AGRICULTURAL LAND CONVERSION AND FRAGMENTATION IN ALBERTA:

A REVIEW OF LAND COVER PATTERNS 2000-2012 AND LAND USE POLICY

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by

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EXECUTIVE SUMMARY

Alberta's landscape is undergoing substantial changes due to growth in its economy and population. The agricultural industry, which uses approximately one third of the provincial area, is significantly affected by these changes. In particular, there is ongoing conversion of agricultural land to non-agricultural uses, and fragmentation of agriculturally productive land. These result in the potential loss of agricultural productivity in the province. This report, written as a background document for the Alberta Land Institute project "Economic Evaluation of Farmland Conversion and Fragmentation in Alberta", provides a summary of the historical pattern of land use and land use change in Alberta, as well as providing a review of relevant land use planning policy in Alberta as well as for other jurisdictions.

The review of land use and land use cover changes used satellite-sourced data for the agricultural landscape from 2000 to 2012. Satellite data analysis for this study period found a trend of Alberta's agricultural land shifting from pasture and livestock production to more intensive annual cropping. Between 2000 and 2012, 23% of pastureland was transformed into cropland. Results also showed that there was a net decrease of 845,200 hectares (-5.63%) in agricultural land, due primarily to pasture land transitioning to shrubland or grassland.

The land use change of primary interest for this review was the agricultural land lost through conversion to residential, industrial, or infrastructure development. Results from the analysis are that from 2000 to 2012, approximately 123,900 hectares (0.82%) of the agricultural land base was converted for development. While this

represents a minor loss on a provincial level, the concentration of development occured in the Edmonton to Calgary corridor, with the focal point being Edmonton and the neighbouring region. Within this region alone, about 38,250 hectares (4.3%) of agricultural land was converted.

Two important aspects of this conversion, agricultural suitability and agricultural fragmentation were also explored. Results showed that of the agricultural land converted within the province 68.4% was from the two highest quality categories of land. However, fragmentation of the agricultural land base decreased between 2000 and 2012, based on examination of multiple fragmentation indices.

This review found that agricultural land conversion is happening at a significant level on the highest quality agricultural land within the province. While the quantity of land available to agriculture in the province is not being largely affected, there may be regional or qualitative issues, as the conversion is focused in the Edmonton to Calgary Corridor.

The review of land use planning policies and legislation revealed that land use planning integrates multiple levels of government and requires thoughtful consideration to effects on the public, regulations and goals. However, given the recent patterns of conversion and fragmentation of agricultural land, it is clear there are shortcomings under the current planning system. An investigation of policy gaps and review of programs in place in other jurisdictions revealed the potential for improvements in agricultural land preservation. The review also suggests that the planning system is constantly evolving and will remain a key issue into the future with evolving perspectives on the environment and increasing demands on the land.

INTRODUCTION

The agricultural land base in Alberta is under pressure from various influences. Alberta continues to experience rapid growth in its resource sector and urban population. Rural and urban development have caused the permanent conversion of some of the province's most productive farm and ranch lands, particularly around cities and in the Edmonton – Calgary corridor. Fragmentation of the land base into smaller parcels (e.g., for acreages, transportation routes, energy/utility corridors, wellheads) is another significant challenge facing municipal authorities and the province's agricultural sector. There are economic, social, and environmental consequences associated with conversion and fragmentation of agricultural land. Concerns include rural landscape preservation, local food production, loss of high quality soil, as well as economic inefficiencies. Potential costs for agriculture may arise from:

1) Conflicts between farm businesses and new residents, as well as bylaws that restrict the ability to conduct normal agricultural operations;

2) Inability to achieve economies of scale due to lack of sufficient continuous land parcels; and

3) farm service businesses moving further away to avoid higher costs (e.g., rental rates).

Once fragmentation starts, policies tend to become less restrictive of alternative housing and business development. As the degree of fragmentation increases beyond a certain threshold, farms may choose to move or exit from the industry altogether. In the

long term, continuing land fragmentation and conversion may change the general landscape in ways that are beyond governmental control.

In Alberta, creating a landscape that supports a healthy environment, diverse communities and a thriving economy involves extensive planning and collaboration between multiple levels of government, stakeholders and the public. With land use decision making, planners must ensure that the requirements of a number of acts are satisfied, while advancing the specific goals of their municipality. Furthermore, there are a multitude of policy documents that have evolved to provide direction for planners such that they can balance multiple values held by society and contribute to development in line with regional and provincial visions. Creating documents that meet these requirements and promote fair and functional land use is a challenging task involving complicated planning systems.

In response to this issue, the Alberta Land Institute commissioned a study, "Economic Evaluation of Farmland Conversion and Fragmentation in Alberta", to examine the extent of agricultural land conversion and fragmentation in the province, and to study factors affecting the rates of conversion/fragmentation. This document provides background information for the study. The objectives of the paper are to provide: a) an overview of trends in agricultural land use in Alberta between 2000 and 2012, focusing on conversion between uses and fragmentation, and b) a review of relevant land use planning policies and processes for Alberta and other jurisdictions.

The overview of agricultural land use change uses classified land cover data obtained from Agriculture and Agri-Food Canada. These data are used to compare land use, based on satellite imagery, for 2000 and 2012 in order examine changes in use as

well as conversion to non-agricultural use and degree of fragmentation. Preceding this analysis is a review of literature on approaches for quantifying land use changes as well as previous findings for agricultural land use patterns in Alberta.

The second part of this report is a review of policies and programs related to land use planning. Specifically land use planning regulations and processes for jurisdictions in Alberta are reviewed. An overview of relevant policies in other regions is included for comparison. Documents of particular relevance include the *Municipal Government Act* (MGA), *Alberta Land Stewardship Act* (ALSA), Alberta *Land Use Framework* (LUF) and Provincial *Land Use Policies*. These documents, in effect, shape the planning and development processes, which in turn determine the standing of agricultural land use and protection.

1 ALBERTA AGRICULTURAL LAND USE 2000-2012

1.1 LITERATURE REVIEW

1.1.1 PRIOR STUDIES OF LAND USE IN ALBERTA

Patterns of land use in Alberta are addressed by a number of recent reports and academic papers. For example, Young *et al.* (2006) analyze a study area east of Edmonton that includes Elk Island National Park and a 50-kilometer buffer around the periphery of the park. Using satellite imagery from 1977-1998 they look at land cover changes and their probable causes. The authors found that the major land cover changes within this area of the province were shifts from perennial forage crops to annual commodity crops. This agricultural intensification corresponded to a decrease in the number of agricultural operations, and signaled a shift to intensive livestock operations and large scale cropping. Four main land use influences identified for this case study were agricultural, urbanization, oil and gas, and fire regime changes.

Another study that focused on agricultural land use changes in the Canadian prairies was conducted by Rashford *et al.* (2011). These authors developed a land use model for agricultural land in the Prairie Pothole Region of Western Canada. Their simulation results predicted that due to rising commodity prices, Alberta would see large shifts in land use, away from hay production and pasture towards intensive spring-seeded crops in the near future. However, the authors also suggested that this trend would probably not persist as it was occurring in areas with high shares of land under hay and pasture production and might not extend beyond those areas.

While these two studies examined changes within the agricultural land base of Alberta, they did not address causes of agricultural land losses. A 2002 Alberta Agriculture and Rural Development report (AARD 2002) assessed the loss and fragmentation of agricultural lands. Using an agricultural land base monitoring report the report stated that although there was a small net decrease in agricultural land during the period 1977-2002, there was a more significant effect on potential agricultural productivity. High quality lands surrounding urban centres were developed for residential uses, while area being converted to agricultural use tended to be of lower quality, more suitable for hay and pasture than annual crops.

In addition to the agricultural land conversion occurring in areas of urban sprawl, fragmentation of the land base was also identified by the 2002 AARD report as having an impact on Alberta's agriculture sector. When surveyed, rural municipality planners identified country residential development, a major contributor to fragmentation, as the greatest issue facing the agricultural land base in the province. Fragmentation in this form, they argued, has multiple effects, increasing the probability of future conversion due to decreased productivity, and increasing speculative land values. This issue was only expected to increase with the growing demand and purchasing power of people looking to enjoy the open spaces of the country.

1.1.2 CONVERSION AND FRAGMENTATION MEASUREMENT TECHNIQUES

In order to examine issues surrounding agricultural land use change, detailed and accurate measurement of both land conversion and fragmentation is necessary. The 2002 AARD report highlights how the only conversion data readily available for policy analysis are the aggregated and sometimes unreliable Census of Agriculture data. There is a need for both more accurate and higher resolution data to test the effectiveness of farmland conservation programs that may be implemented in the future.

Recent improvements in satellite imagery provide opportunities for undertaking high-resolution agricultural land base surveys. Ramankutty and Foley (1999) paired satellite (remote sensing) data with global cropland inventory data to derive a calibration model for agricultural land. They then were able to use historical cropland inventory data (i.e., back to the 1700s) to estimate a historical spatially distributed agricultural land use pattern to be used in climate change models. Cardille and Foley (2003), in a similar manner, paired remote sensing data with land cover census data for the Brazilian Amazon region to describe the expansion of agricultural land over time. This method of calibrating cropland inventory measures using remote sensing data has been used in many applications.

To analyze more recent land cover changes, remote sensing images for different time periods can be differenced directly. Mas (1999) described a variety of remote sensing land cover change detection methods in use. These include raw image differencing, vegetative index differencing, and post-classification differencing. Most of the techniques require an interpretation of the changes after processing, which may be

problematic. The method found to be most accurate, post-classification differencing analysis, uses land cover data that have been classified into land cover categories and then differenced. As the data have been pre-classified, the interpretation of land cover changes are simple to be made and were found by Mas to be the most reliable of the examined change detection methods.

Mas determined the most reliable technique for identifying and quantifying land cover changes, but an understanding of the processes behind these conversions is still lacking. Lambin *et al.* (1999) addressed this problem in a report for the International Geosphere-Biosphere Programme in which they proposed three approaches for analyzing the source of land cover and land use changes. The first one, a narrative approach, involves interpretation of historical events and details, which is valuable in providing a baseline for more robust analysis. A systems/structure approach focuses on the influence of social organizations and other institutions influences on changes, both direct (e.g., policy) and indirect (e.g., markets). Finally, an agent-based approach involves interpreting the effects of individuals' decisions on land cover. These three approaches, either individually or in combination, are appropriate uses dependent on the context of the land cover changes.

Landscape fragmentation is a commonly addressed issue in the ecological sciences, but has been examined less frequently in an agricultural context. Fragmentation has varying impacts on land use, which makes it difficult to determine a single metric of measurement. Jaeger (2000) described a number of metrics, including landscape division and effective mesh size, and provided a discussion of the contexts in which these metrics are appropriate. An important metric to address land contiguity

was highlighted by Latruffe and Piet (2013). Their "normalized average nearest neighbor distance" index combines both patch size and the distance to the nearest patch of the same land use, to measure the connectedness of the desired landscape form.

Irwin and Bockstael (2007) applied landscape metrics to examine the impacts of low-density residential development on the degree of contiguity for undeveloped land in Maryland, USA. The metrics used by the authors were patch density, mean patch size, mean perimeter-to-area ratio, contrasting edge ratio, and mean dispersion. A direct application of similar metrics to agricultural fragmentation was made by Latruffe and Piet (2013). Their case study of France's Brittany region involved the use of high-resolution farm level data, which facilitated measurement of farm level fragmentation. They paired these results with extensive farm operation data, and looked at the effects of fragmentation on farm productivity and performance. The authors concluded that farm performance declined with increased fragmentation, but that multiple aspects of farm profitability were differentially related to the various fragmentation measures. This reinforces the need for multiple metrics to capture the variable impacts of fragmentation on the agricultural landscape.

1.1.3 AGRICULTURAL LAND TO URBAN LAND CHANGES

One specific type of land cover change that has attracted significant interest globally and locally is the urbanization of rural and natural landscapes. A number of papers (e.g., Milesi *et al.* 2003; Xian and Crane 2005) have examined different approaches for identifying the encroachment of urban areas, using remote sensing data. Milesi *et al.* (2003) used nighttime data to delineate urban areas based on light

emissions. In contrast, Xian and Crane (2005) used hydrologic infiltration to identify urban land as areas that are impervious to water. Quantifying the extent of urban land cover is not always simple or straightforward, however, as there is a spectrum of urban intensity from high-density to low-density suburbia. Jat *et al.* (2008) is an example of a paper in which the authors sought to distinguish varying degrees of urbanization within regions using landscape metrics such as entropy and patchiness/map density to qualify the density of residential development.

Urban development has been studied in great detail around the world, with a focus in the rapidly developing countries of China and India. Both countries are experiencing significant urban pressure on neighbouring areas of agricultural land. Sudhira *et al.* (2004) used post-classification analysis on remote sensing data of Southwestern India and found that the developed land had increased three-fold more than population. Also using post-classification land cover change analysis, a study based in China's capital city of Beijing found that from 1978 to 2010 nearly 100,000 hectares of rural land had been converted to urban uses (Zhao *et al.* 2013). A study for Minneapolis/St. Paul in Minnesota USA over the period of 1986 to 2002 was conducted by Yuan *et al.* (2005). Their results revealed the changing proportions of urban, agricultural, and natural lands within the greater metropolitan area. Urban land use increased by 38.5% while agricultural land use decreased by 15%, revealing the strong presence of agricultural land conversion in that region of the United States.

1.1.4 IMPACTS OF AGRICULTURAL LAND CONVERSION

The presence of agricultural land conversion in many parts of the world is indisputable, but the literature does not always provide an indication or understanding of the impacts of losing this agricultural land. An obvious impact is the potential loss in agricultural production. This is addressed by Nizeyimana *et al.* (2001) for the United States. The authors estimated approximate productivity losses from agricultural land converted to urban uses by incorporating soil quality and landscape factors into a categorical measure of productive ability of the land. As expected, the study concluded that the agricultural land being lost in each productivity category was heterogeneous across States, and that high productivity land was being lost in the mid-western (or "Corn Belt") states.

A less obvious impact of losing agricultural land is the reduction or loss of positive externalities associated with the agricultural landscape. This loss of open, rural space amenities was examined by Fleischer and Tsur (2009). They determined that people attach a significant value to rural landscapes surrounding urban centres, and that this value depends on crop type. Plottu and Plottu (2012) added to this discussion of externalities by identifying the multi-dimensional values of landscapes. Their paper outlined the presence of ecological, social, and economic values contained within a landscape. Not all of these values are considered explicitly in land use decisions which, as the authors note, may lead to inefficient outcomes.

Based on this literature review, decisions may be made regarding how best to proceed with the current analysis of Alberta agricultural land conversion and fragmentation. First, it is determined that the most effective and conveniently simple

method of measuring land cover change with remote sensing data is with post-classification analysis. Another important consideration, based on the literature review, is the directive to use multiple landscape fragmentation metrics to quantify agricultural fragmentation. A final conclusion from this review is that land quality is a critical concern when quantifying agricultural land losses, and should be reported in addition to the simple quantities of land being converted/lost.

1.2 AGRICULTURAL LAND USE IN ALBERTA 2000-2012

1.2.1 AGRICULTURAL LAND USE OVERVIEW

Alberta's agricultural land base constitutes a significant portion of the total area of the province and incorporates a diverse range of agricultural uses, include livestock production, intensive cropping, forage production, etc. In this section of the report, changes in use of the agricultural land base over the period 2000 to 2012 are examined. These land use changes were able to be viewed at a high resolution by using classified satellite imagery. Satellite imagery classification is completed by interpreting multiple bandwidths of data into discrete land cover classes that are then interpreted as the various uses of the land. The land uses included in the discussion here are limited to those changes specifically related to the agricultural land base. However, Appendix 1 shows a detailed land cover change matrix for all nine major land cover categories, from 2000 to 2012.

