Assessing Land Use Change in Edmonton, Alberta between 1966 and 1976:

An analysis of Urban Sprawl and Cropland Sustainability

Produced for the City of Edmonton

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Executive Summary

Much like many Canadian provinces, Alberta is rich in natural resources and relies heavily on them to fuel its economy. Edmonton, as one of Alberta's long-time largest cities, is consistently growing and has seen exponential urban sprawl. The idea of the opportunity to gain capital through resource extraction was romanticized highly in the early 1970's as the Great Canadian Oil Sands Project, now known as Suncor, began to work as the first major private extraction company of its kind (Industry Landmark, n.d). With Edmonton being the closest major city to Fort MacMurray (home to the oil sands), and the opportunity that the oil sands hold, it can be speculated that the continued privatization of resource extraction influenced an increase in population and urban sprawl.

For the purpose of this study, land use change between the years 1966 and 1976 will be critically examined. Urban areas, cropland, and mining within this time period proved to show significant overall change. This time of transition for the city and surrounding region has highlighted the importance of implementing strategic land use planning in the future to ensure natural resources in Edmonton are being sustainably used and prudently preserved.

Introduction

John Hansen, in his 1984 article, "Canadian Small Settlements and the Uptake of Agricultural Land, 1966-1976" asserts "…the area of good quality agricultural land in Canada is being taken up at rates that are sufficiently high as to warrant government intervention" (p. 76). Hansen is drawing immediate concern as to how quickly urban sprawl is happening in many Canadian cities. Although the rural landscape of Alberta, specifically surrounding Edmonton, is quite vast, it cannot be discounted that with urban growth and population increase local food cultivation becomes increasingly important. Land use change and planning is a local problem that is driven by a larger scale demand as populations increase (Tramberend et al., 2019). Upon request from the City of Edmonton, our consulting firm has critically assessed the issue of rapidly changing land uses in the region as conscious urban growth can help stabilize the fertile land in the area.

The continued expansion of urban areas is compromising viable cropland that surrounds the exterior of the city's core. Proximity is a defining factor in the conversion of land use as areas immediately bordering the city are more likely to be developed (Wang and Qiu, 2017). As a result, in areas like Edmonton where there is limited physical and geographical constraints, the city will continue to expand.

Furthermore, the long-term projected benefits of urbanization are, economically, more pleasing then that of preserving cropland (Beckie, Hanson, and Schrader, 2013;2016). The growing population is pushing the need for urban expansion: residential, commercial and industrial alike. With the presence of vast natural resource comes a workforce that requires the movement of people into local communities and in turn the housing and community requirements for labourers continues to increase. With resource likely driving urban sprawl urgent mitigation is required to ensure a sustainable future for the Edmonton area.

Results and Discussion

In conducting analysis, the Canada Land Use Monitoring (CLUMP) data from the Geogratis ftp archive site was obtained. Using 100m resolution data from the years 1966 and 1976 we were able to develop functional land use files (Map 1, Map 2). To show how the land use in the Edmonton region has changed over time, we created a transition matrix, and used FRAGSTATS to develop relevant spatial statistics with the goal of visually and quantitatively measuring the changes in land use (Table 2, Table 3).

This dataset proved to show a series of change in many class and landscape-based aspects of the study area. Of importance to this assessment, the changes in cropland, mines/quarries/sandpits, and urban/built-up areas are of significance. Between 1966 and 1976 there has been a 21,559 hectare decrease in total cropland area, a 1,435 hectare increase in total mines/quarries/sandpits area, and a 35,399 hectare increase in total urban/built-up area (Figure 1). Similarly, the overall class-based landscape percentages follow the same kind of trends with cropland decreasing in landscape percentage by 3.3%, mines/quarries/sandpits increasing by 0.2%, and urban/built-up areas increasing its land use percentage by 5.5% in 1976 (Figure 2). These overall trends depict the concern of the rapid urban sprawl as discussed above and indicate that rapid urban sprawl likely correlates with the depletion of cropland (Map 3).

The overall edge length of each of the classes investigated follow the same trends as the other class metrics presented so far (Figure 3). A class that contests this theory of urban sprawl and natural resource extraction depleting viable land is improved pasture and forage crops. In nearly all class metrics presented, there is an indication of positive change from 1966 to 1976. In fact, the total edge of the improved pasture and forage crops increased 2456 kilometers by 1976. The overall fluctuation of land use types across the region in the 10-year time period is indicating that these changes may not be sustainable as many are exponentially increasing or decreasing (Figure 4.).

