LAND USE CHANGE IN EDMONTON, 1966-1976

Lab 1

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GEOB 479

Executive Summary

The decade between 1966 and 1976 has seen large amounts of growth in the Edmonton area. Alongside this has come great amounts of change to the surrounding landscape. This report describes the differences in land cover use over these 10 years. Overall, productive woodlands, urban built-up areas, and horticulture have shown very strong expansion in the period. This is likely the end result of increased urbanization and population growth, as well as an increase in the timber and agricultural industry. However, this has also resulted in loss of patch connectivity meaning that habitats could be increasingly fragmented.

Background

The study area covered in the following report consists of the land cover immediately surrounding the city of Edmonton. The biggest driver of land use change over the years has been for economic purposes following large growths in Edmonton's population. Edmonton continues to growth and expand outwards at a rapid pace, meaning that natural landscapes such as unproductive land sand or unimproved rangelands will likely become pastures and horticultural lands. Urbanization continues to growth in Edmonton, as more and more people move into the city. Expansions in the forestry and timber industry have also led to increased productive woodland use.

Methodology

Land cover data for the Edmonton region was taken from the Canada Land Use Monitoring Program (CLUMP), through the Geogratis website. This provided us with vector land use data for the years 1966 and 1976, allowing for a 10-year comparison. Vector files were then converted into geoTIFF raster files at 100m resolution. The data was then processed and fed into Fragstats, a spatial statistics software, to calculate several metrics. A land use class transition matrix was also created through a pivot table in Microsoft Excel, along with several maps in ESRI Arcmap.

Results

Looking at the area shown in the zoomed in maps, the land cover in 1966 primarily consisted of unimproved pastures and rangelands, with a fair share of unproductive woodlands. However, the 1976 map shows significant land cover change, with a large proportion of land being converted into productive woodlands. This likely indicates a strong growth in the logging industry.

The transition matrix below details the quantitative change in land use types. A transition matrix is a type of stochastic chart showing change between two data sets and can be used to predict future change. The matrix detailed below contains 1966 land use types as rows and 1976 land uses as columns. Highlighted boxes indicate where land use has remained the same. Looking down the highlighted diagonal, cropland and urban built-up areas generally tended to stay the same, while mines, quarries, sandpits, and gravel as well as unimproved pasture and rangelands mostly changed with some portions remaining the same. Conversely, almost every instance of other land use types changed to a significant degree. Outdoor recreation in particular shows great change, with none of the original land staying as recreational, mostly having been changed to horticulture.

The biggest change can be seen in productive woodlands, with 95% of the land being changed to pastures and forage crops. This shows a large growth in the agricultural industry, as forests are clear cut to form feeding pastures for cattle farming, reflective of Alberta's large cattle industry.

With regards to the metrics computed by Fragstats, 12 metrics were compiled, as shown in the chart below. Going from left to right, total class area (CA) refers to the amount of land in hectares occupied by a given land class. Percent of landscape (PLAND) is the fraction of the total map area taken up by a class, while NP is simply the number of patches of a class. Total edge (TE) is the sum of all edges of patches of a land use class. Area_CV is the coefficient of variation in patch area, Shape_MN is mean patch shape index, and Shape_AM is area-weighted mean patch shape index. These metrics provides measures of central tendency with regards to the shape and size of the patches. PAFRAC, or perimeter-area fractal dimension, is a measure of fractal dimension computed with the formula 2/Slope. TCA is the total core area. Core area is the total patch area after a certain edge buffer is removed, to calculate the internal area of a given patch. Total core area then finds the sum of all areas that do not touch an edge, in contrast to TE (total edge). Core area percent of landscape (CPLand) is the fraction of the total mapped landscape that consists of core areas. NDCA is the number of disjunct core areas, which sums up all disjunct core areas for a given land use class. A disjunct core is a spatially distinct core area. These are usually separate, but in certain cases a single patch may contain multiple disjunct cores of the same type due to poor connectivity. In landscape ecology, an organism may see these different cores as completely different patches. Finally, CONNECT refers to connectivity, or the degree of physical continuity between landscape patches. This is a vitally important metric for studying organisms, as it directly relates to the ability of an organism to migrate across landscape patches.

