APPENDIX F

Land Impact Assessment

Land Impact Assessment

AltaLink

ALTALINK

Land Impact Assessment
for the Proposed Central East Area
Transmission Development

Presented to the

Alberta Electric System Operator (AESO)

in Support of the AESO Need Identification Document

Rev.3, April 16, 2010

EXECUTIVE SUMMARY

The intent of this Land Impact Assessment (LIA) is for the Transmission Facility Owner (TFO), AltaLink Management Ltd. (AltaLink), to provide the Alberta Electric System Operator (AESO) with the land impact assessment information it requires for use in the proposed Central East Area Transmission Development (CEATD) Need Identification Document (NID). The LIA assessment process is driven by the major aspects of Alberta Utilities Commission (AUC) Rule 007, Section 6, NID 12 (i.e., agricultural impact, residential impact, environmental impact, electrical considerations, visual impact and special constraints), with the exception of cost, which is an aspect dealt with by the AESO. The LIA focuses on those aspects and considerations for which indicators of impact could be developed based on information currently available.

The AESO has identified the need to upgrade the transmission system within the Central East Region as part of the Central Area Transmission System Study in order to supply the projected load and provide access to new generation (wind and gas-fired) that is proposed for development in this area of Alberta. The Central Area Transmission System Study overlaps AltaLink and ATCO Electric (ATCO) service territories. This LIA is limited to proposed development alternatives that lie only in AltaLink's service territory.

This Land Impact Assessment for the CEATD project examines the following two NID Alternatives (as outlined in Table 1):

- Alternative2
    - A new 240 kV transmission line from the new Nilrem substation to AltaLink's service territory boundary; this line would continue within ATCO service territory to a new Vermilion area substation.
- Alternative 3
    - A new 240 kV transmission line from the existing Hansman Lake substation to a new Hayter area substation;
    - a new 240/138 kV Hayter area substation adjacent to the existing Hayter substation; and,
    - a new 240 kV transmission line from a new Hayter area substation to AltaLink's service territory boundary; this line would continue within ATCO service territory to the existing Lloydminster substation.

Rebuilds of existing 138 kV transmission lines were not considered in this LIA as new 138 kV lines will likely be constructed in existing rights-of-way (ROW) or road allowances. Impacts related to the rebuild alternatives are the same as the impacts that currently exist. Similarly, new 138 kV transmission lines were not considered in this LIA because the related impacts are low-level, common and have negligible effect on the variation in land impact among project alternatives.

AltaLink used a qualitative approach for assessing the potential land impacts associated with the CEATD project. The level of effort required to quantitatively assess relative routes for each of the developments was unnecessary due to the area being rural and sparsely populated.

When consideration is given to the expected general location of the potential 240 kV transmission lines within the areas shown on Figures A and B in Appendix A the following can be expected:

- All villages and towns can be avoided.
- The roughly 80 km of the Nilrem to Vermilion transmission line within AltaLink's service area, will:
    - be generally routed in agricultural cropland, however could avoid the higher Class 2 agricultural land suitability area; and
    - avoid areas of higher potential for environmental impact.
- The roughly 90 km of the Hansman Lake to Hayter to Lloydminster within AltaLink's service area, will:
    - likely be located in the more productive Class 2 agricultural land suitability area; and
    - likely be within or adjacent to areas of native vegetation and wetlands north of Hayter.

Within AltaLink's service territory, the Nilrem to Vermilion transmission line has less potential impacts than the Hansman Lake to Hayter to Lloydminster transmission line. From a potential land impact perspective, each of the developments is feasible and there are no major obstacles that preclude their development. Specific impacts associated with potential routes will assessed at the Facility Application stage. As well the siting principles and criteria used to guide route development will be considered and impacts to residences, agriculture and the environment assessed.

ACRONYMS

AESO	Alberta Electric System Operator
ATCO	ATCO Electric
AUC	Alberta Utilities Commission
CB	Citizen Band
CFB	Canadian Forces Base
CEATD	Central East Area Transmission Development
EMF	Electromagnetic Fields
ESA	Environmentally Significant Area
HRO	Historical Resources Overview
LIA	Land Impact Assessment
NID	Need Identification Document
RDA	Restricted Development Area
RFI	Radio Frequency Interference
ROW	Right-of-Way
TFO	Transmission Facility Owner

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APPENDIX A

1. INTRODUCTION

1.1 Background

The Alberta Electric System Operator is responsible for the safe, reliable and economic planning and operation of Alberta's electricity grid. AltaLink is responsible to design, construct, connect, operate, maintain and/or alter transmission facilities as directed by the AESO. AltaLink maintains and operates approximately 11,800 kilometres of transmission lines and 270 substations in Alberta.

The AESO has identified the need to upgrade the transmission system within the Central East Region (see Figure 1) as part of the Central Area Transmission System Study. The AESO has directed AltaLink to provide a Land Impact Assessment for the proposed Central East Area Transmission Development that is within AltaLink's service territory. The Central Area Transmission System Study overlaps AltaLink and ATCO service territories. This LIA is limited to proposed alternatives that lie only in AltaLink's service territory and discusses the potential land impacts of CEATD alternatives within the context of AUC Rule 007, Section 6, with the exception of cost, an aspect which is dealt with by the AESO. The LIA does not provide an analysis of specific routes, but discusses the potential impacts of potential routing that may occur in a specific geographic area.

AltaLink used a qualitative approach for assessing the potential land impacts associated with the CEATD project. The level of effort required to assess relative routes for each of the developments was unnecessary due to the area being rural and sparsely populated. Siting principles and criteria employed to guide route development at the Facility Application stage will avoid areas of dense population found in towns and villages throughout the area. Routing at the Facility Application stage will also consider impacts to agriculture and the environment (i.e., Environmentally Significant Areas, native prairie). The relative geographic locations of the alternatives within the project areas serve as general descriptors for qualitatively discussing the potential impacts associated with each of the developments. Numerical descriptors are presented for those features that are of particular significance within the study area.

1.2 Central East Area Transmission Development Project

As part of the Central Area Transmission System Study, the AESO has explored several possible alternatives of the CEATD project during its iterative process. Possible system reinforcements include rebuilds and construction of 138 kV transmission facilities, a new 240 kV substation, and new 240 kV transmission lines. Project alternatives that fall within AltaLink's service territory are identified in Table 1. For the purpose of this LIA, NID Alternatives 2 and 3 will be assessed (see Table 1, Section 1.3). Not all developments are necessary as alternatives can be combined in several possible system plans being considered by the AESO and assessed for electrical reliability by the AESO.

Table 1: Summary of Central East Area Transmission Developments

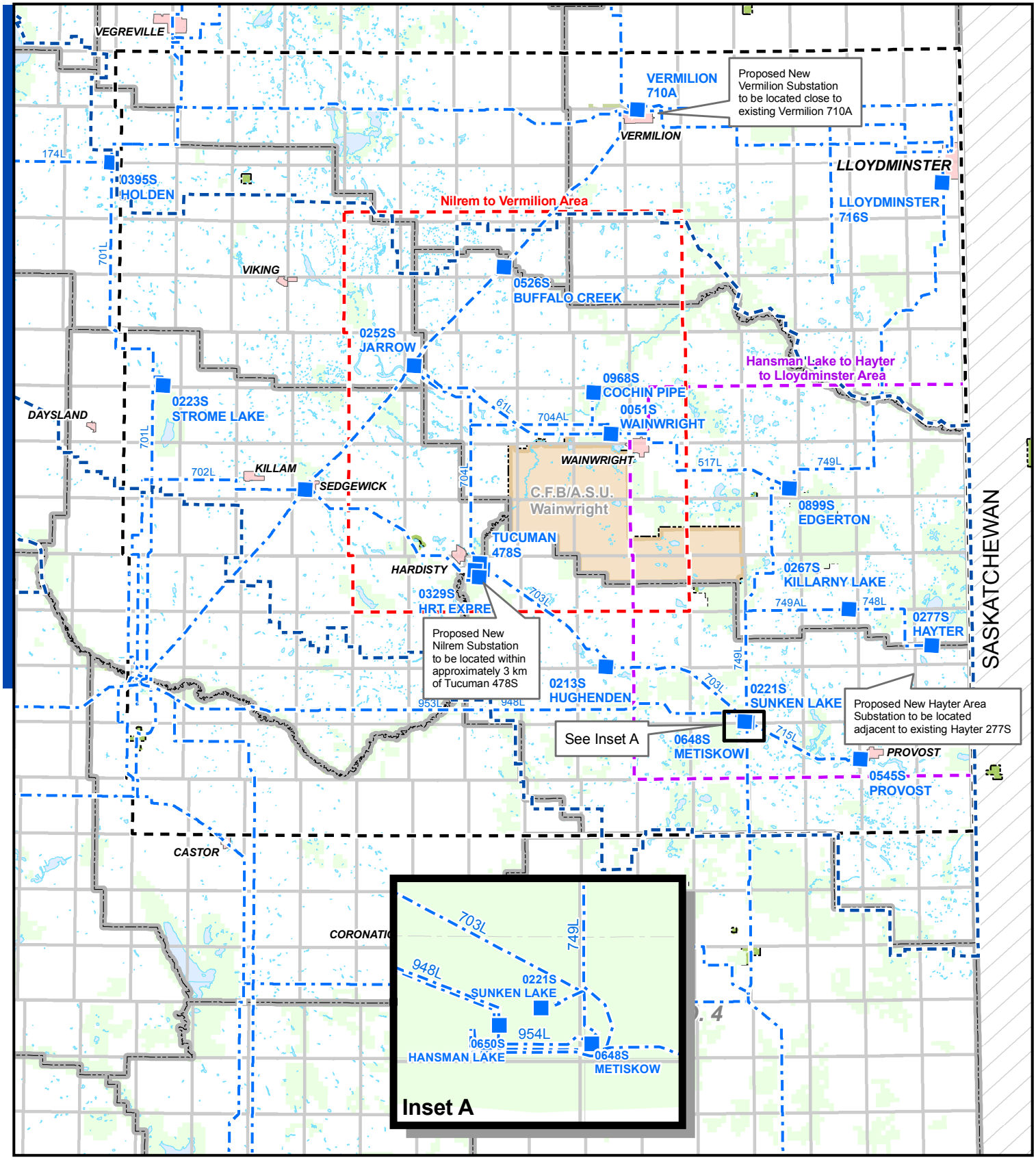
NID Alternative 1 – Rebuild 144 kV line from Battle River to Vermilion	NID Alternative 2 – 240 kV Line from Nilrem to Vermilion	NID Alternative 3 – 240 kV Line from Hansman Lake to Lloydminster	Areas / Developments	Breakdown of Developments		Description
X	X	X	A. Wainwright Area (32)	1		- Rebuild 70 km of 138 kV S/C 704L and 704AL lines
				2		- Identical to option 1 + Rebuild 40 km of 138 kV S/C 517L line from Edgerton 899S to Wainwright 51S
				3	a	- Rebuild of 704L and 704 AL: - 20 km of 138 kV D/C (In-out at Jarrow 252S with breaker addition) - 50 km of 138 kV S/C50 km of 138 kV S/C from Wainwright 51S to Edgerton 899s - Rebuild 40 km of 138 kV S/C 517L line
					b	- Rebuild of 704L and 704 AL: - 20 km of 138 kV D/C (In-out at Jarrow 252S without breaker addition) - 50 km of 138 kV S/C from Wainwright 51S to Edgerton 899s - Rebuild 40 km of 138 kV S/C 517L line
					c	- Rebuild of 704L and 704 AL: - 20 km of 138 kV D/C (In-out at Jarrow 252S with two breaker additions) - 50 km of 138 kV S/C from Wainwright 51S to Edgerton 899s - Rebuild 40 km of 138 kV S/C 517L line

				4		- Rebuild of 704L and 704 AL: - 26 km of 138 kV D/C (In-out at Wainwright 51S with breaker addition) - 45 km of 138 kV S/C - Rebuild 40 km of 138 kV S/C 517L line
X	**X**	**X**	B. Provost Area(37)	1		- 30 km of 138 kV S/C line from Provost 545S to Hayter 277S sub - 18 km of 138 kV S/C (In-out at Killarney Lake 267S) + Rebuild 48 km of 138 kV S/C 749L line -Rebuild 21 km of 138 kV S/C 748L line -Rebuild 22 km of 138 kV S/C 715L line:
				2		- 30.5 km of 138 kV S/C line from Provost 545S to new Hayter sub - 18 km of 138 kV S/C (In-out at Killarney Lake 267S) + Rebuild 48 km of 138 kV S/C 749L line -Rebuild 21.5 km of 138 kV S/C 748L line to be re-terminated at the new Hayter sub -Rebuild 22 km of 138 kV S/C 715L line: -Hayter 277S load will be re-connected at the new Hayter sub
X	**X**	**X**	C. 7L50 Rebuild			- Only one section owned by AltaLink: 0.4 km of 138 kV S/C (Jarrow 252S Tap)
X	**X**	**X**	D. Strome Area			- 45 km of 138 kV S/C line from Strome 223S to Jarrow 252S - 35 km of 138 kV S/C line from Jarrow 252S to Buffalo Creek 526S

X	**X**		E. 749L Rebuild from Edgerton 899S to Lloyd 716S	1	a	- Rebuild 30 km of 138 kV 749L S/C line using 1x477 kcmil conductors.
					b	- Rebuild 30 km of 138 kV 749L S/C line using 2x477 kcmil conductors.
	X		F. 240 kV line from Nilrem 574S to a New Vermillion substation[1]	1	a	- 80 km of 240 kV S/C line using 2x477 kcmil conductor
					b	- 80 km of 240 kV S/C line using 2x795 kcmil conductor
				2	a	- 80 km of 240 kV D/C line with one side strung using 2x477 kcmil conductor
					b	- 80 km of 240 kV D/C line with one side strung using 2x795 kcmil conductor
				3	a	- 80 km of 240 kV D/C line both side strung using 2x477 kcmil conductor
					b	- 80 km of 240 kV D/C line both side strung using 2x795 kcmil conductor
		X	G. 240 kV line from Hansman Lake 650S through new Hayter substation to Lloydminster 716S[2]	1	a	- 90 km of 240 kV D/C line with one side strung using 2x477 kcmil conductor
					b	- 90 km of 240 kV D/C line with one side strung using 2x795 kcmil conductor

[1] About 80 km in AltaLink service territory.

[2] About 90 km in AltaLink service territory.



LEGEND

- Existing Substation
- Existing Transmission Line
- Project Area Boundary
- AltaLink Service Area
- Environmentally Sensitive Area
- Military Base
- Municipal or County Boundary
- Other Protected Area
- Park
- Urban Area
- Water Body

NO.: 001
DRAWN: WM-ST
FILE NO.: 1054669-001-2
REVISION: 0
DATE: 2009-12-9
FOLDER: CETD

N

0 10 20 30 Kilometres

0 10 20 Miles

LAND IMPACT ASSESSMENT

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Figure 1

Central East Area Transmission Development

Project Area Map for Developments in AltaLink's Service Territory

1.3 Scope of the LIA

The CEATD project area is located in Central East Alberta, surrounding Canadian Forces Base (CFB) Wainwright (Figure 1). The project developments potentially involve the rebuild and construction of 138 kV/144 kV transmission facilities, a new 240 kV substation, and new 240 kV transmission lines. As described below, 138 kV transmission facilities are not examined in the LIA, while 240 kV transmission facilities are assessed.

As the related impacts are low level, 138 kV rebuilds and construction alternatives are not considered in this LIA. Two areas of interest within the project area have been defined in order to focus on the new substation and the new 240 kV transmission lines (Figure 1). These areas of interest (Appendix A, Figure A and Figure B) are presented at a finer scale than the Project Area (Figure 1) to give a more specific basis for the qualitative assessment and were also used to generate numerical descriptors for the features of significance.

1.3.1 Rebuilds of Existing 138 kV Transmission Lines

System alternatives involve rebuilds of existing lines. Rebuilds are not considered in this LIA as new 138 kV lines will likely be constructed on the existing ROWs or in road allowances. Impacts related to the rebuild alternatives are similar to those impacts that currently exist.

1.3.2 Construction of New 138 kV Transmission Lines

There are system alternatives involving the construction of new 138 kV lines. In general, 138 kV transmission lines are not considered in this LIA because the related impacts are low-level and common – 138 kV lines are typically sited in road allowances, have little associated land impact in a rural setting and, as a result, have negligible effect on the variation in land impact among project alternatives.

1.3.3 240 kV Transmission Facilities

There are two developments (as outlined in Table 1) pertaining to new 240 kV transmission facilities which are assessed for potential land impact:

- NID Alternative 2
    - A new 240 kV transmission line from the new Nilrem substation to AltaLink's service territory boundary; this line would continue within ATCO service territory to a new Vermilion area substation.
- NID Alternative 3
    - A new 240 kV transmission line from the existing Hansman Lake substation to a new Hayter area substation;
    - a new 240/138 kV Hayter area substation adjacent to the existing Hayter substation; and,

- a new 240 kV transmission line from a new Hayter area substation to AltaLink's service territory boundary; this line would continue within ATCO service territory to the existing Lloydminster substation.

For these developments, only the portions that fall within AltaLink service territory are assessed in this LIA. ATCO has been directed to assess the land impacts of alternatives proposed within their service territory. The new Hayter area substation, and the Hansman Lake to new Hayter area 240 kV line are completely within AltaLink service territory.

A new 240 kV substation is a development being considered in the Hayter area. This new substation is proposed in anticipation of future 240 kV expansions to the north and as a collector for potential wind generation from the Hayter and Provost areas. For assessment purposes in this LIA, the new proposed Hayter area substation is located adjacent to the existing Hayter 277S substation. The new substation serves to connect the new 240 kV transmission line from Hansman Lake, and as the point of origin for the new 240 kV transmission line to the existing Lloydminster substation

The areas of interest for the new Hayter area substation and new 240 kV lines are shown on the maps in Appendix A. Figure A, Nilrem to Vermilion Area, is the basis of assessment for Alternative 2, the AltaLink portion of the Nilrem to Vermilion 240 kV line. Figure B, Hansman Lake to Hayter to Lloydminster Area, is the basis of assessment for Alternative 3, which includes the other 240 kV developments within AltaLink's area and the new Hayter area substation. For the purposes of this LIA, the western, central and eastern portions of these areas serve as general descriptors for qualitatively discussing the potential impacts associated with the developments.[3] A numerical descriptor is presented for those features that are of particular significance within the study area.

AltaLink used a qualitative approach for assessing the potential land impacts associated with the CEATD project. The level of effort required to assess relative routes for each of the developments was not necessary due to the area being rural and sparsely populated. Siting principles and criteria employed to guide route development at the Facility Application stage would ultimately avoid areas of dense population found in towns and villages throughout the area. Routing at the Facility Application stage will also consider impacts to agriculture and the environment (i.e., Environmentally Significant Areas, native prairie).

[3] Western, central and eastern portion each refer to approximately one third of the area of interest (i.e., the western portion is the left most third of the area of interest).

2. LAND IMPACT ASSESSMENT PROCESS

2.1 LIA Methodology

The LIA process allows the AESO to consider the potential land impacts associated with 240 kV components of the CEATD project developments that are potentially within AltaLink's service territory in their evaluation of alternatives.

The assessment of LIA for CEATD is driven by the major aspects of AUC Rule 007, Section 6, NID 12. Agricultural impact, residential impact, environmental impact, electrical considerations, visual impact and special constraints are examined. Cost is an aspect dealt with by the AESO and is not included in the LIA. Associated with each major aspect are several specific factors that require consideration in the LIA as per AUC Rule 007, Section 6. In many cases (i.e., reduced efficiency of field operations, psychological impact of the line, decrease of property values, noise and TV interference, visual impact of tree removal, etc.) these considerations cannot be assessed in great detail until the Facility Application stage, when route, tower location and design are undertaken by the TFO. The LIA focuses on those aspects and considerations that can be described at the preliminary stage; specific impacts associated with potential routes are dealt with at the Facility Application stage.

A description of each major aspect of AUC Rule 007 and associated considerations is presented in Section 2.2. An assessment of the CEATD project NID Alternatives 2 and 3, involving a new 240 kV substation and new 240 kV transmission lines, are provided in Section 2.3.

2.2 Major Aspects of AUC Rule 007

The major aspects used in the Land Impact Assessment conducted under AUC Rule 007 are described below, as are their relevance for evaluating impacts for the CEATD project developments.

2.2.1 Agricultural Impact

Agricultural impact refers to impact upon agricultural activities, which may include cultivation of crops, raising livestock, and other commercial operations.

2.2.1.1 Specific Agricultural Variables

AltaLink has considered the specific agricultural considerations in AUC Rule 007 and how they relate to the CEATD project:

> ***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.***

Short-term crop loss during construction is reduced or avoided with appropriate mitigations and construction practices. Such short-term losses are compensated through damage payments to

landowners. Permanent loss of crop under or adjacent to the tower base is mitigated through working with specific landowners during consultation for the Facility Application, routing of the centerline relative to legal boundaries such as quarter lines, and compensated for with annual structure payments. The majority of a 240 kV ROW can still be used by the landowner for crop production. Potential impacts may be further reduced by landowner input on tower placement.

b) Short-term disruption of farming and livestock grazing resulting from construction.

