieved that result in a better route.

## 2.6 Application of Routing Criteria to the Manitoba Hydro Routing Process

With the foregoing discussion and routing criteria in mind, I will provide my evaluation of the routing criteria, and route evaluation process, contained within the Manitoba Hydro Application for the MMTP line.



### 3.0 EVALUATION AND CRITIQUE OF THE MANITOBA HYDRO ROUTING PROCESS USING EPRI-GTC

#### 3.1 The Manitoba Bipole III Experience

The Bipole III (BP) project involved setting a Project Study Area (PSA), which evolved into three alternative routings (designated A, B, and C). Each had a 4.8 km corridor that was the subject of much more intensive study. The initial phase of route planning involved a constraint analysis, or identification of no-go areas to be avoided. For the more general routing analysis, a Route Selection Matrix (RSM) was developed using 27 factors including biophysical, socio-economic, land use, engineering and stakeholder issues. After splitting the PSA into sections, there were 63 route segments to be evaluated using the RSM.

However, the RSM failed to generate a useful, transparent, or logical means for selecting a route.

Because the previous MH process is so closely tied to the current proceedings, it is worthwhile to note a few specifics.

The CEC, in its report on BP set out a number of key findings relevant to the route selection process used by MH. A number of these are important in the review of the MMTP routing by MH.

Referring to the RSM method, the CEC described it as follows in their Commission Comment : Route Selection portion of the Bipole III Report (pg. 35). They noted:

#### Commission Comment: Route Selection

*Manitoba Hydro's Site Selection and Environmental Assessment (SSEA) process appears to have been cumbersome, unclear and open to subjectivity....*

*Once three alternatives were identified, the site selection process was flawed by a combination of subjectivity, lack of clarity, and false precision. The Route Selection Matrix, for example, contained 23 different criteria, plus four categories for public responses and a mechanism for applying findings from ATK. These 28 factors were used to generate numerical scores for routing alternatives for each line segment. But there are numerous questions to be asked about how this process was carried out. In other cases the start or end points for alternatives differed, and potential impacts were transferred from one line segment to another. These situations created "apples and oranges" comparisons between sections.*

*The route-selection process lacked transparency in many ways. There were very few measurable thresholds that might allow one segment to be compared objectively with another. The scores attached to each of the criteria appear simply to be judgement calls.*

*The potentially invalid comparisons between alternative segments combined with the lack of objective criteria for the scores generated for each criterion mean that the final, combined numerical scores for the alternatives cannot be relied upon. Because of the lack of clarity and the potential for subjectivity, it was unclear where environmental reasons influenced route selection and where technical and cost considerations, such as the desire to avoid using costly angle towers, took precedence.*

*These challenges in route selection became especially acute in agricultural areas. In southern Manitoba, the Route Selection Matrix still included 23 criteria – with agriculture counting as only one – even in areas where virtually all land is farm land. Because of the lack of objective comparison in the Route Selection Matrix charts, it is difficult to know why Manitoba Hydro chose the route it did in agricultural areas...*

*...The Commission is aware that other route selection techniques are in use in Canada and elsewhere that employ quantifiable analysis of routing constraints and opportunities. These other techniques also allow for the results of public consultation to be quantified and used in the route selection process. Manitoba Hydro should investigate ways of applying techniques of this type in site selection processes for future transmission lines and other developments."*

### 3.2 How the Bipole III Report Relates to MMTP Route Selection Process Using the EPRI-GTC Process

The most fundamental characteristic of the EPRI-GTC (E-G) process can be summed up in one paragraph.

The use of algorithms and computers to process information and to generate recommendations and routes, is totally dependent upon clear, objective, logical, and most important – appropriate, inputs. The process of evaluating routing factors, by assigning weights and percentages to multiple criteria will generate “results” in the form of a mathematical score. With the E-G model, the lowest score, or least cost, is said to represent the lowest impact. But a review of that scoring and weighting process shows that there could be wildly different results depending upon the myriad of basically subjective, and unrelated series of sequential decisions made during the process that generated those inputs.



The E-G process has, in my view, the inherent flaw of false precision. The models may yield accurate mathematical results, but if, for example, the weighting for costs, as assigned by MH senior management in the Preference Determination step, was 25%, rather than the 40% that they chose independent of any stakeholder input, the results of each route score would be totally different. The foregoing problem of false precision may be found in yet another component of the E-G model.

MH adopted the State of Georgia based E-G model's use of 1/3, 1/3, 1/3 natural, built, and engineering analytical factors. They clearly assumed it was applicable to southern Manitoba without any critical scrutiny or analysis of any kind.<sup>1</sup> In the original technical paper, it was noted these could be changed.

### ***“Qualitative Expert Judgment***

*The project team uses evaluation metrics that are normalized and assigned weights developed using AHP to derive a relative score for each Alternative Route (Appendix G: Phase 2 – Alternative Corridor Weighting: AHP Pairwise Comparison Questions). The scores are combined for the three Perspectives (Built Environment, Natural Environment and Engineering Requirements) and then totaled for an overall score. The numerical score provides an objective reference for comparing Alternative Routes and stimulated discussion of their relative merits.*

*The left side of Table 2-7, Evaluating Alternative Routes, shows the translation of the “raw” evaluation metrics to normalized and weighted score. In this example, the sub-criteria for each perspective are assigned relative weights. For example, the Built Environment Perspective’s consideration of relocated residences is much more important (40 percent) than close Proximity to Industrial Buildings (2 percent). The three perspectives are weighted equally (33 percent) in this example, but these weights could be changed to make a routing solution more sensitive to the Built Environment Perspective, Natural Environment Perspective or the Engineering Requirement Perspective.”*

Without some justification, there is no basis whatever for the CEC to assume or conclude that cloning the E-G model will yield valid results applicable in Manitoba. Indeed, Kentucky used E-G and had totally different weights.

Moving beyond the inherent weakness that arises in the employment of the E-G model in route selection, the routing team at MH does not appear to have understood or applied a number of recommendations arising out of the Bipole III Report. In that document, the CEC was critical of invalid comparisons, for example, comparing agricultural impacts with factors found only in forested or Crown land areas.

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<sup>1</sup> See transcript of Workshop, pg.104 and pg. 106.

The same could be said of the E-G comparison of Built environmental concerns in areas of mostly Crown land. A route through the eastern portion of the study area would rate as low impact on home sites, but high impact on the natural environment. But that type of comparison is self-evident, not a useful comparative analysis at all.

The invalid comparison aspect involving forested or Crown lands brings up another element where it appears MH failed to comprehend the thrust of a recommendation from the CEC. In Sec 7.4, pg. 40 of the Report, the CEC advised MH to “*discontinue using undeveloped Crown land as a default routing option without appropriate assessment of the impact...*”(my emphasis).”

But, it appears they took this direction to effectively avoid Crown Land completely. Please see the comments on Pg. 5-59, Sec 5.4.3.4, and especially on Pg. 5-90, the bullet on Built criteria. It is quoted below.