This analysis was performed using classified land cover data provided by Agriculture and Agri-Food Canada. These data were available for the years 2000 and

2012, in a raster format with 30 metre pixel resolution. These two datasets were then differenced to obtain land cover changes during the study period, for the white zone portion of Alberta.[1]

Between 2000 and 2012, Alberta's agricultural land base decreased by a net 845,200 hectares, representing a decrease of 5.63% (Appendix 2). Multiple sources contributed to this substantial decrease and, as expected for a diverse province such as Alberta, the degree of loss is spatially heterogeneous. An illustration of this heterogeneity at a township level is provided in Figure 1, which represents a grid of net agricultural land use changes for Alberta's white zone. Each square in Figure 1 represents approximately ~9300 ha.[2] As shown in Figure 1, the area surrounding Edmonton and north of Edmonton is a region experiencing some of the most significant decreases in agricultural land. Additionally a zone in the center of the province, stretching eastward from Red Deer, also displays a significant decrease in land under agricultural use. Despite the overall decreasing trend, there are areas in the province that have net increases in agricultural land (shown in green in Figure 1). These include an area south and east of Edmonton (from Wetaskawin to Vermillion), as well as the area just north of Calgary. There are also scattered areas of increased agricultural land in the Peace River area and in southern Alberta in the irrigation zone. Undoubtedly a complex pattern of economic, environmental, and social dynamics contribute to this heterogeneous pattern of change in agricultural land use.

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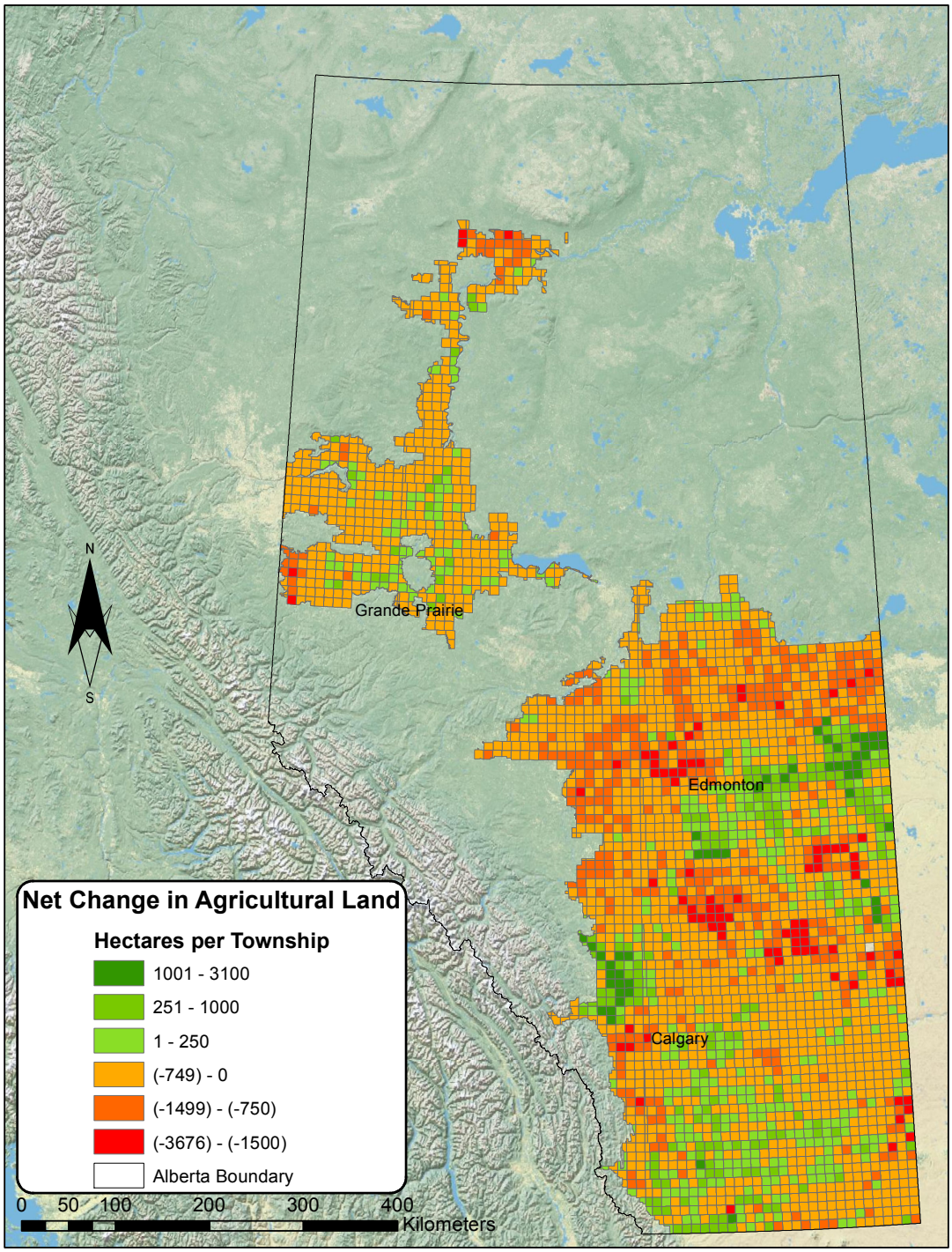
[1] The term "white zone" refers to the settled area of Alberta and includes the southern, central and Peace Rivera areas of the province. Most of the province's agricultural land base is included in the white zone. The rest of the province is referred to as the "green zone", characterized by forested areas that are primarily publically owned.

[2] This same scale (i.e., one square = ~9300 ha) applies for each of Figures 1 to 5 as well as Appendix 5.

FIGURE 1. Net Agricultural Land Change in the White zone of Alberta from 2000 to 2012



Since the Edmonton area appears to be a hotspot for agricultural land loss, a more detailed look at the land cover changes is warranted. Appendix 3 provides a complete land cover change matrix for the Edmonton area, also referred to as the Capital Region.[3] Approximately 97,090 hectares of agricultural land in the Capital Region was "lost" between 2000 and 2012 (Appendix 3). This represents a 10.8% loss of agricultural land, which is twice the provincial average percentage loss, and is indicative of the substantial changes in land use that have occurred and continue to occur in the Edmonton area.

It should be noted that due to the discrete two time period nature of the land cover analysis, there is some potential (possibly significant) for many of these land use changes to be temporary in nature. Fluctuations in agricultural commodity prices as well as moisture and temperature anomalies can cause land to shift in and out of different uses. This consideration is important to remember when interpreting and extrapolating the trends discussed in subsequent sections.

1.2.2 SHIFTS WITHIN THE AGRICULTURAL LAND BASE

As well as gains and losses in agricultural land, the period 2000 to 2012 also saw land shifting between different agricultural uses. Specifically, there were significant changes in the amount of land used for annual crops (i.e., "cropland") and pasture, due to both crop rotation considerations as well as other external forces. Crop rotation

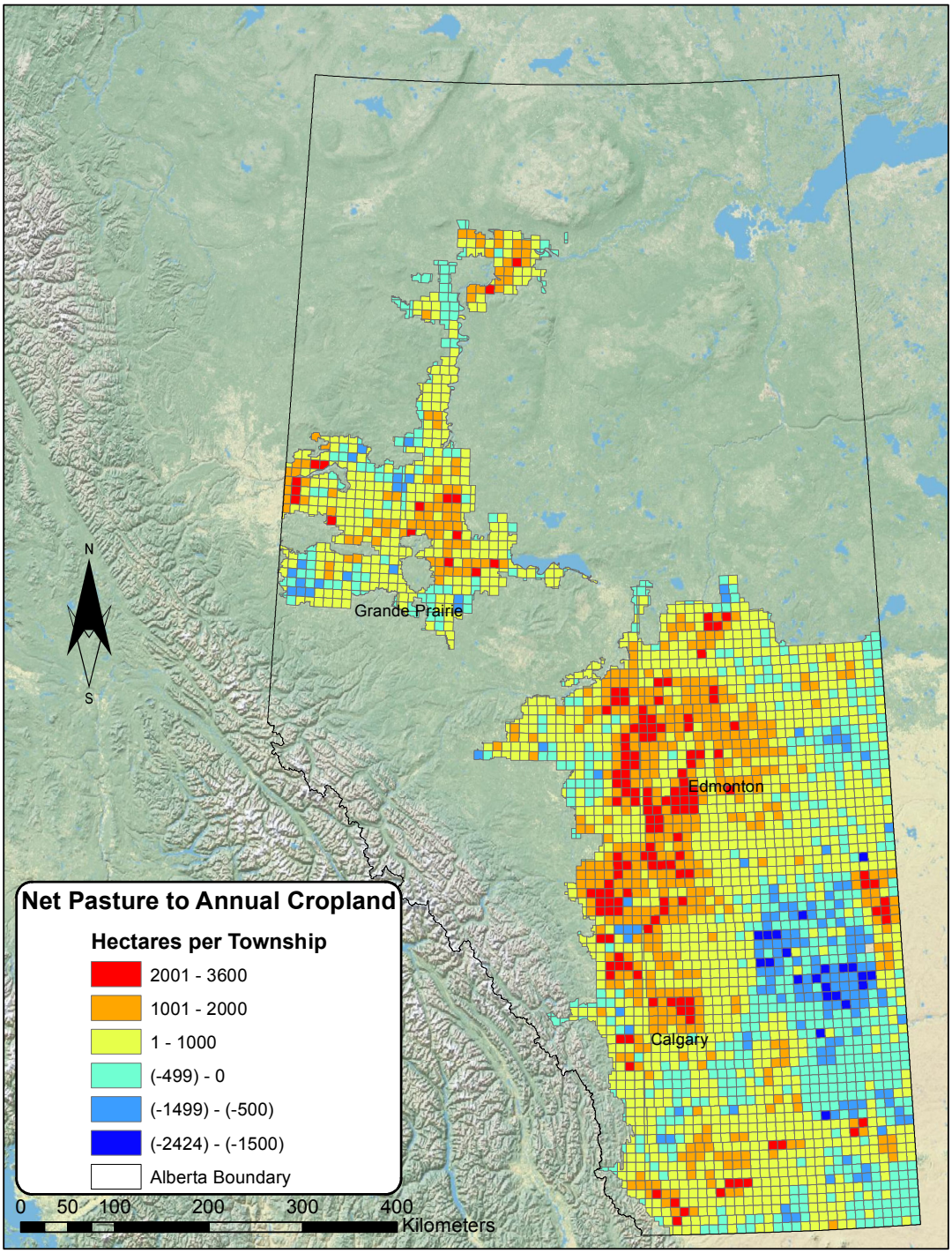
[3] The Capital Region is comprised of the city of Edmonton and five adjacent counties (Lamont, Leduc, Parkland, Strathcona and Sturgeon), including villages, towns and cities contained within those counties. A map of the Capital Region is provided in Appendix 7.

considerations relate to producers who shift land between annual crops and forage production. These effects would tend to "even out" over time. However, there are likely also structural changes in farmers' production decisions that are due to both environmental factors and economic drivers and these may represent more permanent adjustments in agricultural land use.

On significant shift in agricultural land use during the period 2000-2012 was a conversion of 1,379,300 ha from pastureland to cropland (Appendix 1), representing a net "loss" of 22.9% of pastureland. This result is consistent with the predictions from Rashford *et al.* (2011). Figure 2 illustrates the spatial pattern for these net changes. As shown in that figure, the Edmonton to Calgary corridor displays the greatest shifts in agricultural intensity. Appendix 3 provides greater detail at this trend for the Capital Region. Within the Capital Region, there was a net total conversion of 186,150 ha (Appendix 3) from pastureland to cropland. This represents a 40.6% change of pastureland to cropland over the period of 2000 to 2012. The pattern of conversion from pasture to crop production is not uniform across the province, however. For example, over the same 2000-2012 period the net conversion was in the other direction in the southern region surrounding Stettler and Hanna.

The drivers behind these changes may be a combination of environmental and economic factors (Lambin *et al.* 1999). Higher crop prices may contribute to increased intensification in agricultural production, resulting in producers moving from forage production and livestock grazing to production of annual crops such as canola and wheat (Rashford *et al.* 2011). This pattern in commodity prices is illustrated in Appendix 4, with historical prices being provided for

FIGURE 2. Net Pastureland to Cropland Changes in the White zone of Alberta from 2000-2012



canola, wheat and feeder cattle for the period from 2000 to 2012. As shown in Appendix 4, wheat and canola prices increased over this period while beef prices remained relatively constant. It should be noted, however, that any shift in land use from pasture to annual crops is also dependent on the potential productivity of land, which is related to soil quality and climate among other factors. This also contributes to explaining the general pattern of intensification across the province. The Edmonton-Calgary corridor area where this change is most prominent has land with the highest land suitability rating. This rating is a measure of soil quality, landscape, and climate factors. Conversely, the lowest land suitability rating is for the area around Hanna and Stettler where the net conversion has been from cropland to pastureland. The fact that areas in the southeastern part of the province have shown conversion to more pastureland despite rising crop commodity prices illustrates the importance of land suitability in terms of land use decisions.

1.2.3 ADDITIONS TO THE AGRICULTURAL LAND BASE

Although the overall net change in agricultural land in Alberta was a decrease of almost 6%, there were areas in the province that experienced agricultural expansion during the 2000-2012 time period. Figure 3 displays the spatial pattern for conversion of grassland, shrubland and forested into agricultural uses. The expansion that occurred in the north was primarily due to clearing forest (Appendix 1), while in the other parts of the province the majority of conversion to agricultural land use occurred in grasslands. Similar to the shift noted earlier with respect to intensification of agricultural use, expansion has taken place mostly on the highest quality land in the province (Figure 4).

FIGURE 3. Grassland, Forestland, and Shrubland Converted to Agricultural land in the White zone of Alberta from 2000 to 2012