These potential impacts are mitigated through appropriate construction practices and working with specific landowners to reduce or avoid any disruption.

c) Reduced efficiency of field operations.

This potential impact is mitigated by determining tower placement that reduces or avoids impact. Long-term impacts are considered when determining annual structure payments for towers.

d) Restrictions on use of aircraft and high-pressure irrigation systems.

The presence of a transmission line can potentially impact use of aircraft for agricultural operations, such as crop spraying. This is landowner and route specific; aerial spraying is generally being used less often as high-wheel crop sprayers are becoming more common. The impact on the operation of irrigation equipment can usually be reduced through consultation with affected landowners around the placement of towers and centerlines. Unavoidable impacts are considered when determining compensation payments.

e) Risk of collision with tower; damage to equipment, lost time, liability for damage to tower and secondary liabilities.

A landowner will not be held liable for tower damage unless it was deliberately caused by the landowner or his agents. If the transmission line is taken out of service by the damage, it is typically restored to service within 24 to 48 hours, so any disruption to farming activities due to repairs of the line and tower is short in duration. The potential for a collision with a transmission tower is considered low.

f) Reduction in yield adjacent to towers due to overlapping farming operations and added soil compaction.

Permanent loss of crop under or adjacent to the tower base is mitigated through working with specific stakeholders during consultation for the Facility Application. The total area under the towers is relatively small for overhead transmission lines. It is addressed and compensated for through annual tower payments. Potential impacts are further reduced by landowner input on tower placement.

g) Added cost and inconvenience of weed control under towers.

The added cost and inconvenience of weed control is compensated as part of the annual structure payments to landowners.

h) Impact of height restrictions on equipment during field operations.

All transmission lines in Alberta must provide a minimum height clearance of 4.3 m for equipment on agricultural land. New transmission lines must provide a minimum clearance for equipment of 4.88 m high on agricultural land.

i) Psychological impact of line.

This is a subjective impact involving factors such as electromagnetic fields (EMF) and visual impact. Provision of unbiased information around EMF research from national and international health and scientific agencies is available to the public and generally provided at the Facility Application stage.

j) Loss of shelter belts.

Impacts to shelter belts can be mitigated through routing offsets relative to legal boundaries, such as quarter lines, along which shelter belts may exist. In some cases, only trimming may be required. Compensation for re-establishment of a shelter belt is also a possibility. All of these are site specific and determined in consultation with the potentially affected landowner at the Facility Application stage.

k) Shared use with other utilities and transmission lines.

Utilization of existing linear disturbances is a factor in the final determination of routing during the Facility Application stage, as per Alberta Environment's *Guide for Transmission Lines* and Alberta's *Transmission Regulation*. At the conceptual planning stage, no opportunities have been identified for paralleling existing 240 kV lines with the new 240 kV transmission lines.

l) Interference with citizen band radios.

This is becoming less of an issue as Citizen Band (CB) radios are being replaced with newer technologies; however, CB radios operate at frequencies close to that of AM radios, neither of which are designed to be immune to power line interference. The interference produced by power lines diminishes with distance from the power lines, making interference highly localized. All facilities will comply with federal guidelines related to radio interference.

2.2.1.1 Indicators of Agricultural Impact

Agricultural land use and agricultural land suitability were evaluated as potential indicators. Agricultural land use is represented by cropland and forage. Cropland is abundant in both study areas, generally indicative of higher potential agricultural impact. Forage lands, including pasture, are sparse throughout both study areas.

The agricultural land suitability classification system categorizes lands into seven classes, with Class 1 being most suitable for agriculture. The higher the class, the less suitable the lands are for agricultural operations. The lands within the project area range from Class 2 to Class 7, with most lands within the Classes 3 through 5.

2.2.2 Residential Impact

Reducing the potential for residential impact is an important consideration in the routing of transmission lines, particularly in areas of high residential density.

2.2.2.1 Specific Residential Considerations

AltaLink has considered the following specific residential considerations in AUC Rule 007 and how they relate to the CEATD project:

a) Decrease of property values.

This is a site specific impact. Potential concerns are related to property type, size and location of structures. This impact is not considered to be applicable at this stage in the assessment process.

b) Loss of developable lands and constraints on development.

Development tends to happen in proximity to existing developed (urban) areas. There are towns, hamlets and dense areas of country residential in the project area, for which development potential may be affected by transmission lines.

c) Relocation or removal of residence.

It is difficult to assess this specific risk at this preliminary stage, as specific routes are not determined until the Facility Application stage.

d) Psychological impact of the line.

This is a subjective impact involving factors such as electromagnetic fields and visual impact. Provision of unbiased information on EMF research from national and international health and scientific agencies is available to the public.

e) Noise and TV interference.

TV reception problems related to high-voltage transmission lines are unlikely. If interference does occur, it can often be resolved by relocating the TV or changing the antenna. The transmission lines are designed to meet allowable audible noise and TV interference. Where individual landowners are concerned, measurements will be taken before and after construction so signal interference beyond allowable levels can be identified and mitigated. These types of concerns tend to be associated with residences and related to routing which occurs as part of the Facility Application stage.

f) Windbreak and other vegetation removal.

This is an issue when the removal or trimming of trees or other vegetation may be required to establish a new right-of-way. It is also important to note that the overall impact is considered in making compensation payments for structures and land rights. This is site specific and determined in consultation with the potentially affected landowner at the more detailed Facility Application stage.

g) Conflict with recreational use of land holdings.

There are ESAs, river valleys and lakes within the project area. Assuming these areas are used for recreational purposes, there is a potential for conflict with recreational land use if routes are within close proximity to these features.

h) Public versus private land.

The use of public land is generally viewed by landowners as a preferable alternative to using private lands. This project area is dominated by private land.

2.2.2.2 Indicators of Residential Impacts

The presence of urban areas, as well as dense country residential and rural residential areas, can provide an indication of the potential residential impacts associated with the proposed project.

2.2.3 Environmental Impact

Minimizing environmental impact is a consideration when assessing the developments.

2.2.3.1 Specific Environmental Considerations

AltaLink has considered the specific environmental considerations in AUC Rule 007 as well as the additional criteria of "Impacts to Waterfowl and Other Birds".

a) Increased public accessibility to wildlife areas.

This is typically an issue for treed or forested areas where there is currently little access. Much of the project area has been cleared for agricultural purposes and is already accessible. There is potential to increase access to treed or forested areas if new ROWs are used; however, treed or forested areas characterize a small portion of the project area and it is expected that small shrubs or trees can be spanned by the proposed alternatives which will not increase public access through the transmission line rights-of-way.

Access along the ROW on private land is managed in consultation with the landowner to determine the appropriate access mitigation; one method of controlling access involves using locked gates. This consideration will be further discussed at the Facility Application stage when routing is developed and the potential to alter access is more defined.

b) Alteration of natural areas and interference with outdoor educational opportunities.

The location of protected or designated areas within the project area can be determined using existing data sources. This impact may not be applicable to the project as parks, protected areas, and ESAs can be avoided with each option; however, this consideration will be further assessed at the Facility Application stage when routing is developed and site-specific alterations are known.

c) Use of Restricted Development Area.

The CEATD project does not include use of a Restricted Development Area (RDA) as there are no RDAs within the project area.

d) Effect on erosion.

There is a potential to cause erosion when topsoil is disturbed, which can have related effects if surface water is present. AltaLink will attempt to avoid areas that pose potential erosion problems. If they cannot be avoided, then the intent is to work with associated regulatory agencies and landowners to develop appropriate mitigations and construction practices to reduce potential impacts.

e) Unique ecological areas.

The identification of areas of potential ecological value, such as wetlands and ESAs, can be used to determine if unique ecological areas occur in the project area. There are major rivers, ESAs, areas of native vegetation and wetlands within the project area. There is potential to encounter areas of ecological value in the selection of transmission line routes; however, this impact is not applicable to the project as the parks, protected areas, and ESAs can be avoided with each option.

f) Impact to Waterfowl and Other Birds

Bird collisions with overhead transmission lines crossing over or adjacent to wetlands and water bodies are a concern. Visual warning devices can be placed on the shield wires adjacent to water bodies used by waterfowl, in the construction/maintenance phases. There is surface water within the project area, as well as the presence of important wetlands.

2.2.3.2 Indicators of Environmental Impact

Surface water bodies, wetlands, ESAs and native vegetation were considered as potential indicators of environmental impact. Minor water bodies, such as creeks and streams, were not used as indicators as these features are common throughout both study areas. Effects on these features can be avoided or reduced at the Facility Application stage.

2.2.4 Electrical Considerations

While the technical considerations, such as transfer capability, system flexibility, system reliability and losses are considered by the AESO separately, some land impacts related to electrical considerations can be identified. Technical requirements and the other electrical considerations associated with the CEATD project can affect the presence or level of impacts on the land.

2.2.4.1 Specific Electrical Considerations

AltaLink has considered the following specific electrical considerations outlined in AUC Rule 007 and how they relate to the CEATD project:

a) Ease of connections to future load areas.

The final system configuration will be assessed for ease of connection to future load areas by the AESO. As an alternative, the new Hayter area substation has been proposed in anticipation of future 240 kV expansions to the north. This substation would also serve as a collector of potential wind and gas-fired generation produced in the Hayter and Provost areas.

b) Reliability and reparability of the line.

Wet soil conditions can present difficulties for future maintenance and repair activities. Identification of wet areas can be determined during the Facility Application stage.

c) Access for construction and maintenance of the line.

Paralleling major roads or existing transmission lines can reduce some of the potential access considerations associated with new facilities. While paralleling major roads is a consideration for CEATD, paralleling existing lines is not possible since there are no existing 500 kV lines and few 240 kV lines in the project area.

2.2.4.2 Electrical Indicators

Both the length of the ROW and the paralleling of existing lines are high-level indicators of electrical factors. The length of the transmission line is a key cost driver and can be used by the AESO in loss calculations. Paralleling existing transmission lines is an effective way to reduce the amount of new linear disturbance and fragmentation of the landscape. Landowners and agencies commonly request this when new transmission lines are proposed in an area.

For CEATD, the approximate ROW lengths of the 240 kV alternatives are known (Section 1.2); however, the AESO must assess the overall cost and electrical efficiency of the various configurations they are considering. As previously discussed, there are no opportunities to parallel existing 240 kV lines in the project area.

2.2.5 Visual Impact

Visual impacts depend on stakeholder view. These impacts are typically influenced by visibility of transmission lines from residential areas. Visual impact may also be perceived from roads and highways, as well as by users of recreational areas (i.e., hikers, fishermen, hunters, golfers). One general assumption is that underground transmission lines will have little or no visual impact when compared to overhead lines. These impacts will continue to be assessed as the project moves forward and additional information becomes available.

There are some general assumptions that can be made for all overhead transmission lines:

- The closer the line is to a residence, the more likely a visual impact will be perceived.
- The higher the residential density, the more likely a visual impact will be perceived.

- Paralleling similar, existing transmission facilities generally yield a lower visual impact than a greenfield[4] route where there is no existing line.
- Close proximity to parks, natural areas and other recreational areas can be viewed as creating a higher degree of visual impact.
- Clearing of mature-treed areas increases the potential level of visual impact by removing what is generally considered an aesthetically pleasing feature on the landscape and potential screening of the transmission line.

2.2.5.1 Specific Visual Considerations

AltaLink has considered the following specific visual considerations outlined in AUC Rule 007 and how they relate to the CEATD project:

a) Visual impact of tree removal as seen from roads and recreational installations.

Many stakeholders view the removal of trees as a visual impact. The study area consists of primarily cleared land used for agriculture. Potential impacts on shelter belts will be considered during the TFO route evaluations leading to the Facility Application.

b) Visual impact on dispersed recreational users such as hikers, fishermen, hunters, scenic viewers, and cross-country skiers.

Areas commonly used by recreational users can be identified using existing data sources. These can then be compared with the various system developments associated with each of the plans to provide a general indication of the potential level of impact.

c) Visual impact of towers and lines as seen from residences, farms, roads, and recreational installations.

The type of residential development and identification of potential recreational areas can provide an indication of the potential visual impact.

2.2.5.2 Indicators of Visual Impact

Visual considerations described in Section 2.2.5.1 are closely related to residential development and the distribution of recreational areas. Residential development is largely rural residential throughout the study areas, presenting opportunities to avoid residences. The primary urban areas are Hardisty and Wainwright in the Nilrem to Vermilion area (Appendix A, Figure A), and Provost and Wainwright in the Hansman Lake to Hayter to Lloydminster area (Appendix A, Figure B). These urban areas would likely be avoided in the siting of the new 240 kV transmission facilities.

[4] "Greenfield" – new facilities; "Brownfield" – existing facilities

It is assumed that the main recreational areas are the major lakes, major river valleys and ESAs; therefore, visual impact on recreational users is likely to be correlated with proximity to these features. These areas would be avoided where possible.

2.2.6 Special Constraints

Special constraints are issues or factors that are unique to the specific project area being assessed. Using existing sources of available data, there are special constraints that have been identified in the project area and incorporated into the assessment of the project developments.

2.2.6.1 Specific Special Constraints

AltaLink has considered the one specific special constraint mentioned in AUC Rule 007 (Item a, below). Additional project-specific special constraints have also been included and considered below:

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

There is the potential for transmission facilities to impact radio and other telecommunication equipment, as several telecommunications facilities are within the study areas. The intent is to work with affected facility owners to ensure appropriate routing and mitigation methods are employed to reduce or eliminate any potential impact. Following the construction of the proposed facilities, radio frequency interference (RFI) measurements will be taken to ensure that federal guidelines are not exceeded. Interference problems caused by the new facilities will be mitigated by AltaLink.

b) Major river crossings.

Major river crossings can present potential constraints related to technical design, environmental implications, timing restrictions and associated cost implications. Several potential impacts on major river crossings can be avoided by crossing overhead and complying with setbacks to the normal high-water marks for the crossing structures. Riparian vegetation can be selectively removed to reduce impacts. An accurate assessment of major river crossings cannot be made until the Facility Application stage, at which time site-specific routing can occur.

c) Proximity to historical resources.

Historical resources are specific sites that have been identified within the province that hold particular archaeological significance. The province maintains a registry of known locations and, depending on the significance of a particular site, there may be constraints placed on nearby planned developments or disturbances.

d) Oil and gas.

Well sites are common throughout the study areas. These sites pose a challenge to routing, but can typically be mitigated through jogs in the transmission line at the Facility Application stage.

2.2.6.2 Indicators of Special Constraints

No special constraints of concern have been identified in the project area. Review of the area indicates that proximity to radio and other telecommunication equipment, major river crossings, proximity to historical resources and oil and gas facilities are not of concern at this preliminary stage. Special constraints will be identified and assessed at the Facility Application stage.

The Battle River is a major river that runs through both study areas. Certain portions of this river are recognized ESAs. Crossing of the Battle River is necessary to bring the new 240 kV transmission lines into ATCO service territory. Use of existing crossings can reduce or avoid impact on this feature.

Historical resources have been identified in both study areas, but are of lesser category and, as a result, pose no constraint to the project at this preliminary stage. A detailed Historical Resources Overview (HRO) of the CEATD project area will be done during the Facility Application stage.

2.3 Assessment of Developments

This section assesses the new 240 kV substation and three new 240 kV transmission lines proposed in the CEATD project according to indicators derived from the major land impact aspects of AUC Rule 007. A discussion of the major aspects and the selected indicators is presented in Section 2.2. Those representative indicators are used to characterize the potential impacts associated with these developments based on the two areas of interest (refer to Appendix A).

2.3.1 Nilrem to Vermilion

The area of interest that is the basis of assessment for the Nilrem to Vermilion development is shown in Appendix A, Figure A. This development represents new 240 kV line from the new Nilrem substation northward past AltaLink's service territory boundary to connect to a new Vermilion area substation; about 80 km would be within AltaLink's service territory. It is expected that the 240 kV transmission line will head generally north out of Nilrem, avoid the towns of Hardisty and the Village of Irma, and trend generally northeast towards Vermilion. The area is rural residential, with the central portion being the most populated due to the Towns of Hardisty and Wainwright, and the Village of Irma, all of which can be avoided by the route.

Agricultural land use consists mostly of cropland, which decreases eastward. Forage is sparse throughout the study area. Land suitability ranges from Class 2 to 6, with most lands being of Class 3 or 4. The western portion of the area contains the majority of the Class 2 land. Potential for agricultural impact is highest in the western portion and it is unlikely that the 240 kV transmission line will be routed in this area.

The Nilrem to Vermilion area consists of approximately 16% ESAs, with most of the ESAs occurring in the eastern portion. Native vegetation covers approximately 9% of the area, concentrated in the vicinity of Hardisty in the west and central portions, and around Wainwright

in the eastern portion. The western portion has the majority of the major lakes, while the Battle River runs through the central and eastern portions. The presence of these major lakes indicates potential for impacts to waterfowl and other birds. Potential for environmental impact is highest in the western portion of the area. Historical resources occur throughout the area; however, they are concentrated in the western portion, west of Hardisty. It is expected that the route will avoid almost all of these potential environmental impact areas.

2.3.2 Hansman Lake to Hayter to Lloydminster

The area of interest that is the basis of assessment for the Hansman Lake to Hayter to Lloydminster transmission developments is shown in Appendix A, Figure B. This development is represented by the following three components:

- approximately 45 km of new 240 kV transmission line between existing Hansman Lake 650S substation and the proposed new Hayter area substation; and
- a new 240/138 kV Hayter area substation, to be located adjacent to the existing Hayter 277S substation; and,
- approximately 45 km of new 240 kV transmission line from the new Hayter area substation northward past AltaLink's service territory boundary to connect to the existing 716S Lloydminster substation. .

2.3.2.1 Construction of new 240 kV transmission lines

Agricultural land use consists mostly of cropland, which increases eastward. Forage is sparse throughout the area. Land suitability ranges from Class 2 to 7, with most lands being of Class 3 to 5. The eastern portion of the area contains most of the Class 2 land. Potential for agricultural impact is highest in the eastern portion and this is the most likely location for the 240 kV transmission line.

The area is rural residential. The towns of Wainwright and Provost , and the Village of Edgerton can be avoided by the transmission line route. The route will most likely pass by, but avoid the Village of Chauvin.

The project area is approximately 23% ESAs, most of which occur in the western portion where they form a continuous area of overlapping ESAs from north to south. The 240 kV line will not be in this area. Native vegetation covers 16% of the area, concentrated in the west and decreasing eastward. In the central portion, native vegetation is concentrated around Edgerton. In the eastern portion it is concentrated around Reflex, Killarney and Leane lakes. There are six wetlands in the area, most of them in the eastern portion. The Battle River runs through the central and east portions of the area, while major lakes are primarily in the western and eastern portions. The presence of both wetlands and surface water indicate a higher potential for impact to waterfowl and other birds. Potential for environmental impact is highest in the western portion of the area. The 240 kV line will most likely be within or to the west of this

environmental area. Historical resources occur throughout the area, but are concentrated in the central portion between Edgerton and Dolcy Lake, which will be avoided by the 240 kV line.

2.3.2.2 Proposed new Hayter area substation

The AESO has directed AltaLink to assess the general location for the proposed Hayter area substation (as indicated in Appendix A, Figure B) for potential land impacts. While there is cropland, and lands of high agricultural capability in the area, there are also non-agricultural lands of lower capability on which the substation could be sited to reduce or avoid agricultural impact. The project area is sparsely populated, thus having low potential for residential impact. Potential for environmental impact is low, as there are no ESAs, wetlands, nor major lakes, and little native grassland in the general project area. Potential for visual impact is also low, as there are no densely-populated areas, major highways or identified recreational areas within the project area. As well, no special constraints are identified in the area of the proposed substation location.

3. CONCLUSION

This Land Impact Assessment for the CEATD project examined the portion of the Nilrem to Vermilion transmission line within AltaLink's service territory, and the Hansman Lake to Hayter transmission line, new Hayter area substation, and the portion of Hayter to Lloydminster transmission development within AltaLink's service territory. Rebuilds of existing 138 kV transmission lines were not considered in this LIA as new 138 kV lines will likely be constructed on the existing ROWs. Impacts related to the rebuild alternatives are those same impacts that currently exist. Similarly, new 138 kV transmission lines were not considered in this LIA because the related impacts are low-level and common, having negligible effect on the variation in land impact among project alternatives.

When consideration is given to the expected general location of the potential 240 kV transmission lines within the areas shown on Figures A and B in Appendix A (see discussion in sections 2.3.1 and 2.3.2), the following can be expected:

- All villages and towns can be avoided.
- The roughly 80 km of the Nilrem to Vermilion transmission line within AltaLink's service area, will:
    - be generally routed in agricultural cropland, however could avoid the higher Class 2 agricultural land suitability area; and
    - avoid areas of higher potential for environmental impact.
- The roughly 90 km of the Hansman Lake to Hayter to Lloydminster within AltaLink's service area, will:
    - likely be located in the more productive Class 2 agricultural land suitability area; and
    - likely be within or adjacent to areas of native vegetation and wetlands north of Hayter.