Recommendations

Upon close consideration to the class and landscape metrics we are recommending the following:

- the City of Edmonton allocates more funding to their land use planning department
- the onboarding of a sustainability strategist
- encourage public participation within the smaller communities on the perihpery of the city to obtain input on the position of the rural population
- implement qualitative strategies that can complement quantitative strategies to combat rapid urban sprawl (ex. interviews, surveys)

The results presented indicate that cropland in the Edmonton area is suffering greatly due to the rapid expansion of the urban centre of Edmonton, AB. There is also indication that natural resources in the area are not only a factor driving urban expansion, but in depleting cropland (Map 3). The human impact on the landscape of Edmonton is beginning to cause irreversible land use change, and as a governmental body that has the power to employ positive change, we suggest you take immediate action.

References

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Tables, Figures and Maps

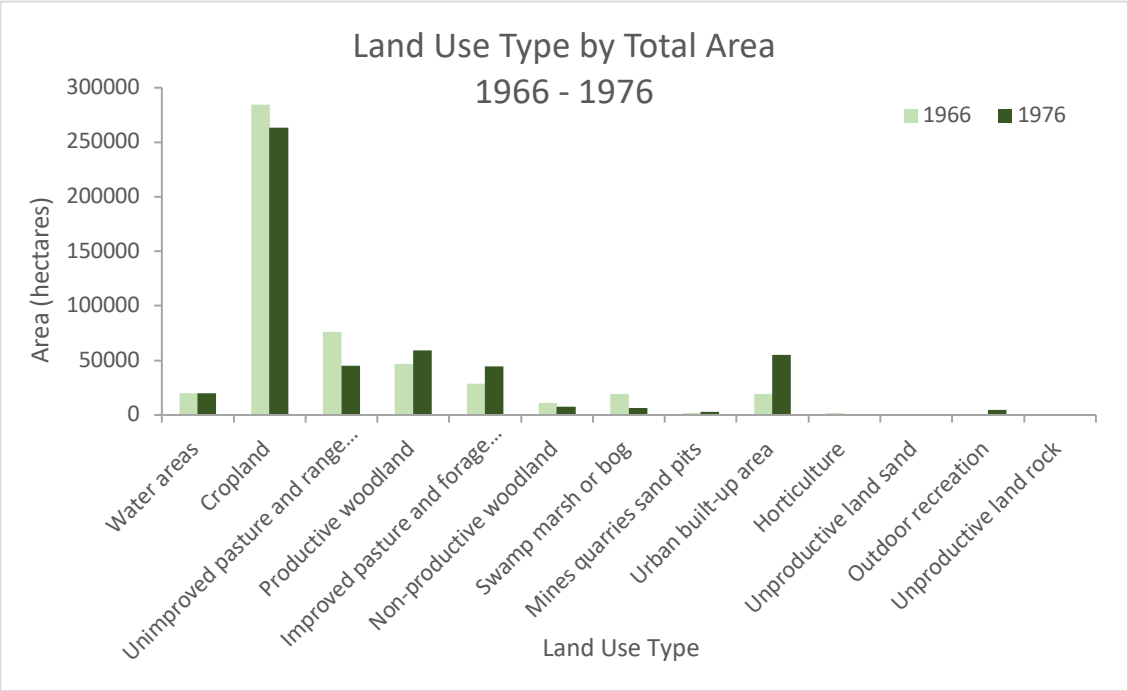

Figure 1 - Land use type by total area (hectares)

