Estimating suburban population growth: A study of the Ottawa-Gatineau CMA, 1996-2016

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Emily Goldney, March 2018

Executive Summary

Research Objective

The purpose of this project was to determine the proportion of Ottawa-Gatineau Census Metropolitan Area (CMA) residents living in less sustainable forms of suburban development and to determine how this proportion has changed geographically and temporally, and to determine if Ottawa's suburban growth management policies are achieving their targets.

Method

This report applied the classification model and suburban definitions established by the Canadian Suburbs research program (Gordon & Janzen, 2013) to data from the 2016 Statistics Canada Census, to classify each of Ottawa-Gatineau's census tract (CT)s as an active core, exurban area, transit suburb, or automobile suburb (See Map 1) . This was accomplished using Geographic Information System (GIS) mapping techniques, and results were verified using satellite imagery. The results of the analysis of 2016 data were then compared against the results of previously-completed analyses of 1996 and 2006 Statistics Canada data, to determine geographic and temporal trends in suburban growth.

Findings

This report found that most Ottawa-Gatineau residents lived in less sustainable forms of development; 76% of the CMA population, over 1 million people, lived in automobile suburbs or exurbs. The good news is that temporal trend analysis found that the share of CMA population growth of the automobile suburbs decreased from 1996-2016, while that of the active cores increased over the same time period. However, the share of CMA growth of the transit suburbs decreased from 1996-2006, while that of the exurbs increased over the same time period. Geographic trend analysis found that most of Ottawa's

population growth was focused outside of the Greenbelt, and mainly in the Western area of Ottawa. Due to boundary and definition issues, direct comparison of study results with Official Plan quantitative growth targets was not possible. However, it is clear that most population growth is still occurring in the less sustainable automobile suburbs and exurban areas.

Recommendations and Conclusions

Firstly, Ottawa is and will remain a suburban city for decades to come. Given the large volume of existing automobile suburbs and exurbs, and the large percentage of growth which remains in these less sustainable suburbs, Ottawa-Gatineau planners must accelerate their efforts to promote the conversion of existing areas to active core areas or transit suburbs, and slow future development in automobile suburbs. The LRT may catalyze significant growth in the number and population of transit suburbs; these effects remain to be verified.

To assist in the conversion of existing automobile suburbs and exurbs, Ottawa and Gatineau should also work to build walkable, bikeable, and transit-supportive 'satellite downtowns' around existing employment centres in the suburbs. The creation of these suburban town centres would allow current residents to walk, bike, or take transit to meet their daily needs and commute to work. Ottawa-Gatineau should also aim to direct future growth to infill and intensification of existing built areas, and avoid future automobile-dependent greenfield development like that located outside of the Greenbelt.