The Nilrem to Vermilion 240 kV transmission line has less potential impacts within AltaLink's service area than the Hansman Lake to Hayter to Lloydminster 240 kV transmission line. From a potential land impact perspective, each of the developments is feasible and there are no major obstacles that preclude their development. Specific impacts associated with potential routes are dealt with at the Facility Application stage. As well the siting principles and criteria used to guide route development will be considered and impacts to residences, agriculture and the environment assessed.

4. INFORMATION SOURCES

Alberta Culture & Community Spirit. 2009. Listing of Historic Resources: Instructions for Use. March 2009. Alberta Government.

Alberta Environment. 1995. Conservation and Reclamation Information Letter: Environmental Protection Guidelines for Electric Transmission Lines. Alberta Government. Available online at: http://environment.gov.ab.ca/info/posting.asp?assetid=6845&searchtype=asset&txtsearch=Electric%20Transmission.

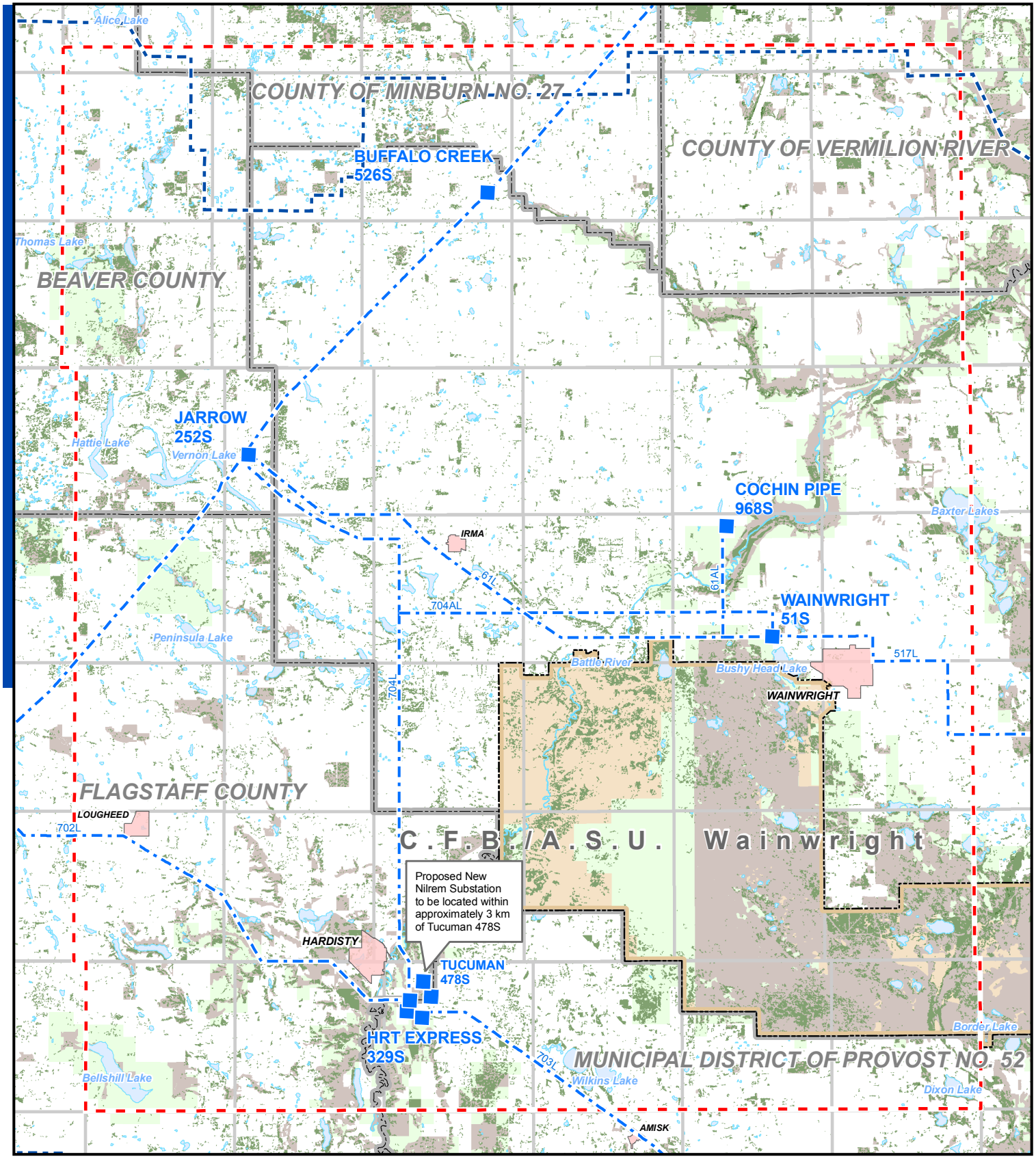
Alberta Utilities Commission. 2009. AUC Rule 007: Rules Respecting Applications for Power Plants, Substations, Transmission Lines, and Industrial System Designations. Version 2, March 24, 2009. Calgary, Alberta. Available online at: http://www.auc.ab.ca/acts-regulations-and-auc-rules/rules/Pages/Rule007.aspx.

Sweetgrass Consultants. 1997. Environmentally Significant Areas of Alberta. Calgary, Alberta. Available online at: http://www.tpr.alberta.ca/parks/heritageinfocentre/environsigareas/default.aspx

APPENDIX A

Figure A: Nilrem to Vermilion Area

Figure B: Hansman Lake to Hayter to Lloydminster Area



LEGEND

NATIVE VEGETATION
- Native Coniferous
- Native Deciduous
- Native Grassland

- Existing Substation
- Existing Transmission Line
- AltaLink Service Area
- Nilrem to Vermilion Area
- Environmentally Significant Area
- Military Base
- Municipal Boundary
- Urban Area
- Water Body

NO.: 010-3
DRAWN: WM-ST
FILE NO.: 1053157-010-1
REVISION: 2
DATE: 2010-04-12
FOLDER: CETD

N

0 4 8 12 Kilometers

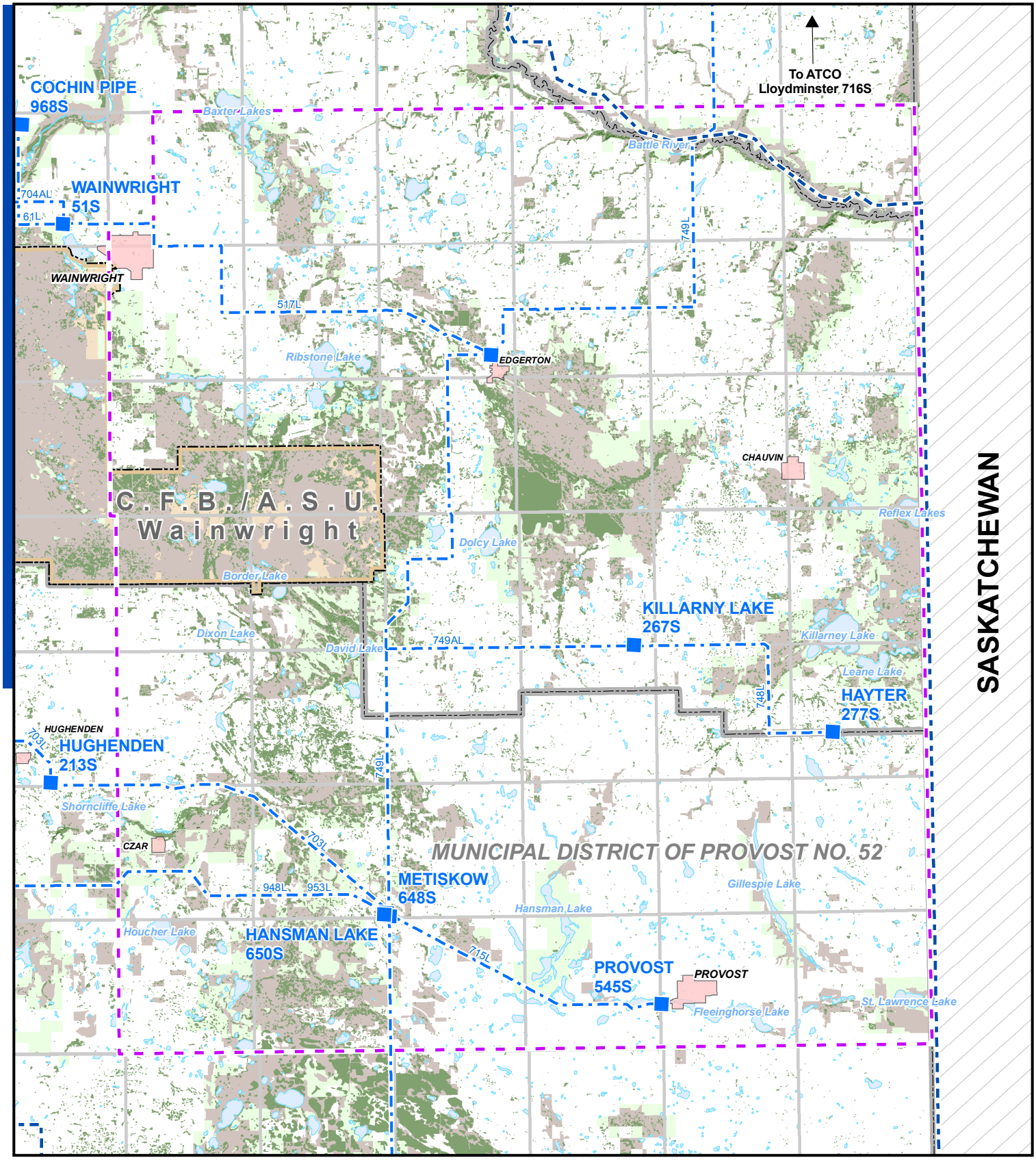
0 2 4 Miles

LAND IMPACT ASSESSMENT

ALTALINK

Figure A

Nilrem to Vermilion Area Transmission Development Native Vegetation Map



LEGEND

NATIVE VEGETATION
- Native Coniferous
- Native Deciduous
- Native Grassland

- Existing Substation
- Existing Transmission Line
- AltaLink Service Area
- Hansman Lake to Hayter to Lloydminster Area
- Environmentally Significant Area
- Military Base
- Municipal Boundary
- Urban Area
- Water Body

NO.: 011-2
DRAWN: WM-ST
FILE NO.: 1053157-011-2
REVISION: 2
DATE: 2010-04-12
FOLDER: CETD

N

0 5 10 Kilometers
0 2 4 Miles

LAND IMPACT ASSESSMENT

ALTALINK

Figure B

Hansman Lake to Hayter to Lloydminster Transmission Development
Native Vegetation Map

Land Impact Assessment

ATCO

LAND IMPACT ASSESSMENT

for the

Proposed Central East Transmission Development (CETD)

Prepared for the
Alberta Electric System Operator (AESO)
in Support of the
AESO Needs Identification Document (NID)

April 9, 2010

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EXECUTIVE SUMMARY

The intent of this Land Impact Assessment (LIA) is for transmission facility owner (TFO) ATCO Electric Ltd. (ATCO) to provide the Alberta Electric System Operator (AESO) with land impact analysis information required for the proposed Central East Transmission Development Project Need Identification Document (NID).

This LIA was achieved by conducting comparative assessments (where applicable) of the AESO's three system development plans. Each system development plan is comprised of several individual components of which there may be different alternatives. The objective of this LIA study was to define and compare potential route concepts for each Alternative. The comparison used measurable indicators to quantify and qualify the major aspects of impacts as identified by the Alberta Utilities Commission (AUC) Rule 007 (NID12, Section 6.1, April 2009). This LIA does not consider cost, technical details, or electrical aspects, as per scope of work previously agreed to for the CETD.

A variety of digital land information data, digital data analysis methods and cadastral mapping techniques were used to generate impact assessment summary statistics ("metrics") and maps. ATCO conducted and developed the LIA using the following direction from the AESO:

- All three system-development plans are to be assessed;
- The LIA is to focus exclusively on those impacts defined in Rule 007;
- Cost is out of scope and therefore is not included in this study;
- Electrical consideration assessments are to be limited to land-related impacts; and
- LIA analyses are to only assess impacts within ATCO's service area, with the exception of two new 240kV lines (9L928 and a line from New Vermilion to Nilrem) and a 144kV replacement line (7L749 and 749L), which cross over the boundary.

To facilitate the comparative assessment of the different alternatives at this stage of project development, representative routing scenarios (i.e. "route concepts") were based on, among other factors, the location of existing transmission lines and substations. Route concepts were then formulated for each alternative, which took into account existing facilities and proposed facilities, and were then compared in terms of their impact metrics.

LIA Findings

It is important to consider that from an LIA perspective, none of the alternatives pose a degree of potential impact that completely excludes them from consideration as a viable solution, based on the impact criteria studied. No specific routing scenarios are being recommended at this time.

For more precise comparisons, detailed, field-level siting and routing research is required. Additionally, Public Consultation (Stakeholder / Land Owner, Agency and First Nations) is required to identify specific routing options for more detailed comparisons. Field-level assessment and public consultation on the key impact factors (per AUC Rule 007) were not undertaken at this level of LIA study. It is highly recommended that detailed field-level studies be undertaken as part of the intensive route-planning process, prior to TFO Public Consultation activities, for determining viable preliminary routing options.

Spatial analysis methods were applied to a variety of digital data sets to quantitatively determine impacts ("metrics") for measurable indicators. Results are presented in Sections **5 and 6** and include metrics summaries for each Alternative.

For purposes of broad-based comparisons of routing concepts for the three design **Alternatives**, **Alternative 3** potentially has the lowest overall impact for the majority of the measurable indicators assessed. **Alternative 3** has the shortest overall length as based on route concept comparisons (approximately 273 km), and thus the lowest overall value for land area required (potentially 819 ha) for potential right-of-ways. **Alternative 2** has the potential for the longest overall length (632 km) and the largest area (1,896 ha) of lands required for potential right-of-ways. In comparison, **Alternative 1** has the mid-range of route length (approximately 434 km) and land area required (1,302 ha).

Alternative 2 takes up more environmentally sensitive land than **Alternative 1 and Alternative 3**, and has the lowest ranking for proximity to and potential impacts to surface water. **Alternative 3** has the lowest potential to impact oil and gas facilities. **Alternative 3** takes up the least amount of privately-owned lands. Additionally, **Alternative 3** impacts the least amount of Historical Resources relative to **Alternatives 1 and 2**. None of the three Alternatives cross military bases, airfields, or Indian Reserves. **Alternatives 1 and 2** are nearly equivalent in the amount of infrastructure and linear features (e.g. transmission lines, highways, railway lines, and pipelines) paralleled. **All three Alternatives** have potential for impacting urban centres.

Social impact is a more qualitative type of assessment, but may be considered as a combination of the impacts related to residential, visual, and special constraints. Using these criteria, **Alternative 3** can be viewed as having the least potential for social impact, whereas **Alternative 2** can be viewed as having the greatest potential for social impact.

1 INTRODUCTION & OVERVIEW

1.1 Background

The Alberta Electric System Operator (AESO) has requested that ATCO Electric Ltd. (ATCO) provide a Land Impact Assessment (LIA) for the proposed Central East Transmission Development (CETD) Project ("the Project"), located primarily within ATCO's service territory in Alberta. This LIA is to be used by the AESO in support of a Needs Identification Document (NID) for this transmission development project. This LIA report is a comparative assessment of the AESO's three potential system development plans and associated route concepts for each alternative.

The proposed route concepts for each of the alternatives are detailed below, in terms of component transmission lines and substations. Existing and proposed lines and existing and proposed substations are described in the text below. Proposed lines are described by "start point – end point" substation sequences, based on existing and proposed (future) substations in the descriptive tables provided in Section 3.

1.2 Study Area

The CETD study area is characterized by a wide range of plains to undulating terrain to gentle and hummocky upland areas. The North Saskatchewan River, Beaver River and (part of) the Athabasca River are the major river basins within the study area. Many creeks and waterbodies occur within the region. Primary land use, particularly in the south portion of the study area is agriculture. Oil and gas exploration and development is very common throughout the region, as is related infrastructure (well sites, pipelines, pump stations and compressor stations). Other land use activities include forestry (primarily in the northernmost portion of the study area), strip and open pit mining and gravel extraction. Hunting and fishing are also typical land uses, primarily in the northern portion of the study area. The southern half of the study area is well populated.

There are three major ecological or natural subregions that occur in the study area. These include the Central Mixedwood, Dry Mixedwood and Central Parkland subregions. The Central Mixedwood and Dry Mixedwood subregions are both characteristic of boreal forest. The Central Mixedwood natural subregion is characterized by "Aspen, mixedwood and white spruce forests on uplands, with extensive areas of mainly treed fens in central areas and jack pine stands on coarser materials to the east"[1]. The Dry Mixedwood subregion is characterized by "Aspen stands with scattered white spruce interspersed with fens, cultivated areas on suitable soils throughout." The Central Parkland subregion is characterized by "Intensively cultivated and heavily populated fertile" areas and a "cultivated mosaic of aspen and prairie vegetation on remnant native parkland areas".

There are larger (i.e., Lloydminster) and smaller population centres or cities and towns located throughout the study area that provide services to the local agricultural community and also support oilfield activities. Edmonton is also located approximately 60 km west of the study area. Population

[1] Natural Regions Committee 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852.

centres within the study area include Coronation, Castor, Stettler, Bashaw, Hardisty, Daysland, Killam, Sedgewick, Wainwright, Viking, Lloydminster, Vegreveille, Mundare, Two Hills, St. Paul Elk Point, Smoky Lake, Vermilion, Bonnyville and Cold Lake. Airstrips are associated with larger population centres, and telecommunications towers are distributed throughout the landscape.

Land ownership is a combination of Municipal Government (MD or County) and private (freehold), as well as Crown (Provincial Government). There are no National Parks but there are Provincial Parks, natural areas, ecological reserves within and designated Environmentally Significant Areas (ESAs) in the region.

Refer to Figures 1.1 and 1.2 for Regional and Study Area maps.