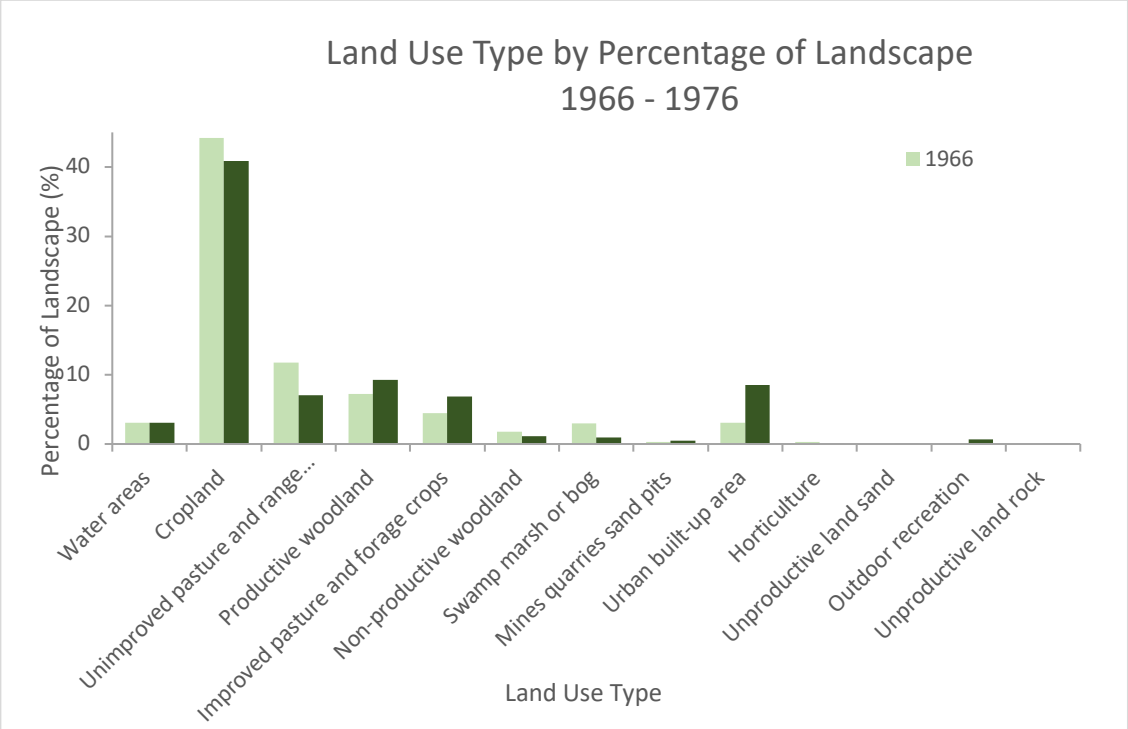

Figure 2 - Land use type by percentage of landscape (%)

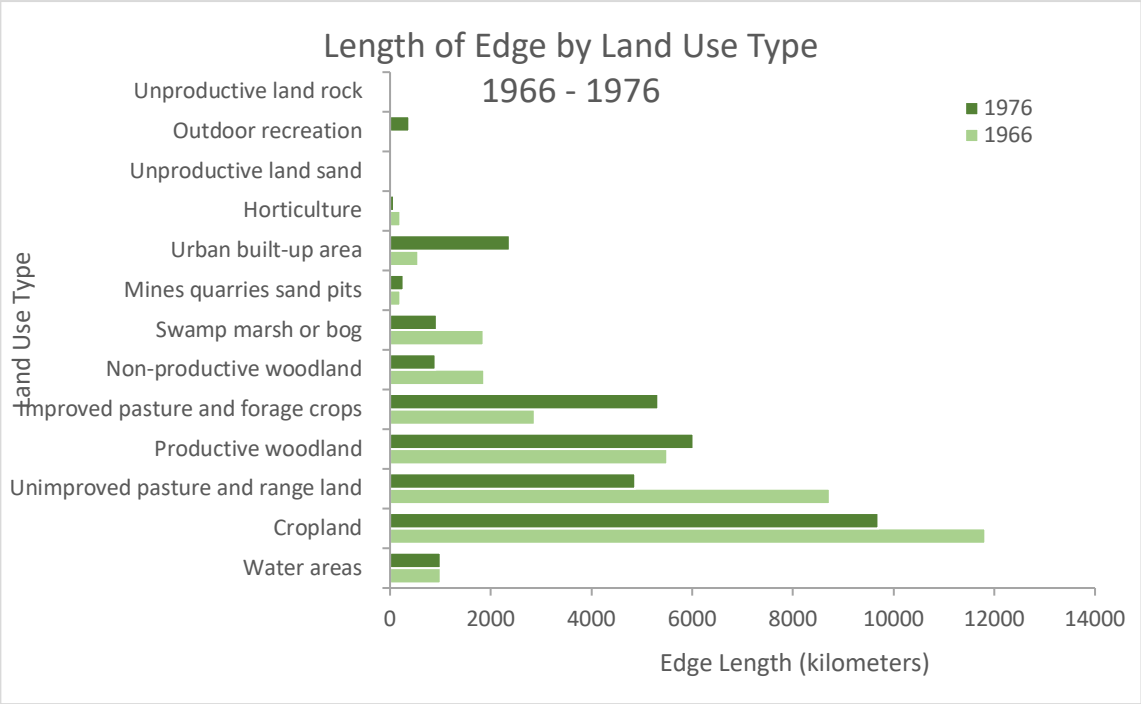

Figure 3 – Land use type by length of edge (kilometers)

