Edmonton Metropolitan Region Board

Land Evaluation Site Assessment (LESA) Model Technical Document

JUNE 2021

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1. Project Context

1.1 Context

The Edmonton Metropolitan Region Board (EMRB) was initiated in 2008 as a growth management board tasked with coordinating strategic growth in the Edmonton region. Coordinated growth includes considerations for land use planning, servicing infrastructure, and socioeconomic well-being and competitiveness. Regional policies are integrated into a provincially ratified Regional Growth Plan that addresses each core planning element.

The EMRB's 2017 Growth Plan's Policy Area 6: Agriculture, included three objectives. The first objective is to 'Identify and conserve an adequate supply of prime agricultural lands to provide a secure local food source for future generations'.

Policy 6.1.1.b further clarified that to achieve the objective the EMRB will 'develop a land evaluation and site assessment model to assess land quality and contextual factors and identify and quantify a supply of prime agricultural lands.' Until this land evaluation and site assessment (LESA) model is developed, prime agricultural lands are identified by the Growth Plan's Schedule 11. Schedule 11 identifies prime agricultural land as lands with Land Suitability Rating System (LSRS) ratings with at least 40% Class 2 or 3 soil.

The LESA tool development was undertaken as a primary component of the EMR's Regional Agriculture Master Plan (RAMP), which included the development of policy to utilize LESA model results to reduce fragmentation and conversion of prime agricultural lands.

1.2 Mapping Objectives

The Growth Plan's Policy 6.1.1.b is supplemented by LESA Tool: Terms of Reference in Appendix C2. The terms specify that a LESA model will systematically provide a relative rating for the region's agricultural lands by considering soil quality and other site factors. The relative ratings may be grouped, and thresholds established as a basis for taking action.

Guided by the terms of reference, the EMR LESA model is intended to assess multiple factors effecting relative agricultural value potential across the Region to identify a prime agricultural land base.

1.3 Model Development Approach

The LESA model development has taken a regionally consistent, objective approach that integrates best practises for agricultural land evaluation by utilizing the experiences of other jurisdictions. This model foundation was supplemented by local agricultural and planning knowledge to ensure the LESA model is appropriate for the EMR land use context and intended policy use.

Throughout the model development ground truthing was completed by assessing agricultural uses and conditions, significant farm operator locations, and additional agri-business locations. In addition to these model validation techniques, local agricultural experts provided input into the model development process.

1.4 Definitions

Agricultural System - All the economic, social, and environmental components of a healthy agricultural sector.

Agricultural Land Density - The percentage of a given land base under current agricultural use. Agricultural uses include annual crops, forage crops, specialty crops, ephemeral wetlands, and native or tame pasture.

Parcel Fragmentation - The degree of legal parcel subdivision within a land base.

2. Technical Input

Stages of Input

Pursuant to the EMRB's 2017 Growth Plan, the LESA model development process began as a component of the Regional Agriculture Master Plan (RAMP) in 2018. Following this early development, the model was paused until February 2021. Input was provided throughout this process in the following stages:

1. Early Input – regional consultation on model approach and factors
2. Framework Input – LESA practitioner and land use specialist input
3. Technical Input – Regional agriculture experts provided feedback on model development

A summary of consultation participants is provided in Appendix 1.

2.1 Early Input

As part of the EMR's RAMP, preliminary development of a LESA model was initiated with input provided by Dr. Tom Daniels (University of Pennsylvania LESA practitioner) as well as EMR municipality representatives with planning and agricultural expertise. The model development focused on reviewing appropriate factors and their relative weightings towards a LESA score. While this early input did not drive subsequent development, the identified factors were a consideration for the next stages of model development.

2.2 Framework Input

In early 2021, the EMRB's RAMP process restarted the LESA model development process. A review of other jurisdictions application of LESA raised the strong applicability of the Province of Ontario's Greater Golden Horseshoe Regional Land Evaluation and Area Review (LEAR) model. The LEAR model framework was used as a starting point for the EMRB"s LESA model and Ontario LEAR practitioners were consulted regarding specific adaptations of the model development process.

The main direction provided by the practitioners was regarding:

- method of receiving feedback from technical and local agricultural experts to inform the model development process
- appropriately adjusting factor calculations for the intended policy use (modifying Evaluation Areas)

Ontario's LEAR technical document embedded the experience from Ontario County LEAR practitioners including from the Upper and Single Tier municipalities of: Region of Halton, Region of York, City of Hamilton, Region of Peel. Input from these practitioners informed the Ontario LEAR model's approach to

- factors included, datasets used, and factor weightings
- key lessons – validation land survey importance, simple methodology, inclusion of agricultural stakeholders in decision-making

2.3 Technical Input

2.3.1 Advisory Group

The primary source of technical input was an Advisory Group consisting of local agricultural system experts from each of the four counties. A series of five meetings were held whereby preliminary factor results, LESA scores, and data adjustment techniques were reviewed, and feedback provided. This feedback informed all elements of the model including factor inclusion, factor weighting, thresholds, and prime agricultural area clustering.

Advisory Group members provided feedback on each element by ground truthing preliminary soil capability score maps as well as prime agricultural area maps with varying LESA score thresholds applied. Feedback on appropriate minimum prime agricultural area cluster sizes was provided from the context of the regions agricultural system.

2.3.2 Technical Experts

Additional model input was provided by subject matter experts through review of model methodology and preliminary results. Expertise included areas of:

- LESA technical application,
- Agricultural systems,
- Soil science experts,
- Provincial and Federal agricultural land use specialization, and
- Planning

Input from these technical experts provided the following directions:

- Compare identified prime agricultural areas to existing agricultural system as a key component of model validation
- Clustering to larger sizes provides more effective policy implementation
- Legal parcel fragmentation has a significant effect on the likelihood of future fragmentation and conversion within the agricultural land base
- Consider using Ecological Goods & Service (EG&S) factors to account for the unconventional value of agricultural land
- If the LESA model was re-run too frequently it would degrade the policy effectiveness
- Soil quality measures are relative to the EMR region only. Considering the region's high-quality soils in relation to the rest of Alberta is valuable context for decision makers

3. Methodology

3.1 LESA Model Overview

Land evaluation is a procedure applied to estimate the potential of land for alternative uses. Evaluations can be used to assess the comparative utility of lands within a land use class or of potential uses between classes. When applied to agricultural lands, land evaluation has generally been used to compare various portions of the agricultural landscape on a relative basis.

LESA was first developed in the USA in the 1970s and proceeded to be used by many states and local governments to identify prime agricultural lands for protection. Some LESA applications targeted protection of all prime agricultural lands, while others prioritized only prime lands with additional geographic and economic characteristics. This range of applications demonstrated and informed the best practises for applying LESA models to prime agricultural land identification efforts[1].

In the mid 1990's the Province of Ontario developed a LEAR (Land Evaluation and Area Review) methodology manual that some southern Ontario counties have applied to identify prime agricultural lands. Beginning in 2015, the Province of Ontario was tasked with developing an agricultural system map for the southern Ontario Greater Golden Horseshoe (GGH) region. An important component of this system map was the consistent identification of prime agricultural lands. The province adapted the early LEAR methodology for use at the regional scale by considering LESA best practises, and the experience of LEAR practitioners within Ontario.

The LEAR model's similar scale, comparable policy application, and integration of best practises from prior LEAR model developments all contribute to make it appropriate for use in the Edmonton context. For these reasons, Ontario's regional model was used as the starting point for the Edmonton Metropolitan Region's LESA model.

1 Pease, J., & Coughlin, R.E. 2014. USDA – NRCS Land Evaluation and Site Assessment: Guidebook. United States Department of Agriculture.

3.2 LESA Method

There are two main components to a LESA evaluation:

1. Land Evaluation (LE) measures the land's biophysical considerations, including soil, climate, and topography in relation to agricultural use
2. Site Assessment (SA) measures other important geographic, economic, and social factors

LE and SA components are combined to provide an overall LESA score for each landscape unit evaluated.

The first step in determining which factors to include in a LESA model is addressing the question, "What is the intention of the LESA score?" (Pease & Coughlin, 2014) The EMRB's LESA tool is intended to "identify and quantity a supply of prime agricultural lands for conservation in the Region" (EMRB, 2017). The LESA Terms of Reference further specify that the model will provide relative landscape ratings based on their agricultural value for continued agricultural use.

A LESA rating system can be applied to a landscape at many different resolutions including, but not limited to:

- Legal Parcel
- Quarter Section
- Grid with equal sized cells of any specified area

The appropriate approach depends on several factors including;

- Available data formats
- Intended policy implementation
- Data Processing Limitations

The EMRB LESA model's intended use of identifying prime agricultural areas to be conserved justifies the use of a consistent grid-based approach. Availability of high-resolution supporting data, and no limitations around data processing supports the use of this approach.

3.3 LESA Principles for the Edmonton Metropolitan Region

The application of LESA to the Edmonton Metropolitan Region is required to qualify and quantify the prime agricultural lands to be conserved in order to maintain a secure agri-food production base for the long term and to support the value-added growth of the agri-economy[2]. Based on this imperative, the following principles were used to inform the LESA model development:

1. Landscape scale relative ratings,
2. Regionally consistent and objective method
3. Designed to identify prime agricultural areas
4. Appropriate for unique agricultural production areas
5. Factors are as simple as possible and understandable to the public, agricultural stakeholders, and decision makers
6. Factors are mutually exclusive to avoid double counting

2 Edmonton Metropolitan Region Board, 2017. Growth Plan. Policy 6.1.1.b (pp78).

3.4 Study Area

The LESA model study area includes all Edmonton Metropolitan Region Board member municipalities.