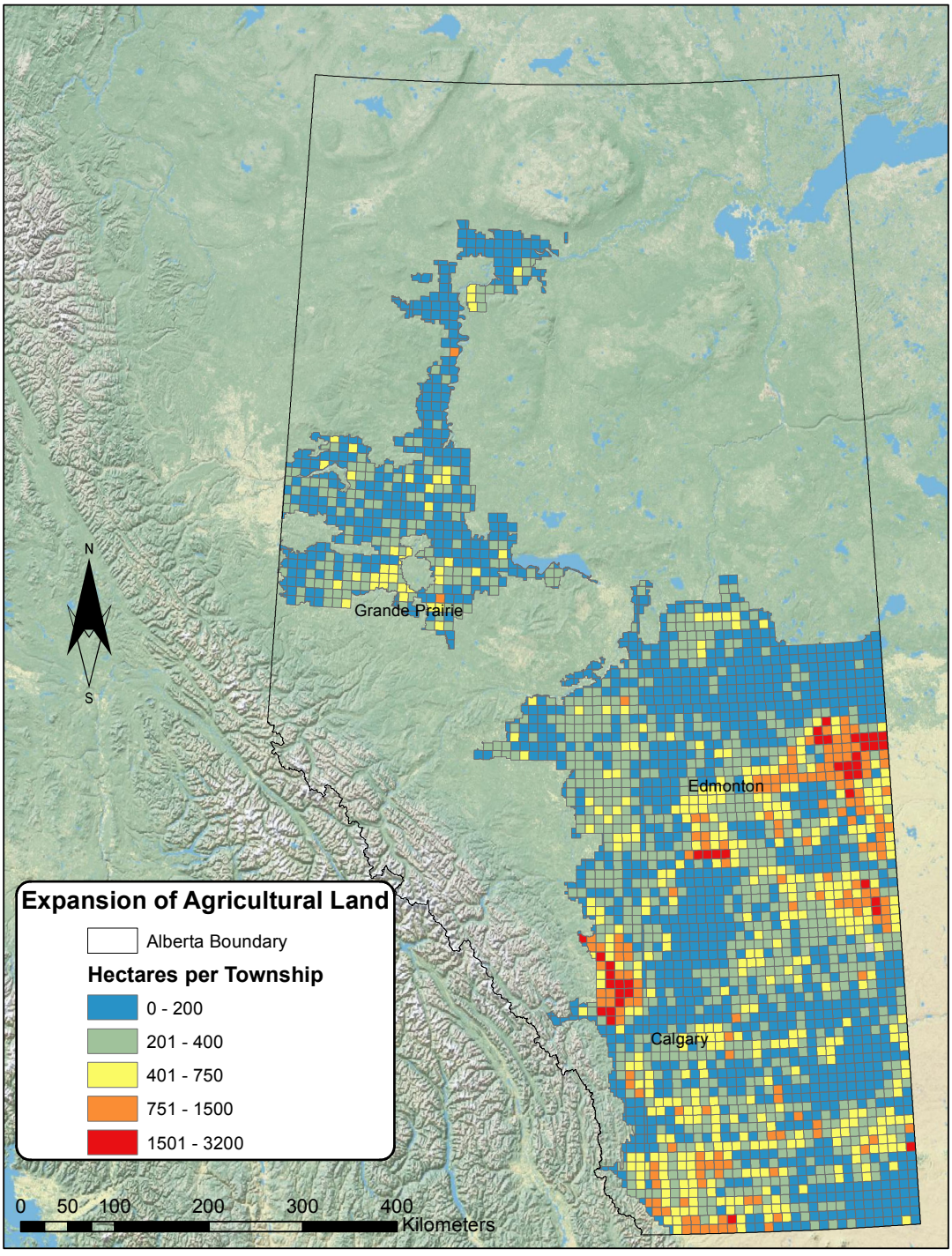
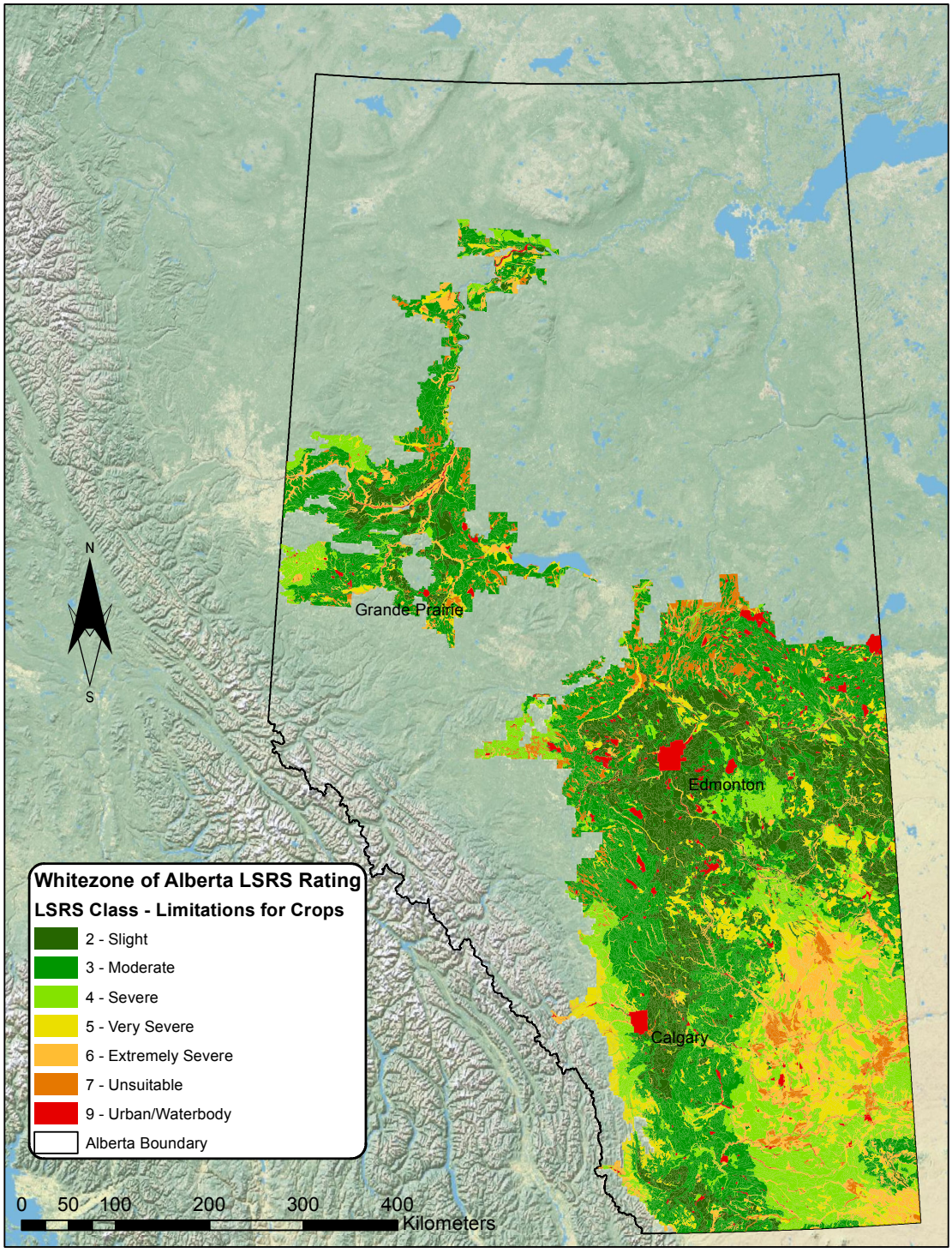


FIGURE 4. Land Suitability Rating System (LSRS) for the White zone of Alberta



Two "hotspots" in terms of additions to the agricultural land base are in the Vermillion area (east of Edmonton) and the Mountain View County area (northwest of Calgary). In both of these areas, substantial conversion of grasslands into agricultural use has taken place. The move from native grassland (that may be used for grazing) to tame pasture and forage production may also be in part supply compensation for the large losses of pastureland to cropping use within the corridor area.

Agricultural expansion into previously forested land mostly occurred in the Peace region and north central Alberta, with a hotspot of expansion occurring in Camrose County, southeast of Edmonton. This expansion is motivated mostly by higher commodity prices and growing scarcity of agricultural land. In particular, this land use change in the Peace region involves high conversion costs and is only economically viable due to higher expected profits. Due to the restricted white zone boundary of this analysis, public land dispositions that bring public land into private use may be missing from this analysis. For instance, in the most northerly agricultural area of La Crete about 55,000 hectares of forested land is in the process of being auctioned off for agricultural uses. This substantial addition to the land base is not included in the review.

The Capital Region had relatively few additions to the agricultural land base. This is not surprising because this relatively densely populated region does not have much land remaining that has not already been expanded into for agriculture. As a result, combining forest, shrubland, and grassland conversions, only 27,900 hectares were added, with 88% of that coming from forested land.

Besides conversion from grassland, shrubland and forested land, there is also a small portion of previously developed land from well sites that has been reclaimed and added into the agricultural land base. The land cover analysis showed that 38,125 hectares of developed land was converted to agricultural use during the study period (Appendix 1). Since it is very rare for residential, or commercially developed land to be reclaimed to agricultural use, the conclusion is made that the source of this addition is almost exclusively reclaimed well sites. Concentrations of this type of conversion/reclamation are shown to surround Edmonton and be spread out east of the city in the St.Paul and Vermillion area (Appendix 5). Reclamation in the Capital Region was determined to be 4080 hectares (Appendix 3), which represents 5.3% of developed land in the region being returned to agriculture. For this land cover change in particular it is important to note the potential for error in the data. Specifically, the classification of the satellite data used for the land cover analysis has some potential for error due to irregularities in images or to incorrect conclusions being made based on the computational land cover judgment. It may therefore be the case that a portion of this reclaimed developed land is actually attributed incorrectly.

1.2.4 AGRICULTURAL LAND BASE LOSSES

The overall decrease in the agricultural land base reported here is contributed to by a number of different types of conversions. From 2000 to 2012 agricultural land shifted to a number of different land cover categories, including grassland, shrubland, forested, and developed use. These shifts differ greatly in the associated degree of permanence. For example, conversion of agricultural land to shrubland may represent

a temporary change due to fields being too wet in one year to cultivate, or because of current market signals (e.g., low commodity prices). However, a shift to residential development (i.e., developed use) is unlikely to ever be reversed. Due to this significant type of difference in conversion of agricultural land, they are discussed separately; potential temporary changes are discussed first followed by a detailed look at the target land cover change of agriculture to developed use.

1.2.4.1 ABANDONMENT OF AGRICULTURAL LAND

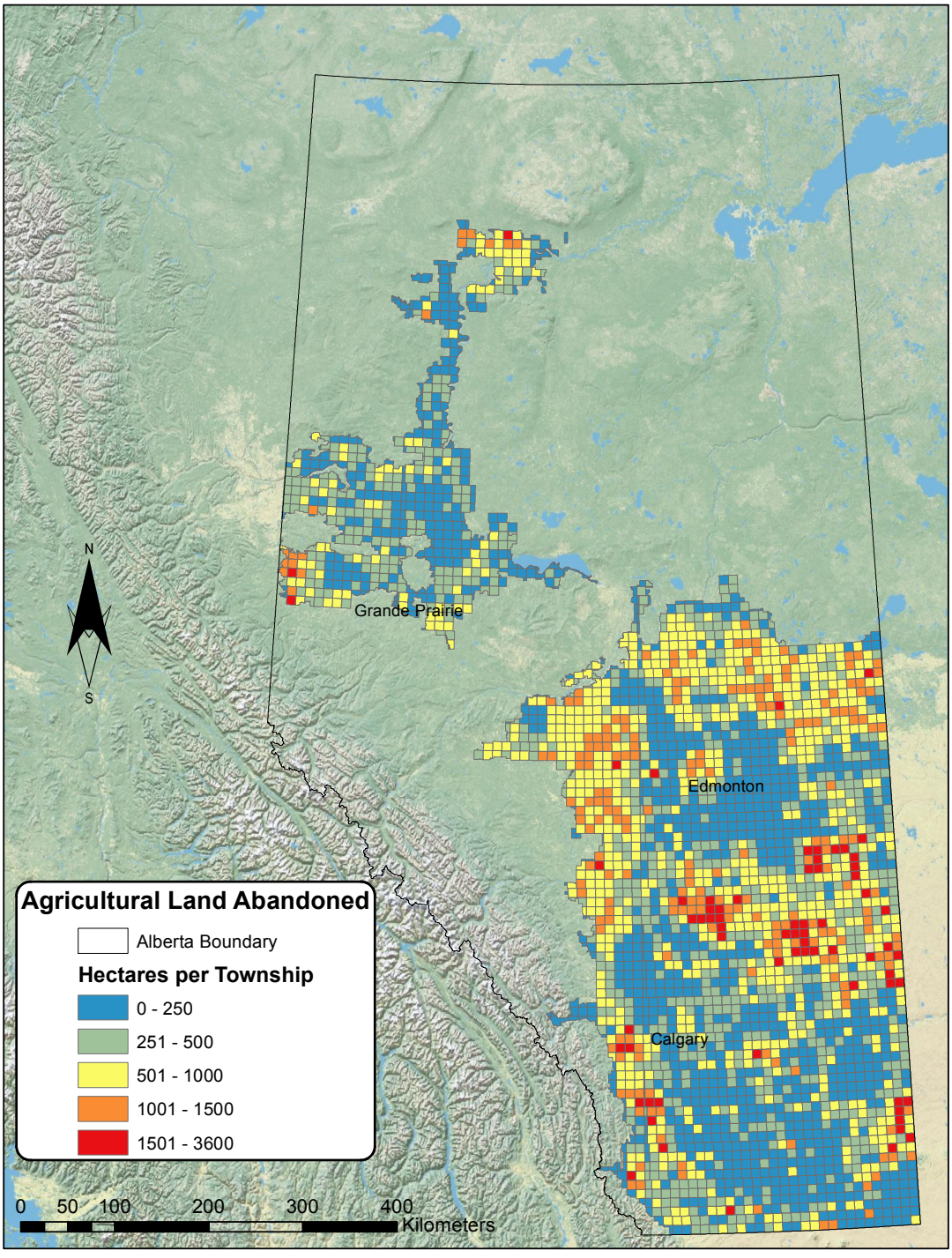
A substantial amount of agricultural land in the province was abandoned (as opposed to being developed), according to the land cover change analysis. These agricultural land losses were distributed largely around the periphery of high quality soils within the corridor area (Figure 5). A prominent hotspot of abandonment extended from the central area near Stettler to the eastern boundary of Alberta. Based on the analysis of satellite imagery, total conversion from agricultural use to grassland, shrubland, and forest during the study period was 1,325,300 hectares (Appendix 1), with 75% of this being converted from pastureland. This figure represents an 8.8% decrease in agricultural land over the 12-year period. However as noted earlier, these changes may be temporary. The Capital Region had 64,050 hectares of agricultural land converted to grassland, shrubland, and forested land (Appendix 3). Similar to the province, 82% of these losses were from pastureland.

These potentially temporary land use changes may be due to normal producer decision making. Some agricultural producers will change land use from year to year based on expected commodity prices and forage costs. In years where forage is readily

available at lower prices, livestock producers will feed more hay rather than grazing tame pasture. Good moisture and strong production may also be driving forces for tame pasture being underutilized and classified within shrubland or grassland categories. Another contributing factor to potentially temporary agricultural land loss is the moisture regime and the associated ability of producers to cultivate the land. In times of high moisture some low lying areas, and occasionally whole fields are left unsown or not grazed. This may be the explanation for the hotspot of agricultural land abandonment in southeastern Alberta around Hanna. Accumulated precipitation numbers from May 1st to July 1st, 2011 show that the region south of Lloydminster and Red Deer received 150-210% of normal precipitation for this period (Appendix 6). There is a strong possibility that this high moisture regime resulted in some land being uncultivated in 2012 when the ending satellite imagery data were collected. The southern most area of the province did not experience the same decrease as the Hanna area, which may be due to the intensive irrigation infrastructure that allows producers to manage drainage much more effectively.

As noted earlier, there is potential for classification errors when using results from satellite imagery. This is particularly true for land uses that are close in terms of their definitions, such as pastureland, grassland, and shrubland. Small changes in plant growth or composition in pastureland may cause the land cover classification to change, resulting in overinflation of the decrease in agricultural land reported during the study period. Unfortunately, this consideration cannot be addressed other than acknowledging its presence because the satellite data were pre-classified before being received for use in this analysis.

FIGURE 5. Agricultural Land Changed to Grassland, Forestland, and Shrubland in the White zone of Alberta from 2000 to 2012



1.2.4.2 AGRICULTURAL LAND CONVERSION TO DEVELOPED USES

A more permanent agricultural loss, and the focus land cover change for this research project, is conversion of agricultural land to residential, commercial, and industrial (i.e., developed) uses. As a consequence of Alberta's growing economy and population an increasing amount of agricultural land has been converted to developed use around urban centres, both large and small. This pattern includes both peripheral expansion as well as pervasive country residential development.

The primary area of agricultural conversion to developed use over the period 2000-2012 was in the Edmonton-Calgary corridor region. Smaller areas of conversion were also scattered around Grande Prairie, Lethbridge, and Medicine Hat. The total agricultural land conversion from 2000 to 2012 for the white zone was 123,900 hectares (Appendix 1). This represents a loss of 0.82% of Alberta's agricultural land. However, in the Capital Region (Appendix 7) the proportional loss was much greater. In this region, 38,250 hectares of agricultural land was developed (Appendix 2), which represents a 4.3% loss in the region's agricultural land.

The Edmonton-Calgary corridor region is the center of development as it is both the center of economic activity and accordingly the center of Alberta's population. For many years the growing population (along with growing incomes) has resulted in a continually growing demand for suburban development on the urban fringe and for acreages in nearby rural areas. In the Edmonton area, which is surrounded by high quality agricultural land, this encroachment has removed a substantial amount of land. Quantifying conversion of agricultural land to non-agricultural uses is important, but the quality (agricultural potential) is an important aspect to consider when analyzing the

degree of conversion. The Land Suitability Rating System (LSRS) is one means to assess potential agricultural productivity. The LSRS assesses land in terms of the degree of potential limitations for use in spring-seeded grain and oilseed crops. Using the LSRS classification, the corridor region aligns with the highest quality agricultural land (i.e., fewest limitations) in the province (Figure 4). Table 1 shows the breakdown of agricultural land converted by LSRS class. The results show that 68.4% of land being converted is from the two highest land suitability rating groups, Classes 2 and 3. These two groups are interpreted as land that has slight and moderate, respectively, limitations for spring seeded crops (due either to temperature or moisture). This rating may not incorporate the potential for other agricultural uses, but it captures the potential for intensive annual crop production.