**“Built**

- *The percentage of Crown Land versus private land on each route was considered. Due to Manitoba Hydro’s established and clearly defined process for the acquisition of private land, the risk to schedule was seen as lower for routes with more private land. Routes with more Crown Land (AY and SGZ) were scored less favourably (i.e., higher). If there is more Crown land, there is a potential increased amount of work and time associated with the Crown consultation<sup>6</sup> process.”*

<sup>6</sup>*The province must complete its Crown consultation process prior to Manitoba Hydro obtaining a licence for the Project. Environmental Act licences can be issued prior to the acquisition of all private land parcels for a project.”*

Any routing agency that prioritizes private land over public land because it is easier and more expeditious to acquire private land has their routing priorities seriously out of balance. There is something perverse in a process that actively avoids using Crown Land for the purposes of a Crown Corporation project. The Supreme Court of Canada has indicated that, “*The expropriation of property is one of the ultimate exercises of governmental authority.*” (Toronto Area Transit Authority v. Dell Holdings Ltd.) The decision to use private land because it is easier to obtain is unjustifiable and terrible routing criteria.

The clear implication from the CEC’s comment is not to ignore or de-emphasize the use of undeveloped Crown land, but to assess the nature and extent of impacts of any kind, consider appropriate mitigation, and then contrast that with the nature, type, and extent of impacts on the alternative, ie. developed lands. Absent this type of comparative process, we are left with a subjective process where a biologist is weighting impacts on fish against an agrologist concerned with farming around towers.

In another example, on the other side of the table, a stakeholder is worried about a tower close to his house, while an engineer with MH is worried about the cost of a deflection tower. None of these side by side comparisons represents an equal either-or question. Yet MH gives them ratings of 1, 2, or 3, and then weights them to yield a supposedly most suitable route. MH has, in this step, confused Impact Assessment with Process evaluation.

Further commentary is required on the E-G process of scoring and weighting. If a series of numbers that tally up to a golf type score where lowest is best (ie. least impact), it is important that the scoring process not unintentionally impact the process. But in the MH model that appears to be exactly the situation.

Using the Preference Determination Model for The FPR seen on pg. 5-119 of Chapter 5 as an example, the impact of a 1, 2, or 3 assigned score can be seen. Obviously 2 is 100% greater than 1, and in a summing process that can impact the outcome. In Table 5-35 (p. 5-119), three routes can be contrasted. Before conducting this exercise, I need to note that in this penultimate scoring Table 2 of the Total sums are incorrect as shown. BMX adds up, using the printed weighted scores to 1.625, not 1.66, while BMY totals 1.155. The rounding in the table is very inconsistent. One can arrive at the totals shown if each weighted score is run to 3 decimal points. Using the totals in the table, I see BMX with a 1.66 total, BMY with a 1.15 total, and BOB with a 1.49 total. BMX at 1.66 is .51 points, or 44% higher than BMY. BOB at 1.49 is .34 points higher or 30% higher than BMY. On the basis of this evaluation, BMY became the Final Preferred Route (FPR).

Reviewing these numbers one might conclude BMY was far and away the lowest impact route. And that conclusion should presumably be clear across the board, given the 30% and 44% “better” scores.

But a closer look at the components tells a different story. A review of the table below shows just how close the ratings are for 5 of 6 criteria, excluding Community.

From Fig 5-35: Weighted Scores

	BMX	BMY	BOB
Cost	.400	.400	.400
System Reliability	.100	.100	.100
Risk to Schedule	.075	.050	.075
Env (Natural)	.100	.075	.090
Env (Built)	.200	.230	.230
Subtotal:	.875	.855	.895

The difference is now .04, or 5% of the “best” score. Where does the rest of the difference arise? The table below is instructive.

	BMX	BMY	BOB	Extent of Difference
Community Score	2.50	1.0	2.0	1.50
Community Weighted Score	0.75	0.3	0.6	0.45

The extent of the difference in score is all the more puzzling when one sees the similarity of the vast majority of these three route alternatives. There is only approximately 15 km of length difference in all three routes (See Map 5-21). Further, the tables on pgs. 5-113, 5-115, and 5-116, show the routes are almost indistinguishable from each other.

We can now see that the single community aspect of the routing criteria, which makes up only 30% of the weight (a completely arbitrary figure to be discussed elsewhere), has accounted for an inordinate percentage of the differential scores. The percentage contribution to the total score is shown below.

<u>BMX</u>		<u>BMY</u>		<u>BOB</u>
$\frac{0.75}{1.66}$	= 45%	$\frac{0.30}{1.15}$	= 26%	$\frac{0.60}{1.49}$
				= 40%

In my view, this comparison displays the kinds of problem that can arise when scoring of wildly different factors are put on an equivalency basis. It creates a pseudo-scientific appearance that defies the typical observers attempt to critique the result, or even argue with the method. It is another example of false precision, as well as an apples to oranges comparison.

In a repeat of the problem noted by the CEC in Bipole III, where a lack of an objective analysis hampered the Commission's process, MH has repeated the error in assigning the scores (ie. 1, 2, 3) that lead to the mathematically misleading conclusions.

The best possible example of this subjectivity is seen in the discussion of Community found on pg. 5-118. In a sentence that perfectly encapsulates the issue, MH states, "*The highest rank was given to the route(s) that best balances the overall concerns.*" MH then goes on to note a number of issues, but gives no mention at all to the BMX and BXP routes, while BOB merits but a single line in the Community discussion.

The result is a completely opaque rating relative to this pivotal aspect that drove the FPR. It is evident to me that the foregoing described E-G scoring process would fairly easily be manipulated to produce support for a desired outcome. At best it is a reflection of a subjective set of opinions. The process of arriving at the final scores and weights is set out on pg. 5-38 to 5-40. In addition to the workshops, inputs and discussions that led to the scores, the CEC needs to understand that the route selection process and more importantly, the final route selected, was effectively determined by 3 people in MH, as seen on pg. 5-6, or 4 people as revealed in Mr. Toyne's cross-examination of the MH panel.\* A quote from pg. 5-38 removes all doubt about the critical nature of this element of the route selection process.

*"Senior Manitoba Hydro managers (management team) from the Transmission Business Unit set the criteria and weightings that are used in the preference determination model, presented in Table 5-9. Because this is the final step in route selection, high level criteria and weightings set by the management team represent the key considerations of Manitoba Hydro in decision making related to transmission line projects."*

The significance of this statement in a discussion of route selection and impact assessment cannot be overstated. Over half (Cost, 40%, System Reliability, 10%; and Risk to Schedule, 5%) of the criteria are self-serving MH driven factors. This is so at odds with the rest of Canada or US approaches, as discussed earlier, that it is difficult to describe. It is worthwhile to note that this process of criteria selection and weighting was done in 2013, well before the PEP process that supposedly guided MH in routing the MMT line.

This aspect deserves further discussion. MH has gone to some effort to make their model appear to replicate the E-G model. To this end, they have re-named the "Expert Judgment" step in E-G. MH calls it Preference Determination. (See transcript from Workshop, pg. 147) However, a careful comparison of the E-G model and the MH process show a number of important differences. Most notably, the Preference Determination (PD) step utilized Criteria and Weighting determined in 2013 by a group of MH executives as noted above.

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\*Given the detail on pg. 5-6 of the members of the Management Team, it is difficult to understand how there could be any confusion on this point.