The following areas were excluded from the development of scores (further areas were removed at the later prime agricultural area refinement stage):

3.4.1 Study Area Exclusions

1. RAMP Policy Area 4 lands. These correspond to lands identified as of August 2021 from Area Structure Plans to be serviced to urban standards
2. Large permanent waterbodies identified within the Land Suitability Rating System (2020) dataset
3. Federal Lands including First Nations Reserves, Federal Airports, and Canadian Forces bases
4. Non-member Municipalities within the Region

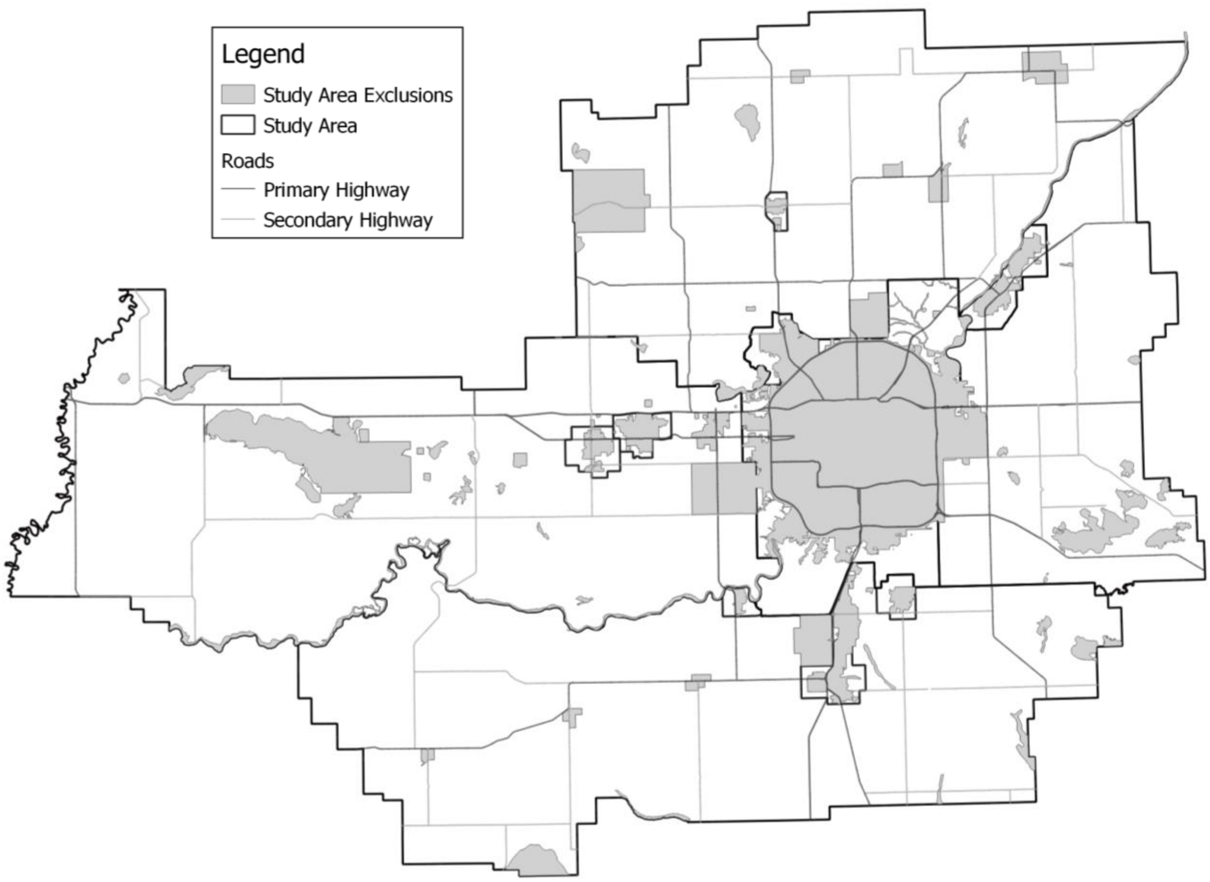

Figure 1. Edmonton Metropolitan Region Board LESA Study Area

3.5 Evaluation Unit

A 1-hectare Evaluation Unit (100m long by 100m wide) is used and applied as a consistent grid across the entire study area. The grid structure provides consistent measurements across the diverse study area, enabling the use of relative ratings for the entire study area.

3.6 Evaluation Area

The Evaluation Area corresponds to the buffered area within a specified distance of each Evaluation Unit (see Figure 2). Evaluation areas are used as a way of adding the consideration of neighbouring soil quality and land use factors to the characteristics of a given evaluation unit. This technique accounts for the identified productivity gains and reduction of land use conflicts from large contiguous agricultural lands within an agricultural system.

A 750-meter buffer extending out from each evaluation unit defines the evaluation area as shown in Figure 2. This buffer distance and the resulting area of 201 hectares was used because it considers an area large enough to consider a few average sized agricultural parcels surrounding an evaluation unit. In addition to measuring agricultural land use density, this is an important technique for appropriately measuring soil capability. Agriculture and Agri-food Canada's Land Suitability Rating System's (the successor to Canada Land Inventory) soil polygon data is not intended for interpretation at a small scale. Using the evaluation area technique provides a scale-appropriate measurement of soil capability.

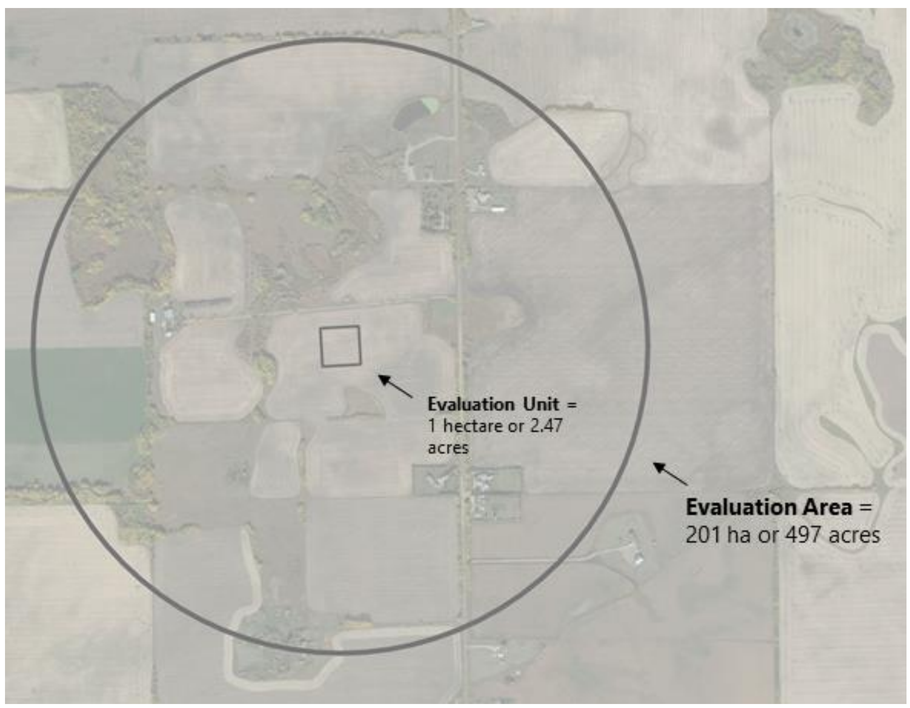

Figure 2. Sample Evaluation Unit and Corresponding Evaluation Area

Using a larger radius than 750 meters risks overstating the negative or positive effect that competing land uses or areas of differing soil quality have on agricultural productivity. This would have an effect of reducing the ability of LESA to differentiate between areas of high and low agricultural productivity. Similarly, a radius smaller than 750m risks overstating the influence that competing land uses have on immediately adjacent agricultural land.

3.7 LESA Factors and Weighting

The lessons learned through the evolution of LESA models has strongly indicated that using the smallest number of factors reduces risk of double counting and inappropriate quantification while also improving the interpretability of the tool. For these reasons, the LESA model has followed the Ontario GGH LEAR model and included three factors:

1. Soil Capability (LE)
2. Agricultural Land Use Density (SA)
3. Parcel Fragmentation (SA)

To compute a consolidated LESA score, factors require weightings that reflect their relative contribution to agricultural value for continued agricultural use. The important role of soil capability in agricultural productivity implies it should have a weighting of at least 50%. Based on comparable models from both Ontario-based County and Province wide applications, a weighting of 60% for the Land Evaluation factor is used.

The Site Assessment factors both measure the contiguity of the agricultural land base. Agricultural land density is a current land use assessment of this, while parcel fragmentation is interpreted as a measure of the likelihood for future fragmentation of the agricultural land base.