TABLE 1. Agricultural Land Conversion by Land Suitability Rating for the White zone of Alberta from 2000 to 2012

Land Suitability Class	Converted (ha)	Percent of Total Conversion	Total Provincial Area (ha)	Percent Conversion per Class
2	42,841	34.58%	3,897,805	1.10%
3	41,700	33.66%	6,224,750	0.70%
4	12,150	9.81%	2,818,550	0.40%
5	3,586	2.89%	992,954	0.40%
6	3,444	2.78%	694,014	0.50%
7	1,827	1.48%	296,715	0.60%
9	18,353	14.81%	71,452	25.70%
Total	123,902	100%	14,996,239	0.83%

In the Capital Region the proportions of land converted to developed uses from Classes 2 and 3 are slightly lower than at the provincial level (i.e., 61% of the total versus just over 68% for the province) (Table 2). This is due at least in part to the LSRS rating for agricultural land within city boundaries being given as Class 9.

1.2.5 PATTERNS FOR LAND USE FRAMEWORK REGIONS

In 2008, the Alberta government enacted the Land Use Framework (LUF) policy to coordinate increasingly competitive land uses within the province. To account for the province's great diversity in land uses, policy areas are divided into seven watershed based regional plans. Each of these regional plans is therefore unique to the land use issues based on the economic, geographic, and social conditions within each region.

Given the significance of this policy structure, an analysis of the largest agriculturally related land cover changes for the LUF regions is completed (Table 3). These results show that for almost all LUF regions, the main change in land cover from 2000 to 2012 is pastureland shifting to cropland. The exceptions are the Lower Athabasca region that had a significant portion of agricultural land shifted to shrubland and the Red Deer region that experienced a large movement of pastureland to grassland. A notable change is the expansion of cropland into forested lands within the Upper and Lower Peace regions, totaling nearly 55,000 hectares. In the South Saskatchewan region there is a large shift of 194,014 ha of grassland to cropland, which in addition to the large pasture to cropland change reveals a significant intensification trend.

TABLE 2. Agricultural Land Conversion by Land Suitability Rating for the Capital Region from 2000 to 2012

Land Suitability Class	Converted (ha)	Percent of Total Conversion	Total Capital Region Area (ha)	Percent Conversion per Class
2	19,282	50%	591,183	3.3%
3	4,230	11%	173,980	2.4%
4	1,398	4%	55,663	2.5%
5	255	1%	20,066	1.3%
6	442	1%	11,225	3.9%
7	156	0%	13,288	1.2%
9*	12,493	33%	30,445	41.0%
Total	38,257	100%	895,851	4.3%

*Note: LSRS Class 9 is land that is considered as urban or water. Urban classification is based on urban boundaries, which has resulted in agricultural land within the boundary of Edmonton being rated as Class 9 instead of being based on actual suitability for agriculture.

TABLE 3. Summary of Three Major Agricultural Land Cover Changes for each LUF Region (2000-2012)

LUF Region	3 Main Agricultural Land Cover Changes (Ha)*			Agricultural Land Conversion (Percentage)	Total Agricultural Land (Ha)
Lower Athabasca	Agricultural land to Shrubland **50,761**	Net Cropland to Pasture **23,491**	Pasture to Forest **7,285**	4,064 (1.4)	295,947
Lower Peace	Net Cropland to Pasture **80,882**	Pasture to Shrubland **30,607**	Forest to Cropland **14,415**	1,775 (0.3)	514,556
Upper Athabasca	Net Cropland to Pasture **201,351**	Pasture to Shrubland **77,886**	Forest to Cropland **29,181**	6,603 (0.6)	1,148,829
Upper Peace	Net Cropland to Pasture **148,725**	Forest to Cropland **39,825**	Pasture to Shrubland **34,036**	5,398 (0.4)	1,541,678
North Saskatchewan	Net Cropland to Pasture **473,788**	Pasture to Shrubland **175,952**	Grassland to Pasture **80,013**	63,617 (1.5)	4,338,642
South Saskatchewan	Net Cropland to Pasture **293,407**	Grassland to Cropland **194,014**	Pasture to Grassland **148,617**	24,810 (0.6)	3,943,982
Red Deer	Pasture to Grassland **169,528**	Net Cropland to Pasture **158,059**	Pasture to Shrubland **69,227**	17,621 (0.5)	3,211,983

* Agricultural land makes up a very small percentage of the land area in the Lower Athabasca and Lower Peace LUF regions (Appendix 8). Due to this, the main agricultural land cover changes may not represent the largest general land cover changes within each region.

The LUF region analysis also highlights the spatial distribution of agricultural land conversion. Within the North Saskatchewan region 1.5% of agricultural land cover shifted to development, which is only closely contested by the Lower Athabasca region (1.4%) in terms of proportion of change. In absolute area, however, the shift in the North Saskatchewan is by far the greatest among the LUF regions.

1.2.6 AGRICULTURAL LAND FRAGMENTATION

The extent of agricultural land fragmentation was examined with a variety of indices that capture size, shape, and spatial distribution effects (Table 4). Fragmentation was measured for the entire white zone of Alberta. As well, due to the concentration of development in the Capital Resion, fragmentation was also measured for a 30-kilometer area surrounding the city of Edmonton. It is important to note that while the measures between these two areas may be compared, the more meaningful analysis is in examining the temporal change within each individual area.

Metrics used for addressing size effects include mean patch size and effective mesh size. These measures differ in how small agricultural patches affect the value. For mean patch size, the addition of a small patch lowers the metric value. With effective mesh size, however, the addition of a small patch has little effect on the metric. This concept is reflected in the results for both the white zone and Edmonton area analysis (Table 5). As indicated in Table 5, mean patch size increased by 50% and 37% for the provincial white zone and the Edmonton area, respectively, while effective mesh size increased to a much greater degree; 177% and 58%, respectively. The large difference in these values shows the varying impacts that large patches have on increasing the patch size value. A much larger increase of the effective mesh size within the white zone shows that additions of large patches through the study period were much more prevalent for the province as a whole than specifically in the Edmonton area.

TABLE 4. Land Fragmentation Metrics Explanation

Metric	Formula	Explanation
Patch Density (+)	$\frac{n_k}{A}$	The total *n* patches of land use *k* divided by the total landscape area *A*
Mean Patch Size (-)	$\frac{\sum a_{ik}}{n_k}$	The sum of land use k's patch area divided by total *n* patches of land use *k*
Mean Perimeter-to-Area Ratio (+)	$\frac{\sum {}^{l_{ik}}/_{a_{ik}}}{n_k}$	The sum of the ratio between length (l) of the patches perimeter and area (*a*) of each respective patch in land use *k*
Effective Mesh Size (-)	$\frac{\sum a_i^2}{A_k}$	The sum of each patch's area (*a*) squared and divided by the total area (*A*) of land use *k*

Note: The ( ) contain the metric's relationship to fragmentation

TABLE 5. Agricultural Land Fragmentation Metric Results (2000, 2012)

	White zone of Alberta			Edmonton with 30 km buffer		
Metric	2000	2012	% Change	2000	2012	% Change
Patch Density	0.47	0.29	-37.01	0.89	0.56	-36.73
Mean Patch Size	125.86	188.59	49.84	81.90	112.24	37.05
Mean Perimeter-to-Area Ratio	748.07	560.44	-25.08	787.94	566.04	-28.16
Effective Mesh Size	115518.7	319856.8	176.89	12804.7	20209.6	57.83

Shape effects from fragmentation were measured using a simple mean perimeter-to-area ratio for each study area. Impacts from the shape of agricultural land are important for farm level efficiency and economies of scale. For the white zone the metric decreased 25%, while the Edmonton area metric decreased 28% from 2000 to 2012. This relatively similar degree of change for the province and Edmonton region reflects a province wide reduction in the level of agricultural polygon complexity. It may be that this result is a response to rising agglomeration of agricultural land as found by the effective mesh size metric.

The metric that captures spatial distribution of agricultural land is patch density. Spatial distribution has a large impact on the efficiency of agricultural production as well as the extent of conflict that farmers may encounter with residential and other competing land users. From 2000 to 2012 patch density decreased substantially for the entire white zone in Alberta as well as in the Edmonton region, due to a decrease in the total number of noncontiguous patches. This metric is limited in meaning, but it gives a measure of the number of patches within the total landscape.

All of these results from the various metrics reveal trends that are somewhat contrary to what is expected. While it would be expected that there is increasing fragmentation of agricultural land, the metrics all show that fragmentation both in the white zone of Alberta and the Edmonton region has decreased over the study period. A potential cause of this is the ongoing consolidation of farms, which maintains parcels of agricultural land in larger groups. This may cause the measure of the remaining patches to become larger, which would offset the effects of losing agricultural land to fragmentation. The mean perimeter to area ratio results show that even though there is development happening throughout the province, agricultural land patches are in fact becoming less complex and more uniform.

A possible error in this index however, may be present due to the resolution of the land cover data. The 30-by-30 meter pixel resolution may not be able to properly

incorporate the presence of well sites or low-density housing which is usually less than 200 m^2. These omitted development activities have significant impacts on the profitability of agricultural land and should be included in fragmentation analysis.

The results display the multiple impacts that fragmentation has on the agricultural landscape, and the need for approaching the issue with a suite of metrics to comprehensively measure the effects of increasing development. Although the findings are inconsistent with expectations, this result shows that fragmentation is more complex than was originally assumed. Multiple processes affect the viability and dynamics of agricultural land, which makes the future of agricultural land very difficult to forecast. To understand the process better however a higher resolution dataset would be very useful to properly consider the finer fragmenting of agricultural land that happens due to rural residential, infrastructure, and small-scale industrial activities.

2 REVIEW OF POLICY AND LAND USE PLANNING PROCESSES

2.1 INTRODUCTION

In Alberta, creating a landscape that supports a healthy environment, diverse communities and a thriving economy involves extensive planning and collaboration between multiple levels of government, stakeholders and the public. With land use decision making, planners must ensure that the requirements of a number of legislative acts are satisfied, while advancing the specific goals of their municipality. Furthermore, there are a multitude of policy documents that have evolved to provide direction for planners in balancing multiple values held by society as well as contributing to development in line with regional and provincial visions. Creating documents that meet these requirements and promote fair and functional land use is a challenging task involving complicated planning systems.

This section of the report serves to outline land use planning processes in the case study areas and provide an overview of relevant policies implemented both in Alberta and in other regions for comparison. Documents of particular relevance include the *Municipal Government Act* (MGA), *Alberta Land Stewardship Act* (ALSA), Alberta *Land Use Framework* (LUF) and Provincial *Land Use Policies*. These documents, in effect, shape the planning and development processes, which in turn determine the standing of agricultural land use and protection.

This review of policies and legislation reveals that land use planning integrates multiple levels of government and requires thoughtful consideration to effects on the public. However, given the recent patterns of conversion and fragmentation of agricultural land, it is clear there are shortcomings under the current planning system. An investigation of the policy gaps and successes of programs in place in other jurisdictions, reveals the potential for improvements in agricultural land preservation. The planning system is constantly evolving and will remain a key issue into the future with evolving perspectives on the environment and increasing demands on the land.

2.2 LAND USE PLANNING TOOLS IN ALBERTA

The framework for land use planning in Alberta is formed through contributions from the federal, provincial and municipal levels of government. Legislation, plans and policies that influence the process of determining land use include the *Alberta Land Stewardship Act* (ALSA), Land Use Frameworks (LUFs), the North Saskatchewan Regional Plan (NSRP), the Capital Region Board (CRB) Regulation under the *Municipal Government Act* (MGA), the Capital Region Growth Plan, Regional Evaluation Framework (REF), Municipal and Intermunicipal Development Plans (MDP, IDP), Area Structure and Redevelopment Plans (ASP, ARP), land use bylaws and subdivision and development approvals. Together, these have made significant contributions to the current state of Alberta's landscape.

2.2.1 DIVISION OF POWER BETWEEN FEDERAL, PROVINCIAL, REGIONAL AND MUNICIPAL LEVELS

In order to understand the interplay of specific plans and regulations involved in land use decision making, the hierarchy and responsibilities of various government bodies should be examined. The federal government is responsible for matters generally defined as in the national interest and as such does not hold direct responsibility for land use planning and development decisions. However, as noted by Manning (1983), the federal government does influence land use through a number of mechanisms These include:

- income and other support programs via the *Farm Credit Act, Prairie Farm Rehabilitation Act (PFRA) and Agricultural and Rural Development Act* (ARDA);
- guidelines for minimizing the conversion of agricultural land via the 1981 Federal Policy on Land Use;
- an Agri-Food Strategy to increase agricultural production;

- federal land management with the Treasury Board Advisory Committee, which reviews federal land disposals and acquisitions;
- fiscal policies;
- the construction of public infrastructure;
- environmental assessments;
- research;
- regulations on marketing boards, trade and freight rates.

These contributions indirectly influence the powers of provincial governments, upon which falls the authority to officially make decisions governing land use.

Responsibility for land use planning is further divided between provincial governments and municipal governments, as established by Alberta's MGA. The long standing Regional Planning Commission was replaced by the MGA in order to "increase jurisdictional autonomy and operating freedom of municipalities and to enhance good governance" (AUMA, 2009). Thus, as of 1994, municipalities were granted power to govern land use decisions with the province (AARD, 2002). In general, the Government of Alberta is responsible for governing land use on public lands in the white zone, as well as for most of the green (forested) zone, while municipalities hold jurisdiction over private lands in the white zone of the province (ERSM, 2008). The provincial government also manages and makes decisions governing air, water and renewable and non-renewable resources (Municipal Affairs, 1996). This implies that provincial agencies such as the Natural Resources Conservation Board (NRCB), Energy Resources Conservation Board (ERCB) and Alberta Energy and Utilities Board (AEUB) may distribute licenses, approvals, or permits for certain developments across the province and these decisions override municipal powers (Leduc County, n.d.). These decisions made by the provincial government are guided by the principles of integrated resource management with integrated resource plans and regional strategies and dispositions (ESRD, 2007).

Laux (1996) outlines the powers of municipalities with respect to land use planning. Laux explains that obligations for municipalities include the creation of MDPs, ASPs and land use bylaws (LUBs), along with the development of a Subdivision Authority, Development Authority, Subdivision and Development Appeals Board and municipal planning commission (Laux, 1996). Meanwhile, municipalities may, at their discretion, also formulate ARPs for existing neighborhoods and may engage in planning with neighboring municipalities through the formation of IDPs (Laux, 1996). Inter-municipal planning is encouraged particularly in areas where significant natural features extend across political borders, or in critical fringe areas (Municipal Affairs, 1996). Planning cooperation also extends to forming joint use agreements, integrated resource plans, collaboration with provincial land and resource management agencies and health authorities and coordination with First Nations reserves (Municipal Affairs, 1996).

While the provincial government does not directly review each decision made by municipal governments, the province exerts authority through the formation of policies to provide guidance and direction, to which municipally created directives are to conform. Moreover, the province may choose to monitor municipal operations and, if issues with compliance are observed, may make decisions overriding local authorities (Government of Alberta, 2014). The Provincial *Land Use Policies* is one example of a document that was created to serve as guidance for municipalities and align municipal decisions with provincial goals and initiatives (ESRD, 2007). Municipalities are therefore responsible for creating plans that conform to provincial directives.

2.2.2 PROVINCIAL AND MUNICIPAL COLLABORATION WITH *LAND USE POLICIES*

In 1996, the Provincial *Land Use Policies,* created by Alberta's Department of Municipal Affairs, received approval. Given the division of responsibilities between the provincial and municipal government, there was clearly a need for coordination, which

is why *Land Use Policies* was created. The document serves as a blueprint to align provincial and local initiatives by outlining goals and specific policies for planning processes and cooperation, land use patterns, the natural environment, resource conservation, non-renewable resources, water resources, historical resources, transportation and residential development. *Land Use Policies* builds on the responsibilities and initiatives outlined in the MGA, offering provincial direction for municipalities.

Municipalities are expected to incorporate *Land Use Policies* into their municipal statutory plans, land use bylaws and planning decisions (Municipal Affairs, 1996). The policies in this document are presented generally and as such may be interpreted differently by various municipalities for meaningful relevance to their specific circumstances. *Land Use Policies* outlines the need to inform interested and affected parties of planning opportunities and allow for participation by multiple stakeholder groups, all with due timeliness (Municipal Affairs, 1996). The document also states that with planning applications, municipalities should consider the public interest and take both immediate implications and long-term cumulative effects into account, while at the same time respecting the rights of citizens and landowners (Municipal Affairs, 1996).