Looking at the data, connectivity indexes have generally dropped, with the notable exception of certain human developed class types such as woodlands and mines and quarries. This indicates a strong growth in human economic activity. Elsewhere, classes such as horticulture have experienced large drops in connectivity, meaning that there is increased landscape fracturing, despite the strong overall growth in horticultural area, up to 730 m^2. Fracturing can result in diminished habitat mobility for many organisms, especially small animals unable to travel long distances. CA (total area) shows a strong growth in several types of land use classes. For example, productive woodland has doubled in 10 years from 28450 m^2 to 59439 m^2, while non-productive woodland has dropped by nearly 12000 m^2. According to the transition matrix, most of the land that became productive woodlands was formerly improved pastures, while most of the non-productive woodlands had become swampmarsh. The vast majority of productive woodlands in 1976 are most likely new growths, as the transition matrix indicates that a large amount of existing productive woodland has been converted to horticulture. This can also be seen in the patch count (NP), which shows a significant drop in the number of patches present for unimproved pasture and rangeland, and a spike in productive woodland patch counts. However, this new woodland is also highly fragmented, as seen by the drop in total core area despite the increase in total area.

Recommendations

We recommend that the City of Edmonton undertake additional consultations with wildlife experts in order to determine the extent of the impact that landscape fragmentation and

land use change has on local protected wildlife. Additionally, protection plans should be put into place for productive woodlands to prevent future deforestation, as new growth trees are less productive overall as compared to old growth.

Figures

1. Transition Matrix

1976 \ 1966	Cropland	Improved Pasture	Mines, Quarries,	Non-productive	Outdoor Recr	Productive Wc	Swampmarsh	Unimproved Pasture	Urban Built-Up	Grand Total
Cropland	82.52%	1.69%	0.70%	0.38%	0.22%	0.02%	0.26%	6.67%	7.53%	283678
Horticulture	36.36%	0.00%	0.00%	0.00%	54.55%	0.00%	0.00%	0.00%	9.09%	22
Improved Pasture and Forage Crops	0.98%	0.77%	0.13%	0.16%	0.01%	94.49%	0.28%	2.15%	1.02%	46705
Mines, Quarries, Sand, and Gravel	4.59%	9.62%	45.00%	0.19%	0.00%	0.13%	4.02%	14.20%	22.25%	1591
Non-productive Woodland	12.86%	52.83%	0.27%	0.47%	0.05%	0.05%	8.73%	13.63%	11.11%	18646
Outdoor Recreation	1.19%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.98%	96.84%	253
Productive Woodland	15.24%	65.11%	0.40%	0.27%	0.04%	0.11%	1.47%	7.48%	9.87%	27861
Swampmarsh or Bog	17.87%	13.01%	0.07%	28.49%	0.04%	0.12%	7.90%	26.37%	6.13%	11209
Unimproved Pasture and Rangelands	26.49%	32.85%	0.25%	2.31%	0.10%	0.14%	4.62%	23.31%	9.94%	74716
Urban Built-Up Area	0.02%	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	99.96%	19596
Grand Total	263086	59306	3116	6224	750	44358	7314	45150	54973	484277

2. Fragstats Metrics

   a. 1966

TYPE	CA	PLAND	NP	TE	AREA_CV	SHAPE_MN	SHAPE_AM	PAFRAC	TCA	CPLAND	NDCA	CONNECT
Water areas	19861	3.0825	337	1000600	599.7003	1.3198	4.0585	1.3359	13003	2.0181	238	0.8072
Cropland	284664	44.1805	579	11817300	1498.1967	1.6392	28.389	1.4975	196305	30.467	1349	0.7333
Unimproved pasture and range land	75934	11.7851	2597	8727000	525.5473	1.4701	4.2198	1.5304	24261	3.7654	1922	0.1692
Improved pasture and forage crops	46750	7.2557	2132	5502800	186.3394	1.3557	1.919	1.4392	11720	1.819	1547	0.154
Productive woodland	28450	4.4155	843	2871600	263.1711	1.4933	2.5668	1.4601	10701	1.6608	670	0.2928
Swamp marsh or bog	11340	1.76	1144	1867200	218.2349	1.2831	1.7161	1.4375	1951	0.3028	365	0.2099
Non-productive woodland	19086	2.9622	517	1861000	339.773	1.5178	2.8952	1.4841	7816	1.2131	413	0.4251
Mines quarries sand pits	1681	0.2609	99	199400	154.1402	1.2398	1.5717	1.3221	508	0.0788	47	1.2781
Urban built-up area	19596	3.0413	133	555400	604.8148	1.2798	2.3059	1.2413	15708	2.4379	88	0.8202
Outdoor recreation	1735	0.2693	80	204400	132.3644	1.3764	1.7891	1.3692	563	0.0874	47	1.3291
Horticulture	23	0.0036	5	4200	89.7381	1.0286	1.0745	N/A	0	0	0	10
Unproductive land sand	36	0.0056	16	10800	83.887	1.1083	1.2407	1.5241	0	0	0	9.1667
Unproductive land rock	208	0.0323	14	40300	65.4976	1.7833	2.0392	1.6275	5	0.0008	2	5.4945