The composite LESA score is calculated using the following equation:

$$\boldsymbol{LESA\ Score\ (0\ to\ 100)} =$$

Soil Capability Score (0 to 60) +

Agricultural Land Density Score (0 to 25) +

Parcel Fragmentation Score (0 to 15)

3.71 Factor 1 (LE) - Soil Capability

The Land Evaluation (LE) component of the LESA model was captured using a single factor representing soil capability. The agricultural productive capability of the soil was measured using the latest available 2020 Land Suitability Rating System (LSRS) spatial dataset. LSRS data is an upgraded form of the Canada Land Inventory (CLI) that incorporates soil, climate, and topographical landscape elements. To acknowledge the differing productivity requirements of various agricultural products, the LSRS is classified separately for agricultural crop systems. These include brome, spring-seeded small grains, and canola. To account for the importance of a viable crop rotation, the spring-seeded small grains LSRS rating was used.

Portions of the Edmonton Metropolitan Region that are within urban boundaries, within certain country residential developments, and within coal or peat extraction areas are not rated by the LSRS dataset. These missing areas were populated with soil capability data by adapting CLI data from 1961. Classes and subclasses were adapted by dropping all classes and subclasses by 1 to reflect the main difference between LSRS and CLI datasets. Figure 3 visualizes the areas with missing LSRS data, which amounted to a total area of 92,696 acres or 4.3% of the Study Area.

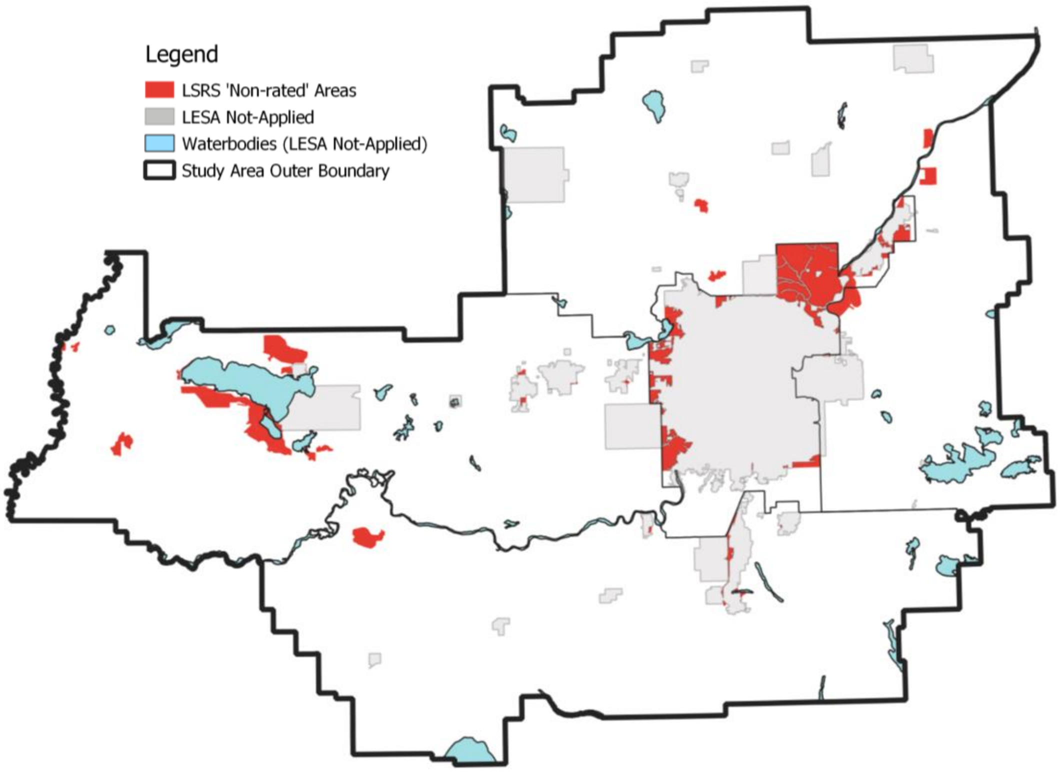

Figure 3. Portion of Study Area Missing LSRS Data

A numerical soil capability value between 0 and 1 was calculated for each of the LSRS dataset's soil polygons using a table of values shown in Table 1. These productive values represent the relative productivity potentials for each LSRS rating. The values in Table 1 are drawn from the Ontario provincial LEAR, which used an extensive stakeholder engagement process to review and finalize.

The table of values was reviewed by the Advisory Group and the consulted subject matter experts. Only one objection was raised, and it was regarding the potential of the class 7 rating being too high given that LSRS 7 corresponds to land classified as 'unsuitable' for spring seeded small grains. LSRS 7 areas include organic soils, which in the EMR include some peat lands under cultivation and/or forage production. For this reason, the value of 0.4 was maintained.

Table 1. Values for each LSRS class

Class	Value
2	1
3	0.9
4	0.8
5	0.6
6	0.5
7	0.4

Soil polygons are landscape scale representations of definable landforms, and as such, they often include some variance in agricultural productive capacity. Subclasses with separate ratings provide acknowledgement of this variance. The following equation provides an example of how a soil capability factor value is derived from a soil polygon LSRS rating [*Class(% of polygon)}* of 2(90%) + 5(10%):

$$(1 \times 0.9) + (0.6 \times 0.1) = 0.96$$

The soil capability value for an evaluation unit is taken as an area-weighted average of the LSRS value within its associated evaluation area.

A considerable amount of developed (built-up) lands are not rated within the LSRS dataset and correspond with Policy Area 4. These areas do not have CLI data available or are developed to urban service standards and are not appropriate to include as part of the agricultural system. If these areas adjacent to the Study Area were included in the Evaluation areas, their soil capability scores of '0' would reduce the soil capability score of adjacent high-quality soils. For this reason, study area exclusions (Policy Area 4, non-member EMRB municipalities, federal lands) were removed from the Evaluation Areas where they intersected. Calculated soil capability scores were taken as the area-weighted average score of the remaining Evaluation Area.

Additionally, some waterbodies within the study area also have an LSRS rating of 'non-rated', while others are part of soil polygons with valid ratings. The 'non-rated' waterbodies were also removed from the Evaluation Areas, while valid ratings were left as rated in the LSRS. In the same manner as with the 'non-rated' developed lands, this ensured that non-rated areas did not inappropriately reduce soil capability scores of land adjacent to thee waterbodies. Calculated Soil Capability scores were taken as the area-weighted average score of the remaining Evaluation Area.

The North Saskatchewan River is classified within the LSRS dataset using two distinct methods. Upstream of the Town of Devon, the river is classified as a waterbody with the riverbank and riverside floodplains rated separately. The removal of waterbodies from the study area results in this case in a reduced negative impact from the water body. Downstream of Devon and Edmonton, the river, riverbank, and floodplains are rated together with subclasses corresponding to each distinct land type. This method results in the river (waterbody) having a negative impact on lands for which the Evaluation Area intersects.
The dataset's classification of the North Saskatchewan River was made consistent by manually separating the river body from the riverbank and floodplains downstream of Devon and Edmonton. The riverbank and floodplains were reclassified with the LSRS class corresponding to the land portion of the original soil polygon. In the case of the dataset, this resulted in all adjusted riverbank and floodplain soils being rated LSRS class 5.

The Advisory Group identified lands within the northwestern portion of Sturgeon County that appeared to have soil capability ratings beyond their productive capacity. This prompted an investigation which verified that 34 soil polygons had LSRS ratings that were inappropriate for the soil type and topography. Adjustments were made to each of the identified soil polygons as shown in Figure 4. Adjusted polygons are outlined in black in the image on the right. Most of the adjustments shifted LSRS ratings about 1 class down.

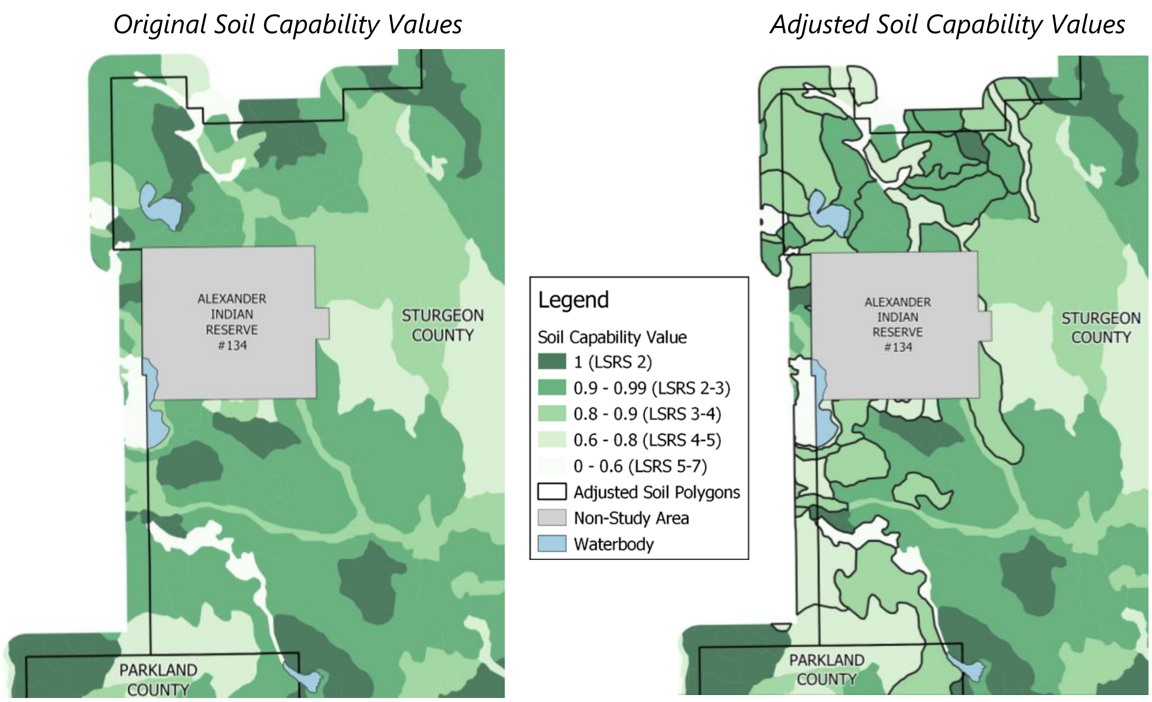

Figure 4. Northwest Sturgeon County LSRS Rating Adjustments

The soil capability factor value is then multiplied by 60 to calculate a factor score between 0 and 60 as visualized in Figure 5. A higher soil capability value corresponds to a higher factor score.