Lastly, planners should be cautious when defining targets in terms of dwelling units, rather than population: This study found that in Ottawa-Gatineau, the many dwelling units which are being built in active core, and transit suburb areas are being occupied by less people per unit compared to automobile suburbs and exurbs, and the number of people per dwelling unit is generally decreasing over time. Therefore, achievement of intensification targets defined in terms of dwelling units instead of population could still result in overall population decline in areas where the decline in household size is
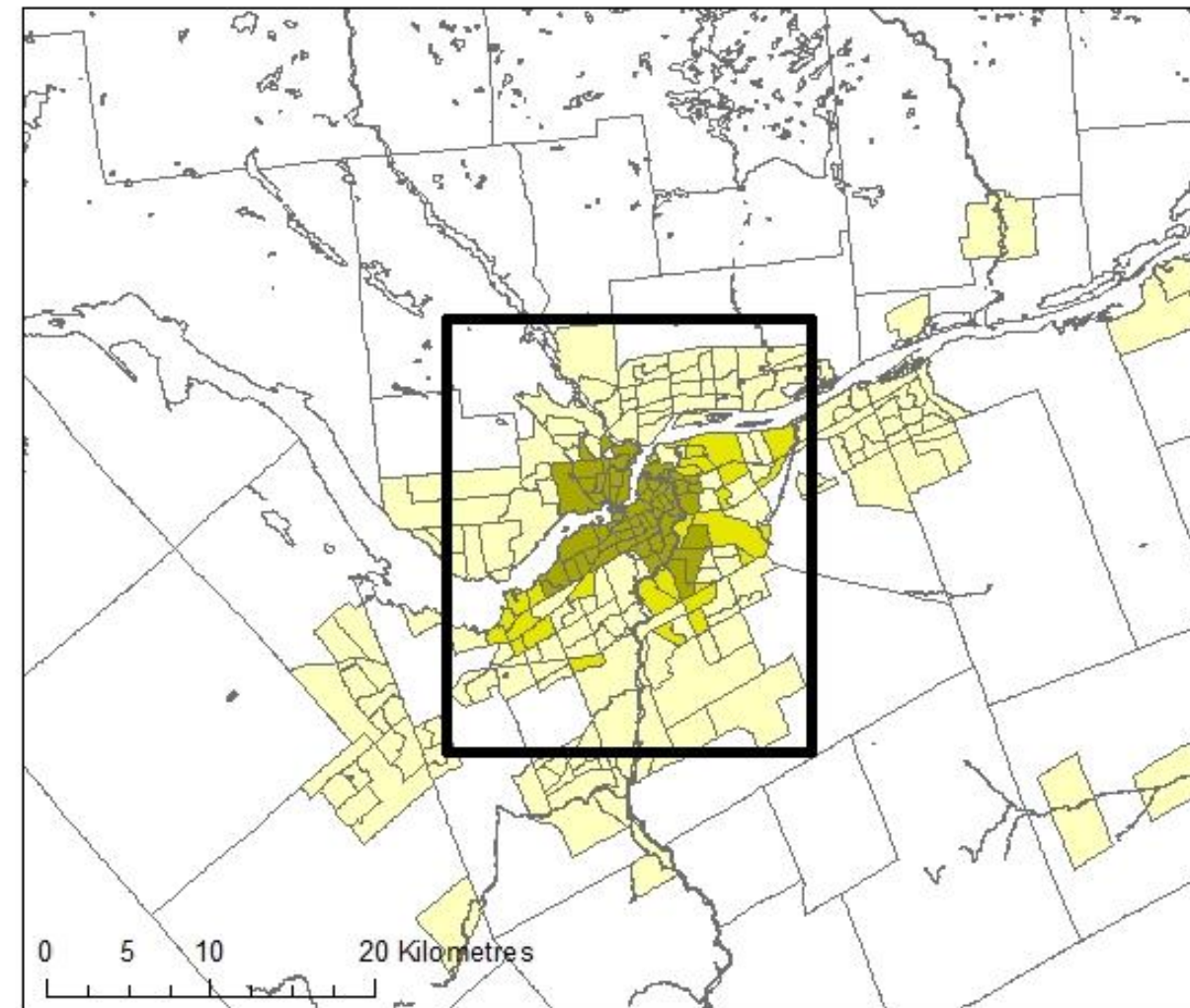
Map 1- 2016 CT Classification
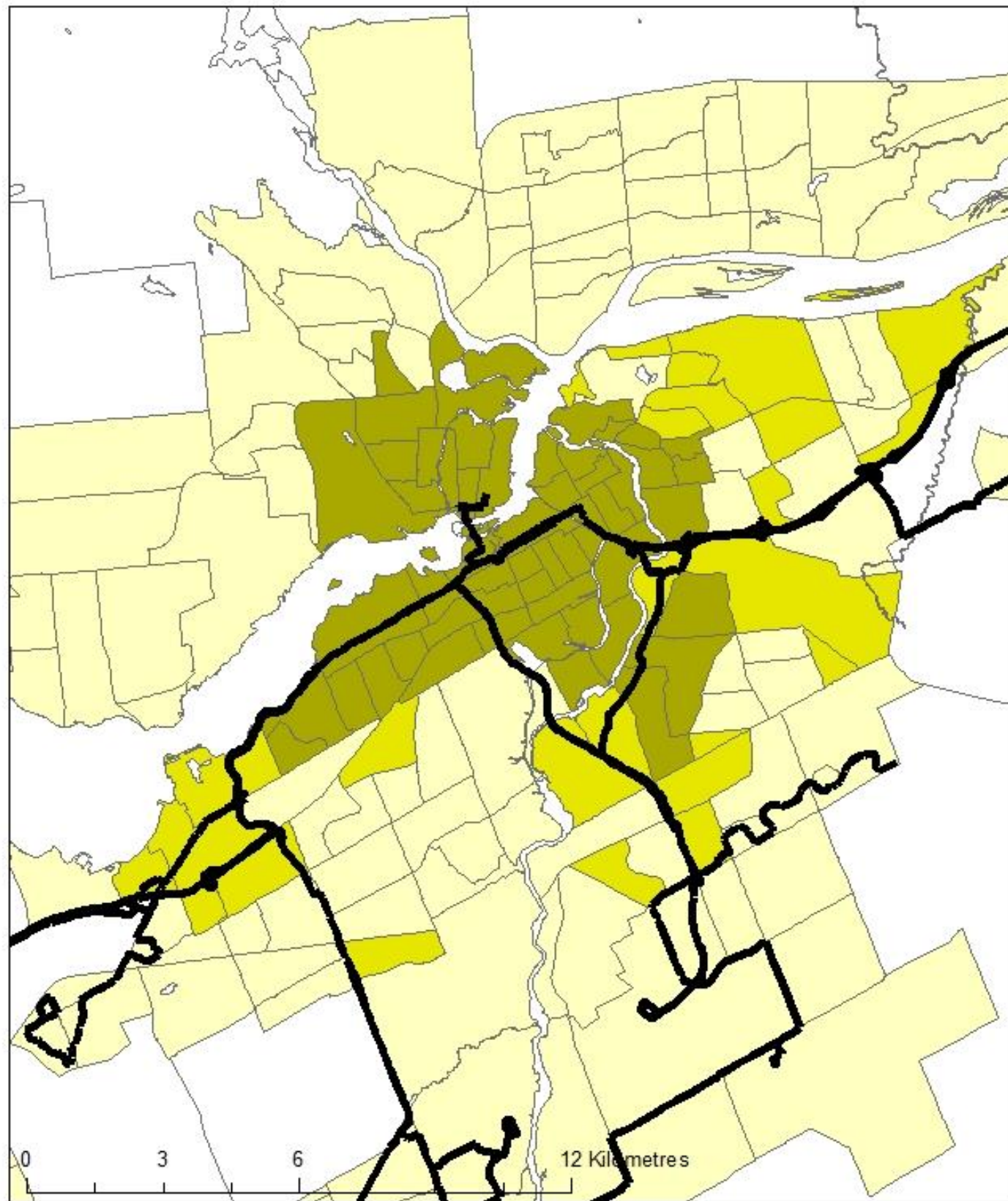
Ottawa-Gatineau