   b. 1976

TYPE	CA	PLAND	NP	TE	AREA_CV	SHAPE_MN	SHAPE_AM	PAFRAC	TCA	CPLAND	NDCA	CONNECT
Water areas	19875	3.0866	340	1003800	602.0022	1.3189	4.0565	1.3356	13003	2.0194	238	0.7965
Cropland	263105	40.8601	709	9696500	1121.912	1.5205	14.2402	1.3997	190266	29.5482	928	0.5857
Productive woodland	59439	9.2308	1718	6029300	414.5431	1.4841	3.4593	1.4643	22773	3.5366	1290	0.2286
Unimproved pasture and range land	45154	7.0124	1715	4865600	281.4969	1.405	2.4061	1.3925	15687	2.4362	1183	0.1819
Non-productive woodland	7316	1.1362	403	905700	219.4666	1.374	1.849	1.3749	2236	0.3472	203	0.3901
Swamp marsh or bog	6228	0.9672	551	926500	197.1752	1.2636	1.7191	1.3734	1375	0.2135	219	0.2666
Improved pasture and forage crops	44358	6.8888	2170	5327500	169.2857	1.3403	1.8312	1.4095	10710	1.6633	1489	0.1537
Mines quarries sand pits	3116	0.4839	84	262400	342.119	1.3176	2.7777	1.3146	1405	0.2182	61	1.6064
Urban built-up area	54995	8.5407	417	2373000	703.7032	1.4787	3.8207	1.3321	38268	5.943	384	0.4681
Horticulture	750	0.1165	44	77800	131.8307	1.1377	1.2681	1.1873	255	0.0396	22	1.3742
Outdoor recreation	4582	0.7116	126	378900	249.2571	1.3274	2.0706	1.2893	2152	0.3342	79	0.8635
Unproductive land sand	18	0.0028	6	4800	81.6497	1.1667	1.3333	N/A	0	0	0	13.3333
Unproductive land rock	31	0.0048	4	6400	136.0587	1.2955	1.9912	N/A	0	0	0	0