These criteria and weights became fixed elements in the analytical process in each of the 3 Rounds. Each of the top (i.e. lowest impact totals) routes in each round, based upon the 1-9 scored criteria that was achieved during the workshops and meetings of professionals in various disciplines, were subjected to the 1, 2, 3 ranking process.

The rank was then weighted by the pre-assigned percentage, and the added-up score indicated the preferred routing.

The E-G model on the other hand, used only the 1-9 rank scoring in each step to get to the final aspect of selecting the preferred route. The E-G model is set out on the next page in the quote from the original technical paper (pg. 2-45)

### ***“Selecting the Preferred Route***

*The final step in the evaluation process applies expert judgment for ranking the top Alternative Routes (Appendix H: Phase 3: Preferred Route Weighting AHP Pairwise Comparison Questions). Each siting team member ranks the top scoring routes based on several important considerations: visual concerns, community concerns, schedule delay risk, special permit issues and construction and maintenance accessibility. These considerations are assigned weights (5, 25, 30, 30 and 10 percent respectively), and individual responses are combined for an overall team ranking.*

*It is important to note that the specific evaluation criteria can be expanded or contracted as the unique aspects of routing situations vary. However, the general process of deriving and evaluating explicit metrics remains the same. The process is designed to encourage thorough discussion of clearly defined evaluation criteria that explicitly captures the thought process of the siting team in evaluating and selecting a final route. The process is objective, consistent and comprehensive, while directly focusing and capturing siting team deliberations.”*

As can be seen in the original E-G method, the entire process of ranking the top Alternative Routes, as well as the assignment of weights (i.e. 40%, 30%, etc), as well as the 1, 2, 3 ranking is done by experts, not by executives.

The difference is meaningful and stark. MH, at the outset, said dollars are more than 5 times (40% vs 7.5%) more important than homesites. This decision pervaded the entire route seeking process because it was applied during each round.

Contrast this to the original process in Georgia. It utilized experts, at the end of the process, to set the weights. Those experts, as noted in the quote above, debated the weighting so as to capture the importance of the various criteria they learned about throughout the process. That seems to me, despite my misgivings about a numerical routing process, to be a much more appropriate order of decision making.

Another issue with the routing process generated by MH, deals with the sequential routing process. As discussed in the Workshop held on January 19, 2017, it was made clear by MH staff that as the project proceeded, criteria shifted that had major effects on the numerical rating for various routes. But because MH was locked into a process, a route discarded due to a bad (read high) rating due to the proximity to the existing M602F line was permanently dropped from consideration. (See pgs. 83 and 84 of the Workshop Transcript), Here again we can see the distortion in evaluating appropriate routing criteria due to the prioritization of MH goals early in the process, over the concerns and likely impacts on stakeholders, across whose lands the transmission line will pass. This again is at odds with the impact avoidance models used all across Canada and the U.S.

Another aspect of the problem caused by multiple reviews that dropped routes from further consideration, is found in the quest for a border crossing. After it became evident that Gardenton would not work for Minnesota Power, the two Piney crossings were the only remaining options. But to create a separate routing and separate analysis for crossing locales that were perhaps a kilometer or two apart is another example of false precision. Indeed, at the end of all this questing for a crossing, the Border crossing location was modified to nearly split the midpoint between them.

It is important for the CEC to understand this particular element of the routing decision process, and how consequential it is to look critically at the process of grouping routes by border crossing. It is clear that viable routes were lost due to the vetting process, not because of inherent defects or excess impacts arising from the route itself. Further, the assignment of a route to an end point saw the entire route thrown away when the only “fatal flaw” along that possible route was in the most southerly few kilometers.

A review of a few maps will illustrate that this situation effectively took all the eastern routes out of contention before they could be fully considered. If we observe the Adjusted Border Crossing blue dot on Map 5-19, one can see it is just east of the north south river that crosses the border. Turning now to Map 5-13, as may be seen, Route DKT lies due north of the final crossing. But, because it deflected 1 km or so north of the border to terminate at Piney East, it was totally discarded when Piney East was rejected, as discussed in Sec 5.4.3.5, pg. 5-61.

The significance of this decision to discard the eastern routes shows up as the next step unfolded. As described in Sec 5.5.2, the preferred route from Round 1, identified as AQS, formed the spine of all future evaluation, both within MH, as well as through the PEP and ATK processes. As seen on Map 5-16, the new or added segments were all close or parallel to AQS. All the efforts going forward were intended to mitigate impacts that arose as a result of the AQS initial preferred route. The first example cited, and shown in Figure 5-10 is put forward as a positive example of the PEP and feedback. In reality, it displays in the clearest possible way, the fallacy of a machine planned route. The purple Round 2 Alternative Route is so poor, and violates so many routing principles, that it should never have seen the light of day.



As the Round 2 Preference Determination process unfolded, the scoring process shown in Table 5-28 reveals what happens when mathematical based scoring is employed to evaluate criteria that are, by their very nature, opposing factors. The best example is Environment Natural versus Environment Built. Natural advocates in the Round 2 route selection workshop held in November 2014, saw any routes through Crown land as the worst (See AY as a 3) and routes through farm land as best (URQ as a 1). Conversely, the Built team members saw exactly the reverse (AY as 1, URQ as 3).

The obvious and predictable result was a cancelling out of what would, in the rest of Canada, be a hugely important factor – Avoid Home Sites. The relatively similar scores for costs, risks to schedule and system reliability did not total enough to yield a true lowest score winner. So again, the best score is determined by the Community criteria, which as we have seen, has nothing but opaque subjective judgement as a basis. The moment the score of number 1 was assigned, versus say 1.5 due to competing interests, the die was cast.

The effect of the avoidance of Crown land was further revealed during a review of this part of the Preference Determination process. Rather than consider routes that ran through Crown lands in the context of *“appropriate assessment of the impact on ecological, traditional, or cultural values of those lands,”* MH simply scored them a 3.

This decision to score a 3 for a Crown Land route does a disservice to the CEC, as it takes away from their role as decision maker relative to assigning weight and importance to the differing and competing factors. MH had a duty to assess the values identified by the CEC in the Bipole III Report, and allow the CEC to decide if trees, birds, plants and cultural values were more or less impacted and important than home sites, farms, and populations. The MH prejudice against routes through Crown land was also revealed prior to any of the kind of assessment referenced by the CEC, in the MH reasons for the Border Crossing selection. In March of 2014, they advised Minnesota Power that it was an undesirable routing option because of the primary routing through Crowns lands. (See pg. 5-59). This effectively killed the eastern route options.

The final aspect of the E-G process that rendered the results unreliable is the sheer number of analytical factors that were combined in scoring and comparisons. In the earlier Border crossing evaluation, Built had 12 criteria, Natural 5, and Engineering 5 for a total of 22 factors. (See pg. 5-35) The prospect for dilution is apparent at the earliest analytic point.

But the multiplicity of factors contributing to the mathematical decision making gets worse the further we dig into the process. On pgs. 5A-15, 16, and 17 we find, as part of the Alternative Corridor Evaluation Model 27 Engineering factors, 46 Natural factors, and 59 (!) Built factors, for a total of 132 contributing categories. Dilution is an understatement. It is, in my view, impossible to reconcile so many factors into a transparent or understandable judgement process. This harkens back to the CEC comment about 28 factors used to determine numerical scores.