Land Use Policies goes on to outline seven policies recommendations intended to promote efficient use of land, infrastructure, services and facilities (Municipal Affairs, 1996). These include calls for sustainable development patterns, mixed land uses, diversified economic development opportunities and coordinating planning with the provision of infrastructure (Municipal Affairs, 1996). Key policy recommendations relating to the natural environment are the call for provincial consultation on significant natural landscape areas, planning to minimize risk on vulnerable lands and minimizing the loss of valuable habitat areas (Municipal Affairs, 1996).

With respect to agricultural land use, Section 6 of the document states the need to identify areas where agricultural activities should be the primary land use, with the goal

of maintaining and diversifying Alberta's industrial industry (Municipal Affairs, 1996). The document explicitly calls for municipalities to limit the fragmentation of agricultural land and the permanent conversion to other uses and, where possible, to direct non-agricultural development to areas where it won't constrain agricultural activities (Municipal Affairs, 1996).

Land Use Policies was the first initiative of its kind to offer provincial direction for municipal planning. An updated and more comprehensive policy document was introduced in 2008, offering additional directives from the Provincial LUF.

2.2.3 PROVINCIAL ROLES, EXTENDED: *THE ALBERTA LAND STEWARDSHIP ACT* (ALSA) AND THE LAND USE FRAMEWORK (LUF)

Subsequent to passing the MGA and establishing *Land Use Policies*, the Government of Alberta provided additional support for land use planning through the establishment of ALSA in 2009 and the LUF in 2008. The LUF is a policy document that reinforces the message that land use planning must conform to the multi-faceted goals of the province and outlines strategies to improve planning and resource management in Alberta. As stated in the LUF, the future vision for the province is where "Albertans work together to respect and care for the land as the foundation of our economic, environmental and social well-being" (ESRD, 2008).

The LUF offers an approach to managing resource growth to help in meeting the province's long-term economic, environmental and social goals (ESRD, 2008). One of the key strategies designed to improve land use decision making is the call to define seven regions within the province and develop a regional plan for each of these regions (ESRD, 2008). The Edmonton-Calgary corridor includes parts of the North Saskatchewan, Red Deer and South Saskatchewan Regions. The remaining strategies from the LUF call for cumulative effects management, a strategy for conservation and

stewardship on private and public lands, a focus on efficient use of land to reduce the size of the human footprint on land, the establishment of an information, monitoring and knowledge system to improve land use decision making and finally, the inclusion of aboriginal peoples in planning decisions (ESRD, 2008).

Closely linked to the LUF is *Understanding Land Use in Alberta*, a policy document directed at the public, offering an overview of land use issues and trends. In this document it is explained that, in 2002, the MGA was amended to require that municipalities include the protection of agricultural operations in their MDPs and bylaws (ESRD, 2007). This stipulation supports individuals who are farming, but not necessarily maintaining and preserving the land in agriculture (ESRD, 2007).

Shortly after the creation of the LUF, ALSA was passed as legislative support for the aforementioned regional planning. In addition to establishing regions for planning and development, the act identifies objectives for the province, offers direction to coordinate the actions of decision makers in potentially conflicting fields, exerts leadership for planning and management that will support current and future generations, and lays the foundation for sustainable development that takes into account cumulative impacts on land (ESRD, 2009). ALSA addresses broader objectives than the LUF and develops a general vision for improved land use planning into Alberta's future. With ALSA, improvements are to be made through coordination between local agents and the provincial government and the integration of provincial policies at the regional level. This focus on regional planning is one of the most unique features of the LUF and ALSA.

2.2.4 THE ESTABLISHMENT REGIONAL PLANNING: THE CAPITAL REGION BOARD

Regional planning is being implemented across Alberta to improve coordination in land use planning and to create mechanisms to resolve issues that occur at a regional

scale. Within ALSA, the provincial Cabinet was granted the power and responsibility to create seven integrated planning regions, oversee the final approval of their regional land use plans, and lead implementation (ESRD, 2009). These regional plans, upon review by the Cabinet, must have the LUF and all provincial policies integrated within them in order to be approved.

The development of regional plans involves three stages. Phase 1 includes the creation of Regional Advisory Councils by the Cabinet, regional profiles from the provincial government, and opportunities for stakeholder input (ERDS, n.d.). This leads to Phase 2 in which the Regional Advisory Council advises on the plan, with further public and stakeholder feedback. The government then develops a draft of the regional plan (ESRD, n.d.). Phase 3 begins with another opportunity for feedback, before the government produces its final plan and the Cabinet offers final approval (ESRD, n.d.). The regional plans are to be designed with consideration of specific economic, environmental and social characteristics of the area. They must describe the region's vision and state one or more planning objectives, with the option of including specific policy approaches to achieve the stated objectives (ESRD, 2009). These plans are to be an expression of public policy of the government and will be considered in legal terms to be regulations (ESRD, 2009).

Beyond the creation of these seven regional plans through ALSA, there is a requirement for smaller scale regional plans to address issues that apply more specifically to areas within the region. For the proposed case study areas in the ALI project, this involves the establishment of the CRB, a board with representation from 24 municipalities defined as existing within Alberta's Capital Region. The regulation governing the CRB outlines provisions that shape the creation of a new regional board and states the need to adopt and implement a growth plan addressing regional land use planning, inter-municipal transit, geographic information services and affordable housing (CRB, 2009). Roles for the CRB include reviewing and approving MDPs as well

as their statutory plans, establishing methods for the ongoing administration of the Land Use Plan, creating criteria for application evaluation, creating monitoring indicators, formulating annual reports, preparing comprehensive reviews, and preparing a Regional Context Statement once the NSRP is created (CRB, 2009). In terms of voting protocol for municipal statutory plans and amendments, proposals are passed only in cases when they receive at least 17 out of 24 votes, comprising at least 75% of the population of the entire region (Municipal Affairs, 2012). Of relevance to this condition is that the City of Edmonton, given its large size relative to the other member municipalities of the region, is granted implicit veto power. This has led to some conflict regarding the perceived fairness of CRB powers. Appeals to CRB decisions are made to the Municipal Government Board. There have been numerous appeals, likely due at least in part to this veto power (Municipal Affairs, 2012).

With the establishment of the CRB came the creation of the region's growth plan, *Growing Forward*. This plan, created in 2009, satisfies the requirements outlined in the CRB regulation and serves as a strategy to "manage growth to minimize development footprints, strengthen communities throughout the region, increase transportation choices and ensure that economic development is strongly supported" (CRB, 2009). A key component to understanding land use planning processes in the case study areas is *Growing Forward*'s Land Use Plan. The Land Use Plan outlines 22 policies to be integrated into local land use planning, in support of regional prosperity. The principles are as follows: protect the environment and resources; minimize the regional footprint; strengthen communities; increase transportation choice; ensure efficient provision of services; and support regional economic development (CRB, 2009).

One policy relating to agricultural land use under these themes is the intent to revise maps of agricultural land within the region within MDPs of CRB municipalities, in order to identify lands needing to be preserved from future fragmentation and conversion (CRB, 2009). With these maps, concentration of new growth will be

encouraged outside of key agricultural lands, in new priority growth areas (CRB, 2009).

The CRB was also responsible for establishing a Land Use Committee, that oversees the implementation and coordination of the Land Use Plan within *Growing Forward*. Principles and policies of *Growing Forward* are evaluated against LUF goals in a checklist to ensure the plan propels development that is consistent with provincial directives; that is, towards a healthy economy, healthy environment and people-friendly communities (CRB, 2009).

With the Capital Region Growth Plan formed under the basis of assured compliance with provincial policies, municipalities must update all statutory plans and bylaws, while all future plans/bylaws that are created must be consistent with *Growing Forward*'s Land Use Plan. Moreover, once the North Saskatchewan Regional plan is created, the Capital Region Growth Plan will be amended as required to conform to any new specifications of the wider-reaching plan (CRB, 2009).

The CRB Regulation goes on to outline guidelines for the review and approval of statutory plans submitted by municipalities within the CRB via the REF, as established by the Minister of Municipal Affairs (Municipal Affairs, 2012). Under the REF, the CRB issues approvals for statutory plans defined by the MGA; that is, IDPs, MDPs, ASPs and ARPs (CRB, n.d.). Additional statutory plans may need approval through the REF in instances where they involve land designated for heavy industrial use, significant changes to residential density levels, where developments are proposed in close proximity to roads identified under the Regional Transportation infrastructure map, or plans outside of Priority Growth Areas or Cluster County Residential Areas (CRB, n.d.). Reviewers are concerned with ensuring that the goals, objectives and policies outlined in municipal statutory plans are consistent with the Land Use Plan (CRB, n.d.). The review process under REF involves proposals being first submitted for third party evaluation, before being passed on either to the CRB itself, or to a subcommittee of Capital Region Chief Administrative Officers (CAOs) (CRB, n.d.). Municipalities apply for

review after the Councilor's first reading and before the third reading and approval is based on consistency with Land Use Principles and Policies (CRB, n.d.).

2.2.5 PLANNING POWERS AND RESPONSIBILITIES HELD BY LOCAL MUNICIPALITIES

In the following section is provided a brief review of planning tools that are available to municipalities. All municipal plans must comply with land use policies under the MGA, regional plans under ALSA, growth management plans such as the Capital Region Growth Plan and any other provincial or federal legislation (Government of Alberta, 2014).

2.2.5.1 MUNICIPAL DEVELOPMENT PLANS AND INTERMUNICIPAL DEVELOPMENT PLANS

At the most generalized levels of municipal planning are MDPs and IDPs. MDPs are required both under the MGA and the LUF for municipalities with a population of 3,500 or greater (Municipal Affairs, 1997). For municipalities that have populations below this level, they are optional. MDPs are created to "establish land use, subdivision and development policies on a municipal-wide basis" (Municipal Affairs, 1997). They outline visions, goals, values and significant cultural aspects of a municipality, while addressing future land use plans, transportation systems, regional planning initiatives, municipal servicing and the protection of agricultural operations (Leduc County, n.d.). IDPs are similar in scope, but are optional and are designed with the intention of ensuring mutually beneficial growth for two neighboring municipalities. They are often created for lands associated with key political and environmental concern, such as urban and rural fringe areas, or areas containing outstanding natural features (Municipal Affairs, 1997). IDPs may address a number of issues of concern to the two municipalities, but, if it is decided that an IDP will be created, it must contain procedures for implementation, dispute

resolution and amendment (Leduc County, n.d.).

2.2.5.2 AREA STRUCTURE PLANS & AREA REDEVELOPMENT PLANS

ASPs are more specific than MDPs and IDPs, serving as the "framework for future subdivision and development of an area" (Leduc County, n.d.). They include provisions for land use, transportation and servicing for those areas with plans for substantial development changes (Leduc County, n.d.). Similarly, ARPs are created for changes to existing developed areas. Where an area at hand is exceedingly large, planners can go on to create more specialized Neighborhood Plans, or Local ASPs within an ASP, although these are not called for under the MGA (Leduc County, n.d.).

2.2.5.3 LAND USE BYLAWS

Land use bylaws (LUBs) are tools for "regulating the use and development of specific parcels of land" (Municipal Affairs, 1997). Essentially, LUBs are meant to divide areas within the municipality into zones with specified use, as well as outline which uses will require permits. All uses are required to be defined as discretionary or permitted, where discretionary uses are up to the Development Authority for the final say. Generally, LUBs will be associated with the requirement that a permit be sought for most developments, although some of these are exempted under MGA provisions while others will have conditions attached to their approval. The requirement for LUB adoption by all municipalities is outlined in the MGA. It is worth noting that, while it is a legislative requirement for municipalities to develop LUBs, they are not required to align these LUBs with statutory plans (Government of Alberta, 2014). While this creates flexibility for municipalities, it also serves as a source of uncertainty in supporting the goals of statutory plans (Government of Alberta, 2014).

2.2.5.4 SUBDIVISIONS AND DEVELOPMENTS

The final hurdles in development regulation are subdivision and development applications. The process of subdividing land involves legally dividing a parcel of land into two or more parcels and obtaining separate legal titles for each (City of Edmonton, 2012). Approval must be granted before any development can proceed. Subdivision applications must comply with statutory plans, zoning bylaws, subdivision design guidelines and must address any additional concerns unique to the particular plot of land.

Municipalities must create an authority and an appeal board for both subdivisions and developments, where reviews are based on fit with ALSA, the MGA, statutory plans and land use bylaws (Municipal Affairs, 1997). The need to comply with conditions outlined in broader policy and legal documents is a unifying theme in the formation and approval processes. Besides simple acceptance or rejection of requests for subdivisions or developments, the reviewer may attach provisions necessary to gain approval, such as the need to create environmental reserves, roads and public utilities, payment for the construction of roads, walkways, or off-street paving, or sanitary sewer and drainage facilities However, these provisions depend on the specific case in the application.

Subdivision applications include an application form, outline of the proposed plan, copy of the current land title, sketches of the plan and other supporting documentation as required based on characteristics and features of the land. These applications are passed on to the Subdivision Authority (Municipal Affairs, 2002). In determining the suitability of a land use plan, the Subdivision Authority must consider factors such as topography, accessibility to roads and land use in the vicinity of the area, in addition to the degree to which the plan conforms with ALSA, before deciding on whether or not an application will be approved (Municipal Affairs, 2002). If they are approved at this stage,

the applications are transferred to an Alberta Land Surveyor for registration at the Land Titles Office, before being sent back to the Subdivision Authority for endorsement and registration at the Land Titles Office (City of Edmonton, 2012). Additional reports or documentation may be required in cases where oil and gas, municipal schools or reserves, lands outside city limits, or parcels in close proximity to highways that are affected. In these cases, the subdivision authority will refer the applications to the relevant body governing those land uses (e.g., Alberta Transportation, owners of public utilities, school authorities, the Deputy Minister of Environment and Sustainable Resource Development) (Municipal Affairs, 2002).

Development applications are submitted for approval in terms of the use, size and location of developments on a site. These developments must conform to zoning bylaws and require that a permit be obtained before construction begins. The authority responsible for development applications takes into consideration distances of the parcel from wastewater treatment, landfills and waste sites and highways, and this authority is not to issue permits for schools, hospitals, food establishments, or residences within certain distances of these features (Municipal Affairs, 2002). Similar to subdivision approvals, development approvals may be conditional on additional fee payments to service the development area.

If an applicant is not satisfied with the decision made by the authorities regarding subdivision and development approval, they may file an appeal to the respective appeal board. Subdivision appeals may also progress to the Municipal Government Board in certain instances outlined in the MGA. In cases regarding questions of law or jurisdiction, appeals to decisions relating to subdivision and development can be made to the Court of Appeal (Municipal Affairs, 1997).

There are some exemptions on the power of municipalities to issue subdivision and development approvals and permits. Included in this list of exemptions are developments to be made by the provincial or federal governments, although these

bodies will often still go through the subdivision or development approvals (Municipal Affairs, 1997). Provincial licenses, permits, approvals and authorizations override equivalen permits and decisions made by municipalities (Municipal Affairs, 1997). Furthermore, provincial approval is needed with developments adjacent to highways, those identified in the Environmental Protection & Enhancement Act (EPEA) as needing an environmental impact assessment, as well as those needing Energy and Resource Conservation Board approval as identified in the Natural Resources Conservation Act (Municipal Affairs, 1997). It is the responsibility of the developer to investigate the need for and to obtain these approvals.

Other noteworthy planning cases occur when development plans do not fit bylaw specifications. In these cases, applications can also be made to amend bylaws and statutory plans, as necessary. If proposed amendments are consistent with ALSA, the process continues with public hearings and an opportunity for council to consider public representations (Municipal Affairs, 1997).

2.3 CONTRIBUTIONS FROM THE PUBLIC

Consultations with the public, including groups such as stakeholders and First Nations and Metis groups, are integral steps in formulating plans and policies for land use decision making in Alberta. The length of the consultation process and the number of opportunities for public participation varies with the scope of policies and plans proposed.