3. Chart of Largest Land Use Changes
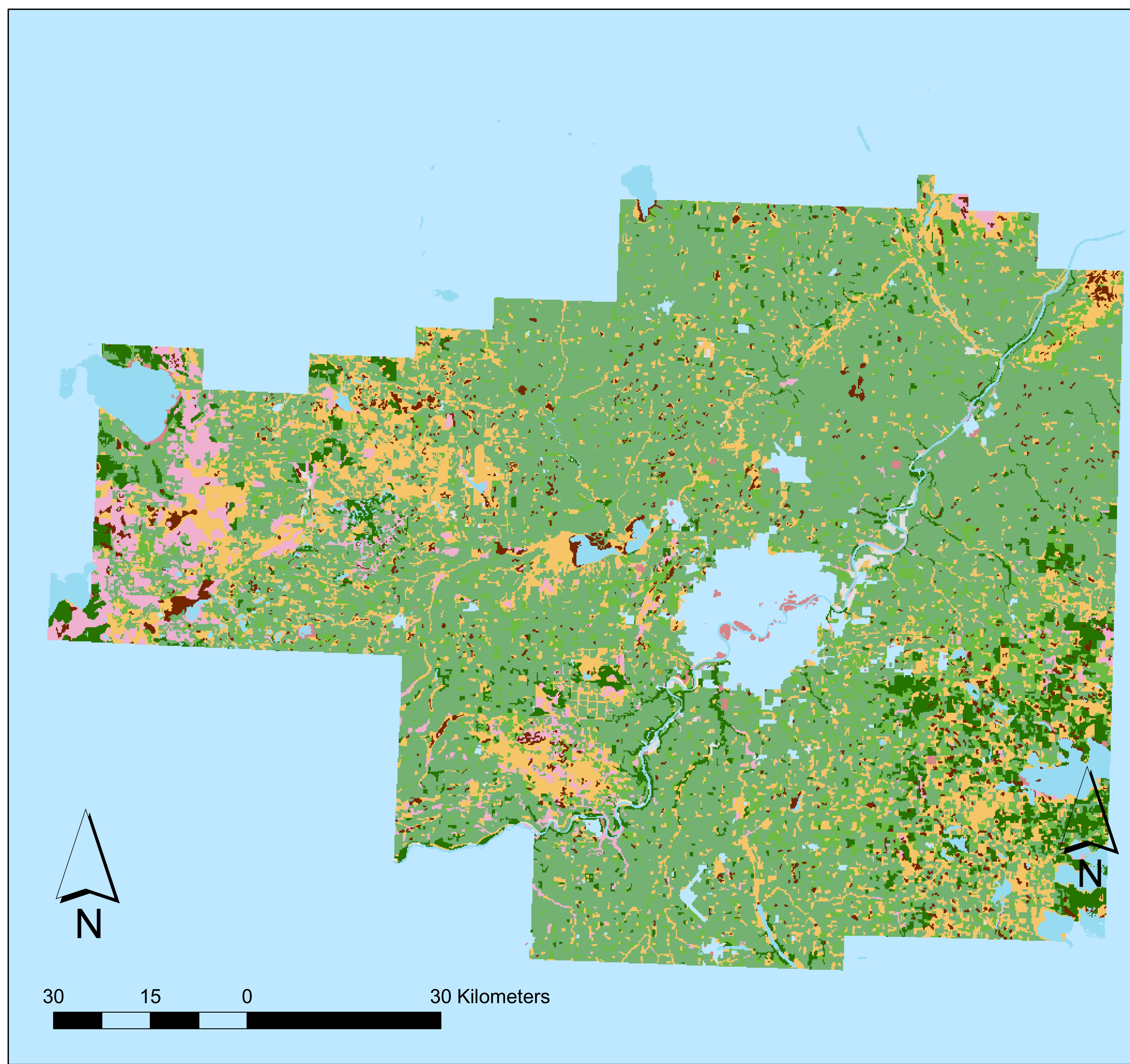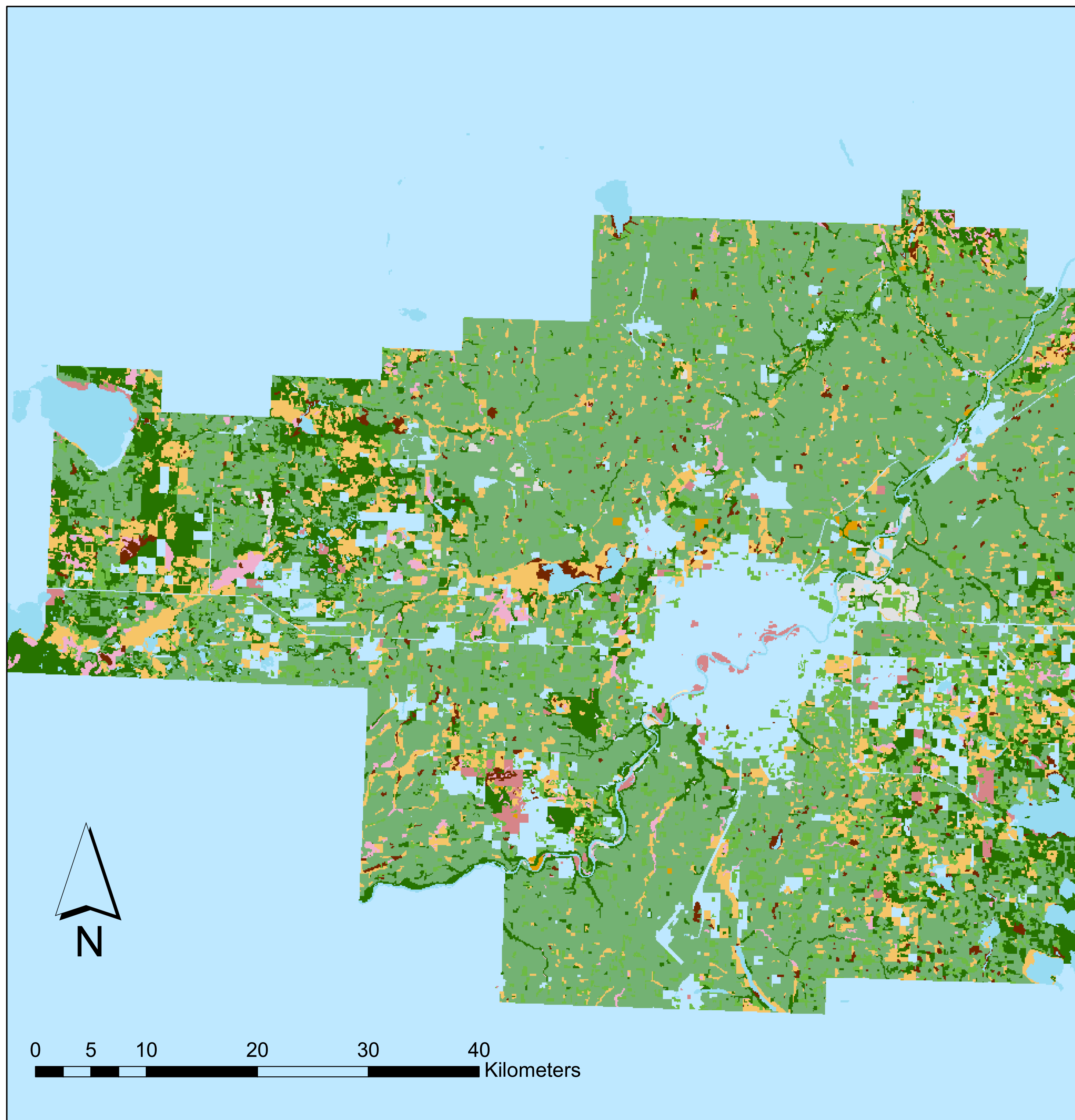
Land Use Classes by M²