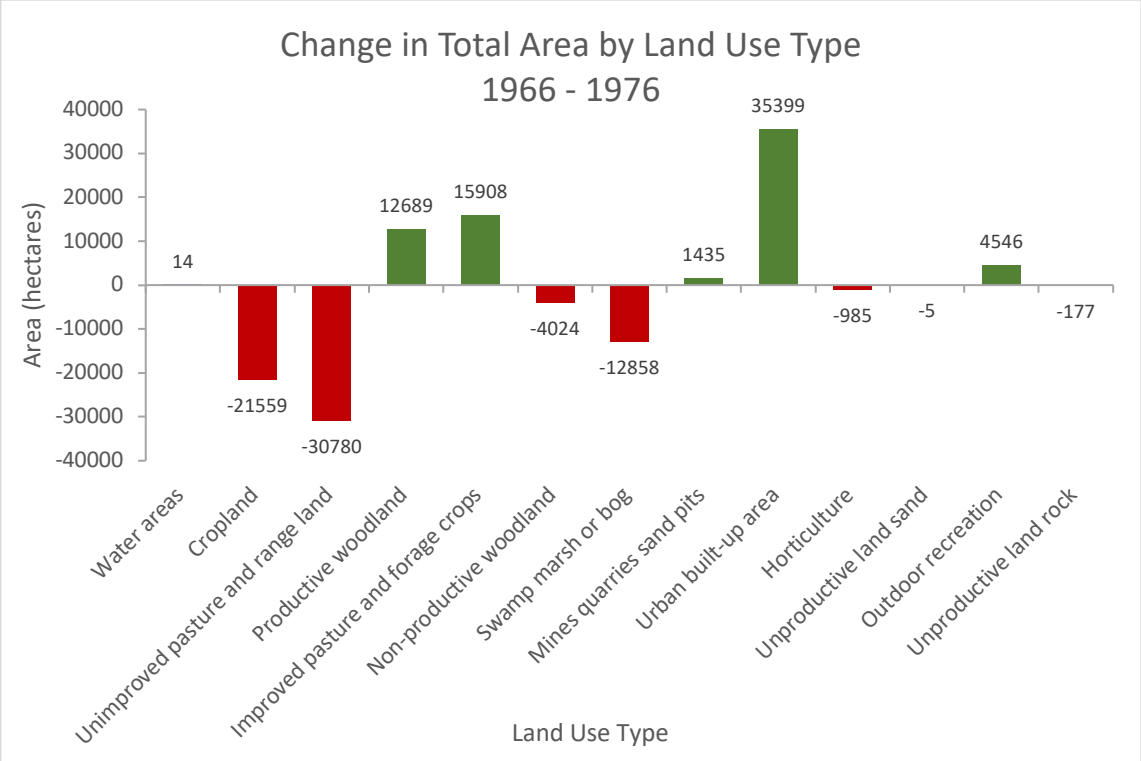

Figure 4 - Land use type by total area change (hectares)

Class-Metric	Description
Total Area	equals the sum of the areas (m2) of all patches of the corresponding patch type, divided by 10,000 (to convert to hectares); that is, total class area
Percentage of Landscape	equals the percentage the landscape comprised of the corresponding patch type
Number of Patches	equals the number of patches of the corresponding patch type
Total Edge	quals the sum of the lengths (m) of all edge segments involving the corresponding patch type
Total Core Area	equals the sum of the core areas of each patch (m2) of the corresponding patch type, divided by 10,000 (to convert to hectares)
Patch Cohesion Index	equals 1 minus the sum of patch perimeter (in terms of number of cells) divided by the sum of patch perimeter times the square root of patch area (in terms of number of cells) for all patches in the landscape, divided by 1 minus 1 over the square root of the total number of cells in the landscape, multiplied by 100 to convert to a percentage
Landscape-Metric	
Number of Patches	equals the number of patches in the landscape. Does not include any internal background patches (i.e., within the landscape boundary) or any patches at all in the landscape border, if present
Patch Density	equals the number of patches in the landscape, divided by total landscape area (m2), multiplied by 10,000 and 100 (to convert to 100 hectares)
Total Edge	equals the sum of the lengths (m) of all edge segments in the landscape
Percentage of Like Adjacencies	equals sum of the number of like adjacencies for each patch type, divided by the total number of cell adjacencies in the landscape; multiplied by 100 (to convert to a percentage). In other words, the proportion of cell adjacencies involving the same class