Figure 1.1 – Regional Map

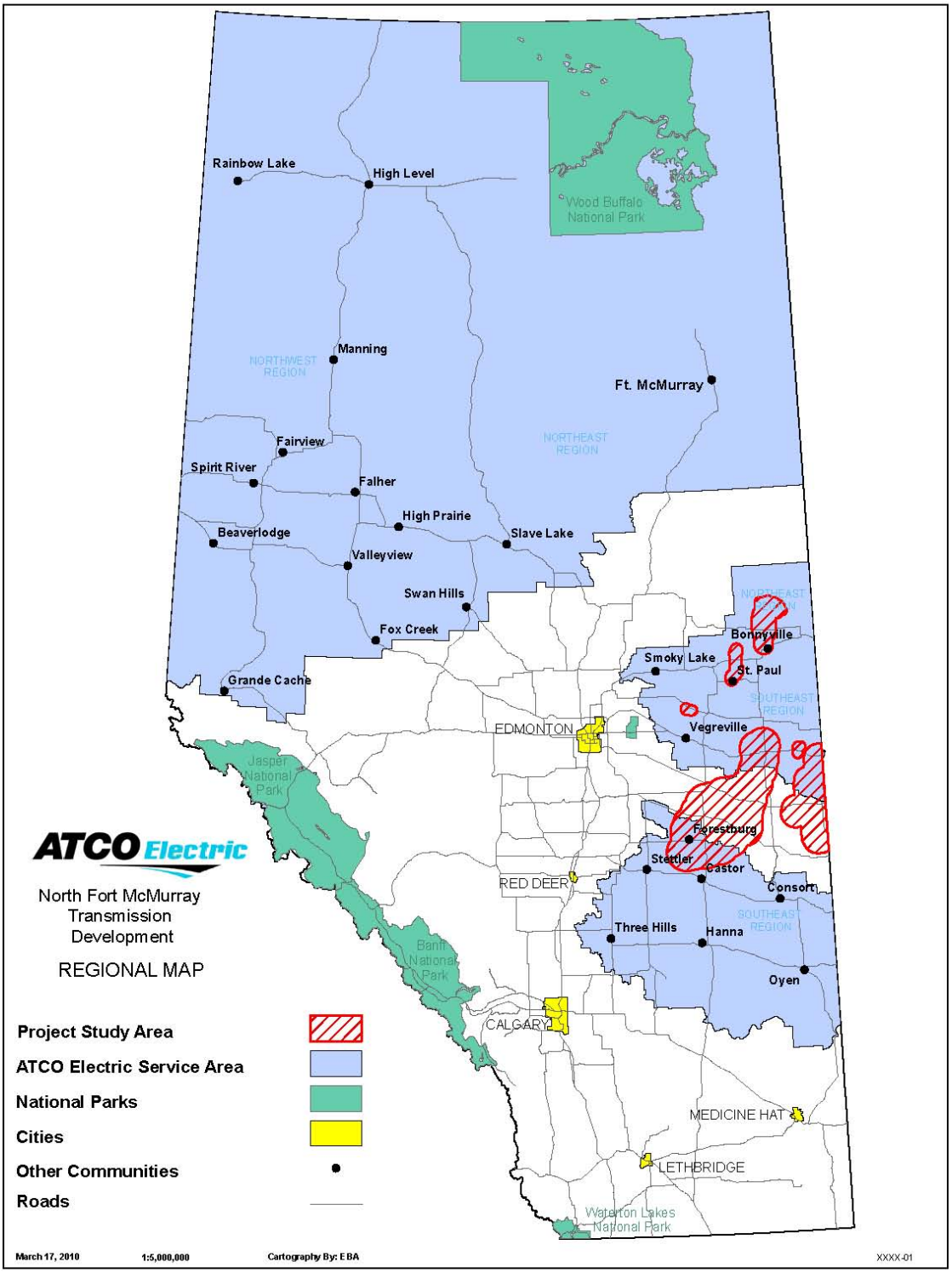
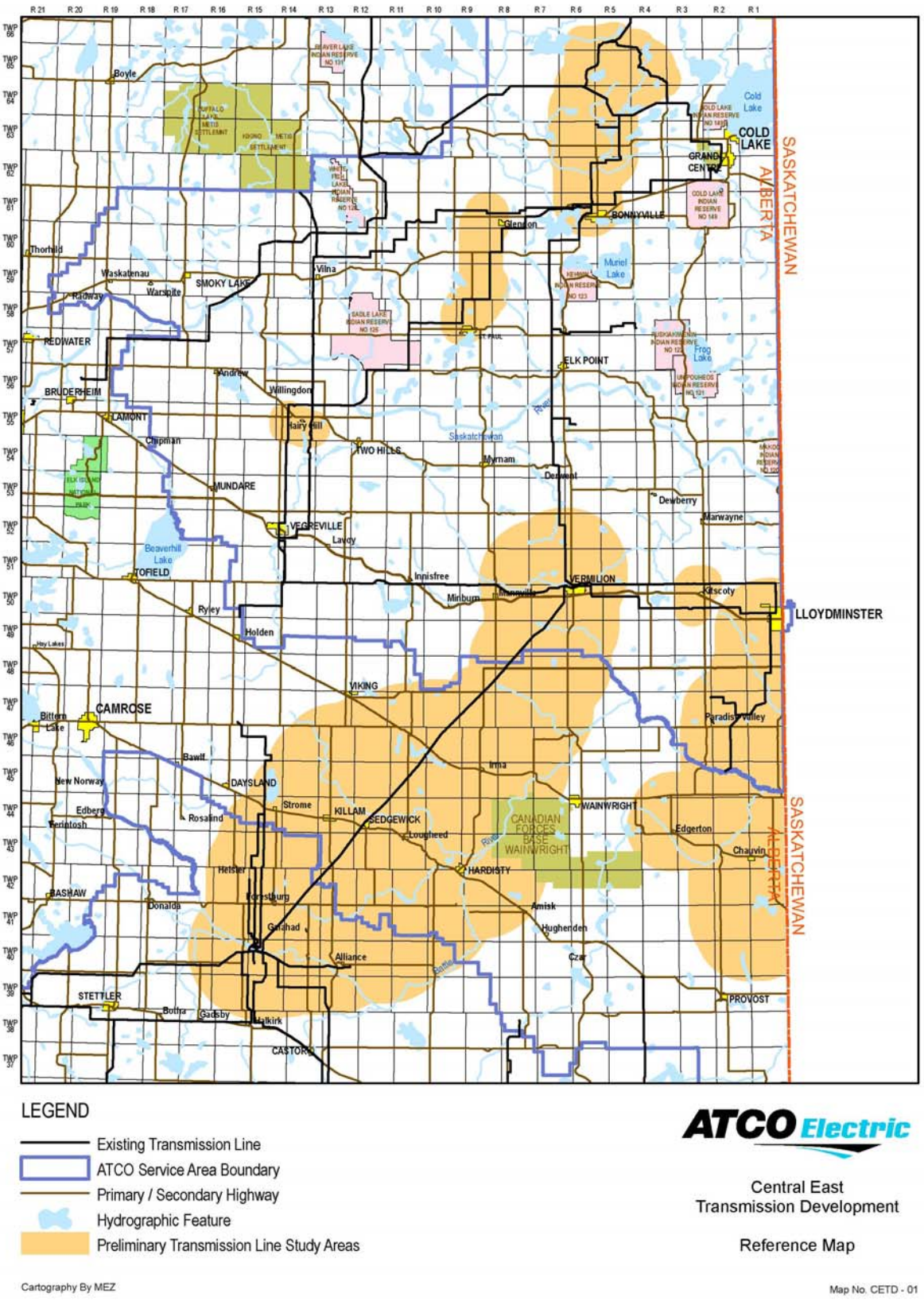


Figure 1.2 – Study Area Map



Primary environmental concerns involve the conservation of native grasslands, parkland and agricultural soils, the protection of bird migration corridors and nesting grounds as defined by presence of water bodies, and the overall protection and conservation of wildlife and associated habitat.

1.3 Route Concepts for the Alternatives

The route concepts for the three "Alternatives" proposed by the AESO are referred to as **Alternative 1, Alternative 2, and Alternative 3.** Each is comprised of combinations of single and/or double circuits of 144 kV and/or 240 kV transmission lines, as well as existing and proposed substations, with some line and substation components common to more than one Alternative. Details on the system components comprising the three AESO CETD Alternatives are presented in Sections 3, and locations of these Alternatives are presented as Figures 2.1, 2.2, and 2.3, respectively.

1.4 Report Organization

This document is organized to provide an understanding of the:

- Background and need for this Transmission Development Project;
- Transmission lines and substation components for each of the three Alternatives being considered;
- Limitations in assessing land impacts of these Alternatives;
- Assumptions made and criteria used to identify impacts as per AUC Rule 007;
- Factors that influence the proponents and stakeholders response to these Alternatives; and
- Rationale for how the LIA findings (metrics data) were attained.

Section 1 (Introduction and Overview) provides background information on the need and focus for the LIA. Section 2 (Methods) provides a summary of methods and data used in this LIA, and insight into the assessment process associated with each system-development Alternative.

Section 3 (System Development Plans & Design Alternatives) provides descriptions of representative route concepts for each Alternative, including summary tables for each Alternative in terms of existing and proposed line and substation components.

Section 4 (Land Impacts & Measurable Indicators) provides insight into the major aspects of transmission line impacts as defined by the AESO Rule 007, and how the measurable indicators can be determined and used to gauge specific concerns for each of the proposed Alternatives. The measurable indicators are then used to conduct a broad comparison and to establish potential differences in impact factors between each of the proposed Alternatives.

Section 5 (Results & Discussion) contains the LIA findings. Section 6 (Summary & Conclusions) provides summary and conclusions, based on the evaluation of the overall determined impacts for each of the three route Alternatives.

Sections 7 (Acronyms) provides a list of Abbreviations and Acronyms, and Section 8 (Glossary of Terms) provides an explanation of terms used within this report.

2 METHODS

2.1 Requirements of AUC Rule 007

AUC Rule 007 requires that specific impact criteria be examined in the assessment of routing alternatives for proposed transmission development projects. This necessitates that an impact assessment be undertaken that considers seven impact categories, as defined in Section 6, NID 12, of Rule 007.

These include:

(1) Agricultural Impact;
(2) Residential Impact;
(3) Environmental Impact;
(4) Cost;
(5) Electrical Considerations;
(6) Visual Impact; and
(7) Special Constraints.

These impact categories are described in terms of their respective components and measurable indicators in Section 4 of this report. Item 6 "Cost" was excluded from the LIA, per request of the AESO.

2.2 Delineation of Regional Study Area

The CETD study area boundaries for this LIA were defined in response to three system development plans and the associated components identified by the AESO. Refer to maps of the Study Area (Figures 1.1 and 1.2), and the three Alternatives' route concepts (Figures 2.1, 2.2, and 2.3). These three different transmission development plans or "Alternatives" were put forth by the AESO. Each of these is characterized by common and unique combinations of proposed 144 kV and 240 kV component transmission lines. The termination points for the proposed transmission lines are either existing or proposed substations. Refer to Section 3 for additional details on these Alternatives.

The new transmission system components, together with a variety of landscape features, existing transmission lines, highways, and populated centres, helped to define the study area boundaries as follows:

- The southern boundary was determined by the service area boundary between ATCO Electric and AltaLink.
- The eastern boundary of the study area was determined by the general area between Provost and Cold Lake. This area is just west of the Saskatchewan border.
- A northern boundary was determined by the existing Foster Creek 877S substation.
- The western boundary of the study area was delimited by a general corridor west of transmission line 701L.
- Route concepts excluded areas viewed as "no-go areas". These areas included heavily populated urban centres, provincial and national parks and protected areas, military bases, Indian Reserves, major water crossings, and other areas with significant constraints.

Refer to Figures 2.1 – 2.3 for additional details on the individual AESO Alternatives. Refer to Figure 1.2 for additional details on potential location of proposed substations and route concepts.

Figure 2.1 – Alternative 1

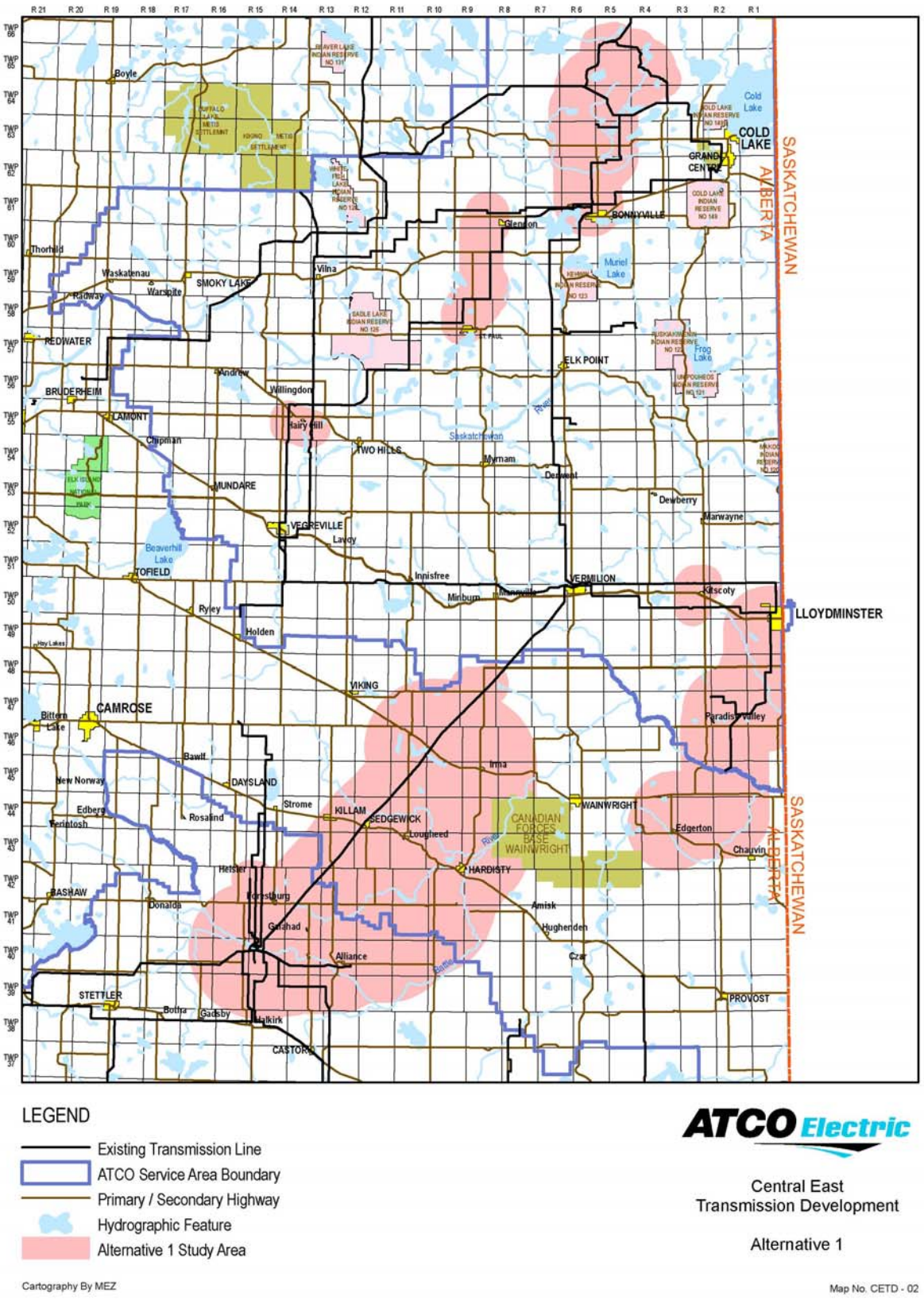


Figure 2.2 – Alternative 2

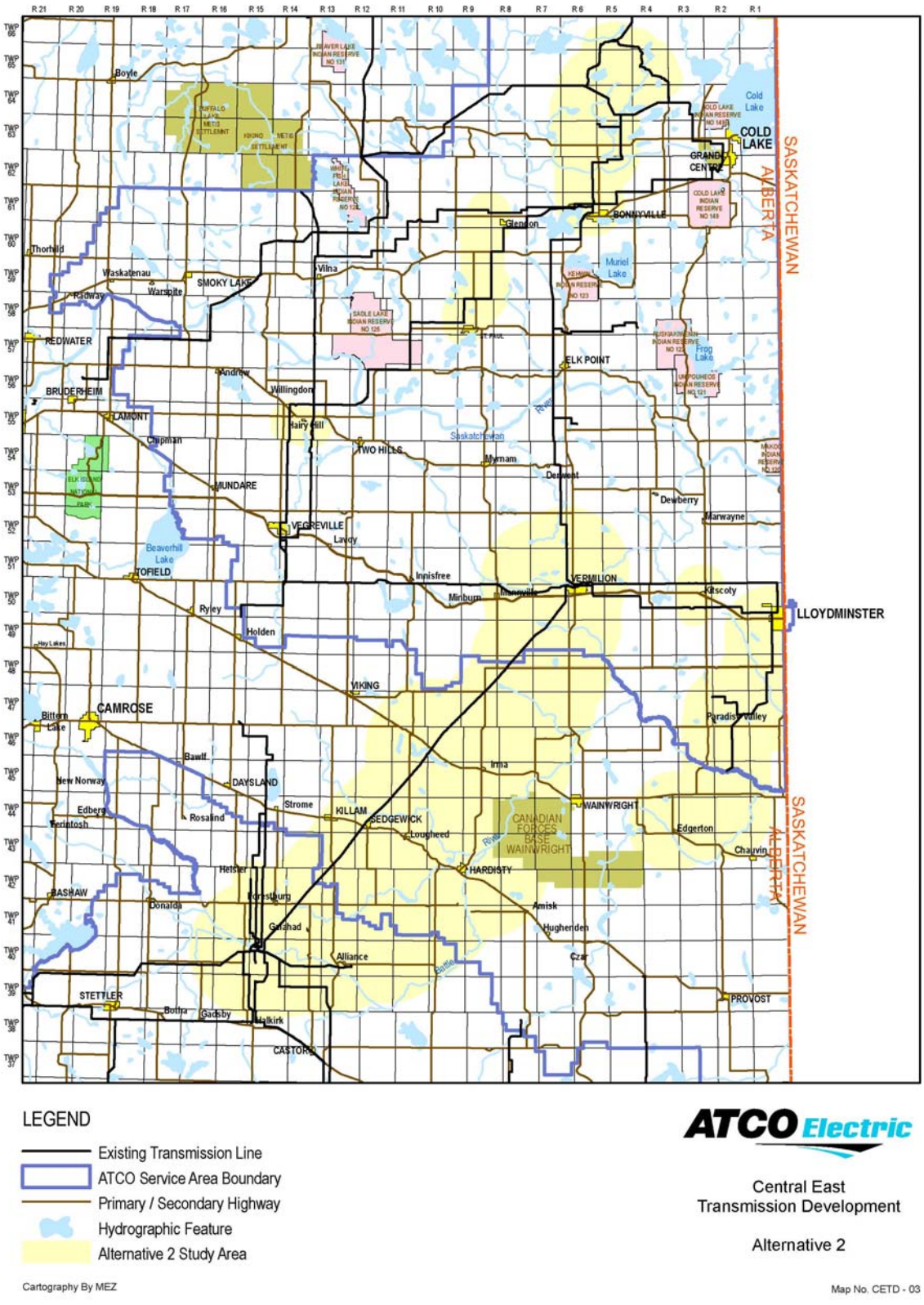
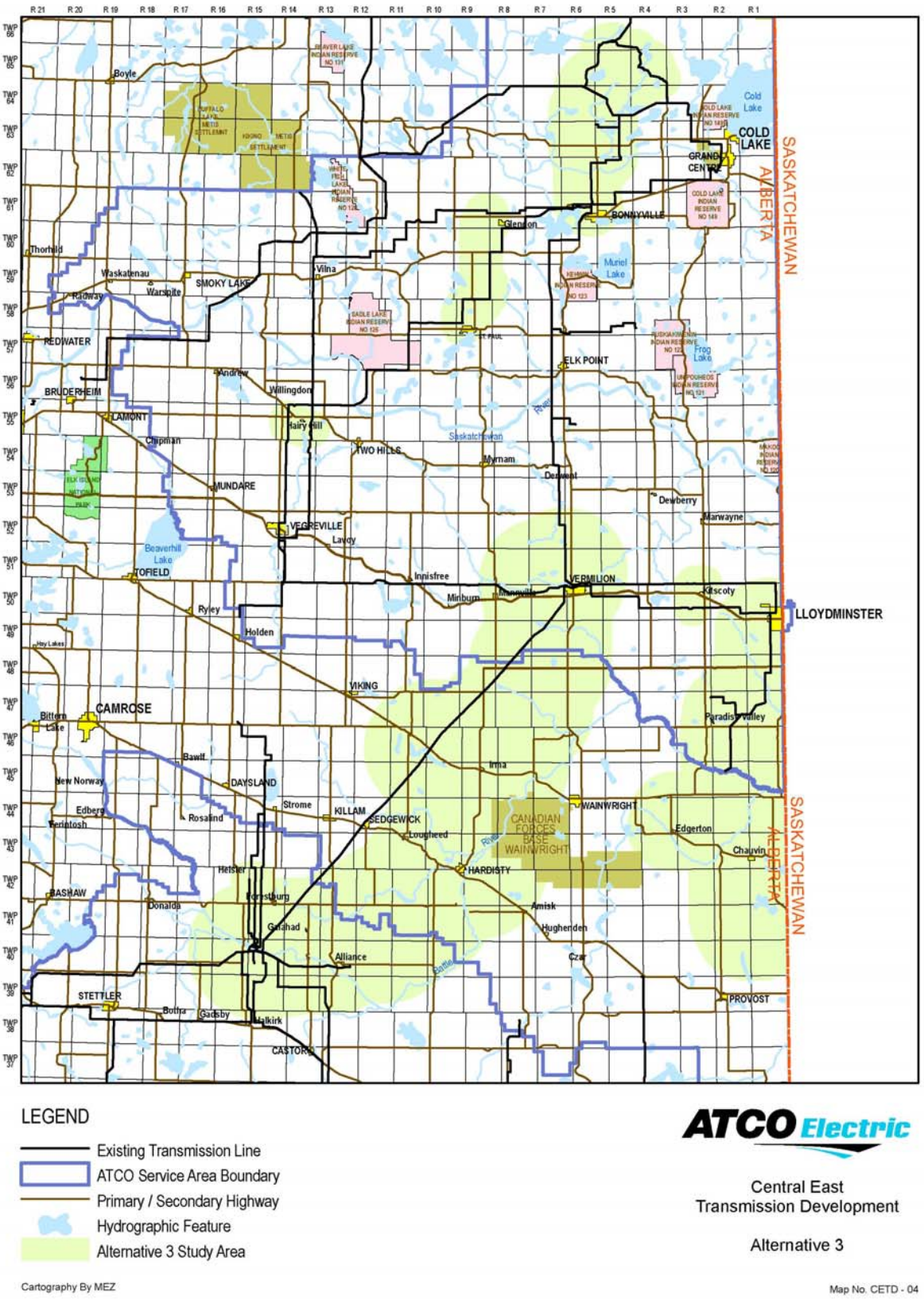


Figure 2.3 – Alternative 3



2.3 Data Utilized

The following data were utilized in the generation of metrics for this study:

Government of Canada, National Archives of Canada, Visual and Sound Archives Division, **"Canada Land Inventory - Land Capability for Agriculture," Soil Capability Classification for Agriculture,** Report No.2, Lands Directorate, Environment Canada, 1972, Ottawa, ON, Canada, <http://geogratis.cgdi.gc.ca/CLI/index_agriculture.html>

Government of Canada, National Archives of Canada, Visual and Sound Archives Division, **"Canada Land Inventory - Land Capability for Forestry," Land Capability Classification for Forestry,** Report No.4, Land Directorate, Environment Canada, 1970, Ottawa, ON, Canada, <http://geogratis.cgdi.gc.ca/CLI/index_forestry.html >

Parks and Protected Areas Division, Alberta Community Development, **"Environmentally Significant Areas (ESAs) in Alberta** – excluding Rocky Mountain Natural Region," Alberta Community Development, March 1997, <http://tpr.alberta.ca/parks/heritageinfocentre/environsigareas/default.asp>

AltaLIS, Digital Mapping for Alberta, Parks and Protected Areas, October 2009. <http://www.altalis.com/prod_base_bound.html>

Historic Resources Management Branch, **"The March 2009 edition of the Listing of Significant Historical Sites and Areas,"** Alberta Culture and Community Spirit, Government of Alberta, March 2009, Edmonton, AB, Canada, <http://culture.alberta.ca/heritage/resourcemanagement/landuseplanning>

Agriculture and Agri-Food Canada, **"PFRA's Generalized Landcover,"** Prairie Farm Rehabilitation Administration - Agriculture Agri-Food Canada, 2001, Regina, SK, Canada, <http://www.agr.ca/pfra/gis/index.htm>

2.4 The LIA Assessment Process

The Land Impact Assessment (LIA) process allows the AESO to conduct a comparative assessment of the potential impacts for the AESO's three proposed system-development plans for the Central East Transmission Development, to support submission of their NID.