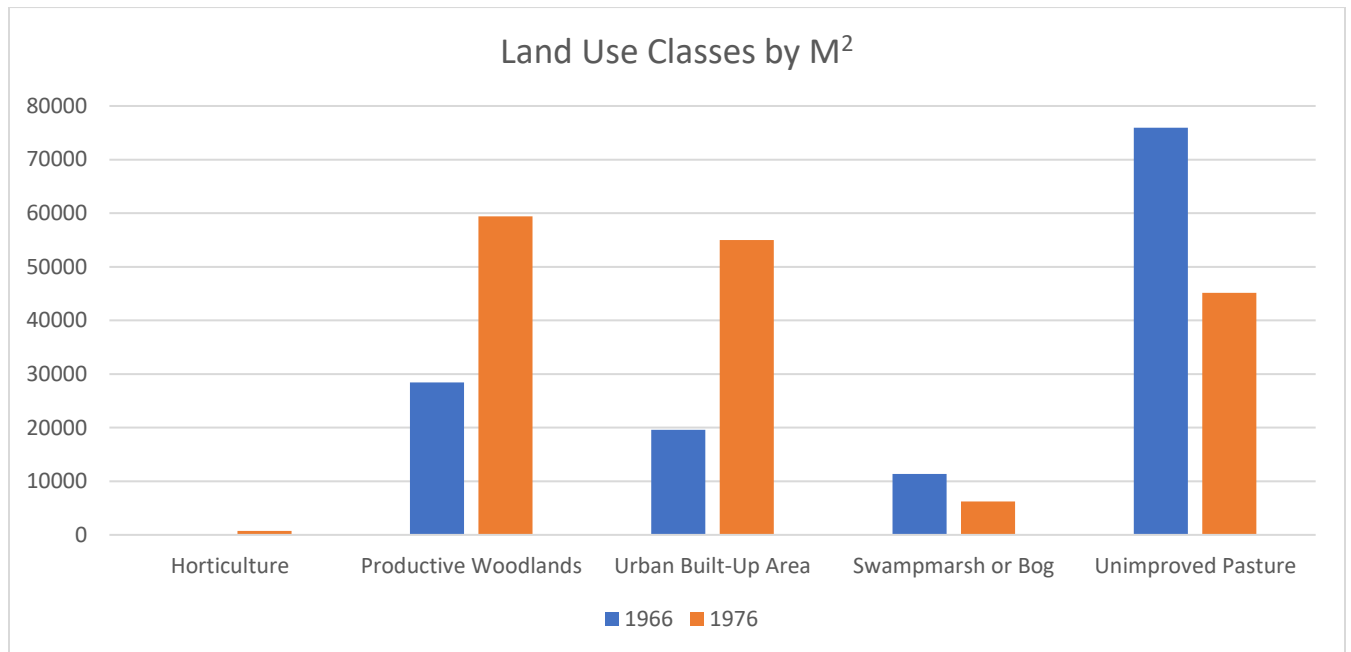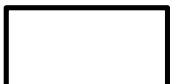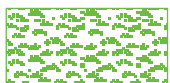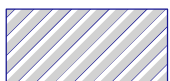
Edmonton Land Use 1966