For provincial policies, there are numerous opportunities for contributions from public consultations, which are spread over an extended period of time. In the development of the LUF, for example, the policy dialogue began in 2005 but yet the final document was not released until 2008. This was due in part to provisions in the process for public consultation. The first stakeholder input sessions were held between August and October of 2006. At that time, information was collected including input and

questions from numerous groups. These included landowners, municipal leaders and planners, agricultural, forestry, transportation and energy associations, conservation and environmental groups, recreational groups, academics and First Nations and Metis groups (ESRD, 2008). A subsequent cross-sector forum was held in December 2006. In May 2007 the first province-wide public open house consultation sessions were held (ESRD, 2008). Following these input sessions and input from additional stakeholder working groups, First Nations and Metis organizations had a chance to respond to drafts. Stakeholder working-groups offered final assistance to drafts (ESRD, 2008). These sessions allowed for the voices of various groups to be heard during the development of the comprehensive provincial plan.

At a more localized level, municipalities are required to hold public hearings for all proposed statutory plans or land use bylaws (Government of Alberta, 2014). In the preparation of statutory plans, municipalities are required to notify school boards and neighboring municipalities of the proposed plan. They are also required to make note of the processes involved in plan development and offer a means for citizens to make suggestions within public engagement sessions (Government of Alberta, 2014). The City of Edmonton outlines the protocol for gaining approval for ASPs and the role the public plays in the approval process. While public discussion occurs throughout the ASP review, specific calls to the public are made following authorization by Council, where key groups such as ward councilors, community leagues and property owners within the ASP and adjacent properties are notified of the proposed plan (City of Edmonton, 2001). The ASP then undergoes review by the municipality's Planning and Development department, at which point input from landowners and the general public is considered and applied to ASP revisions (City of Edmonton, 2001). A public meeting is then held to allow the voicing of public concerns, and with the preparation of a revised ASP a notice appears in newspapers before a final public hearing and council action on the bylaw (City of Edmonton, 2011).

2.4 CURRENT PLANS IN CASE STUDY AREAS

Having established the purpose of each of the statutory plans, the following section continues with an overview of the plans in place in case study areas currently under consideration for Subproject 4 of the ALI project. Subproject 4 involves undertaking a study of public perception of the value of maintaining agricultural land in the Capital Region (i.e., willingness to pay to maintain agricultural land). The potential regions to be associated with Subproject 4 were selected based on the detailed nature of the analysis that will be conducted in the choice experiment. The three areas under consideration at the time that this report was drafted were the Horse Hill region in Northeast Edmonton; Leduc County south of Edmonton; and the area surrounding Alberta's Industrial Heartland in Sturgeon County. These areas were selected based on their high quality agricultural land, and for the unique challenges faced in land use planning in these areas. This in turn places them at risk of future agricultural land conversion and fragmentation.

2.4.1 THE CITY OF EDMONTON

One of the key concerns that has led to conflict between developers, city planners and the public in the City of Edmonton, is whether or not agricultural land within city limits should be preserved. This agricultural land is often of superior quality in terms of climate and soil and is unique in the region with its access to irrigation water, labor force and urban markets (KGEA, 2013). There are significant pressures to develop remaining agricultural land in the city, in part due to the increasing value of land. However, there are also opposing demands to maintain the land in its current agricultural productive state. The basis fpr some of this opposition can be found in the emerging local food movement and the desire to maintain the historic agricultural

character of the land.

There are several plans in effect in the City of Edmonton. While Edmonton is not currently involved in any IDPs, there is a joint planning study taking place between Edmonton and Strathcona County to coordinate future planning that is in the best interest of the two municipalities (City of Edmonton, 2011). To meet the MGA's requirement for an MDP, *The Way Ahead* was created in 2009 to serve as the City of Edmonton's 40 year plan. *The Way Ahead* includes six strategic plans and, of these, the main applications to land use planning processes are found in its MDP, *The Way We Grow.* The MDP includes directives to "prevent premature fragmentation of agricultural lands in the urban growth areas prior to urban expansion" as one of its strategic goals for food and urban agriculture, while also stating that ASPs in the Northeast region will recognize the value of agricultural characteristics of the land (City of Edmonton, 2010). An overarching theme is to have government and communities working together to build sustainable food and agriculture systems (City of Edmonton, 2010).

The Northeast area of focus contains agricultural land covered under the Horse Hills ASP. This ASP has received preliminary approval through a vote by Council and has continued on to the second stage of approval by the CRB. If approved, the next stage in planning will be to design a Neighborhood Structure Plan (KGEA, 2013). Included in the ASP is a plan to develop much of the existing agricultural land as housing for individuals working in Alberta's Industrial Heartland and the Edmonton Energy and Technology Park (KGEA, 2013). Clearly, this is not consistent with the strategies set forth in *The Way We Grow,* which call for sustainable food and agriculture systems, nor does it properly align with the LUF's priority actions of reducing fragmentation and conversion of agricultural land. This is evidence of the vagueness associated with the strategic goals and the need for accountability to create plans that uphold values expressed in more generalized plans and policy documents.

At the most specific level of planning, land use decisions made within the City of

Edmonton must also conform to the Zoning Bylaw (No.12800), Edmonton's LUB, which contains agriculture and reserve zones.

2.4.2 STURGEON COUNTY

Sturgeon County, more rural in nature and outside the capital city's core, also faces development pressures that contribute to agricultural land conversion and fragmentation. The county is in the process of drafting a new MDP (Bylaw No.1281/13) and the current MDP in effect is Bylaw No.818/96. In the MDP's Integrated Regional Growth Strategy, Sturgeon County emphasizes its goal of being a leader in both the industrial and agricultural industries (Sturgeon County, 2013). The MDP also states plans to create an Agriculture Viability Strategy through collaboration with the local agricultural community (Sturgeon County, 2013).

Similar to the situation in Edmonton, Sturgeon County's ASPs have proven to contradict the goals and directions set out in overarching strategic plans. The area of agricultural land being potentially considered in the current ALI study is covered by Alberta's Industrial Heartland Area Structure Plan (Bylaw No.118/07). This ASP includes plans for extensive conversion of agricultural land into heavy industrial uses, with minimal integration of agricultural and environmental protection areas. The plan explicitly calls for cooperation between agricultural and industrial users, which will be challenging as large areas of agricultural land are reduced to a 1.6 km wide perimeter of agricultural policy area (Sturgeon County, 2007).

Sturgeon County's LUB is Bylaw No. 819/96. It outlines zoning provisions for six categories of agricultural land. The maps further emphasize how limited the allocation of agricultural land is compared to industrial land.

2.4.3 LEDUC COUNTY

Leduc County was included as a potential case study region because of the presence of high quality agricultural land that is at risk of annexation and development by the City of Edmonton. The annexation plan, although not yet fully approved, includes provisions to convert agricultural land to residential and business purposes to support Edmonton's growing population. This process is already forming the basis for extensive political debate, not only because of the potential loss of agricultural land base, but also because the planned annexation area includes the Edmonton International Airport, which is an integral establishment of the region and source of substantial tax revenue. Planning for annexation decisions is a provincially regulated process and will involve extensive consultation (Municipal Affairs, 2000).

Planning in Leduc County is covered by the Leduc County Municipal Development Plan (Bylaw No. 35-99), along with an IDP with the City of Leduc, in the City of Leduc/ Leduc County Intermunicipal Development Plan 2010-2044 (City of Leduc Bylaw 772-2011, Leduc County Bylaw 30-11). There are multiple ASPs within the proposed annexation area, which spans 15,600 hectares between the Northwest and Northeast Leduc annexation areas (Ramsay, 2013). To get a sense of the plans in place in the Northwest region, the discussion focuses on the Crossroads ASP, which deals with 581.5 hectares of land located directly north of the Edmonton International Airport (Leduc County, 2012). The Crossroads ASP, adopted with Bylaw No. 39-11, outlines development plans for lands which currently support substantial agricultural operations (i.e., 94% of the area is cultivated fields and pasture lands) (Leduc County, 2012). Due to the region's proximity to the airport, there are numerous restrictions and guidelines associated with development. However, the visions set forth in the ASP depict a highly industrialized future. Despite the current prevalence of farmland, agricultural land preservation does not appear in the vision, purpose, or objectives listed in the ASP. In fact, the land use goal is to capitalize on the location and proximity

to urban centres, by "provid[ing] opportunities for major commercial and employment-driven land uses" (Leduc County, 2012). Upon review of the development concept plan map, the future of the region is set to include primarily developments for logistics and distribution; and business parks and commercial areas, with a limited area of land set aside for parks and municipal reserves (Leduc County, 2012).

In its MDP and LUB, Leduc County's land use policies identify agriculture as a primary activity. There are two defined agricultural districts, for which there are provisions to "conserve extensive areas for agriculture" and "minimize [the] amount [of better lands] removed from agriculture" (AARD, 2002). The County's LUB (Bylaw 7-08) also includes a land use district map that shows extensive zoning for agricultural purposes. Despite these inclusions in the MDP and LUB, there does not appear to be a clear focus on agricultural land preservation in plans in practice, as revealed by the Crossroads ASP.

2.5 POLICIES AND LEGISLATION RELATED TO FARMLAND PRESERVATION

2.5.1 ALBERTA POLICIES

In addition to documents such as the Provincial *Land Use Policies*, which outline goals for directing development away from prime agricultural land, there exist more explicit measures in place in Alberta that support farmland protection. The key mechanisms are Right-To-Farm legislation, preferential tax assessment, agricultural zoning, transfer of development rights and provision for the creation and purchase of conservation easements.

Alberta's Right-To-Farm legislation is the Agriculture Operations Practice Act (AOPA), which protects farmers from nuisance lawsuits. It was enacted in 1987,with subsequent amendments being made in 2000. AOPA includes provisions which state

that agricultural managers can carry out farming activities, as defined in the act, regardless of land use bylaw changes (AARD, 2002).

Preferential tax assessments are intended to assist farm businesses in remaining financially viable. This, in turn, contributes to farmland preservation by reducing the need to sell land because of a lack of profitability. In Alberta, landowners conducting farming operations are taxed based on the productive value of their land as opposed to the market value (AARD, 2002). As for non-market contributions, agricultural zoning provisions are common in bylaws fir Albertan municipalities, wherein physical boundaries for farming operations are created. LUBs set out standards and density restrictions for development on lands zoned for agriculture.

Creation of conservation easements (CEs) on agricultural land is allowed on a legal basis based on provisions of the EPEA. CEs are designed to "protect natural attributes of land" by designating lands as for conservation purposes, where development cannot take place (Unger, 2006). CEs are generally donated or sold to a local municipality or a qualified organization, and they last in perpetuity (Unger, 2006). In Alberta, there are ten organizations eligible to hold conservation easements, including Ducks Unlimited Canada, the Nature Conservancy of Canada and the Edmonton and Area Land Trust (EALT) (Miistakis Institute, 2013). While a list of restricted uses may be negotiated in a CE agreement, it should be noted agricultural land designated as a CE is still subject to the rights of the provincial government for mineral development (Unger, 2006).

One additional tool for the preservation of agricultural land use is the transfer of development rights (TDR). This is similar to the purchase of CEs, but takes place between a private landowner and a developer. This process shifts developments to targeted areas and creates easements on farmland (EALT, n.d.). To illustrate the extent of protection offered by CEs and TDRs, it may be noted that the EALT currently own five properties in the Edmonton area, resulting in the protection of 1574 acres of land (EALT, n.d.).

2.5.2 POLICIES IN PLACE IN OTHER JURISDICTIONS

This section provides a brief summary of policies, programs and regulations promoting agricultural land preservation in other jurisdictions. Examples from British Columbia, Ontario, Colorado and Oregon are discussed. Within Canada, the Agricultural Land Reserve (ALR) in British Columbia and the Greenbelt Plan in Ontario are highlighted. In the United States, Colorado is selected for its similarities to Alberta and Oregon is included as an example of a highly successful agricultural land preservation state.

2.5.2.1 BRITISH COLUMBIA

In British Columbia, like Alberta, land use planning is the responsibility of local municipalities. However, British Columbia has a unique governance structure allowing provincial input to override local government decisions. The Provincial Land Commission (the Commission), with powers assigned through the 1973 Provincial Land Commissions Act, is the provincial body that oversees land use decisions (AARD, 2002). With the establishment of the Commission, the Agricultural Land Reserve (ALR) was created, serving as "province-wide, mandatory, exclusive, agricultural zoning" (AARD, 2002). The ALR encompasses over 4.7 million hectares, representing all land in British Columbia with agricultural production potential, with some exceptions and changes allowed (Provincial Agricultural Land Commission or Provincial ALC, n.d.). On these reserve lands, "farming is encouraged and non-agricultural uses are controlled" (Provincial ALC, n.d.).

The scale of the land commitment associated with the ALR has been regarded as highly innovative across North American jurisdictions and has been met with considerable public support since its implementation. However, the reserves are not without their controversy. There is ongoing debate as to the effectiveness of the ALR in

maintaining land in its productive state, while at the same time some farmers claim the reserves infringe on their rights to develop their land, or sell their land to developers, as these restrictions come without compensation (AARD, 2002). Concerns over boundaries, land classifications and the Commission's mandate have brought the ALR and the Commission under review, with the potential for legislative changes to the Commission's mandate being such that economic development might be added to their list of objectives.

In a policy-based commitment more akin to Alberta planning processes, British Columbia joined the American Smart Growth Network in 1999. This is a network promoting the integration of ten principles into planning decisions; specifically, mixed land use, compact neighborhoods, varied transportation choice, diverse housing opportunities, pursuing growth in existing communities, preserving open spaces, protecting agricultural lands, improving infrastructure and green buildings and fostering unique neighborhood identities and nurturing engaged citizens (Smart Growth BC, n.d.). Overall, the program is designed to "encourage land use decisions that reflect smart growth principles: more efficient use of land, sustainable transportation, affordable housing and environmental protection" (AARD, 2002). These strategies are to be reflected in community plans, bylaws and regional plans.

British Columbia's right to farm legislation, which supports the ALR, is the Farm Practices Protection Act of 1995 (Provincial ALC, n.d.). Similar to AOPA, the Act protects farmer against "nuisance lawsuits and nuisance bylaws of local governments (Provincial ALC, n.d.). Furthermore, like Alberta, British Columbia offers tax breaks to farmers, operating through Preferential Farm Property Assessment (since 1930) and the 1974 Assessment Act for sales and fuel tax reductions, along with partial exemptions from school taxes (AARD, 2002).

2.5.2.2 ONTARIO

Ontario has adopted a distinctive planning approach to protecting agricultural land, with the introduction of its Greenbelt Plan. This program targets prime agricultural land near urban centres with the objective of protecting that land from development due to urban sprawl. The Greenbelt Plan, introduced through the 2005 Greenbelt Act, outlines where urbanization will be directed in order to allow for the permanent protection of the province's agricultural land base (OMAFRA, 2013). Since the Greenbelt Plan was implemented there have been issues with the flexibility of land use and ensuring economic viability of the region, and concerns over leapfrog effects in which development continues beyond the boundaries of the greenbelt. However, this plan has been successful in providing certainty for the preservation of open spaces. Ontario's Greenbelt Plan may represent a model for political and legislative commitment to reduce fragmentation and conversion.

In general, the 1990 *Planning Act* serves as the legislative basis for municipal planning in Ontario. Similar to Alberta, municipalities hold the power and responsibility for land use decision making, although plans are to be consistent with provincial directives. Provincial policy directives are governed by the 2005 Provincial Policy Statement (PPS) (The Environmental Commissioner of Ontario or ECO, 2011). The PPS was created by the Ontario Minister of Municipal Affairs and outlines the province's vision for land use patterns and development (ECO, 2011). The PPS also offers guidelines on other issues such as the management of certain natural resources and natural hazards (ECO, 2011). One key policy within the PPS is the prohibition of non-farm developments in key areas (AARD, 2002). Local land use decisions must be consistent with provisions set out in both the PPS and the Greenbelt Plan.

The Ontario government offers an additional Guide to Agricultural Use and draws on legislation from the 2002 Nutrient Management Act and the 1998 Farming and Food Production Protection Act (OMAFRA, 2013). Like the regional plans established within

Alberta, Ontario also has regional plans such as the 2006 Growth Plan for the Greater Golden Horseshoe (the agricultural land protected by the Greenbelt), which outlines a 25 year strategy to revitalize downtowns, create complete communities, curb sprawl, provide housing options and reduce traffic gridlock (OMAFRA, 2013). Other key protection mechanisms in Ontario include land use policy and legislation, tax incentives, right to farm laws and land tenure programs (AARD, 2002).