To ensure consistent data for all plans, the land impact assessment process was driven by common criteria. The AUC Rule 007 "major aspects for land assessments", with associated measurable indicators and concerns were considered for all plans. All plans required representative routing concepts to generate the measurable indicators, as well as consistent technical assumptions (i.e. using a 30 metre right-of-way (ROW) for both 144 kV and 244 kV transmission route concepts).

This section offers a detailed look at the criteria used in the LIA process, provides an understanding of how the LIA was conducted and metrics were developed, and how findings were reached. The LIA evaluated the relative land impacts of transmission line developments within the geographic

areas associated with the respective system-development plans portrayed as route concepts (Figures 1.2, 2.1, 2.2, and 2.3).

Each system-development plan is comprised of several individual components, including new transmission lines, new substations, or upgrades to existing facilities, all of which are described in Section 3, for each Alternative.

The LIA uses the "major aspects of land impact", with the exception of cost and certain electrical aspects, as identified within AUC Rule 007 (NID 12, Section 6.1) as basis for identifying specific land-impact concerns. These include:

- Agricultural Impact;
- Residential Impact;
- Environmental Impact;
- Electrical Considerations;
- Visual Impact; and
- Special Constraints.

(Note that AUC's "Item 6 - Cost" was not part of the scope of this impact assessment)

Through the analysis of available digital data sources (Section 2.3), for each technical alternative, representative route concepts were determined for each of the three system-development plans and analyzed for potential impacts. These route concepts were derived from reconnaissance level assessments of available digital data and were evaluated for comparative purposes. No detailed route determinations (e.g. on which side of a paralleled transmission line a new line would be located.) were utilized in evaluation of route concepts, as this requires a subsequent narrowing down of route options with detailed field work to facilitate local landscape level comparisons, as well as the TFO's Public Consultation on proposed route options, all which will help determine the most feasible routing given actual conditions at the local landscape level.

The LIA was derived using the best available digital map information including, but not limited to, various land-use and land-feature maps and included:

- Satellite imagery;
- Hydrographic data;
- Environmentally Sensitive Areas (ESA) data;
- Canada Land Inventory (CLI) – Soil capability for Agriculture, and Forestry;
- Cadastral land-base classification data (Alberta Township Survey, Zones, Municipal Boundaries, Crown Lands); and
- Historical and Archaeological Resource data.

ATCO's experience with respect to routing transmission lines in Alberta, including existing and proposed 144 kV and 240 kV transmission lines and substations, and prior knowledge of the study area, were incorporated into selection of the route concepts for each of the three Alternatives. For application of these reconnaissance level LIA findings on the proposed Alternatives and associated

route concepts, there is also a need for Public, Agency, and First Nations consultation by TFOs, detailed environmental assessment fieldwork, visual assessments, historical and archaeological resource impact assessments, a land-titles search, and other route-siting activities that will help determine more specific routing scenarios for the Facilities Applications.

Two approaches were undertaken to evaluate the potential impacts of three proposed alternatives for the CETD. A proximity approach was used to evaluate the impact of representative routes in the project area. A study area approach was used to summarize the whole project area in terms of potential impact for comparison with the impact of the representative routes. Spatial data representing each major aspect and consideration (defined by the AUC Rule 007) was compiled into a GIS database and used to evaluate the Land Impact of the proposed project.

Proximity

In the proximity approach, the total number of features for each major aspect and consideration was counted within the distances regulated, as defined by the AUC Rule 007, for representative routes of each alternative. Buffering and summary-by-location techniques were used in GIS software to count the number of features for each major aspect and consideration within their respective regulated distances.

Area

In the area based approach, the features in each major aspect and consideration were measured within the project study area. The study area was determined by buffering each representative route component by 15% of its length and then merging these buffers into a single area for each major alternative route. If the length of representative routes were such that the 15% of their length was less than 5000m, the default study area buffer was set to 5000m. This approach was designed to create an inventory of major aspects and consideration within a broader area than that captured by evaluating only within the AUC Rule 007 regulated distances.

The results from the area analysis were compared to the proximity/representative route analysis to evaluate whether the potential impacts of the each alternative route would increase or decrease if located elsewhere within the project study area. The results of the area analysis confirmed the results of the proximity analysis. Therefore, for reporting purposes the results of the proximity analysis will be used and discussed in this LIA.

3 SYSTEM DEVELOPMENT PLANS & DESIGN ALTERNATIVES

3.1 System Development Plans and Alternatives

Three "Alternatives" were proposed by the AESO, as options for the Central East Line Transmission Development. These Alternatives are portrayed as route concepts (Figures 1.2, and 2.1-2.3). Summary tables (Tables 3.1 to 3.6) outlining details of the transmission lines and substations associated with each of these three Alternatives are presented below.

Refer to Sections 3.1.1, 3.1.2 and 3.1.3 for additional details on each Alternative.

3.1.1 Alternative 1

Alternative 1 contains the following features common to Alternatives 2 and 3: new 144kV line (7L139) from 7L70 to St. Paul 707S; new 144kV line (7LA92) from 7L92 to Watt Lake 956S; new Watt Lake substation 956S; new 144kV line (7LA701) from 7L701 to Heisler 764S; new 144kV line (7LA14) from 7L14 to Kitscoty 705S; new Bourque substation 970S; new Double Circuit (7L157 and 7L160) 144kV line from Mahihkan 837S to Bourque 970S; re-build 7L74 from Wolf Lake 822S to Bourque 970S; re-build 7L83 from Bourque 970S to Leming Lake 715S; re-build 7L87 from Marguerite Lake 826S to Wolf Lake 822S; new (7L146) 144 kV (pre-built to 240 kV) line from Bourque 970S to Bonnyville 700S; and new (7L163) new 144 kV (pre-built to 240 kV) line from Marguerite Lake 826S to Bourque 970S (2017).

7L50 and 7L749 rebuilds are common to Alternatives 1 and 2 only. The unique feature of Alternative 1 is the addition of a 144kV capacitor at Vermilion 710S.

Refer to Tables 3.1 and 3.2 for summaries of the specific line and substation components associated with Alternative 1.

Table 3.1 Line Details for Alternative 1

Note: Black font denotes "existing" substation, Red font denotes "new substation". Yellow highlight indicates line configurations unique to this Alternative. Green highlight indicates configurations unique to Alternatives 1 and 2.

AE #	SLD Future Line#	kV	Approx. Line Length (km)	S/C or D/C	Start Point	End Point	Comment
1	**7L50**	144	158	S/C	**Battle River 757S**	**Buffalo Creek 526S**	Re-build
2	**7L749**	144	80 (51 in ATCO Service Territory)	S/C	Lloydminster	Service Territory Boundary	Re-build for high winds

AE #	SLD Future Line#	kV	Approx. Line Length (km)	S/C or D/C	Start Point	End Point	Comment
3	**7L139**	144	39	D/C	**7L70**	**St. Paul 707S**	
4	**7LA92**	144	9	S/C	**7L92**	Watt Lake 956S	
5	**7LA701**	144	2	S/C	**7L701**	**Heisler 764S**	
6	**7LA14**	144	10	D/C	**7L14**	**Kitscoty 705S**	
7	**7L157 & 7L160**	144	1	D/C	**Mahihkan 837S**	Bourque 970S	
8	**7L74**	144	19	S/C	**Wolf Lake 822S**	Bourque 970S	**Re-build**
9	**7L83**	144	6	S/C	Bourque 970S	**Leming Lake 715S**	**Re-build**
10	**7L87**	144	16	S/C	**Marguerite Lake 826S**	**Wolf Lake 822S**	**Re-build**
11	**7L146**	144	58	S/C	Bourque 970S	Bonnyville 700S	**Pre-built to 240kV**
12	**7L163**	144	19	S/C	**Marguerite Lake 826S**	Bourque 970S	**Pre-built to 240kV**

Table 3.2 Substation Details for Alternative 1

Future Substations	Tentative ISD	Comment
Watt Lake 956S	2012	replaces existing Willingdon 811S
Bourque 970S	2012	located near existing Mahihkan
Upgrades to Existing Substations	**Tentative ISD**	**Comment**
Vermilion 710S	2012	
St. Paul 707S	**2012**	
Bonnyville 700S	**2012**	
Whitby Lake 811S	**2012**	
Heisler 764S	**2012**	
Kitscoty 705S	**2012**	
Vermilion 710S	**2012**	
Marguerite Lake 826S	**2017**	

3.1.2 Alternative 2

Alternative 2 contains the following features common to Alternatives 1 and 3: new 144kV line (7L139) from 7L70 to St. Paul 707S; new 144kV line (7LA92) from 7L92 to Watt Lake 956S; new Watt Lake substation 956S; new 144kV line (7LA701) from 7L701 to Heisler 764S; new 144kV line (7LA14) from 7L14 to Kitscoty 705S; new Bourque substation 970S; new Double Circuit (7L157 and 7L160) 144kV line from Mahihkan 837S to Bourque 970S; re-build 7L74 from Wolf Lake 822S to Bourque 970S; re-build 7L83 from Bourque 970S to Leming Lake 715S; re-build 7L87 from Marguerite Lake 826S to Wolf Lake 822S; new (7L146) 144 kV (pre-built to 240 kV) line from Bourque 970S to Bonnyville 700S; and new (7L163) new 144 kV (pre-built to 240 kV) line from Marguerite Lake 826S to Bourque 970S (2017).

7L50 and 7L749 rebuilds are common to Alternatives 1 and 2 only. The unique features of Alternative 2 include: the construction of New Vermilion 240-144 kV substation; a new 240 kV line from New Vermilion to Nilrem substation, (the entire new line was assessed by ATCO for the LIA, not just the portion within their service territory); moving all 144kV lines from existing Vermilion 710S to New Vermilion; and new 144kV lines from Vermilion 710S to New Vermilion.
Refer to Tables 3.3 and 3.4 for summaries of the specific line and substation components associated with Alternative 2. The unique components of Alternative 2 are highlighted in Table 3.3.

Table 3.3 Line Details for Alternative 2

Note: Black font denotes "existing" substation, Red font denotes "new substation". Yellow highlight indicates line configurations unique to this Alternative. Green highlight indicates configurations unique to Alternatives 1 and 2.

AE #	SLD Future Line#	kV	Approx. Line Length (km)	S/C or D/C	Start Point	End Point	Comment
1	**7L50**	144	158	S/C	**Battle River 757S**	**Buffalo Creek 526S**	Re-build
2	**7L749**	144	80 (51 in ATCO Service Territory)	S/C	Lloydminster 716S	Service Territory Boundary	Re-build for high winds
3	**7L139**	144	39	D/C	**7L70**	**St. Paul 707S**	
4	**7LA92**	144	9	S/C	**7L92**	Watt Lake 956S	
5	**7LA701**	144	2	S/C	**7L701**	**Heisler 764S**	
6	**7LA14**	144	10	D/C	**7L14**	**Kitscoty 705S**	
7	**7L157 & 7L160**	144	1	D/C	**Mahihkan 837S**	Bourque 970S	
8	**7L74**	144	19	S/C	**Wolf Lake 822S**	Bourque 970S	**Re-build**
AE #	**SLD Future**	**kV**	**Approx. Line**	**S/C or**	**Start**	**End**	**Comment**

	Line#		Length (km)	D/C	Point	Point	
9	**7L83**	144	6	S/C	Bourque 970S	**Leming Lake 715S**	**Re-build**
10	**7L87**	144	16	S/C	**Marguerite Lake 826S**	**Wolf Lake 822S**	**Re-build**
11	**7L146**	144	58	S/C	Bourque 970S	Bonnyville 700S	**Pre-built to 240kV**
12	**7L163**	144	19	S/C	**Marguerite Lake 826S**	Bourque 970S	**Pre-built to 240kV**
13	**9LXXX**	240	113 (31 in ATCO Service Territory)	S/C	New Vermilion	**Nilrem**	Unique to Alt 2
14	**7L14, 7L129, 7L53, 7L65**	144	77	S/C	**Vermilion 710S**	New Vermilion	Re-termination of existing lines- Unique to Alt 2
15	**7LXXX, 7LXXX**	144	7	D/C	**Vermilion 710S**	New Vermilion	New Line- Unique to Alt 2

Table 3.4 Substation Details for Alternative 2

Future Substations	Tentative ISD	Comment
New Vermilion	2012	
Watt Lake 956S	2012	replaces existing Willingdon 811S
Bourque 970S	2012	located near existing Mahihkan
Upgrades to Existing Substations		
St. Paul 707S	**2012**	
Bonnyville 700S	**2012**	
Whitby Lake 811S	**2012**	
Heisler 764S	**2012**	
Kitscoty 705S	**2012**	
Vermilion 710S	**2012**	
Marguerite Lake 826S	**2017**	

3.1.3 Alternative 3

Alternative 3 contains the following features common to Alternatives 1 and 2: new 144kV line (7L139) from 7L70 to St. Paul 707S; new 144kV line (7LA92) from 7L92 to Watt Lake 956S; new Watt Lake substation 956S; new 144kV line (7LA701) from 7L701 to Heisler 764S; new 144kV line (7LA14) from 7L14 to Kitscoty 705S; new Bourque substation 970S; new Double Circuit (7L157 and 7L160) 144kV line from Mahihkan 837S to Bourque 970S; re-build 7L74 from Wolf Lake 822S to Bourque 970S; re-build 7L83 from Bourque 970S to Leming Lake 715S; re-build 7L87 from Marguerite Lake 826S to Wolf Lake 822S; new (7L146) 144 kV (pre-built to 240 kV) line from Bourque 970S to Bonnyville 700S; and new (7L163) new 144 kV (pre-built to 240 kV) line from Marguerite Lake 826S to Bourque 970S (2017).

The unique features of Alternative 3 include: a new 240kV line from Service Territory Boundary to Lloydminster 716S. It should be noted that the entire new line was assessed by ATCO for the LIA, not just the portion within their Service Territory Boundary.

Refer to Tables 3.5 and 3.6 for additional details on the specific line and substation components associated with Alternative 3. The unique components of Alternative 3 are highlighted in Table 3.5.

Table 3.5 Line Details for Alternative 3

Note: Black font denotes "existing" substation, Red font denotes "new substation". Yellow highlight indicates line configurations unique to this Alternative.

AE #	SLD Future Line #	kV	Approx. Line Length (km)	S/C or D/C	Start Point	End Point	Comment
1	**9L928**	240	95 (47 in ATCO Service Territory)	D/C	Service Territory Boundary	Lloydminster 716S	Unique to Alt 3
2	**7L139**	144	39	D/C	**7L70**	**St. Paul 707S**	
3	**7LA92**	144	9	S/C	**7L92**	Watt Lake 956S	
4	**7LA701**	144	2	S/C	**7L701**	**Heisler 764S**	**7LA701**
5	**7LA14**	144	10	D/C	**7L14**	**Kitscoty 705S**	**7LA14**
6	**7L157 & 7L160**	144	1	D/C	**Mahihkan 837S**	Bourque 970S	
7	**7L74**	144	19	S/C	**Wolf Lake 822S**	Bourque 970S	**Re-build**
8	**7L83**	144	6	S/C	Bourque 970S	**Leming Lake 715S**	**Re-build**
9	**7L87**	144	16	S/C	**Marguerite Lake 826S**	**Wolf Lake 822S**	**Re-build**
10	**7L146**	144	58	S/C	Bourque 970S	Bonnyville 700S	**Pre-built to 240kV**
11	**7L163**	144	19	S/C	**Marguerite Lake 826S**	Bourque 970S	**Pre-built to 240kV**

Table 3.6 Substation Details for Alternative 3

Future Substations	Tentative ISD	Comment
Watt Lake 956S	2012	replaces existing Willingdon 811S
Bourque 970S	2012	located near existing Mahihkan
Upgrades to Existing Substations		
St. Paul 707S	**2012**	
Bonnyville 700S	**2012**	
Whitby Lake 811S	**2012**	
Heisler 764S	**2012**	
Kitscoty 705S	**2012**	
Vermilion 710S	**2012**	
Lloydminster 716S	**2012**	
Marguerite Lake 826S	**2017**	

3.2 Development of Route Concepts for the Alternatives

Representative route concepts were developed for the three AESO determined Alternatives in order to provide defined study areas (Figure 1.2) for the collection and analysis of land-impact data. However, no specific routing is being recommended at this time.

To identify representative routes, a network of potentially viable transmission line routes were delineated consistent with criteria employed in transmission line routing projects. The representative route concepts and associated study areas were developed with consideration for environmental features, populated areas, and traverses that would impact the lowest potential number of residences.

In siting the representative route Alternatives, several factors, with the intent to minimize potential impacts, were considered. These factors included, but were not limited to:

1. Minimizing impact to residences;
2. Minimizing number of private landowners directly impacted;
3. Minimizing impact on existing, approved, and planned developments;
4. Paralleling of existing transmission lines (*Alberta Environment's Guide for Transmission Lines*, Nov., 1994, and *Alberta Transmission Regulations Section 15, AR255/2007 s7*);
5. Paralleling other linear features (e.g., pipelines, highways);
6. Utilizing quarter lines where there is less development and less visual impact;
7. Addressing 6 out of 7 major aspects (i.e. excluding cost) in AUC Rule 007; Section 6.1, NID 12, subsections 1 to 7;
8. Following the considerations in *Alberta Environment's Guide for Transmission Lines*, Nov., 1994; and
9. Following the considerations of the Alberta Transmission Regulations (Section 15, AR255/2007 s7).

Through consideration of the above factors, representative route concepts were then identified for each of the three system development plans (Alternatives) proposed by AESO. Refer to Section 3.1 for route concepts and component summaries associated with each Alternative.

The level of assessment presented in this LIA focuses only on the landscape and general criteria, as these can be applied to the representative routing concepts associated with the three Alternatives being considered. More site-specific field work and detailed route reconnaissance studies are required prior to selection of viable routing alternatives for the preparation of a Facility Application. Detailed assessment of the individual Alternatives and the site-specific impacts associated with each Alternative's routing concepts and associated potential right-of-ways is required in order to determine specific, feasible routing options, alternate routing options, and/or rejected routes.

Detailed field level route evaluation would include the following:

- Field reconnaissance of routing concepts by helicopter, and on the ground;
- Determination of access to private lands; followed by site visits;
- Route-specific public and agency notification and consultation;
- A historical and archaeological resource impact overview, with potential need for detailed historical resources impact assessments (HRIAs);
- Environmental assessments (including wildlife surveys) of local conditions through field work;
- Consideration of Environmentally Significant Areas (ESAs) and their specific conservation requirements;
- Determination of extent and intensity of oil and gas and other industrial activities in the potential right-of-ways;
- Consultation with First Nations on Traditional Land Use interests; and
- A determination on the technical and electrical component solutions by the AESO.

3.3 Right-of-Way Width and Tower Footprint

It should be noted that a standard right-of-way width of 30 m was used in land area metrics determinations and is a general assumption at this preliminary planning stage. The numerical measures used for ROWs may change during route selection processes for the Facility Application, given that additional information specific to local areas and potential deviations from the current route concepts remains to be determined. This may include route design variations due to local factors such as topography, local weather history (e.g. wind), major river or coulee crossings, forest cover, native grasslands, water bodies, oil and gas infrastructure, farming and ranching practices, irrigation facilities, existing local infrastructure, air strips and communication towers, and proximity to population centres and residence locations, amongst other factors. While the majority of these factors were considered in this study, there is also potential for new residences and new infrastructure and developments that were not depicted on the data sets utilized in this study.