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Data Source: Canada Land
Use Monitoring Program, ESRI
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January 2020

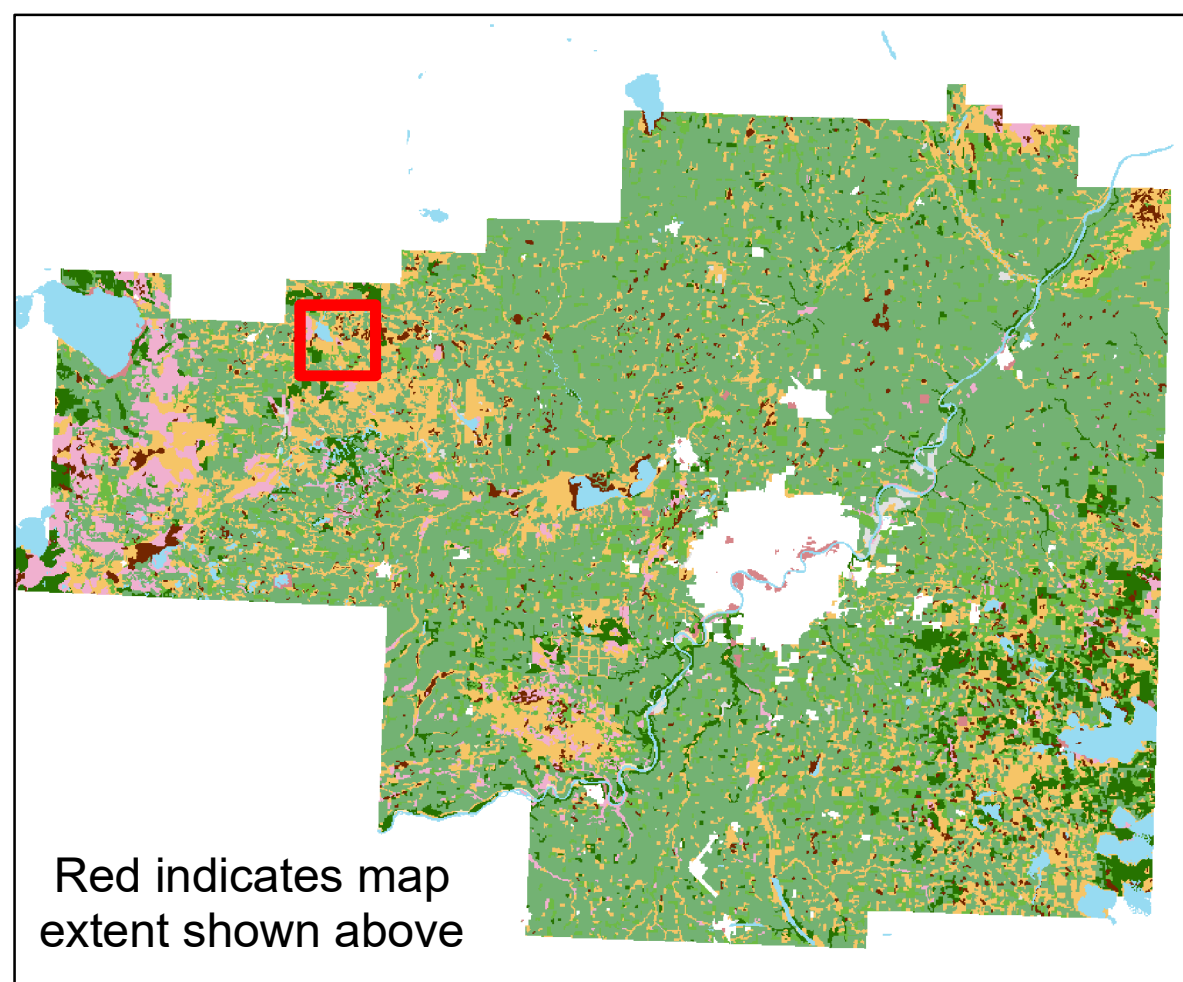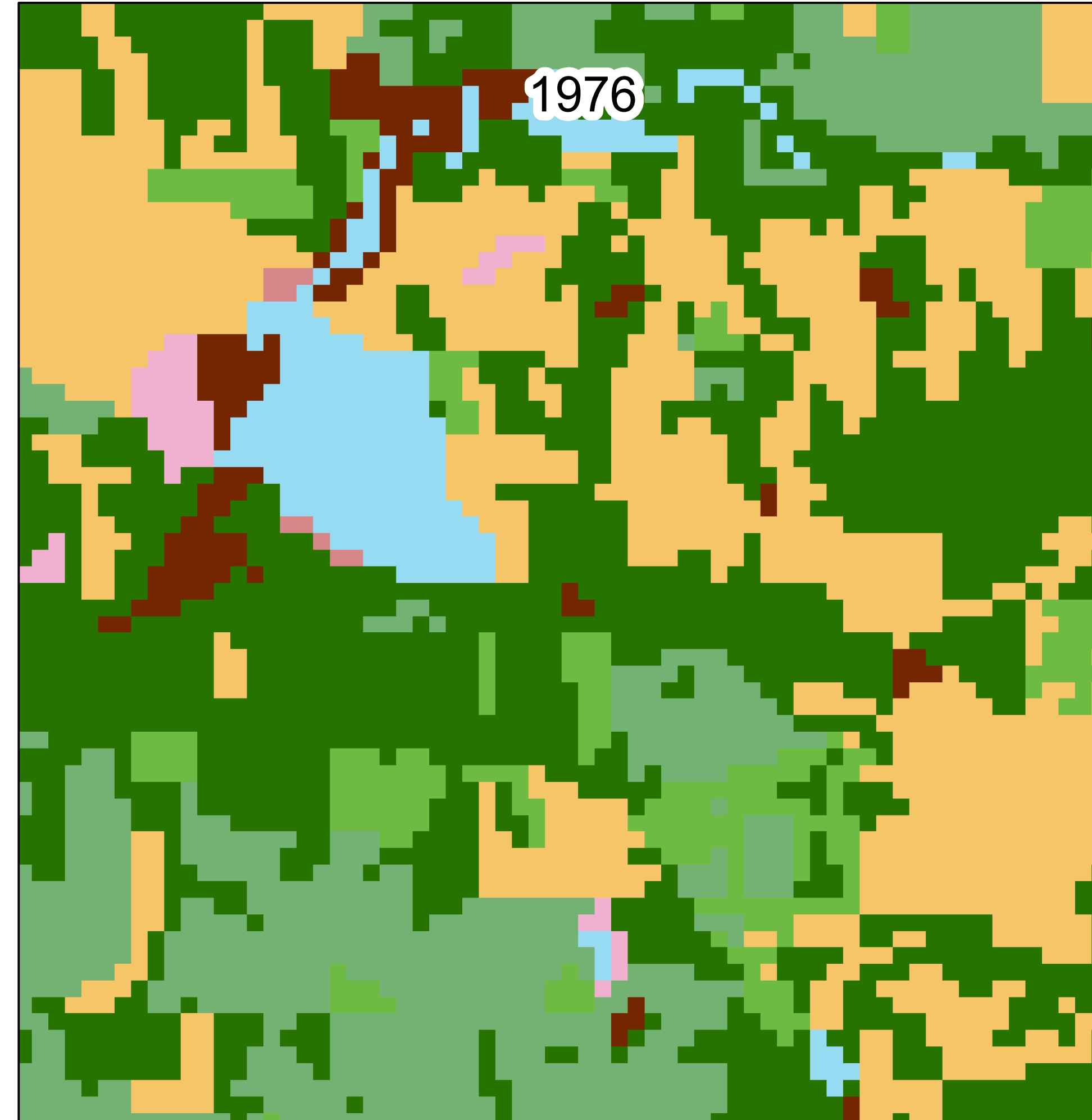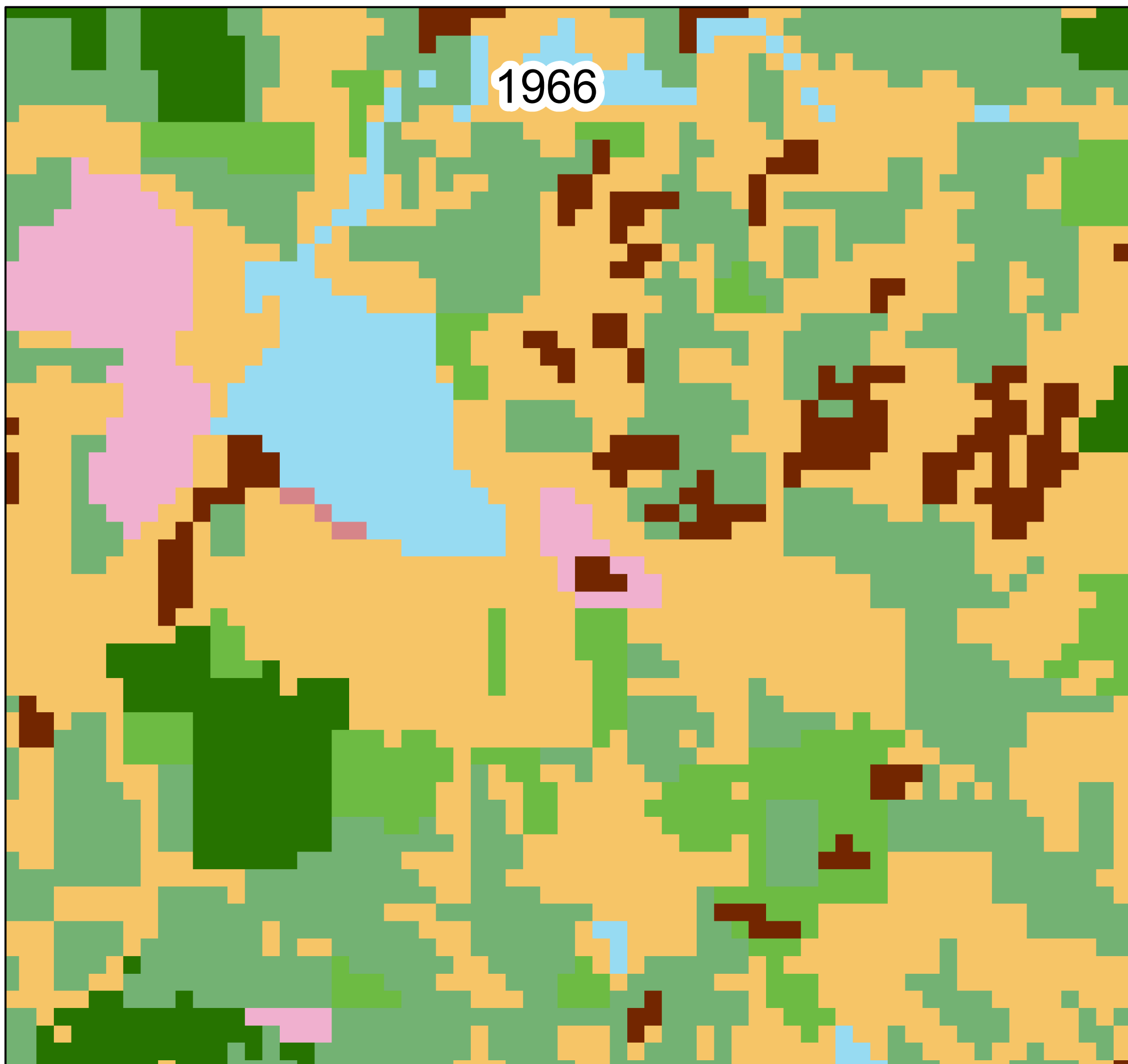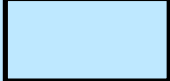## Landuse Types