Active Core 15%, Auto Suburb 62%,
Transit Suburb 9%, Exurban 14%

Statistics Canada 2016 Census

Legend

— Rapid Transit Network

■ Active Core

■ Transit Suburb

■ Auto Suburb

□ Exurban

0   3   6   12 Kilometres

0   5   10   20 Kilometres

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not offset by construction of new units, and continuing population increases in less sustainable exurban and automobile-dependent suburbs.

Primary Limitations and Future Considerations

The trends outlined in this report are based on two 10-year time intervals only: Caution should therefore be used in interpreting the temporal trends revealed through this study, as due to the limited data points the trends could simply represent temporal anomalies.

Further research should be done to extend the analysis of census data further into the past, and this study should be repeated in the future. This will allow for verification of the existence of trends, and will allow for the analysis of the effects of major investments like Ottawa's Light Rail Transit (LRT). Future projects may also wish to conduct an additional level of analysis by compare results to those of Canadian CMAs

The definition of suburbs used for this report is meant to be a working definition only. Care must be taken when interpreting the results of this study to be aware of how suburb was defined for the purposes of this project, as the term 'suburb' carries many different meanings. This will avoid misinterpretation of results based on a different perception of what constitutes a suburb.

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Lastly, I owe a big thank you to all my classmates at SURP. When I began this program two years ago I never dreamed I would find such an amazing community of people, and I hope we will remain close in years to come.

1.0 Introduction

1.1 Statement of the General Problem

Urbanization is a growing trend across Canada, and the majority of Canada's urban growth has been in the suburbs (Statistics Canada, 2017a; Gordon & Janzen, 2013; Harris, 2004). Municipalities have recognized the unsustainability of automobile-dependent suburbs, and as such many have implemented policies to better manage growth and promote sustainable development.

Current planning policy across Canada now recognizes the social, economic, and environmental benefits of compact, transit-supportive development, and attempts to promote residential intensification (Newman & Kenworthy, 2015; Grant, 2009; Newman & Kenworthy, 1999). However, whether these policies are effective remains unknown, as whether rates of suburban growth are changing is unclear. Statistics Canada publishes population and dwelling count information at the CT level. However, Statistics Canada only classifies CTs as urban or rural. This fails to account for the diversity of urban settings: Suburbs and inner cities experience different planning issues, and correspondingly require different planning solutions (Moos & Walter-Joseph, 2017; Gordon & Shirokoff, 2014).

Being able to define which areas of a city constitute 'suburbs' allows planners and researchers to draw inferences on if and how the suburban population is growing across Canada. This, in turn, allows policy makers to determine if their suburban growth management policies are achieving their desired intent.

1.1.1 Characteristics of a Suburb

Suburbs have no standard definition, but are often defined as low-density developments radiating outwards from a city centre or node (Forsyth, 2012; Smith, 2006; Brueckner, 2000). Unlike their downtown counterparts, suburban neighbourhoods tend to have strictly segregated land uses and dwelling types (Skaburksis & Mok, 2006; Smith, 2006; Southworth & Owens, 1993). Suburban residents generally rely primarily on automobiles for transportation (Filion, Bunting, & Warriner, 1999) as their

low-density and separation of land uses prevent the viability of other forms of movement. Most

suburban homes are single-detached, and most are owner-occupied (Harris, 2004).

1.1.2 Sustainability of Suburbs

The suburban form of development has many environmental, social, and economic implications. Low-

density development like that of the suburbs consumes a large amount of land, resulting in the loss of

farmland, forests, wetlands, and other environmentally significant areas. Higher rates of private vehicle

use due to the need to travel between segregated land uses results in increased fuel usage and air

pollution (Jackson, 2005; Paehlke, 1991). This need for a private vehicle leads to a class segregation, as

it impedes low income people from being able to occupy homes in suburban communities (Ewing,

1997). Many suburban communities are also less liveable for their residents, as their low-density,

segregated land uses, and homogenous aesthetic yield a lack of vitality, sense of place, neighbourliness,

and social ties (Ewing, 1997). Due to their low-density, large lots, and distance from existing service

centres, suburban developments are also more expensive for a municipality to service, and

municipalities may spend more on suburban amenities and infrastructure than they receive in taxes and

development charges (Morris, 2005).

1.2 Canadian Suburbs Research Program

From 2009-2013, Dr. David Gordon led a research project aimed at estimating the size and growth rate

of the population living in Canadian suburbs. His research team used Statistics Canada data from the

1996 and 2006 Censuses to classify the CTs in all 33 Canadian CMAs using Geographical Information

Systems (GIS) (Gordon & Janzen, 2013). After testing many definitions and classification models for

Canadian suburbs, the research team determined that the most robust classification model classified

CTs as active core areas or as one of three different types of suburb: Exurbs, automobile suburbs, and

transit suburbs (see definitions in Chapter 5). The most reliable definitions for each of these areas were

found to be based on a combination of journey-to-work and density data. Prior to this study, no

definition of suburb could be applied across Canada and yield consistent results. The research was

updated with the 2011 Census (Gordon & Shirokoff, 2014), and the necessary 2016 Census data was

released in November 2017, allowing the Ottawa-Gatineau results to be updated as compared to the

past.