Table 1 - Class and landscape metric descriptions (Fragstats Metrics, n.d)

	Cropland	Horticulture	Improved pasture and forage crops	Mines	Non-productive woodland	Outdoor recreation	Productive woodland	Swamp	Unimproved pasture and range land	Urban built-up area	Water areas	Total
Cropland	46.02%	0.12%	0.01%	0.39%	0.15%	0.12%	0.94%	0.21%	3.72%	4.20%	0.00%	55.89%
Horticulture	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Improved pasture and forage crop	0.09%	0.00%	8.68%	0.01%	0.03%	0.01%	0.07%	0.01%	0.20%	0.09%	0.00%	9.19%
Mines	0.01%	0.00%	0.00%	0.14%	0.01%	0.02%	0.03%	0.00%	0.04%	0.07%	0.00%	0.33%
Non-productive woodland	0.47%	0.00%	0.00%	0.01%	0.32%	0.09%	1.94%	0.02%	0.50%	0.41%	0.00%	3.75%
Outdoor recreation	0.00%	0.00%	0.00%	0.00%	0.00%	0.29%	0.00%	0.00%	0.00%	0.05%	0.00%	0.34%
Productive woodland	0.83%	0.00%	0.01%	0.02%	0.08%	0.12%	3.57%	0.01%	0.41%	0.54%	0.00%	5.59%
Swamp	0.39%	0.00%	0.00%	0.00%	0.17%	0.02%	0.29%	0.63%	0.58%	0.14%	0.00%	2.23%
Unimproved pasture and range lar	3.89%	0.01%	0.02%	0.04%	0.68%	0.23%	4.82%	0.34%	3.42%	1.46%	0.00%	14.92%
Urban built-up area	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.85%	0.00%	3.85%
Water areas	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.90%	3.90%
Total	51.72%	0.15%	8.72%	0.61%	1.44%	0.90%	11.66%	1.22%	8.88%	10.81%	3.91%	100.00%

Table 2 - Transition Matrix

	Total Area (hectares)		Percentage of Landscape		Number of Patches		Total Edge (km)		Total Core Area (hectares)		Patch Chohesion Index	
Year	1966	1976	1966	1976	1966	1976	1966	1976	1966	1976	1966	1976
Water areas	19861	19875	3.0825	3.0866	337	340	1000.6	1003.8	13003	13003	0.8072	0.7965
Cropland	284664	263105	44.1805	40.8601	579	709	11817.3	9696.5	196305	190266	0.7333	0.5857
Unimproved pasture and range land	75934	45154	11.7851	7.0124	2597	1715	8727	4865.6	24261	15687	0.1692	0.1819
Productive woodland	46750	59439	7.2557	9.2308	2132	1718	5502.8	6029.3	11720	22773	0.154	0.2286
Improved pasture and forage crops	28450	44358	4.4155	6.8888	843	2170	2871.6	5327.5	10701	10710	0.2928	0.1537
Non-productive woodland	11340	7316	1.76	1.1362	1144	403	1867.2	905.7	1951	2236	0.2099	0.3901
Swamp marsh or bog	19086	6228	2.9622	0.9672	517	551	1861	926.5	7816	1375	0.4251	0.2666
Mines quarries sand pits	1681	3116	0.2609	0.4839	99	84	199.4	262.4	508	1405	1.2781	1.6064
Urban built-up area	19596	54995	3.0413	8.5407	133	417	555.4	2373	15708	38268	0.8202	0.4681
Horticulture	1735	750	0.2693	0.1165	80	44	204.4	77.8	563	255	1.3291	1.3742
Unproductive land sand	23	18	0.0036	0.0028	5	6	4.2	4.8	0	0	10	13.3333
Outdoor recreation	36	4582	0.0056	0.7116	16	126	10.8	378.9	0	2152	9.1667	0.8635
Unproductive land rock	208	31	0.0323	0.0048	14	4	40.3	6.4	5	0	5.4945	0