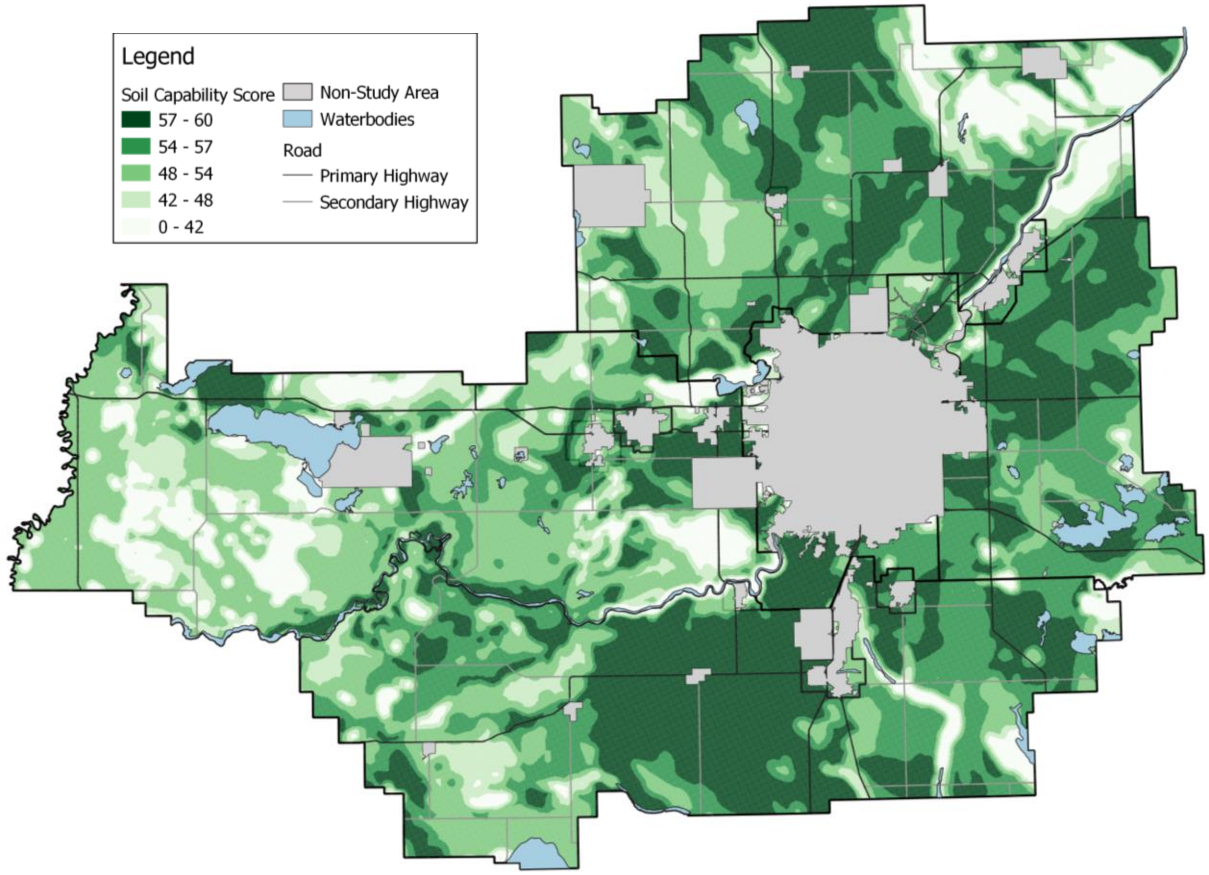

Figure 5. Soil Capability Factor Scores for the Study Area

3.72 Factor 2 (SA) – Agricultural Land Density

Contiguity of the agricultural landscape contributes significantly to productivity by impacting management and operating efficiencies as well as the degree of land use conflicts. The level of contiguousness, or what can be described as fragmentation, has a current use element as well as a future use component. Current fragmentation impacts the level of production efficiency and land use conflict. The risk of future agricultural land fragmentation reduces agricultural operation capital and land investment due to the increased risk of long-term conversion out of agricultural use.

Agricultural land density captures the current use component and is based on the percentage area in agricultural use, calculated by the following equation:

$$\frac{\boldsymbol{Area\ in\ agricultural\ production}}{\boldsymbol{Evaluation\ Area}} \times \mathbf{100} =$$

$$\%\ \boldsymbol{area\ in\ agriculture}$$

The Agriculture and Agri-Food Canada (AAFC) Annual Crop Inventory provides remote sensing based landcover classification for the study area. Classification for the latest available year of 2019 was used and all active agricultural landcovers were selected, including tame pasture and forage, grassland, cropland, and wetlands. Landcover categories not included were all forested covers, shrubland, peatland, water, developed/urban covers, and barren/exposed lands.

Active coal extraction lands provided the sole data issue, as lands destined for reclamation to equivalent productive capability were as of 2019 classified as 'exposed' and therefore not included in the agricultural production area. As a remedy, all coal extraction lands classified in 2019 as 'exposed' were included in the area in agricultural production. This included actively coal extraction areas in Parkland and Leduc County as shown in Figure 6.

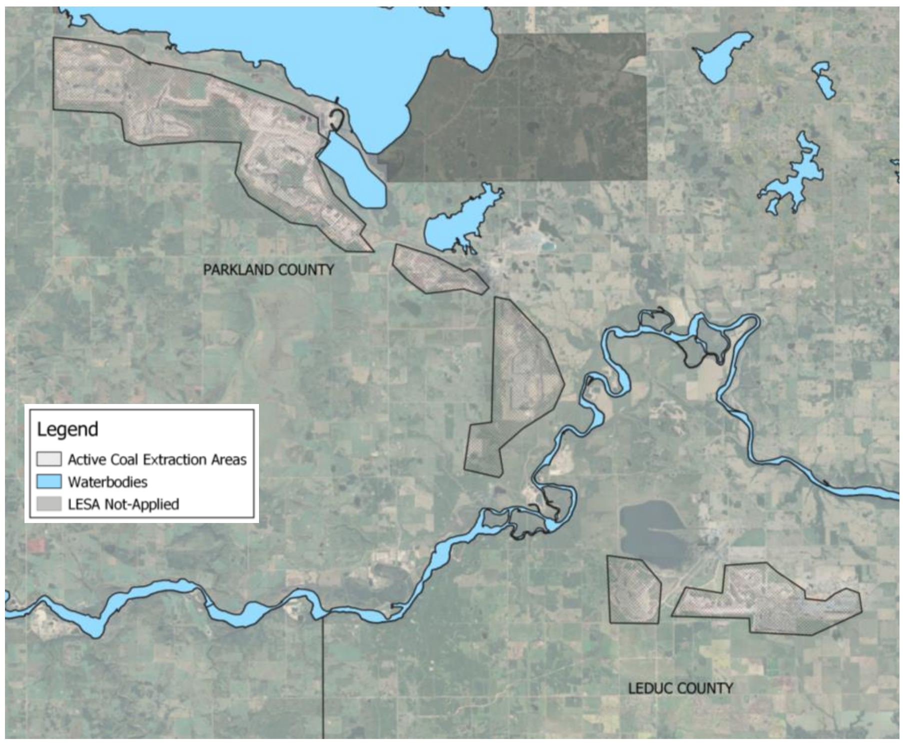

Figure 6. Active Coal Extraction Areas within Study Area

To validate this adjustment, the agricultural land density for the active coal extraction areas was compared to the reclaimed Whitewood mine, immediately north of Lake Wabamun. Figure 7 displays the valid comparison between the adjusted active coal extraction area agricultural land density values with the reclaimed coal extraction lands.