1.3 Research Objective

This report will apply the classification model and suburban definitions established by the Canadian

Suburbs research program to data from the 2016 Statistics Canada Census for the Ottawa-Gatineau

CMA. In so doing, this report aims to answer the following questions:

1. What is the proportion of Ottawa-Gatineau residents living in less sustainable forms of suburban

    development?

2. How has this proportion changed geographically and temporally?

3. Are Ottawa's suburban growth management policies achieving their targets and objectives?

1.4 Description of the Ottawa-Gatineau CMA

1.4.1 Geography

The Ottawa-Gatineau CMA is comprised of the municipalities of Ottawa and Gatineau, as well as the

rural surroundings. The City of Ottawa is located in the Ottawa Valley in eastern Ontario. It lies on the

Ontario-Quebec border on the southern bank of the Ottawa River, at the intersection of the Ottawa,

Rideau, and Gatineau Rivers. It is situated across the Ottawa River from Gatineau, Quebec. Both

Ottawa and Gatineau are located within the traditional territory of the Algonquin Nations.

In 2016, the population of the Ottawa-Gatineau CMA was 1,323,783, the 5th largest in the country

(Statistics Canada, 2017b). Ottawa had a population of 934,243, while Gatineau had 276,745 residents

(Statistics Canada, 2017b; Statistics Canada, 2017c). The population of Ottawa is expected to grow to

1.15 million by 2031, and that of Gatineau to over 309,000 (Ottawa, 2017).
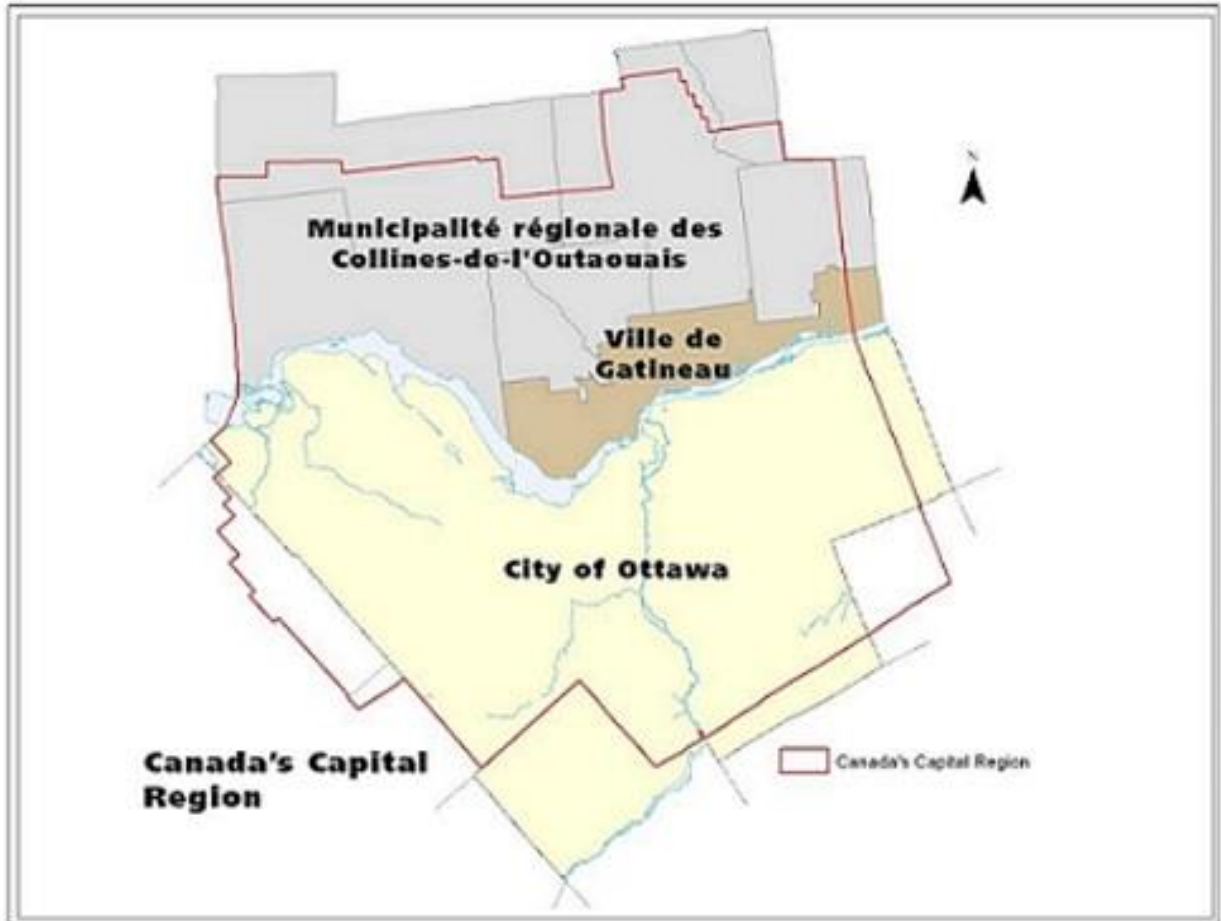
Map 1.1. Ottawa and Gatineau; Gatineau is nearly encircled to the north by the Regional Municipality of les Collines-de-L'Outaouais (Ottawa, 2011).