Table 3 - Class-Metrics (see table 1)

	Total Area (hectares)		Percentage of Landscape		Number of Patches		Total Edge (km)		Total Core Area (hectares)		Patch Chohesion Index	
Year	1966	1976	1966	1976	1966	1976	1966	1976	1966	1976	1966	1976
Cropland	284664	263105	44.1805	40.8601	579	709	11817.3	9696.5	196305	190266	0.7333	0.5857
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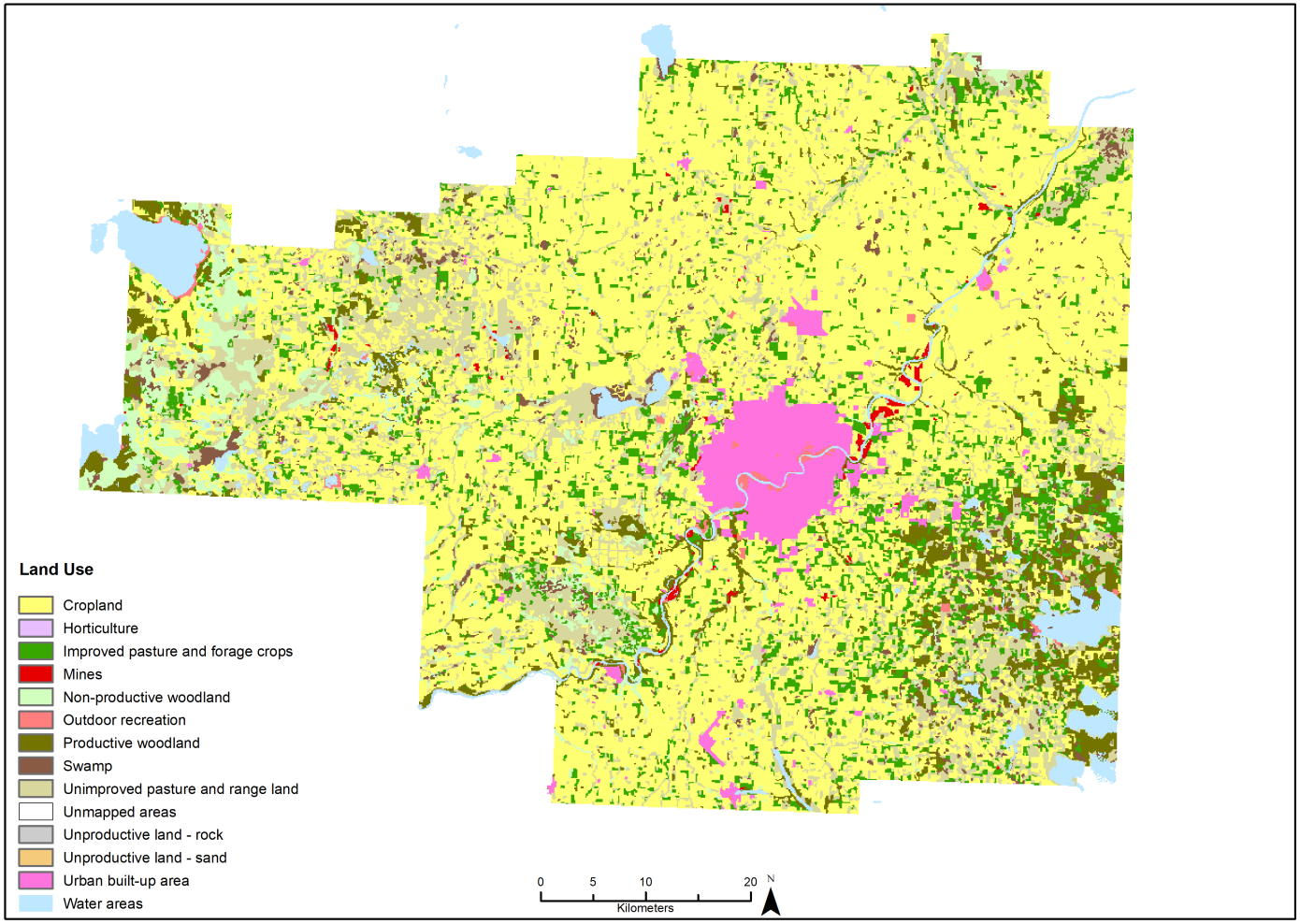
Improved pasture and forage crops	28450	44358	4.4155	6.8888	843	2170	2871.6	5327.5	10701	10710	0.2928	0.1537