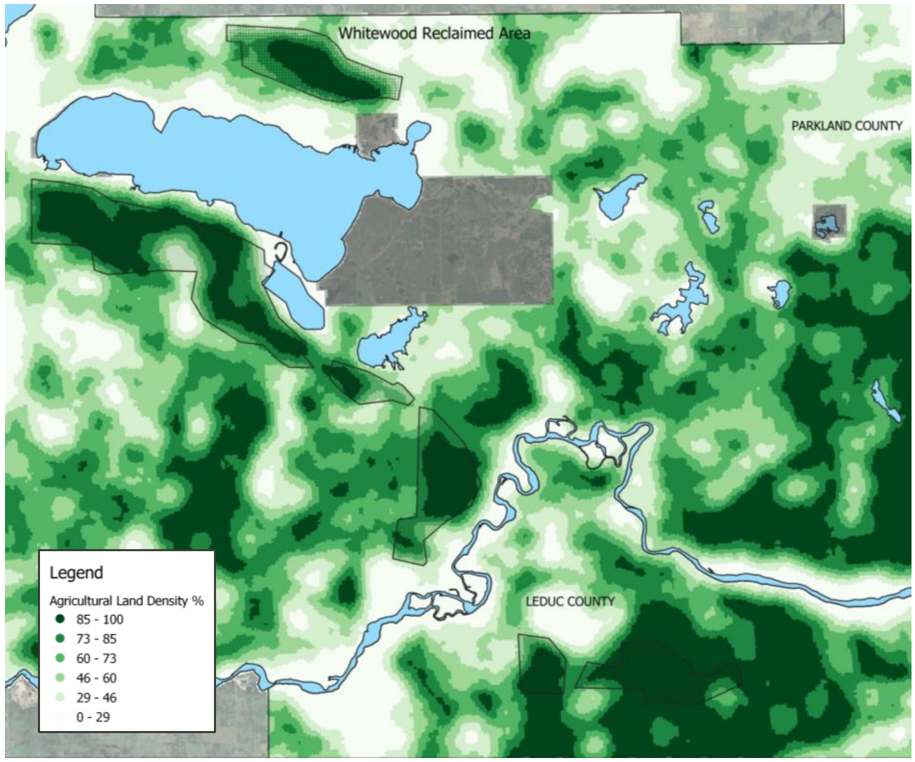

Figure 7. Agricultural Land Density on Whitewood Mine Reclaimed Site

The percentage area in agriculture values are then multiplied by the factor weight (25 points) to get a final factor score between 0 and 25 as visualized in Figure 8. A higher agricultural land density corresponds with a higher factor score.

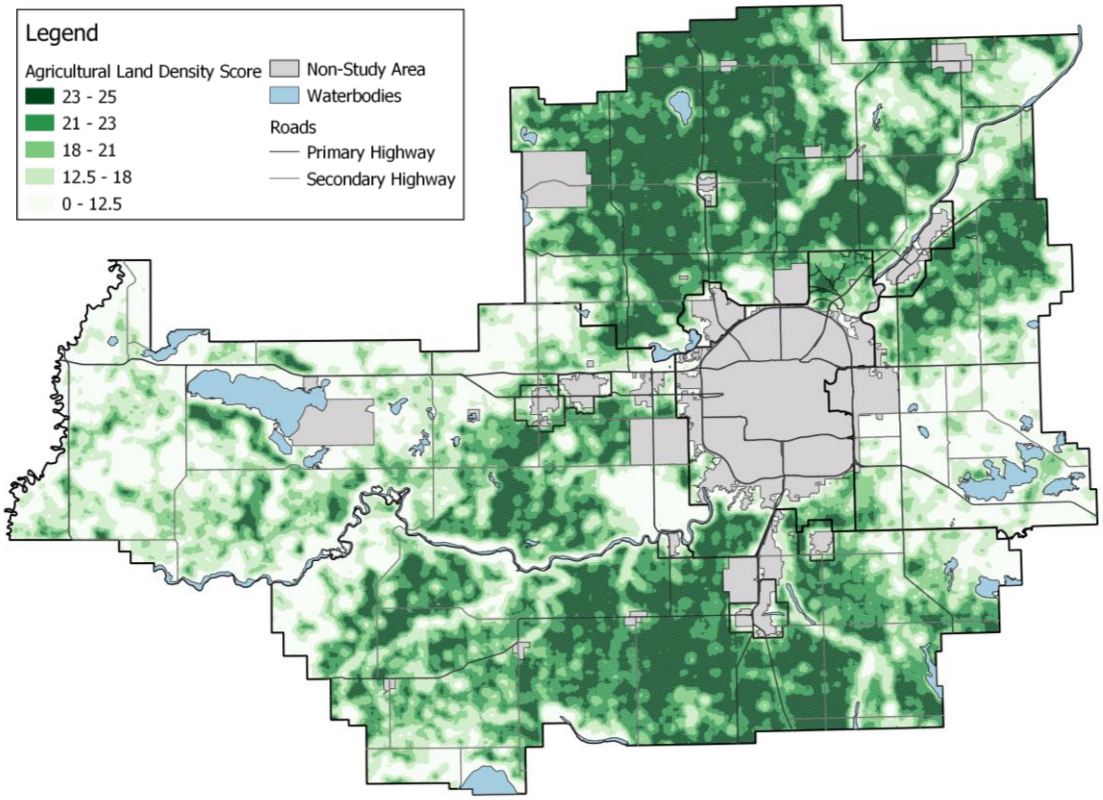

Figure 8. Agricultural Land Density Factor Scores for the Study Area

3.73 Factor 3 (SA) – Parcel Fragmentation

Legal parcel creation within agricultural areas increases land use conflict and the potential for future land use fragmentation and conversion. For this reason, the degree of parcel fragmentation is considered as a contributing factor to agricultural value.

It is important to note however, that small parcels within an agricultural landscape may serve a function of agriculture financial succession strategies or may hold small agricultural enterprises that are integral to the regions agricultural system. For these reasons, the parcel fragmentation factor is given a weighting score of only 15 points.

The Study Area's combined legal parcel dataset include many anomalies due to historical data update errors, dataset fragments, inclusion of non-titled waterbodies, and more. A dataset cleaning process was undertaken to ensure that only appropriate parcels were included in the fragmentation calculation. Due to the large number and type of dataset anomalies, rule-based manual cleaning was undertaken. The following set of parcels were removed from the dataset:

1. Parcels < $75m^2$ (0.018 acres)
2. Road and road allowances
3. Utility corridors

4. Large permanent waterbodies - island parcels retained where applicable
5. Small and isolated geographic features
    a. creeks and remnant contour lines without confirmation found within municipal online property viewer resources

The parcel dataset cleaning process removed approximately 85,000 of about 180,000 original parcels.

Parcel fragmentation is measured by a count of the parcel centroids within each Evaluation Area. Figure 9 provides an individual 201-hectare Evaluation Area surrounding its associated 1-hectare square Evaluation Unit which has a parcel count of 4. As with the other two factors, this landscape method ensures that small parcels within a contiguous landscape do not have an inappropriate effect on the factor score.

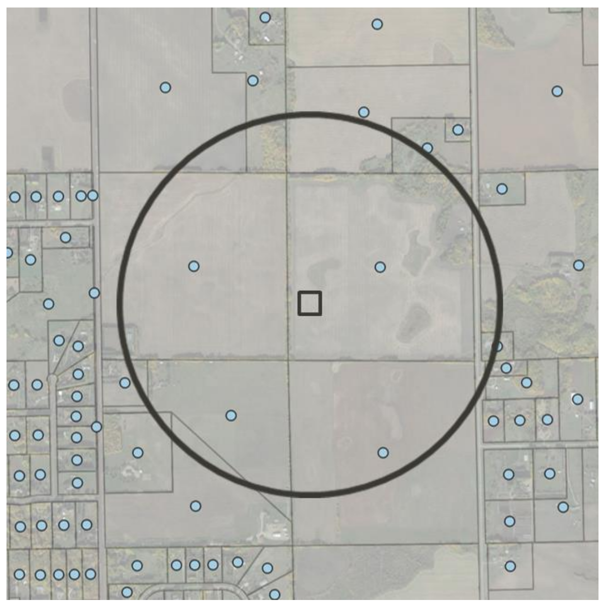

Figure 9. Parcel Centroid Count for an example Evaluation Area

Parcel counts were converted to a factor value based on percentiles within a high and low boundary (Table 2).

Table 2. Values for parcel densities

Parcel Count	Value
1-4	1
4.01 – 49.99	Percentile
50+	0

A high boundary of 1-4 was selected as this value corresponds to a measurement of 4 undivided quarter sections within an evaluation area's 497 acres, which can be interpreted as the lowest level of fragmentation. For the other boundary, parcel counts greater than 50 correspond to an average parcel size within the Evaluation Area of approximately 10 acres (497 acres/50). Adjacent parcels 10 acres or smaller are with few exceptions not used for agricultural production, and so these are assumed to corresponds to the highest category of fragmentation.

Parcel counts within the low boundary were not included in the percentile calculation because a landscape with 4 quarter sections per 497-acre evaluation area has the same effect on long-term productivity as evaluation areas that measure lower than 4. Contrasting this, parcel counts above the high boundary of 50 were excluded because their inclusion would reduce the scored (percentile) impact of parcel counts immediately above 4.

Developed areas that fall within RAMP's Policy Area 4 are typically small, densely concentrated parcels and would have a strong effect on fragmentation values of land adjacent to them. With respect to the likelihood of future fragmentation or conversion, these fragmentation values do appropriately signal their impact. The LESA tool is however tasked with identifying prime agricultural areas for conservation. This implies that agricultural land adjacent or near areas serviced to urban standards does not necessarily have an increased likelihood of future fragmentation or conversion. For this reason, Policy Area 4 lands were removed from the Evaluation Areas. Parcel counts within fragmented Evaluation Areas were adjusted upwards using the average parcel count per hectare of the included area.

The fragmentation values are then multiplied by the factor weight of 15 points to get the factor score between 0 and 15 as visualized in Figure 10.