1.4.2 Development History of Ottawa

The Ottawa-Gatineau area was first permanently settled in the 1800s, with the establishment of villages on the sites of what are now Gatineau and LeBreton Flats. The area developed rapidly as a lumber town following the construction of the Rideau Canal, which has Ottawa as its northern terminus. By the time Ottawa was named as Canada's capital in 1857, Ottawa was a rough, crime-ridden, timber town with a population of just over 10,000 people (Taylor, 1986). Post-Confederation, successive federal governments commissioned comprehensive plans for the national capital area.

Arguably the most important of these government-led comprehensive plans was the 1950 Plan for the National Capital, prepared by Jacques Gréber. This plan defined four residential areas with decreasing densities from the core to the suburbs, identified existing and future employment, commercial, and industrial areas, and proposed the protection of parkways and vast greenspaces. By the 1970s, many of the plan's proposals had been realized, including the decentralization of government offices to suburban campuses, the establishment of a greenbelt around Ottawa, the protection of the Gatineau Hills as a wilderness area, development of a cross-town expressway, and the construction of suburban railway lines and yards (National Capital Commission, 2017; Gordon, 2005)

One of the most significant outcomes of the Gréber plan was the establishment of the Ottawa Greenbelt, one of the world's largest urban parks. The Greenbelt is a 200 km^2 crescent of protected greenspace and agricultural land. It was established in the 1950s around the then-built up area of the City of Ottawa to act as a barrier against urban sprawl (See Greenbelt Map in Appendix G). The intent was that this greenbelt would accommodate Ottawa's population growth into the 2000s, with future development to take place in satellite cities outside of the Greenbelt. These satellite cities were to have a mix of housing types, their own employment bases, their own municipal governments, and be self-sufficient from central Ottawa. However, the population grew more rapidly than anticipated, and traditional low-density residential suburban development had leapfrogged outside the Greenbelt by the 1970s (Taylor, Paine, & FitzGibbon, 1995).