Because the primary purpose of this LIA report is to provide information that can be used by the AESO to compare three system-development plans, the exact size of the right-of-way and tower footprints have little impact on the metrics at this stage. To standardize calculations for all Alternatives, a typical right-of-way width and tower footprint size that covers all the tower types and right-of-way widths being

considered for all the system-development plans were chosen. The right-of-way width used for this LIA report is 30 m for both 144 kV and 240 kV lines. Footprint areas for proposed future substations were not included in the metrics calculated for this study. These data can only be determined at the line design stage, once a route concept has been finalized.

3.4 Paralleling Existing Linear Features

Linear features of interest include existing transmission lines, telephone lines, pipelines, highways, and railways.

3.4.1 Existing Transmission Lines

The Alberta Transmission Regulations (Section 15.1, AR255/2007 s7) outlines the requirement for siting transmission lines as follows:

> *(1) In preparing plans and making arrangements for new transmission facilities or for enhancements or upgrades to existing transmission facilities, the AESO must take into consideration geographic separation for the purposes of ensuring reliability of the transmission system.*
>
> *(2) When considering the location of new transmission facilities or of enhancements or upgrades to existing transmission facilities, the AESO must consider*
>
> *(a) wires solutions that reduce or mitigate the right of way, corridor or other route required, and*
>
> *(b) maximizing the efficient use of rights-of-way, corridors or other routes that already contain or provide for utility or energy infrastructure.*
>
> *(3) The AESO must consider the measures described in subsections (1) and (2) notwithstanding that those measures may result in additional costs.*
>
> *(4) In subsection (2)(a), "wires solutions" includes, without limitation,*
>
> *(a) providing new, higher capacity transmission facilities in combination with the salvage of lower capacity transmission facilities, or*
>
> *(b) providing staged transmission capacity increases that reduce the need to access rights of way for subsequent capacity increases.*

In developing representative preliminary route concepts for the Alternatives, ATCO included route segments within each Alternative that paralleled existing 240 kV and 144 kV transmission lines wherever possible.

3.4.2 Other Linear Facilities

In developing these route concepts, ATCO included route segments that were adjacent to existing roads, railways and major pipelines where possible. This is particularly important in forested areas where following existing disturbances reduces forest fragmentation and the associated impacts to wildlife habitat in the province's "Green Area". In the "White Area" however, the tendency is to route high voltage transmission lines along quarter section lines rather than along road allowances. Given that the

study area is located primarily in the White Area, the latter routing criteria were adopted in determination of the route concepts for each Alternative.

An order of preference for paralleling features was used during the analysis, to reflect the reality that existing transmission lines of greater than 144 kV create limitations with regards to how close they can be located to certain linear disturbances. The potential for induction, ground fault, obstruction, and other factors may result in large transmission lines (144 kV and larger) requiring set-backs of certain distances to mitigate some of these issues.

While a line may technically parallel an existing linear development, the associated necessary set-backs may increase the overall impacts to the adjacent lands on which the new line must be located. For this reason, on transmission lines of 240 kV or higher voltage, the trend is to route the right-of-ways on quarter section or blind lines to avoid use of road allowances.

Other linear features that may require mitigation, as well as associated formalized crossing permissions, include primary and secondary highways, railways, pipelines, telephone lines and buried fibre-optic cables.

3.5 Existing and Future Substations

This LIA does not include impact metrics for substations; however, the following tabular summary and comments are presented for AESO's consideration:

There are potentially 4 substations that could be utilized in the various Alternatives, depending on the specific design and components plan selected. These include both existing and proposed substations as follows:

Table 3.5.1 Substations for Alternative 1

Existing Substations that may Require Upgrades	Proposed (New) Substations / (Proposed ISD)
Vermillion 710S	Watt Lake 956S
St. Paul 707S	Bourque 970S
Bonnyville 700S	
Whitby Lake 811S	
Heisler 764S	
Kitscoty 705S	
Vermilion 710S	
Marguerite Lake 826S	

Table 3.5.2 Substations for Alternative 2

Existing Substations that may Require	Proposed (New) Substations

Upgrades	/ (Proposed ISD)
St. Paul 707S	Watt Lake 956S
Bonnyville 700S	Bourque 970S
Whitby Lake 811S	New Vermilion
Heisler 764S	
Kitscoty 705S	
Vermilion 710S	
Marguerite Lake 826S	

Table 3.5.3 Substations for Alternative 3

Existing Substations that may Require Upgrades	Proposed (New) Substations / (Proposed ISD)
St. Paul 707S	Watt Lake 956S
Bonnyville 700S	Bourque 970S
Whitby Lake 811S	
Heisler 764S	
Kitscoty 705S	
Vermilion 710S	
Lloydminster 716S	
Marguerite Lake 826S	

3.5.5 Future High Voltage Transmission Projects

An Edmonton to Calgary 500 kV transmission project involves 500 kV developments that may involve significant transmission line infrastructure and related facilities construction within this study area.

3.6 Determination of Land Impact Metrics

Cadastral mapping and geographic information systems (GIS) (overlay and spatial analysis) techniques were used to determine numerical impact assessment values ("metrics") for the various land impacts under consideration in this LIA study. Impact metrics were determined for each line (i.e. single circuit line) or line pair (i.e. double circuit) combination for each Alternative. Summary metrics are presented at the end of Section 4 for each impact category, and each Alternative in Tables 4.1 through 4.3 (Section 4). Additional summary metrics are presented (Tables 5.1 to 5.7) and are discussed in Section 5.

4 LAND IMPACTS & MEASURABLE INDICATORS

The LIA uses the "major aspects" (with the exception of cost and certain electrical factors) identified in the AUC Rule 007 document (Section 6.1, NID12) as direction in identifying measurable indicators and specific concerns. These indicators and specific concerns can be used to determine levels of potential land-related impacts associated with the three development plans being considered. These measurable indicators are calculated and evaluated based on experience in routing transmission lines in Alberta.

The following provides a definition of the specific measurable indicators used in this LIA and how they were used to provide land-impact information.

The major impact categories under Rule 007 are Agricultural Impact, Residential Impact, Environmental Impact, Cost, Electrical Considerations, Visual Impact, and Special Constraints. Each major impact category contains a list of relevant concerns that are discussed in the following sections.

4.1 Agricultural Impact

Agricultural impacts refer to agricultural activities associated with rural lands, which may include cultivation of crops and livestock, and also includes ranching.

Agricultural impacts will be significant factors in this project, as the majority of the study area is located in the "White Area" [2] of the province. The White Area contains most of the land suitable for cultivation. The majority of this land is privately owned, however, the provincial government has also retained a few parcels of land for protection due to environmental sensitivity and for natural resource management. Some of the land is undesirable from an agricultural perspective, in terms of the Canada Land Inventory (CLI) capability ratings for Agriculture, and as such is not cultivated. Considerable land areas, often native prairie, are utilized for ranching and grazing, for production of hay and forage crops, and for recreational purposes.

4.1.1 Specific Concerns

The TFO has considered the agricultural concerns outlined in AUC's Rule 007. These concerns are listed below with commentary provided on some mitigation strategies for the potential impacts identified for this project.

a. Loss of Crops – (***This includes short-term loss caused by construction; longer-term losses possible from soil erosion, rutting, drainage, disturbance, and soil mixing, and permanent loss of crop area under or adjacent to the tower base.***)

Short-term crop loss during construction is kept to a minimum with appropriate mitigation and construction practices. Any such short-term losses are compensated through damage payments to landowners. Any permanent loss of crop under or adjacent to the tower base is mitigated through working with specific landowners during the Facility Application consultation, routing of the centerline relative to legal boundaries such as quarter-lines, and compensation by annual tower payments.

[2] The White Area and Green Area are defined in the *Public Lands Operational Handbook*, December 2004, published by Alberta Sustainable Resource Development.

Potential impacts may be further reduced by landowner input on tower placement. The vast majority of the right-of-way can still be used by the landowner for crop production. Quantifying the amount of cropland and forage lands in the study area provides an indication of the potential level of impact, with cropland being the most significant indicator. Identification of the Agricultural Capability Class (CLI rating) of the land in the study area also provides an indication of the agricultural suitability of the land, and thus constructing transmission line infrastructure on less-suitable lands may be viewed as preferable.

b. Short-term disruption of farming and livestock grazing resulting from construction

These potential impacts are mitigated through appropriate construction practices and working with specific landowners to minimize any disruption. Quantifying the amount of cropland and forage lands affected can be used as an indicator of the potential level of impact.

c. Reduced efficiency of field operations

This potential impact is mitigated through strategic tower placement. Long-term impacts are considered when determining annual structure payments for towers. Quantification of the amount of cropland and forage lands can be used as an indicator of the potential level of impact, with cropland being the most significant indicator. Identification of the Agricultural Capability Class (CLI) of the land in the study area also provides an indication of the agricultural quality of the land, such that impacting less-desirable lands may be viewed as preferable.

d. Restrictions on use of aircraft

The presence of a transmission line potentially impacts agricultural aircraft use, such as crop spraying. This, however, is landowner and route specific, and aerial spraying is being used less often as high-wheel crop sprayers are becoming more common. Any unavoidable impacts are considered when determining compensation payments for mitigations or impacts.

e. Risk of collision with tower; damage to equipment, lost time, liability for damage to tower and secondary liabilities

A landowner is not held liable for tower damage unless it was deliberately caused by the landowner or his agents. If the transmission line is taken out of service by the damage, it is typically restored to service within 24 to 48 hours, so any disruption to farming activities due to repairs of the line and tower is short in duration. The potential of collision with a transmission tower is considered very low.

f. Reduction in yield adjacent to towers due to overlapping farming operations and added soil compaction

Permanent loss of crop under or adjacent to the tower base is mitigated through working with specific stakeholders during the Facility Application consultation. The total basal area under the towers may be considered relatively small (i.e., 10 m x 10 m) for overhead transmission lines. This is addressed and compensated for through annual tower payments. Potential impacts are further reduced by landowner input to tower placement. Quantifying the amount of cropland and forage lands can be used as an indicator of the potential level of impact with cropland being the most significant indicator.

g. Added cost and inconvenience of weed control under towers

The added cost and inconvenience of weed control is compensated as part of the annual structure payments to landowners.

h. Impact of height restrictions on equipment during field operations

All transmission lines in Alberta provide clearance for equipment 4.3 metres high on agricultural lands. Any proposed power lines will be designed to meet or exceed any clearance requirements, including consideration of any unique clearance requirements identified by affected landowners during the Facility Application consultation.

i. Psychological impact of line

This is a subjective impact involving factors such as visual impact, electric and magnetic fields (EMF), land values, and other issues, all of which are incorporated in the LIA and will be addressed in the Facility Application. Provision of unbiased information around EMF research from national and international health and scientific agencies often helps address stakeholders' concerns.

j. Loss of shelter-belts

Impacts to shelter-belts can be mitigated through routing offsets relative to legal boundaries such as quarter-lines along which shelter-belts may exist. In some cases only trimming may be required. Compensation for re-establishment of a shelter belt is also an option. All of these are site specific and determined in consultation with the potentially affected landowner during the Consultation process prior to the Facility Application.

k. Shared use with other utilities and transmission lines

Utilization of existing linear disturbance is a factor in the final determination of routing during the Facility Application stage, as per the Alberta Environment's Transmission Planning Guidelines, and Alberta Transmission Regulations. At this conceptual stage, potential opportunities to parallel existing transmission lines have been identified in the representative route concepts. Paralleling existing linear disturbance is often preferred by government agencies and local jurisdictional authorities (e.g., Counties or MD) in order to minimize fragmentation of the landscape.

l. Interference with citizen band radios

This is becoming less of an issue as Citizen Band (CB) radios are being replaced with newer technologies. However, CB radios operate at frequencies close to those of AM radios, neither of which are designed to be immune to power line interference. The interference produced by power lines diminishes with distance from the power lines, therefore interference is highly localized. All facilities will comply with federal guidelines related to radio interference.

Telecommunications towers must also be considered in the development of route plans.

4.1.2 Measurable Indicators

There are several high-level indicators that can be assessed and measured at this conceptual stage for each of the representative routes in each of the six study areas. These measurable indicators can be used to conduct a broad comparison and establish potential differences between the study areas. The measurable indicators, some of which may relate to one or more of the specific concerns identified in the AUC Rule 007, developed for agricultural impacts are:

a. Amount of Cultivated Land Crossed

Using existing land cover data, the approximate amount of affected agricultural land (cropland lands) can be determined. This can then be directly related to potential impacts on agricultural activities and associated concerns.

The most significant indicator for potential agricultural impact is amount of cultivated land crossed or otherwise impacted, and taken up within the transmission line ROW.

b. Total Amount of Agricultural Land Crossed

This includes the cultivated land crossed plus forage lands, including pasture. Using existing land cover data, the approximate amount of affected forage land can be determined. This can then be added to the cultivated lands and directly related to potential impacts on agricultural activities and associated concerns.

c. Agricultural Land Crossed

This measures the suitability of the lands from an agricultural perspective. CLI Class 1 through 3 lands are considered suited for cultivation, and Class 4 through 7 lands are those that require increasingly intensive management for them to be productive.

4.2 Residential Impact

Minimizing residential impact is an important consideration in the routing of transmission lines. There are sources of information that provide an indication of the potential residential impacts associated with the proposed system-development plans. These can include Municipal District (MD) and County maps, along with aerial photo and satellite image interpretation.

Residential impact is a significant factor in routing for all transmission projects. This holds true for rural and urban environments and residential properties. Some portions of the study area are highly settled when compared to other areas within the study area. This includes areas such as Lloydminster, Vermilion, Wainwright, Bonnyville, St. Paul, Kitscoty, Hardisty, Sedgewick, and several other towns and smaller communities. In addition to the urban areas, there are several country residential subdivisions (acreages) present, under construction, and in the planning stages in these rural areas.

4.2.1 Specific Concerns

ATCO has considered the specific residential concerns outlined in Rule 007, which are listed below with commentary provided on mitigation strategies, and the identification of potential impacts for this project.

a. Decrease of property values

This is a very site-specific impact. A preliminary determination of potential residences within 150 m and 800 m of the right-of-way has been completed and applied to representative routes to provide an indication of the potential number of residences that may be affected.

b. Loss of developable lands and constraints on development

Development tends to happen in proximity to existing developed (urban) areas, i.e., residential density is a measure of potential impact. Therefore, minimizing routing in areas of existing residential density may help avoid areas with the highest development potential.

c. Relocation or removal of residences

A preliminary determination of potential residences within 150 m of the representative routes can be used as a general indicator of the potential level of impact. However, at this preliminary stage of evaluation this is difficult to assess, as the specific routes will not be determined until the Facility Application stage.

d. Psychological impact of the line

This is a subjective impact involving factors such as visual impact, EMF, land values and other issues, all of which are incorporated in the LIA and are addressed in the Facility Application. Provision of unbiased information around EMF research from national (e.g. Canadian Electricity Association) and international health and scientific agencies (e.g., World Health Organization) often helps address some stakeholders' concerns.

e. Noise and TV interference

TV reception problems related to high-voltage transmission lines are unlikely. If interference does occur, it can often be resolved by relocating the TV or changing the antennae. The transmission lines are designed to meet allowable audible noise and TV interference. Where individual landowners are concerned, measurements will be taken before and after construction so that signal interference beyond allowable levels can be identified and mitigated. As these types of concerns tend to be associated with residences, the number of residences within 150 m can be used as an indicator of the potential level of impact.

f. Windbreak, Shelter-belts, and other vegetation removal

This is an issue where the removal or trimming of trees or other vegetation may be required when establishing a new right-of-way. It is also important to note that the overall impact is considered in making compensation payments for towers and land rights. This is site-specific and determined in consultation with the potentially affected landowner at the Facility Application stage.

g. Conflict with recreational use of land holdings

The proximity of known recreational areas, such as parks and natural areas can be determined in relation to representative routes. This can be used as a preliminary indicator of potential impacts.

h. Public versus Private Land

Landowners may view the use of public land as a preferable alternative to using private lands. Existing data sources can provide a general indication of the amount of public ("Crown") versus private land, providing an indicator of the potential level of impact. The majority of public land is located within the Green Area of the province, while the majority of private lands are located within the White Area. This project is located primarily in the White Area, where predominant agricultural land use is farming and ranching.

Large areas of public land (e.g. Federal or Provincial Parks) and protected areas were identified and avoided during this stage. Further determination of smaller parcels of public land within the White Area is to be completed during the more detailed route evaluations and land title searches used for the Facilities Application. In addition, Environmentally Significant Areas (ESAs) must also be considered in route planning and in mitigation strategies.

4.2.2 Measurable Indicators

There are several high-level indicators that can be assessed at this preliminary stage and measured for each of the proposed alternatives. These measurable indicators can be used to conduct a broad comparison and establish potential differences between the alternatives. The measurable indicators, some of which may relate to one or more of the specific concerns identified in the AUC Rule 007, developed for residential impacts are:

a. Number of residences

It is generally accepted that the closer residences are to a transmission line and the higher the number of residences, the more residents will feel they are impacted. The categories assessed in this LIA include:

- Residences within 150 m of the right-of-way centerline; and
- All residences within 800 m of the right-of-way.

For the purpose of this LIA, it is assumed that there is a greater potential for residential impact on those residing within 150 m of the centerline, as there is a higher potential for direct impact to existing homes and buildings. This distance has been established through landowner consultation during the route selection in previous Facilities Applications. In urban areas, it is the first-row of residences that are

assumed to have the highest potential for residential impact. The most significant indicator for potential residential impact is the total number of residences within 150 m.

4.3 Environmental Impacts

Existing environmental information was used to define route concepts for representative route options or alternatives. Use of this data provided a generalized indication of the potential environmental issues and relative impacts that may occur along the representative routes associated with each of the system-development plans. These impacts will need to be assessed in greater detail as the project moves forward, and as additional information becomes available.

The potential environmental impacts from transmission lines are a concern for a variety of stakeholders, and efforts to minimize such environmental impacts factor into the assessment of the potential routing and the technologies associated with transmission lines.

With respect to this project area, portions of the study area are more settled in comparison to other areas, resulting in differential levels of landscape utilization for urban and agricultural purposes. Several parks, natural areas, and other environmentally significant areas that exist within the study area have also been considered during evaluation of the plans.

One thing to note is that each of the three system-development alternatives can be built almost anywhere within the study area and each of them will have some level of environmental impact. While some will have a lower or higher potential level when compared to others, on a factor by factor basis, almost all identified environmental impacts can be mitigated using various planning, routing, and construction techniques to avoid, mitigate, or lower the overall potential impact.

4.3.1 Specific Concerns

ATCO has considered the specific environmental concerns outlined in AUC Rule 007. These concerns are listed below with commentary provided on mitigation strategies and the identification of potential impacts for this project.

a. Increased public accessibility to wildlife areas

Typically this is an issue for treed/forested areas where there is currently little access. Access along the right-of-way on private land is managed in consultation with the landowner. One method of controlling access involves using locked gates. The proximity of representative routes to known wetlands and large forested areas can be determined using existing data sources, and can provide a general indication of the potential for increased public access. The identification of the Forest Capability Class can also provide an indication of the potential for an area to support commercial forest development. Forest Capability Classes 1-3 generally represent the productive forest types with few, if any, biophysical limitations to the growth of commercial forests, while classes 4-7 would be less productive areas. This is applied in forested areas, known as the “Green Area”. The study area for this project is primarily part of the “White Area”, and as such, wildlife and recreation access are subject to different accessibility constraints due to private land ownership.

b. Alteration of natural areas and interference with outdoor educational opportunities

The number of protected or designated areas that could be crossed by each plan can be determined using existing data sources. This can provide a general indication of the level of this potential impact.

c. Use of Restricted Development Area (TUC)

While utilization of existing areas set aside for utility developments such as transmission lines is preferable, the closest Transmission Utility Corridors (TUCs) are located around the cities of Edmonton and Calgary. The location of the TUCs in relation to the routing concepts associated with the CETD plan removes TUCs from consideration as components of the routing concepts associated with the three Alternatives.