Table 4 - Landscape-Metrics (see table 1)

Land Use in Edmonton, Alberta

1966



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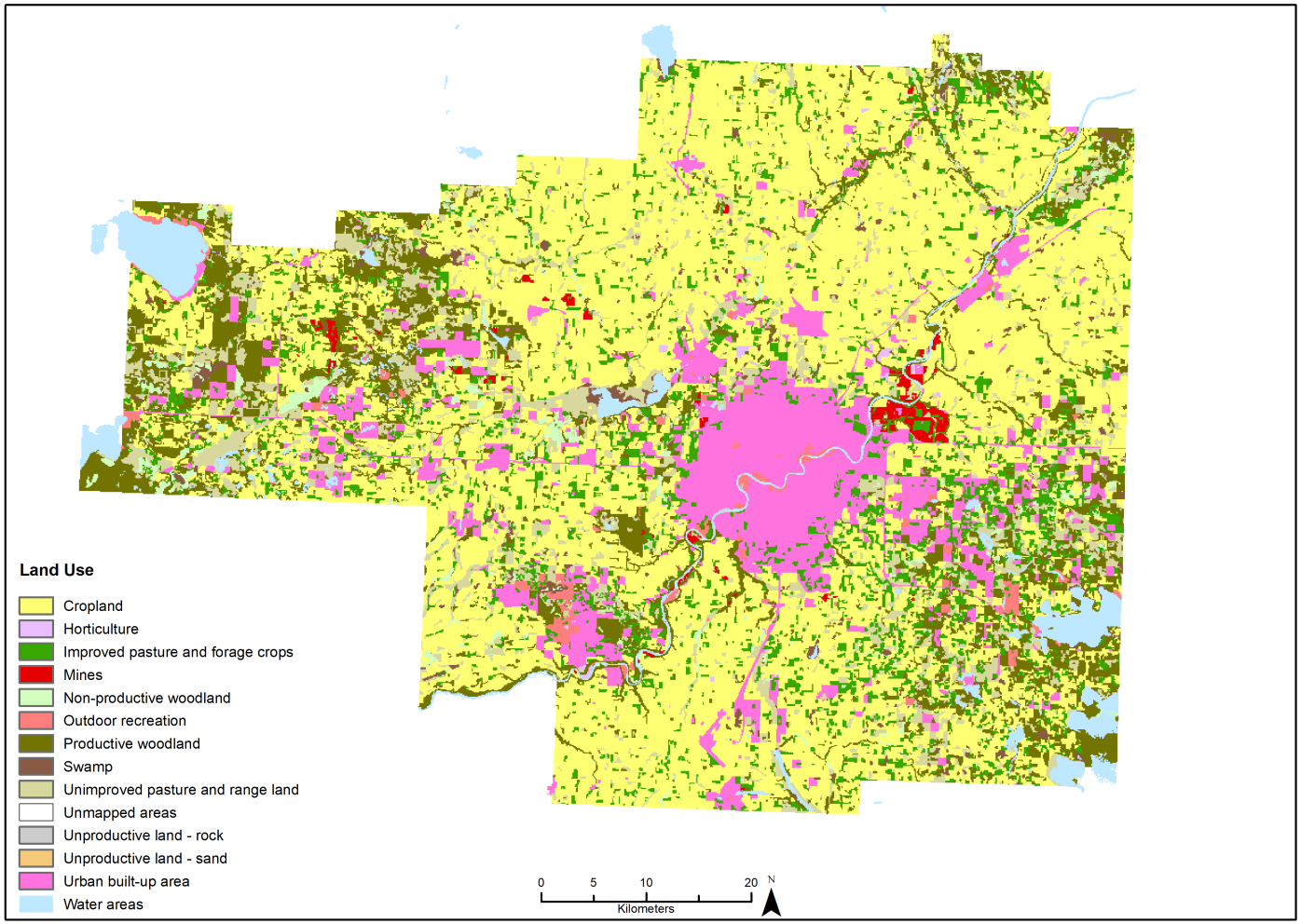
January 31, 2020
Projection: NAD_1927_UTM_Zone12
Data Source: Canada Land Use Monitoring Program, Geogratis