Maps 1.2-1.4: Urban Growth over time in the Ottawa-Gatineau CMA (National Capital Commission, 2017)
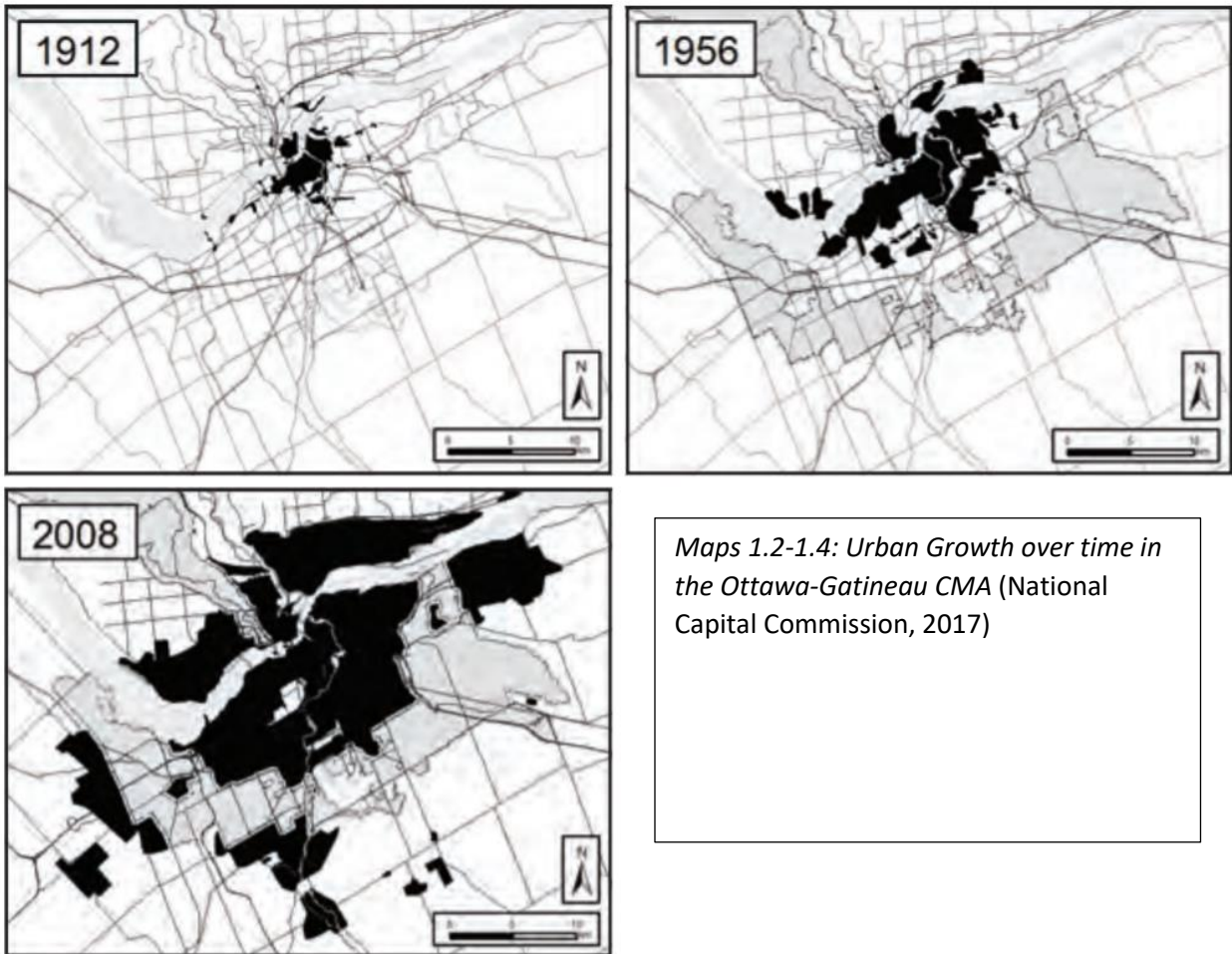
In 1969, a two-tiered government was established, composed of the upper-tier Regional Municipality of Ottawa-Carleton and 16 lower-tier municipalities. The regional municipality was responsible for spending 80% of regional taxes, and the lower tiers had local autonomy (Beckstead, 2002).

The 1980s marked a boom in the high-tech sector in Ottawa, and by the 1990s, employment in the tech sector exceeded that of the federal government for the first time in Ottawa's history (Graham, Maslove, & Phillips, 2001). By 2000, Ottawa was the fastest growing metropolitan area in Canada. This tech boom corresponded to a shift in employment location towards large campuses and business parks in the suburbs, rather than the traditional inner city. This led to a rapid growth of suburban communities and a dissociation between inner cities and the suburbs, as many suburbanites newly lived and worked in the

suburbs (Graham, Maslove, & Phillips, 2001). Correspondingly, from 1981 to 2012, the employment

share of the areas outside the greenbelt rose from 3.8% to 15% (Ottawa, 2013a).