If this miasma of numbers were not confusing enough, the final weighting of criteria in the Preference Determination step shows how little MH cares for the concerns expressed by the stakeholders. In the PEP process, in the Round 1 results, the top two categories by a wide margin were: *“Separation from residences and urban acres”*, and *“Avoid agricultural lands”*. (PEP, pg. 30) In Round 3, *“Property and Residential Development”* was the top category (pg. E5-6). However, the Management Team at MH decided that 7.5% was all the weight that should be accorded to the entire Built Criteria, and only roughly half of that related to homesite issues.

I found that despite a total weight of 50.6% in the Built Criteria of the MMTP Alternative Route Evaluation Model (pg. 5A-27) for the most important Homesite Avoidance routing criteria, that factor was relegated to only 3.5% (50.6% of 7.5%; pg., 5-119) of the total mathematical contribution to the score that selected the final route!

Just to summarize this especially important aspect of the route selection process, the original E-G model has 1/3 of the weight for the Built Criteria. And they noted it could be modified in line with local factors. The PEP process showed, far and away, Homesite Avoidance was the major concern, followed by minimizing farming impacts. In the face of that information, MH decided that Homesites will be such a minor contributor to the route selection formula as to make it a meaningless criteria, easily balanced out of relevance by the Natural criteria.

A process, computer facilitated or otherwise, that generates a result that pays so little heed to such evidently important criteria, in my view, lacks any credibility whatsoever. Further, the route selected, scored, or evaluated by that process cannot be judged to have the lowest impacts on the lands, environment, and people under or beside that line.

## 4.0 EVALUATION AND CRITIQUE OF THE BMY FPR

### 4.1 Introduction

Up to this point in this report I have set out the routing criteria in widespread use across Canada. Further, I have evaluated the MH routing process and criteria that they have set forth in their application. While I have highlighted the inappropriate criteria and weighting, as well as the lack of transparency in their route selection process, MH did come up with a FPR. It is now appropriate to look specifically at what they have submitted to the CEC.

I see this review taking two steps. First, the corridor selection, and second, the specific attributes (or problems) with the FPR.

### 4.2 Corridor Selection

The first thing that strikes me is the Border Crossing, and how entire, top to bottom corridors, were set out based upon a prospective end point. From the west side of Gardenton East to the east side of Piney East there were 60 kilometers of border involved.

Rather than meeting to get some appreciation of Minnesota Power's (MP) views upfront, whole route options were devised and evaluated that died the first time they were shown to MP. The Gardenton crossing was too far west for MP, which should have been obvious considering the MP end point, the Forbes Station, which lies some 160 km east of the eastern Minnesota border with Ontario (See Map 5-1, and discussion on pages 5-59 and 5-61). Map 5-12 shows the 5 complete routes that were run through the E-G process before being summarily dropped.

The other element of the Round 1, Corridor determination process that is troubling is the assignment of 8 entire route alternatives being generated, with 4 assigned to each of the Piney East and Piney West points. These crossing sectors were only 2 km(!) apart.

In my view, a process that seeks to devise separate corridors for end points that are essentially the same is a contrivance. Two crossing sectors called East and West Piney is a distinction without a difference.

### 4.3 Route Selection and Characteristics – Final Preferred Route

At this point in the evaluation, MH notes there were 750,000 alternative routes (See pg. 5-32) that were found in the 3 prospective corridors. In my view, it is highly inaccurate to call a series of points a route just because one could start at Dorsey and end up somewhere on the US border.

Turning now to the actual FPR, as noted in Chapter 5 of the application documents, the location of the routes were determined by a sequence of decision making steps using pre-determined parameters. As I noted earlier, many of the determinative criteria were distinctly at odds with well established factors at work across the country. Employing these led, in my view, to a number of poor routing decisions at various points. Taken together, and as discussed in detail in the next section of this report, the MH (Final Preferred Route (FPR) designated as BMY (See Sec 5.7, pg. 5-120) is a high impact route compared to other possible routes, some of which were explored and rejected.

#### 4.3.1 Specific Comments

The only reasonable way to comment on specific route elements is by cross-referencing the exceedingly small scale Map 5-20, plus the legal descriptions. The process would have been greatly enhanced if deflection points were numbered from start to finish once the FPR was selected. Instead the non-sequential segment numbers must be used, many of which were discarded as the process unfolded.

##### 4.3.1.1 Segment 401, NW¼ 17-10-7 E

Here the FPR runs south to the railway ROW. It then turns SE at a 75 degree angle for approximately 550 m, turning then to the south with a further 75 degree angle. The large heavy angle structure on the north side of the railway tracks is approximately 250 m from the homesite in the SW corner of the NW ¼ 17.

A much less costly and lower impact routing is available at this point. I have termed this Berrien Alternate Route 1 (BAR 1). Illustrated on the next page, two 45 degree angle towers (much less costly), plus one midspan tangent tower (spaced approximately 350 m from the angle towers) will cover this portion of the route. This alignment increases the spacing for the closest homesite to 500± m, while keeping the separation from the homesite in the NE corner of the NW¼ 17 at 400 m.