Class

- Unmapped areas
- Water areas
- Cropland
- Improved pasture and forage crops
- Unimproved pasture and range land
- Productive woodland
- Swampmarsh or bog
- Non-productive woodland
- Mines quarries sand and gravel pits
- Urban built-up area
- Outdoor recreation
- Unproductive landsand
- Horticulture
- Unproductive landrock

N

N

30   15   0   30 Kilometers
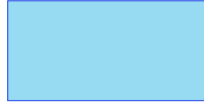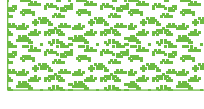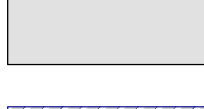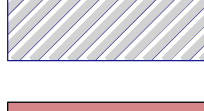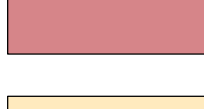
Edmonton Land Use 1976

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Data Source: Canada Land
Use Monitoring Program, ESRI
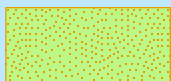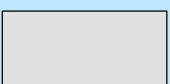Datum: NAD27 UTM 12N
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Landuse Types

Class

- Unmapped areas
- Water areas
- Cropland
- Improved pasture and forage crops
- Unimproved pasture and range land
- Productive woodland
- Swampmarsh or bog
- Non-productive woodland
- Mines quarries sand and gravel pits
- Urban built-up area
- Outdoor recreation
- Unproductive landsand
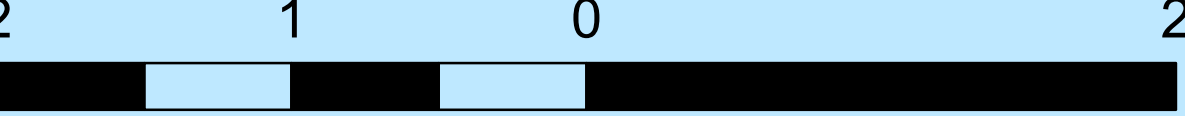- Horticulture
- Unproductive landrock

N

0   5   10   20   30   40
Kilometers
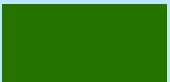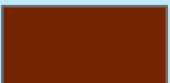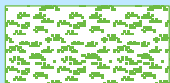
Landuse Change in Edmonton From 1966-1976

1966

1976

Red indicates map extent shown above

Landuse Types

Class

Unmapped areas

Water areas

Cropland

Improved pasture and forage crops

Unimproved pasture and range land

Productive woodland

Swampmarsh or bog

Non-productive woodland

Mines quarries sand and gravel pits

Urban built-up area

Outdoor recreation

Unproductive landsand

Horticulture

Unproductive landrock

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Data Source: Canada Land Use Monitoring Program, ESRI
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2   1   0   2 Kilometers

N