2.5.2.3 UNITED STATES JURISDICTIONS

Based on a review of the literature on relevant policy, Bengston *et al.* (2004) outline three policy vehicles that have been used to manage growth and preserve open space in the United States: public ownership and management, regulation and incentives. Regulations for controlling urban growth include development moratoria, interim development regulations, controlled rates of growth, minimum density zoning, greenbelts, urban growth boundaries, and urban service boundaries (Bengston *et al.,* 2004). Meanwhile, open space regulations include cluster zoning, downzoning, exclusive agricultural zoning, nontransitional zoning, mitigation ordinances and banking and concentrating rural development (Bengston *et al.,* 2004). Incentives may be negative or positive and include development impact fees, taxes, infill and redevelopment incentives, split-rate property taxes, Brownfields redevelopment, location efficient mortgages, historic rehabilitation credits, Right-To-Farm laws, agricultural districts, TDR, purchase of development rights, conservation easements, use-value tax assessment, circuit breaker tax relief credits, or capital gains tax on land sales (Bengston *et al.,* 2004).

2.5.2.3.1 COLORADO

Colorado is said to be similar to Alberta in terms of "topography, land in agricultural production, amount of irrigation, [and] cattle on feed" (AARD, 2002). Like Alberta, this state faces challenges with the loss of open space and the fragmentation and conversion of agricultural land, due in part to urban growth (AARD, 2002). The primary tools utilized in Colorado to reduce and combat this trend are grant assistance and tax breaks.

Colorado has many cited examples of state-funded conservation easements (CEs) made possible through the Great Outdoors Colorado (GOCO) Trust Fund. GOCO is unique in that grant money (for local governments and land trusts) is made available from the state lottery program, where up to 50% of lottery funds are distributed for CEs (GOCO, n.d.). Approximately one quarter of GOCO's funds are allocated towards the preservation of open spaces, which is achieved through collaboration with land trusts such as the Colorado Cattlemen's Agricultural Land Trust (GOCO, n.d.). GOCO's initiatives to protect open spaces and agricultural land have been successful, at least in part due to widespread public support stemming from the desire to sustain the state's tourism industry.

According to the US Land Trust Alliance, a national private conservation organization, tax credit programs such as that offered in Colorado are the "most powerful state incentives for conservation" (Land Trust Alliance, 2014). As an incentive to donate land for preservation, 50% of the market value of land is returned via tax credits to "residents, corporations, estates and trusts who donate a conservation easement" in the state, to a maximum value of $375,000 (Land Trust Alliance, 2014). Furthermore, like all states in the United States, Colorado offers preferential tax assessments on agricultural land, based on use-value (Kashian, 2004). The above stated programs combine to form a solid state-wide open space preservation scheme.

2.5.2.3.2 OREGON

Tulloch *et al.* (2003) conduct a review of the literature on farmland preservation in the United States and reach the conclusion that Oregon stands as the most effective example of farmland protection. Tulloch *et al.* (2003), argue that this is the result of a "long-term comprehensive land use planning system with state-level regulatory control," The primary tool contributing to the success of Oregon's farmland preservation is in its Farmland Protection Program (FPP), with additional contributions from preferential farmland tax assessment.

Oregon's FPP is a state-wide program created and sustained over three decades with the goal of maximizing the protection of farmland, which is recognized by the state as being limited in supply (Department of Land Conservation and Development, n.d.). In a hierarchy similar to the LUF in Alberta, standards are set at the state level, through Oregon's Land Conservation and Development Commission (LCDC). These standards are then applied by cities and counties in plans and ordinances (Department of Land Conservation and Development, n.d.). The FPP operates through four clearly defined steps; creating an inventory of farmland, designating farmland in comprehensive plans, adopting preservation policies, and zoning land under Exclusive Farm Use (EFU) (Department of Land Conservation and Development, n.d.).

EFU zoning is associated with a series of restrictions and benefits. On farmland designated for EFU, developments and subdivisions are limited in order to sustain commercial agriculture (Department of Land Conservation and Development, n.d.). Meanwhile, these lands are assessed with lower property taxes as a compensation measure (Department of Land Conservation and Development, n.d.). All counties have applied EFU zoning, for a combined total of 16.1 million acres of farmland in EFU zones (Department of Land Conservation and Development, n.d.).

As further support for the perception that farmland preservation is a primary goal for planners in Oregon, it has been observed that four of nineteen statewide

planning goals directly relate to farmland preservation (AARD, 2002). These planning goals relate to land use planning; agricultural lands, natural resources, scenic and historic areas and open spaces, and urbanization. Goal 14, which deals with urbanization, has proven to be particularly effective through the creation of Urban Growth Boundaries (UGBs). UGBs have been established in all cities and counties "to provide for an orderly and efficient transition from rural to urban land use, to accommodate urban population and urban employment inside urban growth boundaries, to ensure efficient use of land and to provide for livable communities" (Oregon, 2006). Essentially, UGBs limit infrastructure improvements to areas within their boundaries (AARD, 2002).

In terms of supporting mechanisms for farmland preservation, Oregon's tax practices are in line with the nationwide standard. Lands zoned in EFUs and some qualifying non-EFU agricultural lands are subject to preferential tax assessment, where property taxes are assessed at their farm-use value (Department of Agriculture, n.d.). TDRs, despite having been implemented in many states, are still in the pilot phase of development in Oregon. With the passing of Senate Bill 763 in 2009, TDR programs can be enacted by the DLCD and local governments (Oregon, 2010). The goals of the projects currently in place are to establish the optimal conditions with which to implement the tool in the future.

The success of Oregon's agricultural land preservation program over that of Alberta might be explained by the tangible standards set by the LCDC with the FPP, as opposed to the general statements of vision by the Alberta Government. However, AARD (2002) makes notes of two limitations of Oregon's progressive initiatives; specifically, land fragmentation continues within the EFU zones, and some urban centres are running out of land to develop within UGBs. With knowledge of these limitations and an understanding of the FPP, planners in Alberta are equipped with the background

information necessary to create future plans which contribute to reduced agricultural land fragmentation and socially optimal rates of agricultural land conversion.

2.6 CURRENT POLICY GAPS AND ISSUES

Despite the creation and advancement of policies and legislation to address multiple concerns with land use, there remain shortcomings in the land use planning process. As evident from the trends in agricultural land fragmentation and conversion, there remain significant issues with the initiatives in place to preserve agricultural land in Alberta. As noted in the above review of land use plans in the case study areas, one of the major issues with planning is the disconnect between goals and directives set out in policy and the decisions made in practice. The resulting perception is that short-term pressures and gains appear to override working towards long-term objectives.

There are several potential causes for this apparent inconsistency between policy and action. These include a lack of checks in place, ambiguity in implementation, non-commitment to goals set by higher levels of government and conflicts between property rights and government control over land use. Although the Government of Alberta provides direction with policies for governing land use, they do not review the plans created by municipalities to ensure compliance with provincial goals. "Performance" with respect to maintaining agricultural land might be improved if the provincial government were to follow-up on municipal plans.

Implementation might also be made more consistent if the provincial government were to outline specific steps to be adopted by municipalities for agricultural land preservation, thus increasing accountability. The fact that planners and decision makers of municipalities do not appear to be taking the initiative to act in support of agricultural land preservation reveals a lack of commitment to the visions set forth in the overarching plans. Planners must be on board with the fundamental

goals of land preservation in order to engage in proper implementation. Finally, given the review of policies/programs in place in other regions, which in several cases are more strict than those currently in place in Alberta, it may be observed that there are conflicts between maintaining property rights and setting land use restrictions. Personal freedom to decide how one's property will be used must be balanced with society's goals and resulting government authority to dictate land use, and adequate compensation must be offered.

Given the inconsistency between policy and practice, it might be necessary to grant MDPs more legal standing. While the MGA legally requires municipalities to create MDPs, councils are not bound to deliver on their contents, nor are they required carry out the initiatives that are identified by the MDPs.

The LUF contributes to the process of evaluating shortcomings in land use planning within the province. In particular, six policy gaps are identified for which the Government of Alberta acknowledge a commitment to address. These include the need for coordination between the management of subsurface and surface activities to reduce conflict, the need for a transportation and utility corridor strategy to consolidate multiple activities and reduce fragmentation, the need to better manage the recreational use of public lands for increased variety and safety of activities, and directives to conserve and protect the diversity of Alberta's ecological regions and to manage flood risk (ESRD, 2008). Of these, the most relevant to the current agricultural land conversion and fragmentation study is undoubtedly the need to reduce fragmentation and conversion of agricultural lands through government implementation of market based incentives, transfers of development credits, agriculture and conservation easements and smart growth planning tools (ESRD, 2008).

Growing Forward offers additional recommendations for the Government of Alberta to address policy gaps perceived by the CRB. Some of these relate to implementation of the growth plan directly, while others relate to land use planning in a

more generalized way. One recommendation that remains unresolved is the suggestion that the provincial government collaborate with the CRB to identify and protect land for future transportation corridors in the region (CRB, 2009). *Growing Forward* also calls for more regional partnerships. Examples include partnerships between the CRB and Alberta's Industrial Heartland Association, Capital Region infrastructure organizations and the CRB, CRB and the Water Management Framework, and between the CRB and ESRD and conservation organizations (CRB, 2009). The document suggests that these regional partnerships would assist in implementation of the growth plan.

Growing Forward goes on to outline the shortcomings that constrain the ability to meet guidelines of CRB regulation. These include a lack of identification of a) priority growth areas, b) land supply for residential, commercial and industrial purposes, c) agricultural lands, d) buffer areas, e) density development, e) infrastructure and corridors (CRB, 2009). These considerations will be incorporated into an updated version of the Land Use Plan, set for 2015.

Academics have also contributed to the evaluation of policy gaps as they relate to land use planning. Bengston *et al.* (2004) conduct a review of the literature on public policies and implementation in the United States that are relevant for management of urban growth and protection of urban space. They describe five key shortcomings. The first is a lack of empirical evaluation of growth management policies, to objectively measure the impacts of programs and policies. The authors explain that empirical evaluation is often overlooked because of challenges with the absence of baseline data, long-term effects of programs, scale and lack of clearly testable goals established with programs (Bengston *et al.,* 2004). Bengston *et al.* (2004) go on to explain that administrative efficiency (and other details of policy implementation), more so than type of policy, are of greatest importance in determining policy effectiveness. Effectiveness is also increased with the use of a combination of multiple policy instruments (Bengston *et al.,* 2004). Bengston *et al.* (2004) also identify a need for vertical and horizontal

coordination, as well as improved stakeholder participation for successful growth management. Finally, to help increase the effectiveness of growth management and open space protection policies, the authors suggest that the federal government should play a more prominent role in planning (Bengston *et al.,* 2004). These recommendations could all be applied in a Canadian context.

Given the identified shortcomings in policy governing land use planning in Alberta, it is clear there are improvements that can be made in the land use planning process. Upon review of the literature on farmland policy and protection, AARFD (2002) concludes that policies should be broader and more comprehensive than Right-To-Farm legislation and preferential tax assessments. They suggest planners place a greater emphasis on zoning, agricultural districts, cluster zoning, the purchase of conservation easements, tradable development rights, urban growth boundaries and more comprehensive planning (AARD, 2002). Enacting these changes and drawing on influences from other jurisdictions that have been successful in preserving agricultural land, could lead to a powerful land use scheme in Alberta with limited fragmentation and conversion of agricultural land.

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APPENDIX 1. Land Cover Changes Matrix for the White zone (Private Land) of Alberta: 2000 to 2012

Land Cover 2000	Land Cover 2012																	
	Cropland[a]		Developed		Exposed		Forest		Grassland		Pasture		Shrubland		Water		Wetland		Total	
	Hectare	%[b]	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%
Cropland	7,434,881	29.11	66,775	0.26	59,884	0.23	52,280	0.2	122,934	0.48	1,015,484	3.98	154,711	0.61	38,766	0.15	41,818	0.16	8,987,533	35.19
Developed	28,169	0.11	247,765	0.97	1,477	0.01	3,691	0.01	5,026	0.02	9,956	0.04	3,857	0.02	863	0	2,220	0.01	303,026	1.19
Exposed	3,712	0.01	1,428	0.01	141,897	0.56	1,474	0.01	2,895	0.01	1,575	0.01	2,396	0.01	1,180	0	1,587	0.01	158,145	0.62
Forest	185,440	0.73	12,468	0.05	2,994	0.01	3,299,353	12.92	7,545	0.03	100,193	0.39	77,938	0.31	6,800	0.03	41,641	0.16	3,734,371	14.62
Grassland	323,945	1.27	14,090	0.06	54,172	0.21	28,223	0.11	3,339,864	13.08	199,635	0.78	49,020	0.19	7,502	0.03	33,232	0.13	4,049,683	15.86
Pasture	2,394,787	9.38	57,127	0.22	29,531	0.12	185,693	0.73	341,431	1.34	2,412,262	9.45	468,259	1.83	51,035	0.2	73,588	0.29	6,013,712	23.55
Shrubland	13,368	0.05	2,204	0.01	2,095	0.01	33,234	0.13	7,437	0.03	9,883	0.04	800,661	3.14	1,180	0	8,264	0.03	878,325	3.44
Water	3,325	0.01	881	0	11,260	0.04	8,125	0.03	2,735	0.01	1,880	0.01	5,139	0.02	453,444	1.78	110,325	0.43	597,114	2.34
Wetland	9,792	0.04	1,722	0.01	1,775	0.01	28,942	0.11	8,368	0.03	7,781	0.03	9,761	0.04	39,806	0.16	706,540	2.77	814,486	3.19
Total	10,397,418	40.72	404,461	1.58	305,084	1.19	3,641,015	14.26	3,838,234	15.03	3,758,649	14.72	1,571,743	6.15	600,577	2.35	1,019,215	3.99	25,536,396	100

[a] Agricultural land includes both Cropland and Pasture land cover categories
[b] The percentage of total land cover

APPENDIX 2. Summary Land Cover Change Table for the White zone of Alberta (2000-2012)

	Cropland	Developed	Exposed	Forest	Grassland	Pasture	Shrubland	Water	Wetland	Total	Agricultural Land[a]
Land Cover 2000 (Hectare)	8,987,533	303,026	158,145	3,734,371	4,049,683	6,013,712	878,325	597,114	814,486	25,536,396	15,001,246
2000 (%)	35.19	1.19	0.62	14.62	15.86	23.55	3.44	2.34	3.19	100.00	58.74
Land Cover 2012 (Hectare)	10,397,418	404,461	305,084	3,641,015	3,838,234	3,758,649	1,571,743	600,577	1,019,215	25,536,396	14,156,067
2012 (%)	40.72	1.58	1.19	14.26	15.03	14.72	6.15	2.35	3.99	100.00	55.43
Net Change	1,409,884	101,436	146,939	-93,356	-211,449	-2255063	693,417	3,463	204,729	0	-845,179
Change as % of Total Land	5.52	0.40	0.58	-0.37	-0.83	-8.83	2.72	0.01	0.80	0.00	-3.31
Change as % of Own Class	15.69	33.47	92.91	-2.50	-5.22	-37.50	78.95	0.58	25.14	0.00	-5.63