#### 4.3.1.2 Segments

Seg 451 (Map 5-20, Inset 1); SW¼ 28-9-7-E

Seg 452 (Map 5-20, Inset 1); SW¼ 15-9-7-E

Seg 406; SW¼ 18-8-8-E

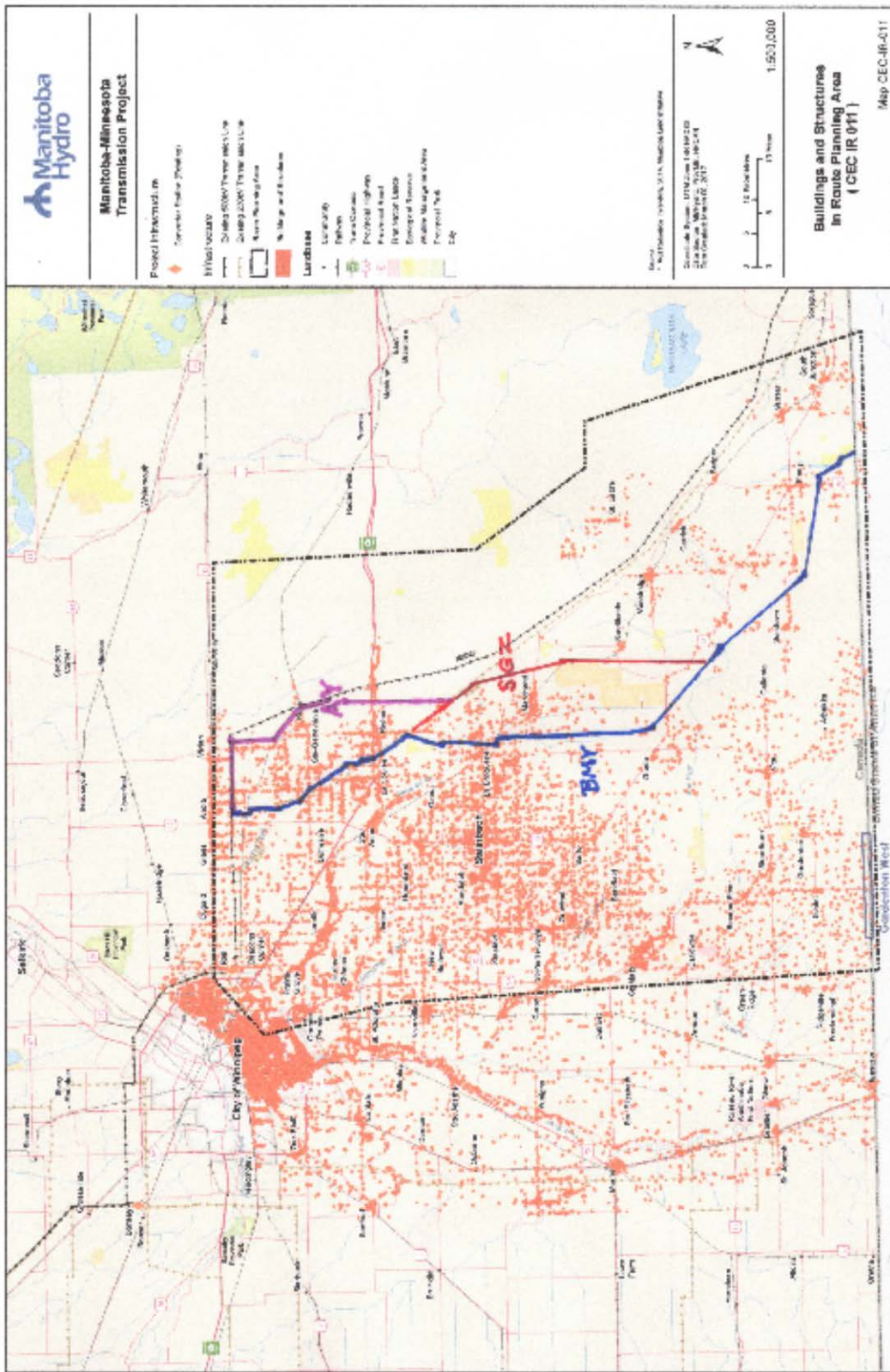
Seg 407; SE¼ 18; NE¼ 7; SE¼ 7-7-8-E

Seg 469 (Map 5-20, Inset 2); La Broquerie and NE¼ 31; SW¼ 32

All the aforementioned locales have high concentrations of homesites within close proximity of the MMTP line. This is the highest impact situation in all route planning processes, with the evident exception of the MH modified E-G approach, which does not prioritize homesite avoidance. Such placement of a high steel power line should be avoided if logical and reasonable alternative routings are available.

I have utilized Map CEC-IR-011 (see next page) to illustrate the issue. Only 10 km or so to the east of the BMY route, (the FPR), there are two Round 2 route segments, AY and SGZ that I have sketched on the Buildings and Structures map. The differences are stark. While there are other routing characteristics and criteria involved, from the number one impact criteria perspective, there is no comparison.





#### 4.3.1.3 Segments 482 and 472 (Map 5-20, Inset 3)

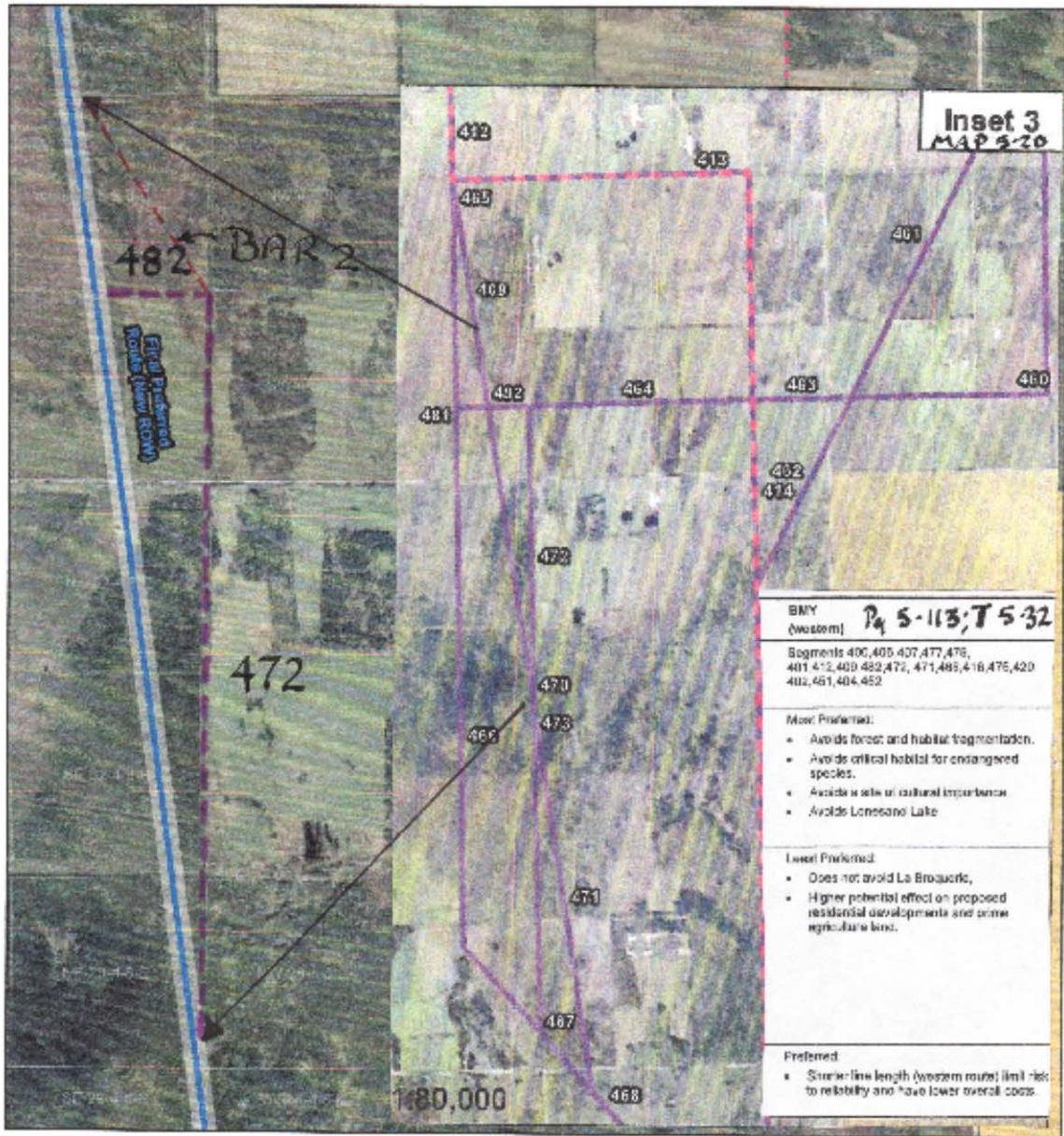
In this portion of the route, the FPR is not shown on the map viewer in the correct location. Route BMY, the FPR, is noted to follow Segments 409, 482, 472, 471 and 468. The mapping shows it follows Segment 409 down to 468. It is self-evidently critical for the CEC to know which of these routes is actually being applied for. I simply cannot tell from the discussion and description in Chapter 5 which is the FPR. Depending on the actual preference, the statistics of the route may well change.