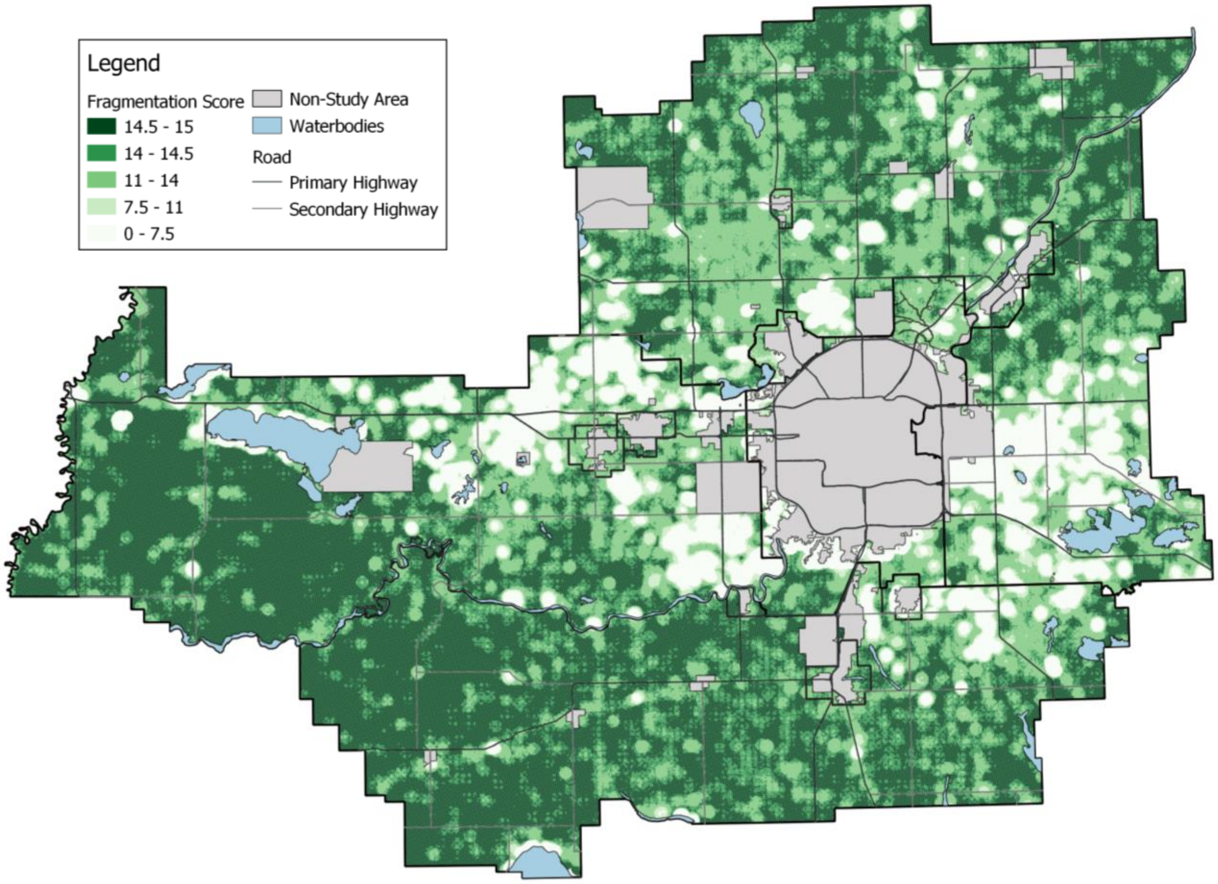

Figure 10. Parcel Fragmentation Factor Scores for the Study Area

4. Mapping Prime Agricultural Areas

4.1 Prime Agricultural Land Threshold

EMR's LESA calculates relative agricultural productive potential ratings for the entire study area. A threshold score is selected to determine which parts of the Region are to be considered prime agricultural areas. Areas with a high density of land with LESA scores above the threshold indicate a high potential that the area is a prime agricultural area. In contrast, areas with high density of land with LESA scores below the threshold indicate a high potential that the area is not prime.

The determination of an appropriate threshold was supported by sensitivity analysis based on several factors:

- The portion of land included within current agricultural production
- The portion of land included within areas identified by the Advisory Group as being highly productive
- The portion of the land included that is currently designated as an agricultural land use district
- The level of inclusion for identified core production areas of various production systems including, cow/calf production, cropland, and potato production

The above sensitivity analysis was conducted to inform the threshold selection. Review from municipally selected agricultural experts involved drawing on knowledge of relative regional productivity potentials and ground-truthing or further desktop review of areas of concern.

Considering each of these elements, a threshold score of 87.9 (or the 58th percentile of LESA scores) is used. It is our opinion that this threshold score best reflects the critical elements that were assessed in the sensitivity analysis in addition to the input from the Advisory Group.

A series of three validation procedures were performed to assess alignment with metrics of agricultural productive capability or agricultural use. Each of the three procedures found strong alignment with the identified prime agricultural areas (Appendix 2).

4.2 Clustering Prime Agricultural Lands

Prime agricultural areas are mapped areas corresponding to areas with the highest LESA ratings. Prime areas, and non-prime lands are used for two reasons. First, contiguous agricultural areas are critical for reducing land use conflict and for effective operational scale. Secondly, reasonable sized land use policy areas are important for effective policy implementation. For example, having small patches of prime agricultural lands, or small patches of non-prime agricultural lands makes interpreting the relevant policy difficult, and reduces the effectiveness of conserving high quality agricultural land.

Clustering of prime agricultural lands is a technique that sets a minimum size for a contiguous set of prime or non-prime lands, below which an area is amalgamated into the surrounding category. For instance, a contiguous patch of prime lands smaller than the selected minimum size would be amalgamated into the non-prime category.

A minimum cluster size of 250 hectares (617 acres) is used as nearly a full-section of land represents a viable agricultural unit and corresponds with a practical policy implementation scale. This area also corresponds quite closely to the average farm size within the EMR of 523 acres[3].

It is important to note that due to the clustering process, some LSRS class 4, 5, and 6 lands have been included in the prime agricultural areas.

4.3 Extension to Parcel Boundaries

Clustered prime agricultural areas as pictured in Figure 10 are projected to identifiable boundaries by including all legal parcels with 50% or more of its area within a prime agricultural area.

4.4 Final Exclusions

The additional areas excluded from the identified prime agricultural areas were based on data provided by the Edmonton Metropolitan Region Board. The following areas were excluded:

a. Provincial parks and protected areas – Note: no adjustments were necessary as there were no identified prime agricultural areas that coincided with these areas.

4.5 Technical Adjustments

Following the projection of identified prime agricultural areas to legal parcels, it is likely necessary to make several small adjustments for small parcels. Narrow slivers of prime agricultural areas corresponding to roads or other linear infrastructure will be removed as designating them prime does not improve the connective function between prime agricultural areas.

4.6 Prime Agricultural Areas

The prime agricultural areas are shown in Figure 11. At this stage, the areas have not been projected to parcel boundaries.

This LESA calculation includes a total of 888,360 acres of land which is 45% of the Growth Plan's identified area and in our opinion a more precise delineation of prime agricultural land to considered for protection.