Map 1 - Edmonton, AB land use 1966

Land Use in Edmonton, Alberta

1976



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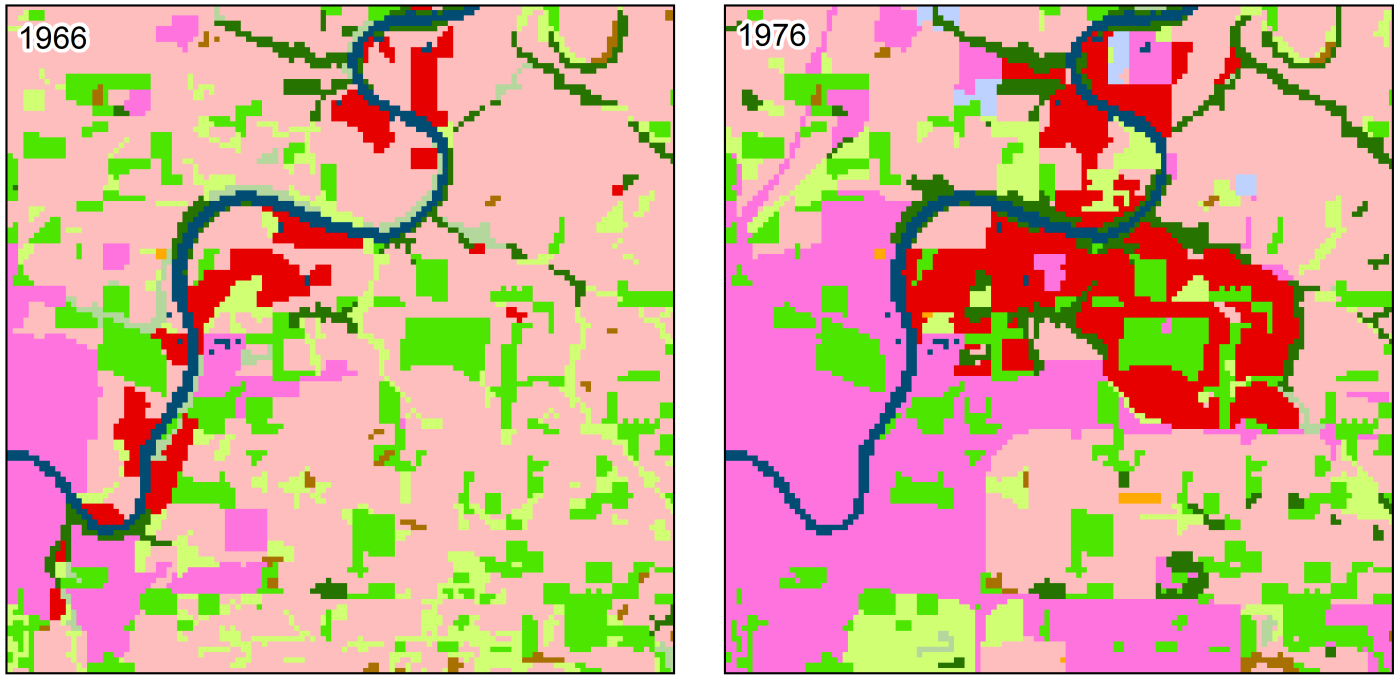
Data Source: Canada Land Use Monitoring Program, Geogratis

Map 2 - Edmonton, AB land use 1976

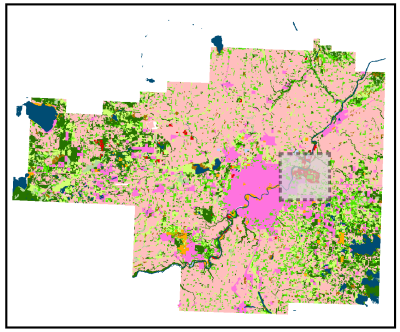
Land Use Change in Edmonton, AB

1966 - 1976



Land Use

- Cropland
- Horticulture
- Improved pasture and forage crops
- Mines
- Non-productive woodland
- Outdoor recreation
- Productive woodland
- Swamp
- Unimproved pasture and range land
- Urban built-up area
- Water areas



Note:
The inset map depicts the extent of Edmonton, AB. The highlighted region within the inset map displays the location of the area of interest shown in the close up maps.

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Kilometers

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Projection: NAD_1927_UTM_Zone12
Data Source: Canada Land Use Monitoring Program, Geogratis

Map 3 – Land use change in Edmonton, AB 1966 - 1976