I would further comment that the Segment 482, which is specifically included in the description on pg. 5-113 is, to my eye, a highly expensive routing with 2 of the heaviest and most expensive structures only 400 m apart. A diagonal routing from approximately the north boundary of the NE¼ 5-5-8-E, down to the junction of 482 and 472, would run through wooded land, not near any buildings or other features. I call this BAR 2.

All these aspects are shown on the map on the following page.



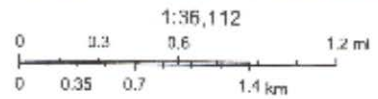
### MMTP Final Preferred Route



May 10, 2017

**Final Preferred Route**

- Final Preferred Route Southern Loop Transmission Corridor (SITC)
- Final Preferred Route Riel to Vivian Transmission Corridor (RVTC)
- Final Preferred Route (New Right of Way)
- Proposed M802F
- M802F Salvage
- - MMTP Round 3 Preferred Route



Utility & Environmental Assessment  
 Source: Esri, DigitalGlobe, GeoEye, IGN, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

MapInfo 11.5  
 Version: USA, FEA, DigitalGlobe, GeoEye, IGN, CNES/Airbus DS | Utility & Environmental Assessment

## 5.0 ALTERNATE ROUTING

### 5.1 Introduction

As noted in earlier sections of this report, the FPR is a high impact route that came about as a result of a flawed routing process that failed to properly consider the impacts a high voltage transmission line (HVTL) will create. Having disparaged the BMY routing, what alternatives may be placed before the CEC for comparative purposes.

Given that significant components of the MMTP route are not, at least in my view, problematic, it would seem appropriate to note these are approvable, then focus on the problematic ones. In this respect I should add that over the last few years I have proposed this exact thing to the two Alberta regulatory bodies, and they have taken up my recommendations. The “ends” of a pipeline near Fort Saskatchewan were approved by the Alberta Energy Regulator, while a middle section was rejected and revisions were required. In another example, the segment of a power line through Claresholm, Alberta was sent back for review by the Alberta Utilities Commission, while the rest of the line was approved. Hence, there is precedent for what I am proposing. Obviously, such a move must fit into Manitoba’s legislated guidelines, but I leave the “how to do it” to others.

#### 5.1.1 Acceptable Portions of the MMTP Route

Reviewing the Canada wide criteria, and using my own well defined factors, it is evident to me that the Dorsey to Vivian portion of the Southern Loop Transmission Corridor is very suitable for the MMTP line. It uses existing linear disturbances (ELD’s) and makes use of MH previously acquired ROW. The new line will have an existing HVTL in either the foreground or background, so the view impacts are incremental rather than new.

In reviewing this stretch of the MMTP line I noted that some 18.5 km (see pg. 5-121-122, Sec 5.7.1.1) of this route is immediately beside an existing HVTL that is oriented in a north-south direction. The rationale for this route selection is to avoid new ROW through prime agricultural and rural development land. These are factors that the landowners along the FPR from Anola south would also think are very important criteria.

However, this the north-south orientation of side by side HVTLs was made despite the objections of the MH engineering staff respecting parallel close north-south alignments south of Vivian. This concern seems to have abated to a degree after weather studies indicated what was evidently acceptable risk levels.

A review of the Weather Study document found in the Biophysical technical data reports as Historic and Future Climate Study, in Sec 3.3.2.3 Tornado Occurrences (reproduced in amended format with added data on the Fujita Scale on the next page) shows the location and intensity of recorded tornados for southern Manitoba.



### 3.3.2.3 TORNADO OCCURRENCE

The effects of climate change on tornado occurrence are difficult to model. Poor quality of observational data means studying and predicting tornadoes is difficult based on historical data (Brooks, 2013). By combining statistical methods with lightning flash density data and population density data, Sills et al. (2012) identified southern Manitoba as a region prone to F2 to F5 tornadoes. Using data from Sills et al. (2012), Figure 17 shows general locations of all confirmed and probable tornadoes between 1980 and 2009 in Southern Manitoba.”

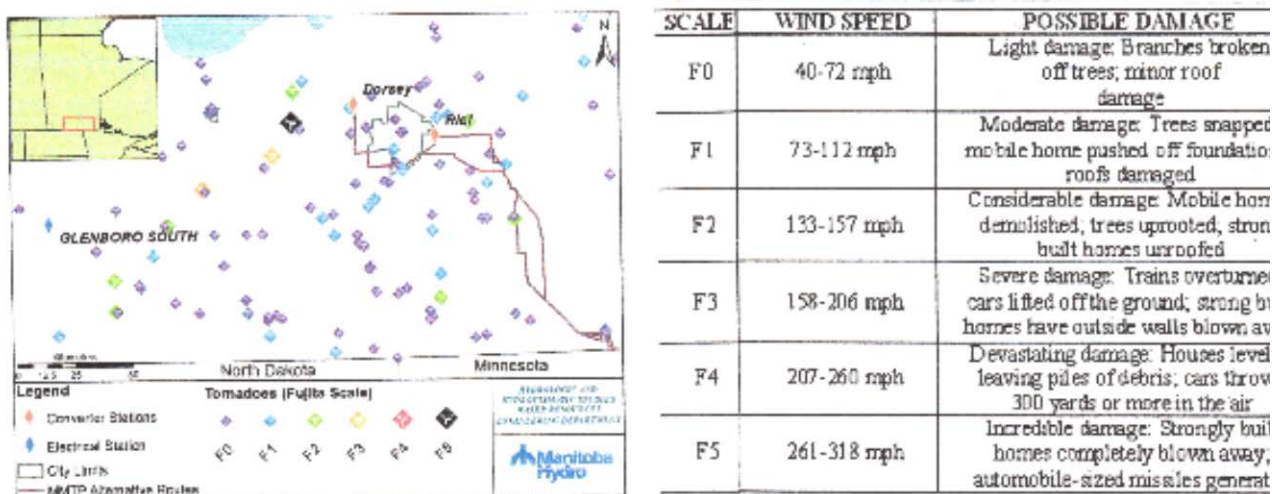


Figure 17 - Confirmed and probable tornadoes for 1980-2009 (Sills et al., 2012)

Future tornado projections can, however, be centered on the processes which lead to formation of tornadoes. Two important parameters in formation of convective storms and tornadoes are convectively available potential energy (CAPE) and deep troposphere wind shear (SHR6). Climate change simulations suggest an increase in CAPE and a decrease in SHR6 (Brooks, 2013). While decreases in SHR6 lead to lower occurrence of tornadoes, Dillenbaugh et al (2013) found that the decreasing SHR6 occurs on days with low CAPE. Days with high CAPE were found to have also have low convective inhibition. The atmospheric conditions on these days may increase the occurrence of severe storms and tornadoes (Dillenbaugh et al, 2013). Therefore, both Brooks (2013) and Dillenbaugh et al (2013) indicate that the increase in CAPE in future climate scenarios may lead to more favourable conditions for severe thunderstorms and tornadoes, however there still remains a high degree of uncertainty in projections on conditions that favour tornado development.

Cusack (2014) found that tornadoes are 50% more frequent over metropolitan areas, after corrections for observational bias. This is because of the heat island effect of cities and increased roughness causing an increase in low-level shear (Cusack, 2014). If climate changes were to amplify the urban heat island effect, it is possible that this could result in an increased risk of tornadoes over and downwind from metropolitan areas.