[a] Agricultural Land Is the combination of Cropland and Pasture Land

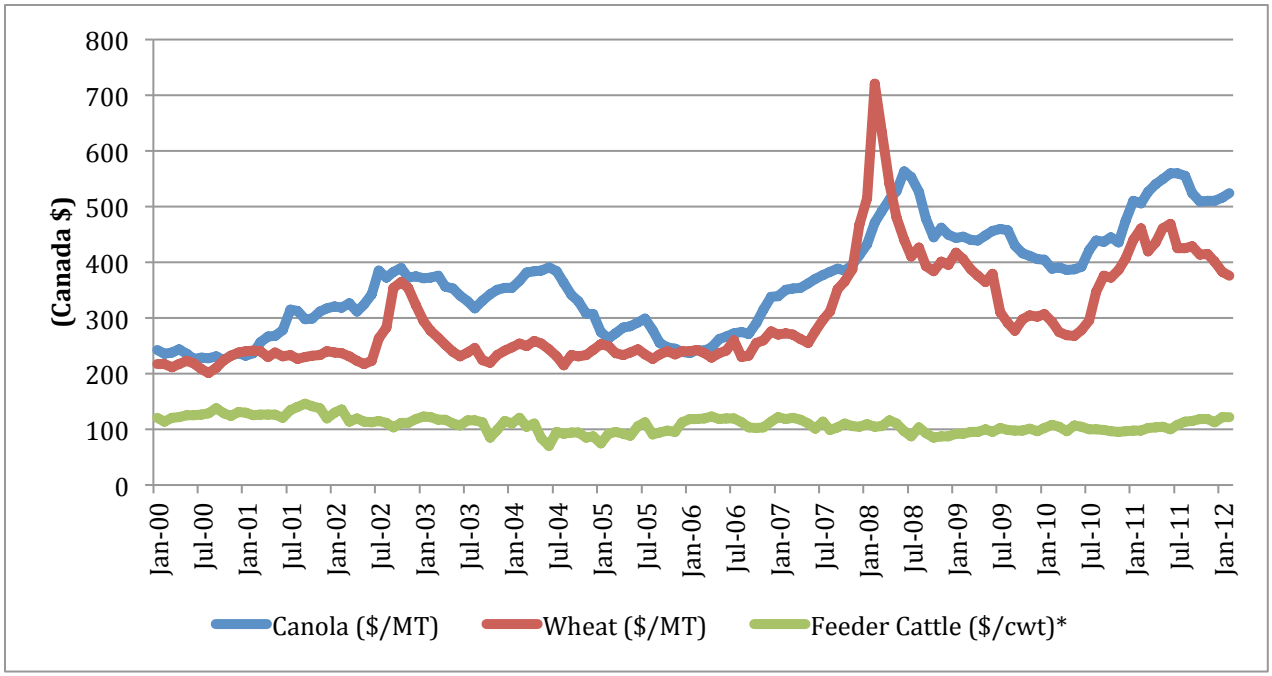
APPENDIX 3. Land Cover Change Matrix for the Capital Region of Alberta: 2000-2012

Land Cover 2000	Land Cover 2012																			
	Cropland[a]		Developed		Exposed		Forest		Grassland		Pasture		Shrubland		Water		Wetland		Total	
	Hectare	%[b]	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%	Hectare	%
Cropland	355,777	28.35	20,470	1.63	1,596	0.13	4290	0.34	67	0.01	39,833	3.17	7,609	0.61	5,993	0.48	2,195	0.17	437,829	34.88
Developed	3,381	0.27	70,583	5.62	121	0.01	979	0.08	11	0	704	0.06	474	0.04	341	0.03	268	0.02	76,863	6.12
Exposed	258	0.02	199	0.02	5,197	0.41	32	0	0	0	97	0.01	47	0	84	0.01	51	0	5,964	0.48
Forest	18,276	1.46	3,653	0.29	131	0.01	153173	12.2	48	0	6,256	0.5	4,002	0.32	1,190	0.09	2,447	0.19	189,175	15.07
Grassland	1,541	0.12	145	0.01	11	0	528	0.04	1,681	0.13	1,217	0.1	294	0.02	75	0.01	193	0.02	5,684	0.45
Pasture	225,977	18	17,787	1.42	1,497	0.12	22391	1.78	546	0.04	143,863	11.46	29,144	2.32	12,468	0.99	4,340	0.35	458,012	36.49
Shrubland	439	0.04	131	0.01	17	0	597	0.05	13	0	185	0.01	12,389	0.99	67	0.01	114	0.01	13,953	1.11
Water	156	0.01	257	0.02	205	0.02	806	0.06	7	0	63	0.01	99	0.01	31,794	2.53	6,974	0.56	40,361	3.22
Wetland	548	0.04	263	0.02	55	0	1420	0.11	15	0	177	0.01	304	0.02	2,482	0.2	22,001	1.75	27,266	2.17
Total	606,353	48.31	113,488	9.04	8,830	0.7	184214	14.68	2,389	0.19	192,396	15.33	54,361	4.33	54,493	4.34	38,583	3.07	1,255,107	100

[a] Agricultural land includes both Cropland and Pasture land cover categories

[b] The percentage of total land cover

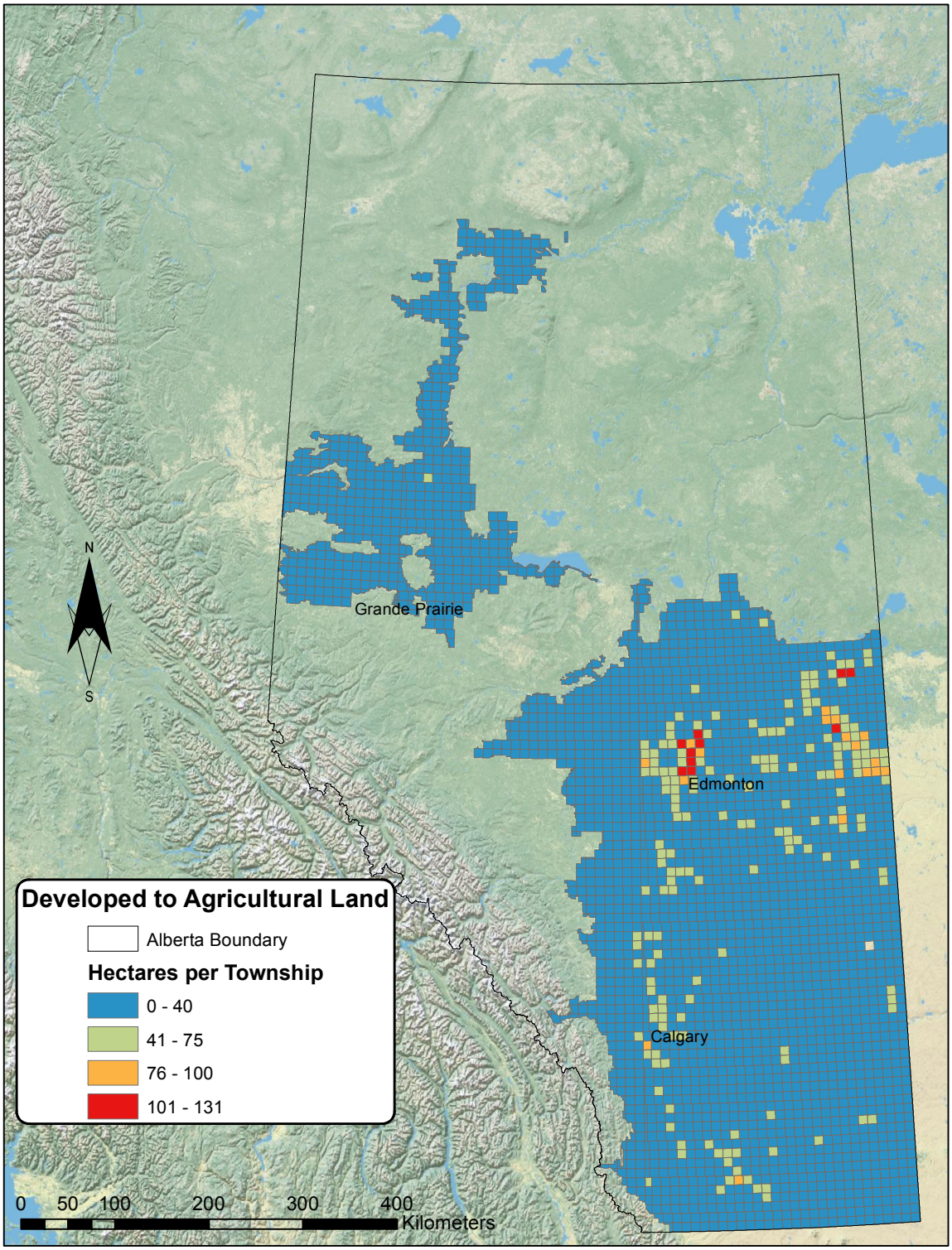
APPENDIX 4. Alberta Agricultural Commodity Monthly Price Series (Jan/2000- Feb/2012)



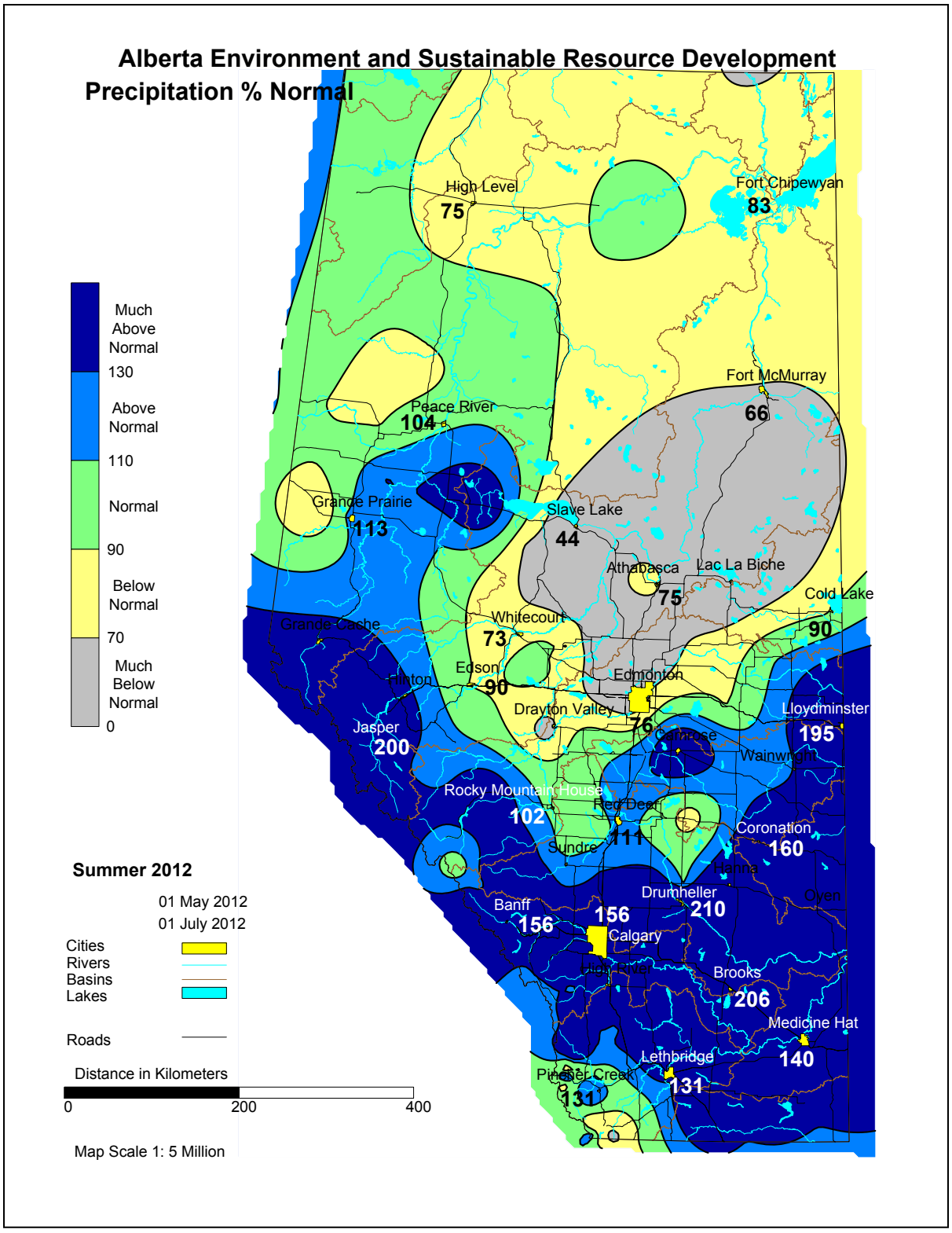
**Feeder cattle in the 800-900lb category*

Source: Statistics Canada. Table 002-0043 - Farm product prices, crops and livestock, monthly (dollars per metric ton unless otherwise noted); Global Financial Data: Wheat (Canada), no. 1, Western Red Spring (CWRS), in store, St. Lawrence, export price.

APPENDIX 5. Developed to Agricultural Land Cover Changes for the White zone of Alberta from 2000-2012

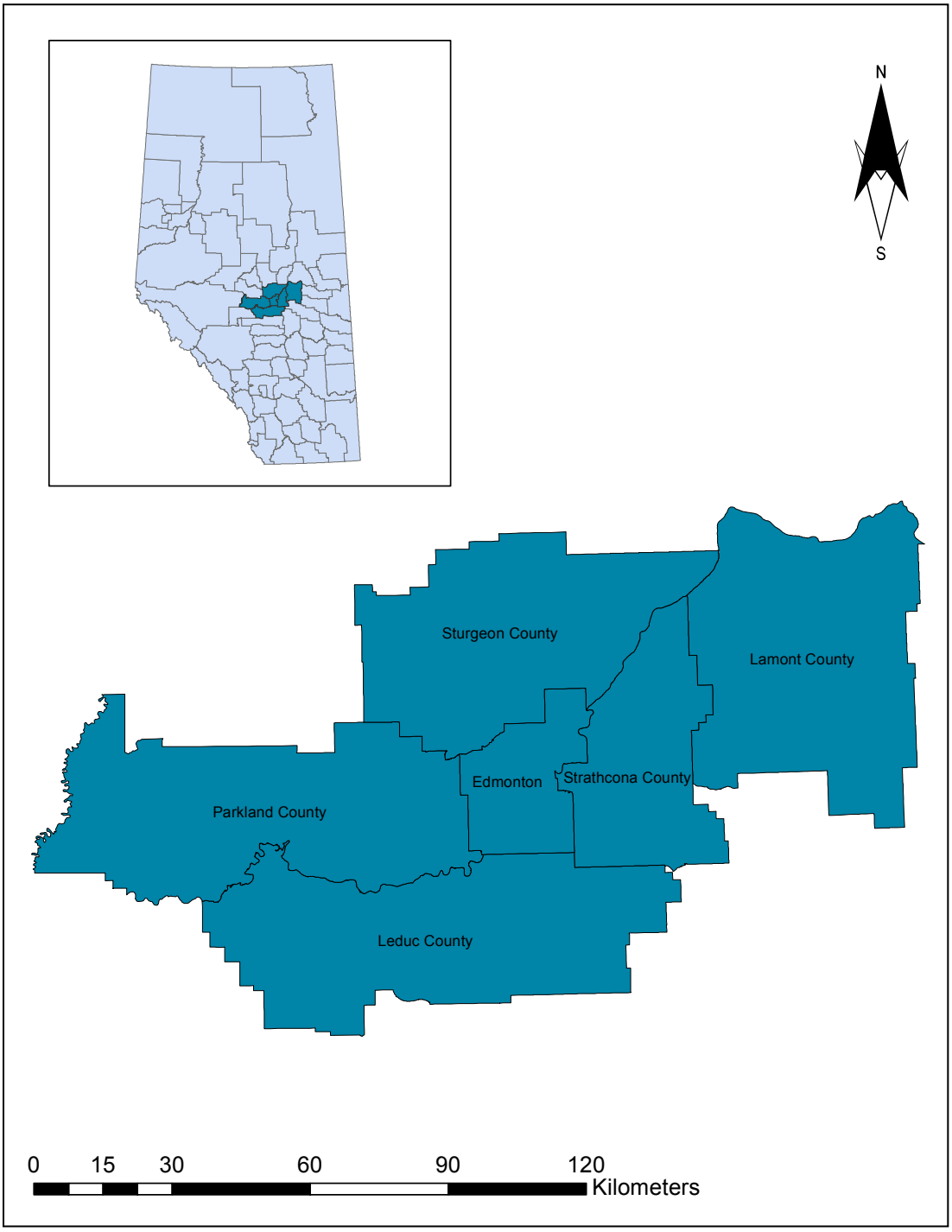


APPENDIX 6. Alberta Precipitation as Percent of Normal (May 1st, 2012 – July 1st, 2012)



Source: Alberta Environment and Sustainable Resource Development: Historical Weather Data

APPENDIX 7. Capital Region (Edmonton Area) Broken into Counties



APPENDIX 8. Land Use Framework Regions of Alberta and the White zone Distribution