4.3.2 Measurable Indicators

There are several high-level indicators that can be assessed and measured at this preliminary stage for each of the three proposed plans. These measurable indicators can be used to conduct a broad comparison and establish potential differences between the plans. The measurable indicators, some of which may relate to one or more of the specific concerns identified in the AUC Rule 007, developed for environmental impacts are:

a. ***Forest Land Crossed (km)***

Using existing Canada Land Inventory (CLI) data, the approximate amount of forest lands crossed can be determined. This data can provide further indication of the productive quality of forests present through use of the CLI Forest Capability Classification system. Forest capability classes 4-8 are considered lower quality and generally involve biophysical conditions that are not conducive to commercial forest productivity.

b. Amount of Environmentally Significant Areas Crossed (km)

Environmentally Significant Areas (ESAs) are areas identified as significant by municipal, provincial, or federal governments, and have been subsequently designated as requiring additional consideration. In the study area, several ESAs have been identified.

c. Number of Protected or Designated Areas in or within 800 m of ROW Edge (# count)

Identified protected or designated areas can be associated with potential wildlife and recreational use/activity. Lines constructed in close proximity to these areas may pose a potential impact.

d. Wildlife Habitat Crossed (km)

Any non-urban land area crossed could be interpreted as a potential wildlife habitat area subject to potential impacts. Determining the prevalence of individual species and the potential for impacts to populations and habitats would require wildlife surveys. Wildlife surveys would determine the presence and abundance of individual species and distribution of habitats, and the potential for impacts to populations and habitat once a preferred route has been selected. The assistance of local area Alberta

Sustainable Resource Development (ASRD) Fish and Wildlife biologists would be requested in determining the extent and scope of such wildlife studies.

e. Major River Crossings (# count)

There is the potential for environmental impact when crossing major river systems because these crossings generally involve the use of larger structures to facilitate crossings, as well as consideration of the actual conductor span. The crossing of the North Saskatchewan River, as well as several large waterbodies, will need to be considered in greater detail during route selection.

f. Wetlands and Peatlands Crossed (km)

The Alberta Wetland Inventory is often used to identify peatlands, which are often characterized by organic soil types (CLI class O) associated with wetlands and riparian areas. In central Alberta, peatland areas are very rare. In this project area, there are no defined peatland areas that will be crossed, however riparian areas will need to be considered in greater detail when preferred routes are being selected.

g. Distance Through Provincial Zone (km)

Using provincial data, the amount of Green Area and White Area crossed by the various system-development plans can be calculated. This provides a reasonable indicator of the amount of public (Green Area) versus private (White Area) lands crossed. The Green Area is also generally more forested than White Area lands. Transmission lines in the Green Area may have more potential environmental impacts, but may avoid other impacts landowners are concerned about. In the LIA analysis, more length (km) in the Green Area is viewed as favourable. The study area lies primarily within the provincial designated "White Area", and as such, the majority of the lands crossed are native grasslands or cultivated lands/agricultural areas. Site specific determinations of route options and amounts of these lands crossed can only be undertaken at the time of route selection.

4.4 Cost

The information and findings in this LIA do not consider the influence of cost and associated issues.

4.5 Electrical Considerations

Electrical considerations play an important role when assessing potential impacts associated with the proposed plans. While the technical considerations, such as transfer capability, system flexibility, system reliability and losses are considered by the AESO separately, some land impacts related to electrical considerations can be identified. Technical requirements and the other electrical considerations associated with the plans can affect the presence or level of impacts on the land. Existing sources of data can be used to estimate the potential impacts associated with the proposed plans.

4.5.1 Specific Considerations

ATCO has considered the specific electrical concerns outlined in AUC Rule 007. These concerns are listed below with commentary provided on mitigation strategies and the identification of potential impacts specific to the Alternatives.

a. Ease of connections to future load areas

This relates to electrical capacity, location of the facilities and the type of technology used (overhead vs. underground). This specific concern does not have a direct land impact for purposes of this study and will be considered by the AESO separately.

b. Reliability and maintenance of the line

The reliability and maintenance of a line as it relates to the specific technology being considered does not have any impact from a land perspective. However, paralleling certain existing linear developments can provide better access, thus improving the ability to repair the line in a timely fashion. Paralleling certain linear developments can also potentially reduce impacts associated with the amount of adjacent trees, resulting in greater transmission line reliability as the potential for faults caused by falling trees is reduced.

c. Access for construction and maintenance of the line

Paralleling major roads or existing transmission lines can reduce some of the potential concerns associated with access to new facilities, as this existing infrastructure can provide access.

4.5.2 Measurable Indicators

There are several high-level indicators that can be measured for each of the components and their associated system-development plans being considered. These measurable indicators can be used to conduct a broad comparison and establish potential differences between the components and their associated system-development plans. The measurable indicators, some of which may relate to one or more of the specific concerns identified in the AUC Rule 007, developed for electrical impacts are:

a. Amount of Existing Disturbances Paralleled (km)

Paralleling existing linear disturbances can be an effective way to reduce the amount of new linear disturbance and fragmentation of the landscape. Four typical linear developments have been identified and considered for paralleling: existing transmission lines (>138kV), Primary/Secondary Highways, Railways, and large pipelines (>/= 16" diameter). Distances are calculated for each of these linear developments.

b. Total Amount of Existing Disturbances Paralleled (km)

This metric combines all four of the individual linear development types identified above.

4.6 Visual Impacts

Visual impacts are generally considered a social impact dependant on individual stakeholder opinion. A general assumption is that underground transmission lines have a minimal impact when compared to overhead lines, but the issue of cost is often overlooked when making comparisons.

Visual impacts are closely related to residential impacts as they are typically influenced by similar factors – with aesthetics of transmission lines and tower structures being a common concern. However,

visual and other impacts may be experienced by other stakeholder groups, such as recreational users (hikers, fishermen, hunters, etc.), recreational installations, and back-country access roads.

There are some general assumptions regarding visual impacts that are relevant to all overhead transmission lines:

- The closer the line is to a residence, the more likely a visual impact will be perceived.
- The higher the residential density, the more likely a visual impact will be perceived.
- Paralleling similar, existing transmission facilities has a lower visual impact than a new greenfield route where there is no existing line. Double-circuiting on tower structures helps to reduce impacts to land base and aesthetic considerations.
- Close proximity to parks, natural areas, and other recreational areas, can be viewed as creating a higher degree of visual impact than in other less frequented areas.
- Avoiding hilltops, ridges, and other topographic features, reduces the potential level for visual impact, particularly when these features serve as local vistas.
- Significant clearing of mature-treed areas in the White Area of the province, tends to increase the visual impacts and raise public concern, by removing what is generally considered an aesthetically pleasing feature on the landscape.

4.6.1 Specific Concerns

ATCO has considered the specific visual concerns outlined in AUC Rule 007. These concerns are listed below with commentary provided on mitigation strategies and the identification of potential impacts for this project.

a. Visual impact of tree removal as seen from roads and recreational installations

Many stakeholders, particularly in the White Area of the province, view the removal of trees as a visual impact. The study area for this project primarily involves the White Area of the province. While the White Area represents the predominantly cultivated lands, and can be used as a general indicator of where cultivated lands are, the Canada Land Inventory (Soil Capability) data can also provide an indication of where forested lands occur. The amount of White Area and associated agricultural lands crossed by a particular system development plan may be considered a potential indicator of visual impact.

b. Visual impact on dispersed recreational users such as hikers, fishermen, hunters, scenic viewers, and cross-country skiers

Areas commonly used by recreational users can be identified using existing data sources. These can then be compared with the various routes associated with each of the plans to provide a general indication of the potential level of impact. This would also involve consideration of Parks and Protected Areas in the study area.

c. Visual impact of towers and lines as seen from residences, farms, roads, and recreational installations

The number and type of residences and landowners near representative routes can provide an indication of potential visual impact. The type of tower being proposed can also impact the potential level of visual impact.

4.6.2 Measurable Indicators

There are several high-level indicators that can be measured for each of the components and associated system-development plans being considered. These measurable indicators can be used to conduct a broad comparison and establish potential differences between the system-development plans. The measurable indicators, some of which may relate to one or more of the specific concerns identified in the AUC Rule 007, developed for visual impacts are:

a. Number of Residences

While the context in which the results are considered may differ, the metrics developed for the "Residential Impacts" section can be referred to in relation to Visual Impacts.

b. Proximity to Protected or Designated Areas

While the context in which the results are considered may differ, the metric "Number of Protected or Designated Areas in or within 800 m of ROW Edge" developed for the "Environmental Impacts" section can be referred to in relation to Visual Impacts.

c. Distance Through Provincial Green Area

While the context in which the results are considered may differ, the metric "Distance Through Provincial Green Area" developed for the "Environmental Impacts" section can be referred to in relation to Visual Impacts.

d. Forest Lands Crossed

While the context in which the results are considered may differ, the metric "Forest Lands Crossed" developed for the "Environmental Impacts" section can be referred to in relation to Visual Impacts.

4.7 Special Constraints

Special constraints are issues or factors that may impact potential routing options for the study area being assessed. Using existing sources of available data, there are several special constraints that have been identified and incorporated for the project study area.

4.7.1 Specific Concerns

The TFO has considered the one specific concern in AUC Rule 007 that can be associated with special constraints (i.e. Historical Resources), as well as identified several additional special constraints that relate to the project study region.

a. Proximity to Historical Resources

Historical resources are specific sites (given an associated Historical Resource Value - HRV) which have been identified within the province and hold particular archaeological, or historical and cultural significance. Alberta Culture and Community Spirit (ACCS) maintains a registry of known locations and depending on the significance of a particular site, there may be constraints placed on nearby planned developments or disturbances.

4.7.2 Measurable Indicators

Each of the plans being considered includes a measure of the high-level indicators. These measurable indicators can be used to conduct a broad comparison and establish potential differences between the plans. The measurable indicator, which may relate to one or more of the specific concerns identified in the AUC Rule 007, developed for special constraints includes proximity to Historical Resources. ATCO has elected to also consider proximity to Indian Reserves and Military Bases.

a. Proximity to Historical Resources

This utilizes data provided by ACCS to determine the presence of any identified historical resources within 800 m of the ROW of route options (route concepts) for these system-development plans.

b. Proximity to Indian Reserves and Metis Settlements

This involves determination of the proximity or likelihood of routes crossing through Indian Reserves. The TFO has considered this factor in this LIA.

c. Proximity to Military Bases and Military Lands

This involves determination of the proximity or likelihood of routes crossing through Military Bases in the project area. The TFO has considered this factor in this LIA.

d. Proximity to Cemeteries

This involves determination of the proximity or likelihood of routes crossing through cemeteries in the project area. ATCO has considered this factor in this LIA.

In addition to the above, other "Special Constraint" indicators may include:

- Parks and Protected Areas (local, provincial and national);
- World Heritage Sites (e.g., UNESCO designated sites);
- Special wildlife habitat area designations under the Species at Risk Act (SARA);
- Community Pastures;
- Local Airports and Airstrips;
- Military Bases and Associated Facilities;
- First Nations Traditional Lands (e.g., ceremonial areas, hunting and gathering areas, camping areas, burial sites); and

- Unlisted historical features, such that Historical Resources Overviews (HROs) or Historic Resources Impact Assessments (HRIAs) could be required.

4.8 LIA Metrics

Summary results for the LIA analyses are presented in Tables 4.1 to 4.2, and include:

- Total values (km, ha, or #) for land categories and features crossed or paralleled (Table 4.1) and ratio of these values to total km of transmission line proposed (i.e. % for km, ha/km or #/km) (Table 4.1), for each impact category evaluated for the three Alternatives; and
- Ranges of values (minimum and maximum) (Table 4.2) for each impact category evaluated for the three Alternatives.

Additional summary tables for selected impact classes, and associated discussion are presented in Section 5 (Results and Discussion – Tables 5.1 to 5.8). These serve as the basis for comparing the three Alternatives with respect to specific impact categories, as well as for determining lands taken up, both in km of line length, and in hectare values of potential lands taken up, for select impact categories.

Table 4.1 – Metrics Summary as Kilometres Crossed (km) per Alternative

Major Aspects and Considerations		Technical Components		
		Alternative 1	Alternative 2	Alternative 3
		7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928
		Total	Total	Total
ROW Length (km)		434	632	273
Land Impact				
Amount Agricultural Land Crossed (km)	Crop land	159	193	64
	Forage Land	5	5	0
	Total	164	198	64
Land Capability for Forestry (km)	Forestry Capability Class 1	0	0	0
	Forestry Capability Class 2	0	0	0
	Forestry Capability Class 3	17	17	17
	Forestry Capability Class 4	122	122	122
	Forestry Capability Class 5	7	7	7
	Forestry Capability Class 6	4	4	4
	Forestry Capability Class 7	12	12	12
	Forestry Capability Class 8	0	0	0
Land Capability for Agriculture (km)	Agricultural Capability Class 1	14	14	2
	Agricultural Capability Class 2	80	138	16
	Agricultural Capability Class 3	177	268	98
	Agricultural Capability Class 4	109	128	43
	Agricultural Capability Class 5	86	17	87
	Agricultural Capability Class 6	18	37	19
	Agricultural Capability Class 7	0	0	0
	Agricultural Capability Class 8	0	0	0
	Agricultural Capability Class O	11	11	11
Residential Impacts				
Residences (#)	Within 150 m of centreline	20	24	7
	Within 800 m of R-O-W	131	218	84
Environmental Impacts				
Amount of Environmentally Significant Areas Crossed (km)		12	18	2
Number of Protected or Designated Areas in or within 800m of R-O-W edge (#) includes: Parks (Municipal, Provincial)		1	6	0

Major Aspects and Considerations		Technical Components		
		Alternative 1	Alternative 2	Alternative 3
		7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928
		Total	Total	Total
Environmental Impacts				
Number or Grazing Reserves, Community Pastures within 800m of R-O-W edge (#)		3	3	3
Major River Crossings (#)		2	3	2
Surface Water (ha) in or within 800m of R-O-W edge		2693	3667	1347
Electrical Considerations				
Amount of Existing Linear Disturbances Paralleled (km)	Existing Transmission Lines >= 240 kV	0	0	0
	Existing Transmission Lines = 144 kV	152	153	25
	Primary / Secondary Highways	11	11	3
	Railways	0	0	0
	Pipelines	13	22	14
Total Amount of Existing Disturbances (km)		*176*	*186*	*42*
Number of Telecommunications Towers (>25m) within 800m of R-O-W (#)		87	93	79
Number of Gas Facilities Within 800m of R-O-W (#)		1	1	0
Number of Wells within 40m of Centreline (#)		74	87	62
Visual Impacts				
see "*Residences (#)*" *in Residential Impacts*				
see "*Proximity to Protected or Designated Areas in or within 800 m of R-O-W edge (#)*" *in Environmental Impacts*				
Special Constraints				
Proximity to Historical Resources in or within 800 m of R-O-W (#)		17	37	6
Urban Areas within 800m of R-O-W (#) (Cities, Towns, Villages, Hamlets, Rural Subdivisions)		4	6	2
Cemeteries within 800m of R-O-W (#)		3	4	3
Airfields within 800m of R-O-W (#)		0	0	0
Municipal Lands Crossed (km)		0	0	0
Crown Lands Crossed (km)		78	81	80
Private Lands Crossed (km)		350	537	189

Table 4.2 – Metrics Summary as % of Total Kilometres Crossed per Alternative

Major Aspects and Considerations		Technical Components		
		Alternative 1	Alternative 2	Alternative 3
		7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928
		Total	Total	Total
ROW Length (%)		100%	100%	100%
Land Impact				
Amount Agricultural Land Crossed (%)	Crop land	37%	31%	23%
	Forage Land	1%	1%	0%
	Total	38%	31%	23%
Land Capability for Forestry (%)	Forestry Capability Class 1	0%	0%	0%
	Forestry Capability Class 2	0%	0%	0%
	Forestry Capability Class 3	4%	3%	6%
	Forestry Capability Class 4	28%	19%	45%
	Forestry Capability Class 5	2%	1%	3%
	Forestry Capability Class 6	1%	1%	1%
	Forestry Capability Class 7	3%	2%	4%
	Forestry Capability Class 8	0%	0%	0%
Land Capability for Agriculture (%)	Agricultural Capability Class 1	3%	2%	1%
	Agricultural Capability Class 2	18%	22%	6%
	Agricultural Capability Class 3	41%	42%	36%
	Agricultural Capability Class 4	25%	20%	16%
	Agricultural Capability Class 5	20%	3%	32%
	Agricultural Capability Class 6	4%	6%	7%
	Agricultural Capability Class 7	0%	0%	0%
	Agricultural Capability Class 8	0%	0%	0%
	Agricultural Capability Class O	3%	2%	4%

Major Aspects and Considerations		Technical Components		
		Alternative 1	Alternative 2	Alternative 3
		7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928
		Total	Total	Total
Residential Impacts				
Residences (#)	Within 150 m of centreline (#/km)	0.05	0.04	0.03
	Within 800 m of R-O-W (#/km)	0.30	0.34	0.31
Environmental Impacts				
Amount of Environmentally Significant Areas Crossed (%)		3%	3%	1%
Number of Protected or Designated Areas in or within 800m of R-O-W edge includes: Parks (Municipal, Provincial) – (#/km)		0.00	0.01	0.00
Number or Grazing Reserves, Community Pastures within 800m of R-O-W edge (#/km)		0.01	0.00	0.01
Major River Crossings (#/km)		0.00	0.00	0.01
Surface Water in or within 800m of R-O-W edge (ha/km of ROW)		6.21	5.80	4.93
Electrical Considerations				
Amount of Existing Linear Disturbances Paralleled (#/km of proposed line)	Existing Transmission Lines >= 240 kV	0.00	0.00	0.00
	Existing Transmission Lines = 144 kV	0.35	0.24	0.09
	Primary / Secondary Highways	0.03	0.02	0.01
	Railways	0.00	0.00	0.00
	Pipelines	0.03	0.03	0.05
Total Amount of Existing Disturbances (%)		41%	29%	15%
Number of Telecommunications Towers (>25m) within 800m of R-O-W (#/km)		0.20	0.15	0.29
Number of Gas Facilities Within 800m of R-O-W (#/km)		0.00	0.00	0.00
Number of Wells within 40m of Centreline (#/km)		0.17	0.14	0.23
Visual Impacts				
see "*Residences (#)*" *in Residential Impacts*				
see "*Proximity to Protected or Designated Areas in or within 800 m of R-O-W edge (#)*" *in Environmental Impacts*				

Major Aspects and Considerations	Technical Components		
	Alternative 1	Alternative 2	Alternative 3
	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928
	Total	Total	Total
Special Constraints			
Proximity to Historical Resources in or within 800 m of R-O-W (#/km)	0.04	0.06	0.02
Urban Areas within 800m of R-O-W (%) (Cities, Towns, Villages, Hamlets, Rural Subdivisions) (#/km)	0.01	0.01	0.01
Cemeteries within 800m of R-O-W (#/km)	0.01	0.01	0.01
Airfields within 800m of R-O-W (#/km)	0.00	0.00	0.00
Municipal Lands Crossed (%)	0%	0%	0%
Crown Lands Crossed (%)	18%	13%	29%
Private Lands Crossed (%)	81%	85%	69%

Table 4.3 – Metrics Summary as Minimum and Maximum Values per Alternative

Major Aspects and Considerations		Technical Components								
		Alternative 1			Alternative 2			Alternative 3		
		7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50			7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129			7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928		
		Min – Max			Min – Max			Min – Max		
R-O-W Length (km)		1	-	124	0	-	124	1	-	95
40m Buffer Area (ha)		6	-	988	0	-	988	6	-	761
150m Buffer Area (ha)		27	-	3699	0	-	3699	27	-	2855
800m Buffer Area (ha)		314	-	19928	0	-	19928	314	-	15558
Land Impact										
Amount Agricultural Land Crossed (km)	Crop land	1	-	68	0	-	68	1	-	56
	Forage Land	0	-	3	0	-	3	0	-	0
	Total	1	-	70	0	-	70	1	-	56
Land Capability for Forestry (km)	Forestry Capability Class 1	0	-	0	0	-	0	0	-	0
	Forestry Capability Class 2	0	-	0	0	-	0	0	-	0
	Forestry Capability Class 3	0	-	12	0	-	12	0	-	12
	Forestry Capability Class 4	0	-	45	0	-	45	0	-	45
	Forestry Capability Class 5	0	-	6	0	-	6	0	-	6
	Forestry Capability Class 6	0	-	4	0	-	4	0	-	4
	Forestry Capability Class 7	0	-	4	0	-	4	0	-	4
	Forestry Capability Class 8	0	-	0	0	-	0	0	-	0
Land Capability for Agriculture (km)	Agricultural Capability Class 1	0	-	12	0	-	12	0	-	2
	Agricultural Capability Class 2	0	-	59	0	-	59	0	-	10
	Agricultural Capability Class 3	0	-	54	0	-	57	0	-	47
	Agricultural Capability Class 4	0	-	34	0	-	34	0	-	20
	Agricultural Capability Class 5	0	-	26	0	-	26	0	-	26
	Agricultural Capability Class 6	0	-	8	0	-	14	0	-	12
	Agricultural Capability Class 7	0	-	0	0	-	0	0	-	0
	Agricultural Capability Class 8	0	-	0	0	-	0	0	-	0
	Agricultural Capability Class O	0	-	5	0	-	5	0	-	5
Residential Impacts										
Residences (#)	Within 150 m of centreline	0	-	7	0	-	7	0	-	6
	Within 800 m of R-O-W	0	-	40	0	-	40	0	-	35