A weather-risk assessment (Teshmont, 2006) states that as summer and spring temperatures increase as a result of climate change, there may be an increase in tornado frequency in southern Manitoba. A related weather study on transmission lines states that, despite a low probability of occurrence of tornadoes in Manitoba, there is a higher probability that tornadoes will cross transmission lines because of the long tracks of both the transmission line and the tornado itself (Morris, 2014).

For the CEC to gauge the weight to be given to this aspect of routing (i.e. separation from an existing HVTL transporting power to and from, [mostly to] the USA), it seems appropriate to see what the MH team saw. By my view, Fig 17 and the reading of the text, the more damaging tornadoes would be expected in the area of the north-south 18.5 km MMTP routing immediately west of Winnipeg. Given this level of risk acceptance, it seems reasonable that a similar or lower risk profile would allow for some side by side routing on a north-south alignment on routes a few kilometers further east of the FPR.

Moving on, it would also appear to me that the more southerly segments of the FPR would also be non-contentious. This segment would be the portion that runs southeast from the junction of the south end of SGZ with URV as seen on Map 5-18. I recognize URV is superceded by BMY, but the junction point is effectively the same.

The issues I have with the routing are all found from Vivian to the SGZ/URV junction. In my view, approval of the “ends” of the FPR would not be inappropriate.

#### 5.1.2 Prospective Alternate Routes

MH, in the early Round 1 and Round 2 evaluations, discarded routes based upon their misguided criteria and weights. If the CEC agrees with the rest of the country, they may decide that certain earlier routes are indeed, worthy of consideration.

In my view, there are three prospective routes, a comparison of which would allow the CEC an opportunity to exercise their own collective judgment on criteria and weighting. Using as much as possible the data that can be gleaned from the MH multiple route evaluations, I have set out in the next section, the statistics for a variety of criteria typically important across the country.

MH did not make this comparative process an easy one to undertake, as the statistics were not put on a consistent basis. Some incorporate the South Loop Corridor (SLC) and therefore start at Vivian. Others kick off part way through the SLC. So, in an effort to provide some consistent basis, I have selected three routes with a common start and nearly common end point at the US border. I concede there can and should be tweaks to any of these statistics when final detailed routes are re-evaluated through the PEP. That process should follow if the CEC remits the central segment back to MH. But the comparisons should be valid in their overall indications of the various route characteristics.

The first of the three routes I have chosen is BZG, the farthest east route from the Piney West review. Then I selected the AY route from Round 2 as a middle route. Finally, the SIL route from Round 2 is a proxy for the BMY route selected as the FPR. This BMY is farthest west, but for some reason the statistics in Table 5-33 start at Anola rather than Riel, as do all the tables up to that point. Hence, the need for the SIL statistics.

Given that the statistics applicable to the selected routes are the basis for any comparative process, including the E-G one employed by MH, it is imperative they be reliable. However, it is extremely unsettling to note that a cross check of the statistics provided in Chapter 5, pages 85, 86 and 87, with the data in the Reply to SSG-IR-251 shows virtually no agreement. For the SIL route exactly 1 out of 22 parameters is the same on both tables. For the AY route, 19 of 22 are different. While I laud MH for setting the record straight, it is more than disconcerting to see many of the values off by large percentages. It must also raise a very serious question about the capacity of the workshop participants back in February 2014 to do their job when they had such faulty data. The reliability of the expert's opinions rests on the reliability of their data. Here, there is no such reliability and it is impossible for the CEC to rely on a number based routing process when the base numbers are uncertain. A true example of a garbage in – garbage out analysis.

For the comparison, the updated statistics for AY and SIL will be used. For BZG I am forced to utilize the likely shaky data from Table 5-16, pg. 5-51.

### 5.1.3 Comparative Statistics

The following table will set out the meaningful statistics that relate to the important Canada wide criteria. Where certain criteria have a calculated “value”, rather than an actual measurable and observable statistic, I will not use it. As well, for the “Feature” in Table 5-27 labelled Current Agricultural Land Use, I will substitute acres of crop land and hay land, which were provided through the IR process.

The chart will note what reflects a “good” route trait or a “poor” route trait. The statistics are then colour coded as green for best, yellow for mid-point or insignificant difference, and red for poorest, all within each criteria. The route comparison is set out as west to east. This provides a handy visual and transparent ranking within each criteria. The CEC is then empowered to assign weights and decide which criteria should be emphasized in route selection.

I should note it is of no small significance to me that the dozens of factors at work in the E-G analysis have boiled down to a few dozen when it comes time to display the characteristics of the routes. And, many of these are directly relatable to Canada wide criteria.

As I reflect on the MH listed criteria, it occurred to me that the “Features” list was not complete enough to capture at least the most basic elements of First Nations preferences or concerns.

It may be that these issues are not sufficiently represented in the routing process used elsewhere in Canada. But in Manitoba, this is a major consideration. It deserves, in my view, some quantitative evaluation.

As such, I have noted 5 “Features” that I could measure using the mapping provided in Chapter 11 of the EIS. I have added the AY and BZG routes to Map 11-3, 11-4, and 11-5 to allow this measurement. These features, plus a measure of the length of line following Existing Linear Disturbances – Power Lines and Railways are added to the MH listing criteria. This ELD criteria is of major importance in the rest of Canada.

Feature (Based Upon Table T5-27)	Impact Assessment	SIL (BMY Proxy)	AY	BZG
Relocated Residences	Less is Better	1	0	0
Potential Relocated Residences (within 100 m)	Less is Better	15	6	1
Proximity to Residences (100 m – 400 m)	Less is Better	130	68	13
Proposed Residential Development (within ROW)	Less is Better	31	4	0
Proximity to Buildings (within 100 m)	Less is Better	72	28	5
Crop Land (Acres)	Less is Better	828	730	617
Hay Land (Acres)	Less is Better	133	46	35
Proximity to Hog Operations (Acres)	Less is Better	1,754	596	235
Diagonal Crossing of AG Land (Acres)	Less is Better	140	140	20
Public Use Areas (within 250 m)	Less is Better	17	7	12
Historic Resources (within 250 m)	Less is Better	8	10	11
Potential Commercial Forests (Acres)	Less is Better (?)	521	863	1,536
Natural Forests (Acres)	Less is Better (?)	1,656	2,068	1,752
Stream, River Crossings (Number)	Less is Better	27	14	11
Wetlands (Acres)	Less is Better	383	707	215
Existing Transmission Line Crossings (Number)	Less is Better	13	11	11
Length (km) (from Anola)	Less is Better	161	166	160
Cost (\$)	Less is Better	\$152M	\$145M	\$134M
Following ELD (HVTL or RR) (km)	More is Better	12.2	29.2	21.7
Areas of Concern (Heritage or Zone 3) (km)	Fewer is Better	17	17	53
Areas of Interest (km)	Fewer is Better	37	33	?
Potential TLE (km)	Fewer is Better	0	0	9
Plant Gathering Site (Number)	Fewer is Better	1	7	5
Hunting Sites (Number)	Fewer is Better	10	1	3



In my view, the CEC now has something that is actually a *“streamlined, open and transparent approach to route selection, making more use of quantitative criteria.”* And it is something that allows the CEC to exercise its own judgement when weighting various routing criteria. The alternative is a process where the CEC is being asked to rubberstamp a route based on dozens and dozens of subjective judgments made by MH staff.