3 Statistics Canada. 2016. Census of Agriculture. https://www.statcan.gc.ca/eng/ca2016

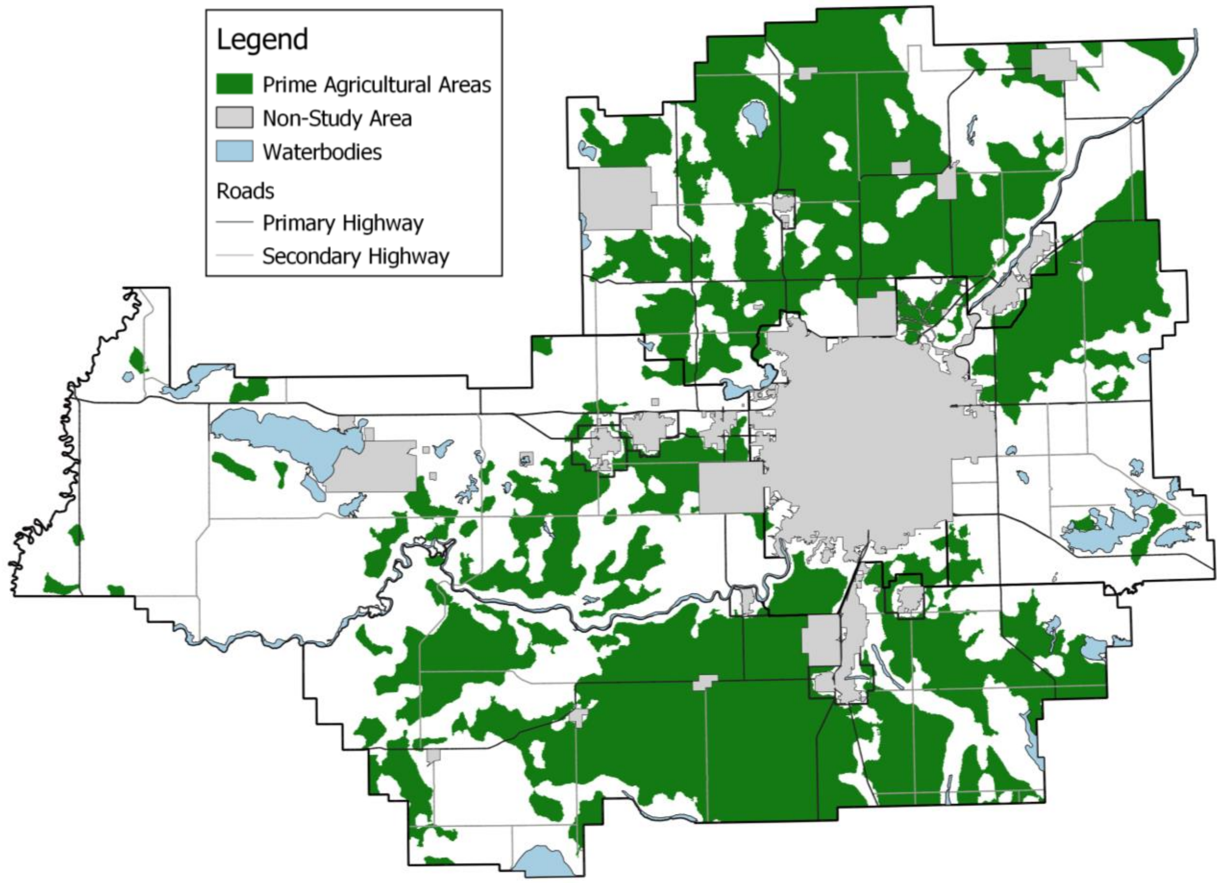

Figure 11. EMRB Prime Agricultural Areas

4.7 Specialty Agricultural Products

In the EMR there are several agricultural products that may be considered a specialty agricultural product. For the sake of this analysis, specialty products are determined by their production system not coinciding with the major livestock and cropping systems. Because their productive capacity requires different variables it is possible that the factors contributing to the LESA model may not be appropriate in capturing the land base's agricultural value with regards to some specialty crops. Within the EMR, potato (seed and fresh) and market garden production were considered as the two most significant specialty crops.

The land base requirements for potato and market garden vegetables were reviewed to see if the model captured factors that impact their productive value. Potato production is found to align quite closely with the LSRS soil capability ratings and benefit from large contiguous agricultural lands. Due to its intensity of production, potatoes can however make better use of a fragmented land base then conventional livestock and crop production systems.

Similarly, market garden vegetable productive capacity aligns quite well with LSRS soil capability ratings, however market gardens can be very productive on an even more fragmented agricultural land base then potatoes. In the case of market gardens, the proximity to customers that often coincide with a fragmented land base can be an advantage to market garden vegetable producers.

The reviewed specialty agricultural products are both found to have lower requirements for a contiguous agricultural land base. It is also true that both production systems can be just as productive in a large contiguous land base. Adjusting the LESA model to account for high soil capability areas with higher levels of fragmentation would include lands strongly suitable for these specialty crops, however the additional areas would not be as suitable for most other production systems. For this reason, it is better to include no model adjustments that specifically account for specialty crops as the current model already captures a large majority of suitable areas.

4.8 Municipally Identified Agriculture Areas

Each of the region's four counties have a slightly different approach to how they currently prioritize agricultural areas. Parkland County's MDP identifies three prime agricultural areas, with two representing large contiguous areas, and one for small agricultural holdings. Sturgeon County includes agricultural development within the priorities of a few of its MDP's ten distinct neighbourhoods. Strathcona County identifies both an agricultural large holdings and small holdings policy area where certain agricultural uses are encouraged. Leduc County also identifies multiple large and small agricultural holdings areas with enhanced policies targeted towards limiting agricultural land fragmentation.

The identified priority agricultural areas were compared as a measure of model validation to the prime agricultural areas identified by the LESA model. There is strong correlation except for Parkland County's West Prime Area and Strathcona County's Small Holdings area. LESA is not intended to displace the identified areas, but to provide a regionally consistent set of identified prime agricultural areas, which may be added to by individual municipalities.

4.9 Other Considerations

The LESA model is intended to be re-run only if the factor datasets undergo significant changes or a significant amount of time has passed. For instance, the updating of Land Suitability Rating System ratings due to shifting climate normals may justify re-running the model.

4.10 Parcel Size of Prime Agricultural Areas

The summary and distribution of parcel size within the prime agricultural areas identified by the LESA model is an important element of the agricultural land base. The following statistics are calculated following the projection of prime agricultural areas to a parcel cadastral using the method described in section 4.3. Table 3 indicates that 416,000 acres or 19.6% of the study area is within parcels greater than 150 acres in size and in Policy Area 1 as defined by the Regional Agricultural Master Plan 1.0.

Table 3. Policy Area 1 Prime Agricultural Area Parcel Size Summary

	Acres					
Parcel Size	Sturgeon	Leduc	Parkland	Strathcona	Policy Area 3	Total
150+	141,831	196,767	40,272	37,156	-	416,027
80-150	42,407	59,733	18,394	15,488	-	136,021
40-80	62,107	60,409	9,339	8,382	-	140,237
0-40	8,655	12,034	3,631	4,293	-	28,613
Total	255,001	328,943	71,636	65,319	-	720,898

	% of Total Prime Agricultural Area					
Parcel Size	Sturgeon	Leduc	Parkland	Strathcona	Policy Area 3	Total
150+	48	53	43	42	-	47
80-150	14	16	20	18	-	15
40-80	21	16	10	9	-	16
0-40	3	3	4	5	-	3

Table 4. Total Prime Agricultural Area Parcel Size Summary

	Acres					
Parcel Size	Sturgeon	Leduc	Parkland	Strathcona	Policy Area 3	Total
150+	162,957	222,082	52,722	48,606	11,967	498,336
80-150	51,748	66,222	21,673	22,772	10,024	172,440
40-80	70,436	67,828	12,496	10,988	9,319	171,066
0-40	10,338	14,155	5,889	6,084	3,141	39,608
Total	295,480	370,287	92,781	88,450	34,451	881,450

	% of Total Prime Agricultural Area					
Parcel Size	Sturgeon	Leduc	Parkland	Strathcona	Policy Area 3	Total
150+	55	60	57	55	35	57
80-150	18	18	23	26	29	20
40-80	24	18	13	12	27	19
0-40	3	4	6	7	9	4

Appendix 1: Consultation Summary

Advisory Group

Name	Municipality
Angela Veenstra	Sturgeon County
Mike Hittinger	Sturgeon County
Diana Wahlstrom	Strathcona County
Aaron Van Beers	Leduc County
Barb Shackel-Hardman	Parkland County

Subject Matter Experts

Name	Company/Organization	Specialization
Tom Daniels	University of Pennsylvania	Land Evaluation Modeling
Helma Geerts	Government of Ontario	Land Use Policy
Dan Bihari	Government of Ontario	GIS Specialist
Jason Cathcart	Government of Alberta	Land Use Governance
Candace Vanin	Agriculture and Agri-food Canada	Land Use Specialist
John Steil	Stantec	Land Use Planning
Jerry Bouma	Toma and Bouma Management Consultants	Agricultural Systems
Bruce Walker	Beau Terre Soilscapes Consulting	Soil Analysis and Classification

Appendix 2: LESA Model Validation Procedure

Summary

The prime agricultural areas identified by the LESA model underwent three validation procedures. Each procedure was selected to assess the identified prime agricultural area's alignment with other measures of agricultural productive potential or use.

Each of the analyses indicated strong alignment between the prime agricultural areas identified by the LESA model and the measure of agricultural productive potential or use.

EMRB Growth Plan's Schedule 11 Prime Agriculture Lands

The EMRB's 2017 Growth Plan identified prime agricultural lands intended to be revised by the prime agricultural area output from the LESA model. Prime agricultural lands within Schedule 11 of the Growth Plan identify 1,949,119 acres. ***The LESA model with the selected threshold identifies 888,360 acres or 45% of the Growth Plan's identified area.*** With few minor exceptions as shown in Figure 12, the prime agricultural areas completely overlap with the Schedule 11 prime agricultural lands.

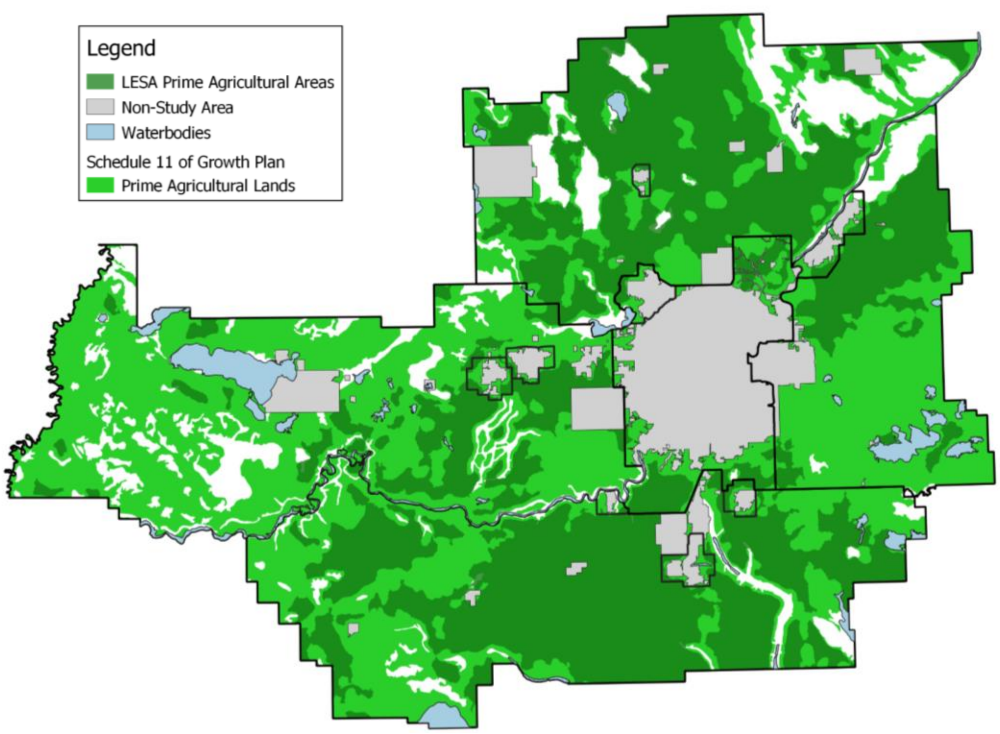

Figure 12. Prime Agricultural Areas Compared to EMRB Growth Plan Schedule 11 Prime Agricultural Lands

LSRS Composite Soil Capability Rating

The LESA model is heavily weighted towards considering soil quality, however agricultural land density and parcel fragmentation have a significant impact on area ratings. For this reason, it is useful to compare soil capability values to prime agricultural areas identified by the LESA model to ensure a reasonable element of alignment. Soil capability values are the composite value calculated by the method described in section 3.71. Table 5 and Figure 13 demonstrate the strong alignment between prime agricultural areas and high productive capability soils.