Major Aspects and Considerations		Technical Components								
		Alternative 1			Alternative 2			Alternative 3		
		7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50			7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129			7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928		
		Min – Max			Min – Max			Min – Max		
Environmental Impacts										
Amount of Environmentally Significant Areas Crossed (km)		0	-	10	0	-	10	0	-	2
Number of Protected or Designated Areas in or within 800m of R-O-W edge (#) includes: Parks (Municipal, Provincial)		0	-	1	0	-	1	0	-	0
Number or Grazing Reserves, Community Pastures within 800m of R-O-W edge (#)		0	-	1	0	-	1	0	-	1
Major River Crossings (#)		0	-	1	0	-	1	0	-	1
Surface Water (ha) in or within 800m of R-O-W edge		0	-	858	0	-	858	0	-	312
Electrical Considerations										
Amount of Existing Linear Disturbances Paralleled (km)	Existing Transmission Lines >= 240 kV	0	-	0	0	-	0	0	-	0
	Existing Transmission Lines = 144 kV	0	-	75	0	-	75	0	-	19
	Primary / Secondary Highways	0	-	5	0	-	5	0	-	2
	Railways	0	-	0	0	-	0	0	-	0
	Pipelines	0	-	6	0	-	6	0	-	6
Total Amount of Existing Disturbances (km)		0	-	75	0	-	75	0	-	19
Number of Telecommunications Towers (>25m) within 800m of R-O-W (#)		0	-	31	0	-	31	0	-	31
Number of Gas Facilities Within 800m of R-O-W (#)		0	-	1	0	-	1	0	-	0
Number of Wells within 40m of Centreline (#)		0	-	14	0	-	14	0	-	19
Visual Impacts										
see "*Residences (#)*" *in Residential Impacts*										
see "*Proximity to Protected or Designated Areas in or within 800 m of R-O-W edge (#)*" *in Environmental Impacts*										
Special Constraints										
Proximity to Historical Resources in or within 800 m of R-O-W (#)		0	-	14	0	-	14	0	-	3
Urban Areas within 800m of R-O-W (#) (Cities, Towns, Villages, Hamlets, Rural Subdivisions)		0	-	2	0	-	2	0	-	1
Cemeteries within 800m of R-O-W (#)		0	-	1	0	-	1	0	-	3
Airfields within 800m of R-O-W (#)		0	-	0	0	-	0	0	-	0

Major Aspects and Considerations	Technical Components								
	Alternative 1			Alternative 2			Alternative 3		
	7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50			7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7L749, 7LA92, 7L50, 9LXXX, 7L53, 7L14, 7L65, 7LXXX, 7L129			7L163, 7L146, 7L157/7L160, 7L74, 7L83, 7L87, 7LA14, 7LA701, 7L70/7L139, 7LA92, 9L928		
	Min – Max			Min – Max			Min – Max		
Special Constraints									
Municipal Lands Crossed (km)	0	-	0	0	-	0	0	-	0
Crown Lands Crossed (km)	0	-	21	0	-	21	0	-	21
Private Lands Crossed (km)	0	-	121	0	-	121	0	-	90

5 RESULTS & DISCUSSION

5.1 Interpretation of LIA Findings

It is important to consider that from an LIA perspective, none of the three alternatives pose a degree of potential impact that completely excludes any from consideration as a viable solution, based on the impact criteria evaluated. For more precise comparisons, detailed route and site-specific research is required. Additionally, detailed field work (i.e. routing reconnaissance) and Stakeholder / Land Owner, Agency and First Nations Consultation by the TFO is required to identify more specific and locally viable routing concepts for detailed comparisons. Additionally, the key impact factors (per AUC Rule 007) as well as the terms of overall costs, were not considered at a site specific or field level detail in the scope of this LIA. Consequently, the metrics and resulting comparisons for each Alternative are to be kept in context of a reconnaissance level study only.

Summaries of the overall LIA metrics determined for each Alternative (i.e. potential route concepts) were presented in Section 4, Tables 4.1 to 4.2.

Tables 5.1 to 5.7 below provide summarized information for each Alternative as basic measures of kilometers (km) of land crossed, and hectares (ha) of land area required for right-of-ways for each Alternative for “major categories” of impact per Rule 007.

5.1.1 Route Concepts and Land Categories Impacted

Tables 5.1, 5.2, and 5.3 provide comparative summaries of base values as “totals” for each route option in kilometers (km) of lands crossed, and potential lands required for right-of-ways in hectares (ha). The base values have been rounded to the nearest 10, upon request of the AESO. For small values relating to specific counts, rounding was not applied.

Additionally, ranges for the base values associated with various land impact factors were derived using an approach of (-5%) and (+10%) calculated for each base value. This established a level of variance that may account for specific, local conditions that may either reduce or extend a proposed route. Given that landscape variables and stakeholder concerns most often result in increases to overall route length to enable mitigations, a +10% variance was deemed reasonable for estimation purposes, and therefore applied to define the maximum range values presented below. Range values were rounded to the nearest 10 km.

Table 5.1 Route Concepts by Length and Area

Route Concept	Total Line Length* (km)	Total Land Area* (ha)
Alternative 1	**430*** (410 – 480)**	**1,300** (1,240 – 1,430)**
Alternative 2	**630** (600 – 700)	**1,900** (1,800 – 2,090)
Alternative 3	**270** (260 – 300)	**820** (780 – 900)

Note:
***Rounded to the nearest 10.**
****Ranges of values were calculated using a (-5%) and (+10%) variance, and rounded to the nearest 10.**

Table 5.2 provides a comparative summary of major categories of land area potentially taken up by the route concepts for each Alternative, presented in kilometers (km). The (-5%) to (+10%) variance approach was applied to the base values (i.e. totals for each category, per Alternative) for a definition of ranges.

Table 5.2 Major Land Categories Crossed in Kilometres (km)

Alternative	Env. Sensitive Areas (ESAs)	Grazing Reserves & Community Pastures (#)	Municipal Lands	Crown Lands	Privately Owned Lands**
1	**10**	**3**	**0**	**80**	**350** (330-390)
2	**20**	**3**	**0**	**80**	**540** (510-600)
3	**2**	**3**	**0**	**80**	**190** (180-210)

Note:
***Rounded to the nearest 10.**
****Ranges of values were calculated using a (-5%) and (+10%) variance, and rounded to the nearest 10.**

Table 5.3 provides a comparative summary of major categories of land area potentially taken up by right-of-ways for the route concepts for each Alternative, presented in hectares (ha). The (-5%) to (+10%) variance approach was applied to the base values (i.e. totals for each category, per Alternative) for determination of associated ranges.

Table 5.3 Major Land Categories Potentially Taken Up (ha)

Alternative	Environ. Sensitive Areas (ESAs)**	Municipal Lands	Crown Lands**	Privately Owned Lands**
1	**73,220*** (69,560 – 80,540)	**0**	**155,700** (147,910 – 171,270)	**1,104,390** (1,049,170 - 1,214,830)
2	**108,330** (102,910 – 119,160)	**0**	**166,590** (158,260 – 183,250)	**1,629,290** (1,547,830 - 1,792,220)
3	**17,060** (17,910 – 18,770)	**0**	**136,750** (129,910 – 150,430)	**412,710** (540 -600)

Note:
***Rounded to the nearest 10.**
****Ranges of values were calculated using a (-5%) and (+10%) variance, and rounded to the nearest 10.**

Table 5.4 provides a summary of potential river crossings and the amount of surface water (hectares) that lies within the potential right-of-ways, or within 800 m of the edge of the potential right-of-ways, for each Alternative.

Table 5.4 Summary of Water Crossings

Alternative	Major River Crossings*	Surface Water (ha) in or within 800m of ROW edge
1	**0**	**2690*** (2560 – 2960)**
2	**0**	**3670** (3490 – 4040)
3	**0**	**1350** (1280 – 1480)

***Note:**
***Numerical values from LIA summary were rounded to nearest 10.**
****Ranges of values were calculated using a (-5%) and (+10%) variance, and rounded to the nearest 10.**

Tables 5.5 and 5.6 summarize Electrical Considerations for each Alternative.

Table 5.5 Electrical Considerations – Amount of Linear Features Paralleled (km)

Alternative	Existing 240 kV Lines*	Existing 144 kV Lines*	Primary & Secondary Highways*	Railways*	Pipelines*	Total km Linear Features Paralleled*
1	0	152	11	0	13	176
2	0	153	11	0	22	186
3	0	25	3	0	14	42

***Note: Values are the actual distances (i.e. not rounded).**

Table 5.6 Electrical Considerations – Industrial Structures and Facilities

Alternative	TeleCom Towers >25m tall & within 800 m of ROW*	Gas Facilities within 800 m of ROW*	Wells within 40 m of ROW*
1	87	1	74
2	93	1	87
3	79	0	62

***Note: Values are the actual numeric counts (i.e. not rounded).**

Table 5.7 provides a summary of special constraints that are located within 800 m of the potential right-of-ways for each Alternative.

Table 5.7 Special Constraints within 800 m of ROW

Route Concept "Alternative"	Historical Resources*	Urban Centres*	Cemeteries*	Airfields*	Indian Reserves / Metis Settlements*
1	17	4	3	0	0
2	37	6	4	0	0
3	6	2	3	0	0

***Note: Values are the actual numeric counts (i.e. not rounded).**

The findings of this LIA, which considered a variety of impact factors representative of those aspects defined in AUC Rule 007, may be summarized comparatively for the three Alternatives as follows:

Alternatives 3 has the shortest overall length (approximately 273 km) and thus the lowest value for overall land area required for right-of-ways (potentially 819 ha). **Alternative 2** has potentially the longest overall length (632 km) and the largest area (1896 ha) of lands taken up for right-of-ways overall. In comparison, **Alternative 1** has the mid-range of route length (approximately 434 km) and land area taken up (1302 ha). Refer to Tables 5.1 and 5.2 for details.

5.2 Comparison of Alternatives

The three Alternatives were compared with respect to their potential impacts as determined by the metrics for each route concept associated with each Alternative. The following summary of specific impacts was derived from analysis of the LIA metrics, comparative evaluation of numeric counts, determination of potential amount of lands crossed and lands taken up for each Alternative, on the basis of a 30 m wide right-of-way, for each respective route concept.

5.2.1 Agricultural Impacts

Potential agricultural impacts were determined through analysis of provincial maps for land use and the Canada Land Inventory (Soil Capability for Agriculture).

- **Alternative 2** takes up the most agricultural land (for both crop and forage land) (approximately 193 km / 579 ha), while **Alternative 3** takes up the least (approximately 64 km / 192 ha) for potential right-of-ways. Refer to **Tables 4.1 to 4.2** (Summary Totals and Ranges) for additional details on all categories examined.

- For **all three Alternatives**, the majority of lands rated for agricultural that are taken up are those of CLI Capability Classes 1 through 6 Soil Capability for Agriculture. **Alternative 2** takes up the most Class 2, and Class 3 lands (Class 2: 138 km crossed, approximately 414 ha taken up; and Class 3: 268 km crossed, approximately 804 ha taken up), followed by **Alternative 1** (Class 2: 80 km crossed, approximately 240 ha taken up and Class 3: 177 km crossed, approximately 531 ha taken up) and **Alternative 3** (Class 2: 16 km crossed, approximately 48 ha taken up and Class 3: 98 km crossed, approximately 294 ha taken up) . Each of the alternatives take up 11 km (33 ha) of CLI-classified Organic soils.

- Each of the alternatives affects 3 community pastures and/or grazing reserves.

5.2.2 Residential Impacts

- **Alternative 3** has the least potential impact to residences within both distance measures of 150 m and 800 m (7# count and 84# count, respectively), of the potential right-of-way. **Alternative 2** affects the greatest number of residences within both distance measures (24# count and 218# count, respectively).

- **Alternatives 1 and 2** may be considered comparable with respect to residences affected within 150 m of centre line of the potential ROW, (20# count and 24# count, respectively) .

- **Alternative 3** affects the least number of residences within 800 m of the right-of-way (84# count), while Alternative 2 affects the greatest (218# count).

- **Alternative 2** poses the highest potential combined impact with respect to residences both within 150 m (24# count) and 800m (218# count) of the right-of-way for the associated route concept.

5.2.3 Environmental Impacts

Potential environmental impacts were determined through analysis of Environmentally Significant Area (ESA) maps, in addition to consideration of grazing reserves and community pastures, major river crossings, and surface water located within 800 m of the potential ROW.

- In terms of the amount of ESA land crossed, **Alternative 3** (2 km crossed, 6 ha potentially taken up) affects the least amount of land area classed as being environmentally sensitive, according to the ESA data analyzed. Refer to Table 5.2 and 5.3 for associated ranges of values in terms of approximate amounts of ESA crossed and potential lands taken up for each Alternative.

- **Alternative 2** takes up the most ESA land area (potentially 18 km crossed, 54 ha taken up) relative to the other two Alternatives. Refer to Tables 5.2 and 5.3 for comparative ranges of values.

- **Alternative 2** involves 3 major rivers, Alternatives 1 and 3 are associated with 2 major rivers. All will likely cross named and unnamed creeks locally. The extent of this can only be determined through site-specific field studies during selection of routes.

- **Alternative 2** has the highest ranking in terms of proximity to water bodies, (3,667 ha of water within 800 m of the ROW). Refer to Table 5.4 for comparison of the three Alternatives.

- **Alternative 3** has the lowest ranking in terms of proximity to water bodies (1,347 ha of water within 800 m of the ROW). See Table 5.4 for comparison of the three Alternatives.

Refer also to Tables 5.2 and 5.3 for additional information on the amount of land taken up in by each Alternative

Additional research is required at a more site-specific level for each Alternative to better determine potential local environmental impacts (e.g. Species at Risk Act (SARA), to identify locally protected areas, land areas of high erosion potential) and to identify conservation concerns at local levels.

5.2.4 Electrical Considerations

Transmission line maps, road network maps, and railway network maps, were used to determine the electrical considerations. Refer to Tables 5.6 and 5.7 for related summary data. Based upon the information analyzed:

- **Alternatives 1 and 2** have similar potential for paralleling existing linear disturbances and existing transmission lines (144 kV and 240 kV), 173 km and 186 km, respectively. Alternative 3 has the potential to parallel approximately 42 km of existing linear disturbance.

- **All three Alternatives** have similar potential for telecommunications towers (a count of 87, 93, and 79, respectively) to be present within 800 m of the right-of-way.

- **Alternative 3** has the lowest potential to impact oil and gas facilities, with no gas facility within 800 m of the right-of-way, and approximately 62 wells within 40 m of the right-of-way for the associated route concept. **Alternative 2** has the highest potential for impacting oil and gas facilities, with 1 gas facilities within 800 m of the right-of-way and approximately 87 wells within 40 m of the right-of-way associated with the route concept.

5.2.5 Visual Impacts

The potential for visual impacts was deduced from analysis of residential data and the determination of proximity to protected or designated areas in or within 800 m, of the right-of-way associated with the route concept for each Alternative.

- **Alternative 2 is** within 800 m of 6 protected or designated protected areas; Alternative 1 is within 800 m of one protected or designated area; and Alternative 3 does not fall within 800 m of any protected or designated areas. All Alternatives cross Environmentally Sensitive Areas (ESAs) (see Section 5.2.3 for Environmental Impacts).

- **Alternative 3** has the lowest potential visual impact, when considering the number of residences impacted overall.

- **Alternative 2** can be considered to have the highest potential visual impact, when considering the number of residences impacted.

Additional, detailed field work will be required to gauge visual impacts using “line of sight” methodology to obtain a better understanding of local topography and scenic view-points.

5.2.6 Social Impacts

Social impacts can be considered as a combination of those impacts related to residential, visual and special constraints. Within this realm, **Alternative 3** can be viewed as having the least potential for social impacts, whereas **Alternative 2** can be viewed as having the greatest potential for social impact, when these impact factors are considered together.

5.2.7 Special Constraints

Special constraints included consideration of Historical Resources, Indian Reserves, Special Areas lands, military facilities, cemeteries and airfields.

- **Alternative 2** has the greatest potential for impacting special constraints overall, and **Alternative 3** has the least overall.

- **Alternative 2** has the greatest potential for impacting Historical Resources, while **Alternative 3** has the least.

- **All three Alternatives** are equivalent in their potential for impacting cemeteries and airfields, with three to four cemeteries and no airfields within 800 m of the route concepts associated with each Alternative.

- **None of the Alternatives** cross military lands or facilities, airfields, Indian Reserves or Municipal lands.

- **All three Alternatives** have potential for coming within 800 m of urban areas with their respective route concepts.

- **All three Alternatives** have the same potential to cross crown (provincially owned) lands (78, 81, and 80 km, respectively).

- **Alternative 3** crosses the lowest amount of privately-owned land (approx 189 km) and **Alternative 2** crosses the most (approximately 537 km).

6 SUMMARY & CONCLUSIONS

This LIA provides both qualitative and quantitative analysis of the three routing Alternatives AESO has put forth for the Central East Region Transmission Development project.

These three Alternatives were compared quantitatively through use of two GIS spatial analysis overlay techniques to determine the amount of lands and features impacted by route concepts associated with each Alternative. Extensive quantitative data were generated through this process, and are presented in various formats in within the report as summary tables. Several summary tables were also presented for specific impact categories.

Of the three Alternatives studied, **Alternative 3** has the lowest potential for overall land impact, in consideration of total lands crossed (km) and land area taken up (ha). **Alternative 2** has the greatest potential for overall land impacts in this regard. **Alternative 1** maintains mid-range values for these land impacts.

Of the multiple land impact factors examined, comparatively **Alternative 3** tends to demonstrate the least amount of impacts overall. However, this does not eliminate consideration of **Alternatives 1 and 2** as viable options**,** given that site specific information for each Alternative is required to provide a more representative assessment of the potential local impacts associated with each Alternative.

Additionally, extensive stakeholder consultation must be undertaken by the TFO prior to the Facility Application, to determine the extent of concerns and objections to preliminary routes associated with each Alternative, and to further identify potentially feasible route options and associated mitigations.

7 ACRONYMS

AESO	Alberta Electric System Operator
AltaLink	AltaLink Management Ltd.
ACCS	Alberta Culture and Community Spirit
ASRD	Alberta Sustainable Resource Development
ATCO	ATCO Electric Ltd.
AUC	Alberta Utilities Commission
CLI	Canada Land Inventory (Land Capability for Agriculture, Forestry, Wildlife or Recreation)
DC (D/C)	Double Circuit
DFO	Distribution Facility Owner
DND	Department of National Defense
EIA	Environmental Impact Assessment
ESA	Environmentally Significant Area
EU Act	Electrical Utilities Act
ha	Hectare
HEE Act	Hydro and Electrical Energy Act
HRV	Historical Resource Value
HVDC	High Voltage Double Circuit
km	Kilometre
kV	Kilovolt
LIA	Land Impact Assessment
m	Metre
MER	Meridian, as per Alberta Township Survey
NID	Need Identification Document
QTR SEC	Quarter section, per Alberta Township Survey
RGE	Range, per Alberta Township Survey
R/W	Right-of-Way
ROW	Right-of-Way
SARA	Species at Risk Act
SC (S/C)	Single Circuit
SEC	Section, per Alberta Township Survey
TFO	Transmission Facility Owner
TWP	Township, per Alberta Township Survey

8 GLOSSARY OF TERMS

Aspect — The seven major aspects that the AESO must have regard for in determining technical options. These include: Costing, Agricultural Impact, Residential Impact, Environmental Impact, Visual Impact, Electrical Considerations, and Special Constraints. Consult AUC Rule 007 (Section 6.1 NID12, for further details.)

AUC Rule 007, or Rule 007 — Alberta Utilities Commission Rule 007 (formerly EUB Directive 028): Rules respecting applications for power plants, transmission lines and industrial system designations April 21, 2009.

Facility Application — The Facility Application is developed and submitted by the TFO to the AUC once final route and site selections have been made. These final selections are based on the direction provided by the AESO. It also involves an extensive public consultation program, detailed field surveys, and other related activities in the route selection process.

Green Area (of Alberta) — Geographically, the "green area" represents about 69% of the province's land area of forested lands located in northern Alberta, and in the mountains and foothills. Nearly all these lands are publicly (provincially) owned. Main land uses are timber productions, oil and gas development, tourism and recreation, conservation of natural spaces, watershed protection, and fish and wildlife habitat.

Need Identification Document (NID) — The need identification document is developed and submitted by the AESO to the AUC once a technical solution has been recommended.

Right-Of-Way — (ROW, R/W) The right-of-way refers to the width of a segment of land required to build a proposed transmission line. The width considers several factors to ensure safe and reliable operation of the line, which includes adequate clearance distances, access for maintenance, and other factors.

Route Concept — A schematic representation of a potential route option, which is supported at a reconnaissance level of assessment, by its favorable characteristics relative to other options. The route concept is not an indication of a final route or ROW, as it is only a potential consideration in a reconnaissance level study.

Study Area — The study area refers to the general area in which the proposed developments could be located. This is the land area that is considered for potential routing scenarios and the subsequent land impact assessment.

White Area (of Alberta) — Geographically, the "white area" covers about 39% of Alberta, and is comprised of land owned by individuals and groups. Main land uses are settlements, agriculture, tourism and recreation, oil and gas development and conservation of natural spaces and wildlife habitat.