#### 5.1.4 Observations on the Various Route Statistics

As I view the chart that sets out the statistical features, and which notes the negative (red) impacts versus the lower impacts (green), for each criteria a number of useful breakdowns suggest themselves. I find 5 homesite issues, 4 features that apply to agriculture, 2 for public use criteria, 2 for forestry, which may be added to the 2 Environmental criteria, 4 for Engineering issues, and 5 for First Nations, Metis (FN/M) concerns. It seems worthwhile to provide some commentary on each category.

##### 5.1.4.1 Homesite Features

The first 5 features all deal with the number one priority issue across Canada, and as noted in the MMTP – PEP results, the statistics could not be worse for the FPR. It ranks lowest for every single criteria. I can advise the CEC that this would almost be enough to send the proponent home in any other proceeding. BZG is best, and AY is middle ranked, but still with low counts.

##### 5.1.4.2 Agriculture Impacts

This was the second most important set of concerns from the PEP surveys. Again, the FPR is worst of the 3 routes compared. BZG is best, while AY is in the middle.

##### 5.1.4.3 Public Use Features

There is a saw-off in these relatively low importance criteria.

##### 5.1.4.4 Forestry Features

The results here are somewhat equivocal. If your perspective is “don’t cut any trees”, the west is best, getting progressively worse as one moves east. But, if the approach is “use public land for a public project”, then it would be reversed. The chart shows best is fewest acres of cut or disturbed acres. However, it is clearly a category very subject to the CEC’s final weighting. It may be worthwhile to note that cutting down trees on a right of way sees them salvaged. It is called logging.

#### 5.1.4.5 Environmental Criteria

This category yields something of a surprise. The FPR has more stream crossings than either of the other routes, twice as many actually. The wetland statistic is best for the most easterly route, again a bit of a surprise.

#### 5.1.4.6 Engineering Criteria

This category produced another surprise. The FPR came out worst in 3 of 4 categories – including cost. The AY route has the best statistics for the important criteria of following existing linear disturbances.

#### 5.1.4.7 First Nations/Metis Issues

I was interested to see the number of impact areas that were noted for the FPR, especially hunting sites. The ratings for BZG were not unexpected. The minimal impact of AY was a bit unexpected given its “easterly locale.” Except for Plant gathering, the AY route has the lowest impacts.

## 5.2 Conclusions and Discussions

A comparative look at the chart as a whole shows what an abysmal route the FPR is compared to other ones that were dropped by the wayside as a result of the flawed E-G process. Only in Forestry is the FPR a clear “winner”, but that is only from a single perspective. The CEC may see it very differently. What is actually very interesting in relation to the Natural Forest criteria, is how close all the routes are in acres impacted. The difference is only 25% from highest acres to lowest acres.

The Engineering issues are also noteworthy given the similar lengths and costs. One can see that the costs are not likely to be the determinative factors, especially considering how rough those estimates are.

It seems to me that there is some basis for further discussions focused on the issue of Crown land versus Private land as it involves the FN/M factors. MH perceives its E-G process “*represented tradeoffs between these values*” (Sec 24.2, pg. 24-9). However, in my view, the homesite issues were traded away in favour of environmental issues as a result of the E-G weighting and method of comparison. Natural and Built criteria were equal percentages, and predictably, they offset each other. That left the earlier discussed “Avoid Crown Land” bias to minimize risk to schedule, according to the MH thinking. The result is that the final route was pushed to private lands.

But what if the Crown land for a Crown Corporation is seen in a more neutral light? Then, if the PEP results were to have any weight that remotely reflected their importance in routing everywhere but in a MH world, the results of the E-G process would be vastly different.

Just to put a bit of meat on the bones of the assertion that the Environmental Issues were more extensively considered, one might look at Table 24-1, a summary of the MH view of the Environmental Impacts. Please note that in this context “Environmental” covers people, agriculture, mining, etc., as well as traditional components. I could not find a single reference to Proximity to Homesites among the 42 listed “Valued Components (VC).” As close as I could come was 1 Visual Quality and 2 Agricultural items. These 3, plus all but one of the rest of the VC’s were deemed to suffer “not significant” effects from the project. Compared to the 3 VC’s noted above, there were 10 purely environmental VC’s and 1 Forestry VC.

With impacts on private landowners, homeowners, and farms given such low importance, it is easy to see how the FPR was plotted to go through the westerly private land areas.

I need to also consider the issue that I for one, did not find in the Chapter 5 discussions. And that is, how does the FPR consider the impacts on First Nations/Metis peoples. For this I have only the maps in Chapter 11, which I am sure is only a shadow of the overall concerns that a powerline ROW causes to FN/M communities.

At first glance, I supposed that the FN/M communities would prefer to see the lines as far west as possible, putting it as far from their areas of interest as possible. The lands to the east of the M602F are largely unbroken (ie intact) and contain significant Heritage Areas or Zone 3 Areas of Concern. The BZG route is most problematic here.

But if we consider the flip side of the issue, the private landowners have the opposite view that there is lots of Crown land, so the line should be put there. These landowners have the added concern about impacts that arise from the woefully inadequate compensation scheme that follows an expropriation by MH for a powerline. They get paid once but have to farm around, or look at and hear the line forever. The FPR has the most impact on these private lands.

But the FN will counter by noting that once an area of natural habitat is cut over for a ROW, it is altered and may be lost forever.

So both interests would have legitimate concerns about essentially permanent impacts if the FPR or BZG lines went forward.

### 5.3 Final Recommendation

The AY route sees a middle ground, both in impact and geography wise. It still affects some homesites and some farmland, but it is much better than the FPR. Route AY ranks best in most of the FN/M criteria. It will infringe on a number of gathering sites, but there are many, many more that are not impacted. Comparatively, the landowner with a set of towers has nowhere else to go – they are fixed in place and must be accommodated on site. So AY shares the pain in a manner of speaking.

It is hard to call anything a win, that involves placing an HVTL near a site that someone values, but AY may be termed a win-win in terms of balancing impacts between the two largest stakeholder communities.

If the CEC sees the routing application before them in the same light as I do, they can seek more information on the central part of the FPR. I especially see the AY as a suitable routing. Meanwhile, the ends can be given a recommendation for approval, so as not to seriously impact the time table. The CEC's options should not be limited by arbitrary deadlines or applications that compromise good routing principles.

## 6.0 CERTIFICATION

I, the undersigned appraiser, certify that the subject routes were viewed on April 27<sup>th</sup> and 28<sup>th</sup>, 2017. The effective date of this evaluation is late Spring, 2017.

I further certify that neither the assignment to do this evaluation, nor the fee, is contingent on the findings herein. I have no undisclosed interest, either present or contemplated, in the routes assessed. The facts contained in this report, upon which the analysis and conclusions are based, are believed to be correct, however, accuracy and validity cannot be guaranteed.

This route evaluation is made under the Code of Ethics of the Canadian National Association of Real Estate Appraisers.

Respectfully submitted,

**BERRIEN ASSOCIATES LTD.**



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Robert A. Berrien, DAC  
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