Table 5. Soil Capability of Prime Agricultural Areas

Soil Capability Value	LSRS Rating Equivalent	Acres	% of Prime Agricultural Areas
0.95 – 1	2 – 3	486,650	54.8%
0.9 – 0.95	2 – 3	308,470	34.7%
0.8 – 0.9	3 – 4	88,800	10%
0 – 0.8	4 - 7	4,400	0.5%

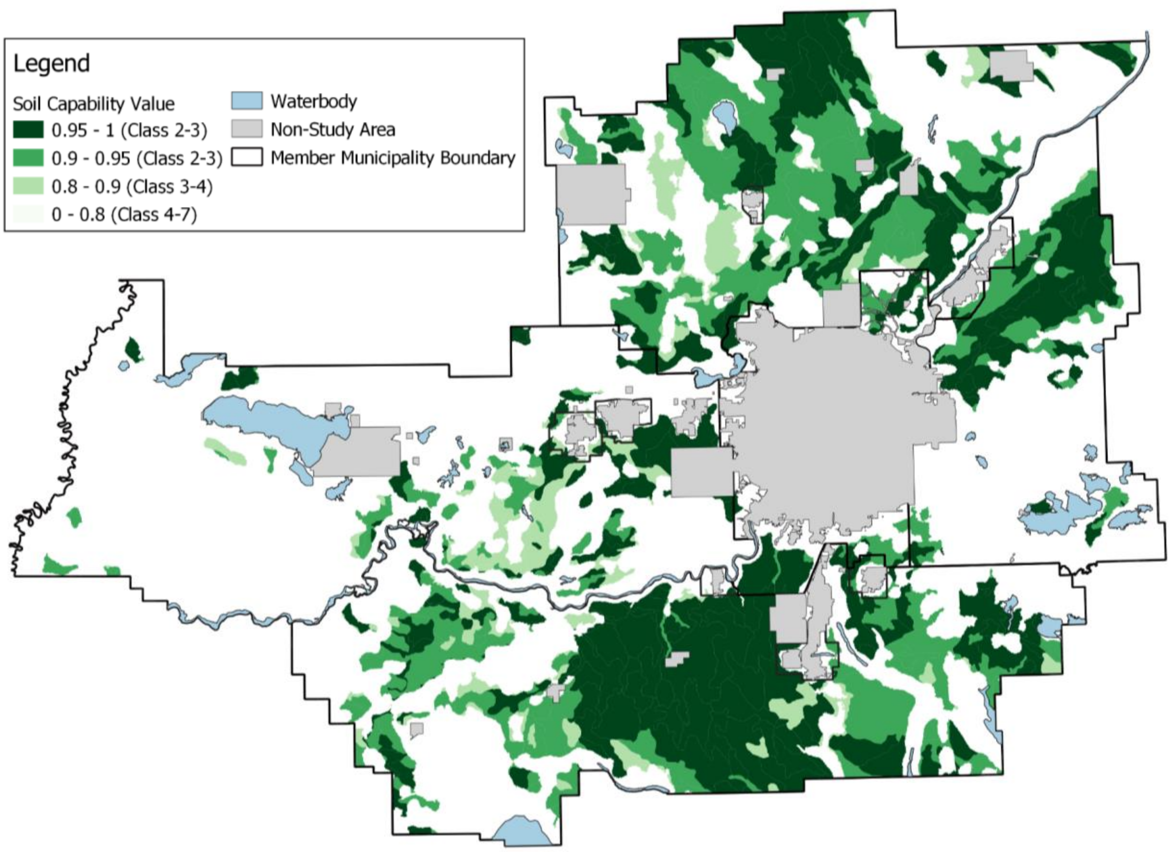

Figure 13. Composite Soil Capability Values of Prime Agricultural Areas

Land Use Designations

The intended use of lands is an important element in terms of identifying prime agricultural areas. Table 6 and Figure 14 below demonstrate that most of the identified lands fall within agricultural land use designations, which supports the validity of the prime agricultural areas. Policy Area 3, 'Transition Lands', is as delineated by the EMRB Regional Agriculture Master Plan 1.0.

Table 6. Land Use Designation of Prime Agricultural Areas

Land Use Designation Category	Acres	% of Prime Agricultural Areas
Agricultural	777,570	87.5%
Industrial/ Commercial	32,030	3.6%
Policy Area 3	57,270	6.5%
Residential	8,500	1.0%
Other	12,990	1.4%

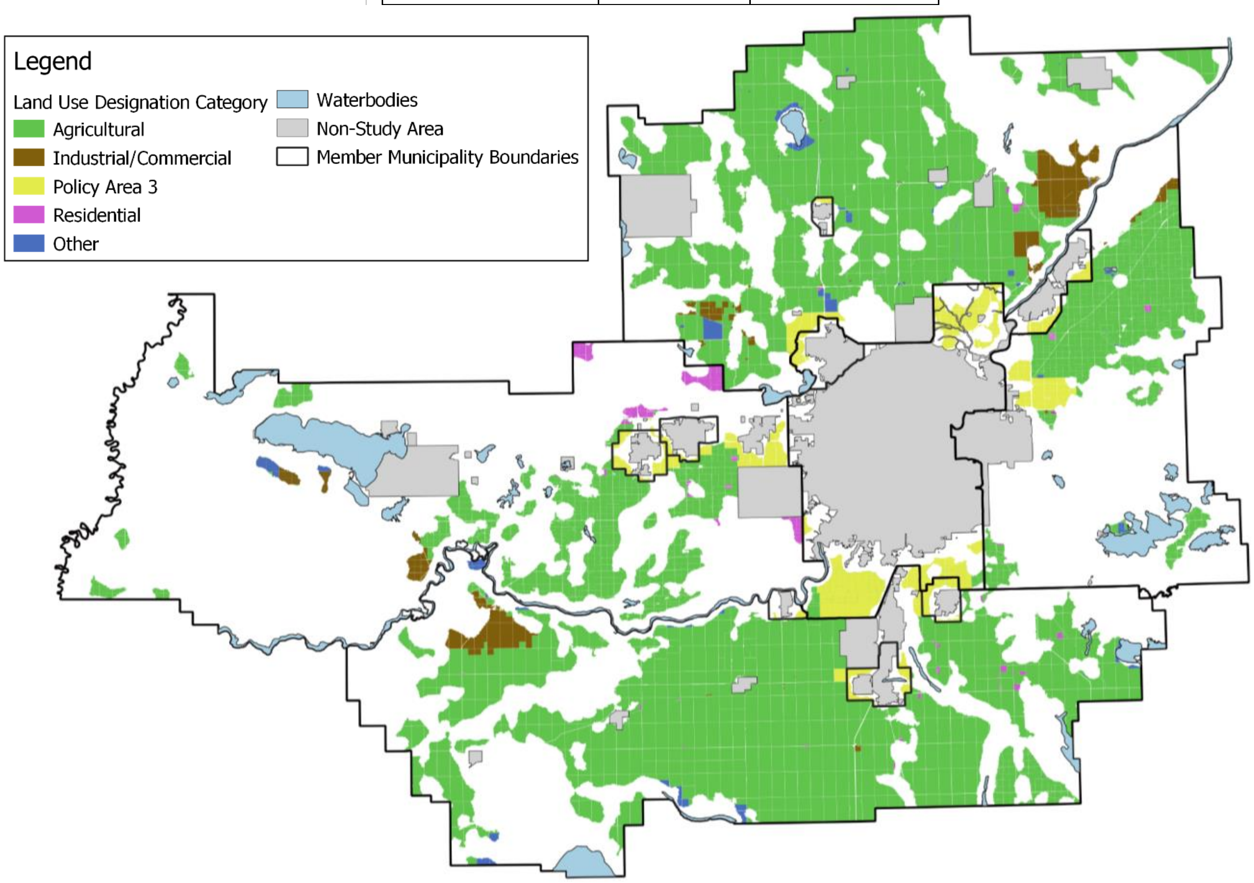

Figure 14. Prime Agricultural Areas within Land Use Designation Categories