In 2001, the municipalities of the former Regional Municipality of Ottawa-Carleton were amalgamated

into one single-tier city: Ottawa. The city now spans 2,790.30 km^2, which is larger than the area of the

cities of Vancouver, Calgary, Edmonton, Toronto, and Montréal combined (Statistics Canada, 2017b).

1.4.3: Development History of Gatineau

What is now the City of Gatineau was first settled in the 1800s, and grew rapidly with the growth of the

timber trade. In the 1880s, it became a major centre for the pulp and paper industry, with the opening

of the EB Eddy Mills at the Chaudière Falls. The area remained a mid-size manufacturing town

characterized by worker tenement buildings until the 1960s, when factories began to close. In the

1970s, the Federal Government built large office complexes in the downtown core to achieve

proportional representation in its National Capital Region offices, resulting in an economic shift to the

civil service sector. Suburbanization began in the 1960s, and continues to this day. In 2002, the cities of

Gatineau, Aylmer, Hull, Masson-Angers, and Buckingham were amalgamated, and are today collectively

known as Gatineau (Historica Canada, 2002; Gaffield, 1997).

1.4.4 Public Transit Agencies

The City of Ottawa's public transit service is called OC Transpo. It is a hub-and-spoke system focussed on

Ottawa's downtown, comprised of:

- Bus routes travelling with other traffic

- The Transitway, a bus rapid transit (BRT) system of on-road reserved and grade-separated bus

  lanes, with its own stations and priority traffic signals.

- The O-Train, a LRT system which is currently 8 km long. In 2018, the existing downtown BRT will

  be replaced by a new 12.5 km east-west LRT line.

(OC Transpo, 2018a)

La ville de Gatineau's transit service is called the Société de transport de l'Outaouais. It is based around typical bus routes as well as a 12 km east-west BRT line called the 'Rapibus,' which opened in 2013. (Société de transport de l'Outaouais, 2018)'

Both transit systems provide limited service to the downtown core of the other province.

1.4.5 CMA Planning Context

The Ottawa-Gatineau CMA is unique, as it includes the cities of Ottawa and Gatineau, which lie in different provinces. Planning, servicing, and infrastructure is generally done separately by the separate municipalities, with little inter-jurisdictional regional cooperation. The National Capital Commission (NCC) is a federal crown corporation with the mandate of building a better capital for all Canadians. It is the largest landowner in the region, and owns land in both provinces. It is the main planner and administrator for its lands.

1.5 Report Structure

The following chapter will describe the procedure and methods used to analyze Ottawa-Gatineau's suburban development, including data sources, technical definitions of CT classifications, classification methods, and method limitations. Chapter 3 discusses the analysis of results produced by the classification of CTs, and presents maps and tables summarizing the main findings of the report. The final chapter provides conclusions addressing the main research questions posed by this report, and summarizes implications of these findings for suburban growth management in Ottawa and Gatineau. The appendices include technical discussions, maps, and tables which were not integral to the main findings of the report, but may be of use to an interested reader.

2.0 Methods

2.1 Overview

This report aims to answer 3 questions:

1. What is the proportion of Ottawa-Gatineau residents living in less sustainable forms of suburban development?

2. How has this proportion changed geographically and temporally?

3. Are Ottawa's suburban growth management policies achieving their targets and objectives?

To address these questions, this study will use data from the 2016 Statistics Canada census to classify CTs in the Ottawa-Gatineau CMA as exurban, automobile suburbs, transit suburbs, or active cores. The results of this assessment will then be compared against the results of Ottawa-Gatineau CT classifications conducted by Gordon and Janzen (2013) using identical methods on 2006 and 1996 Statistics Canada Census data. To answer the third research question, Ottawa's growth management policies will be reviewed and compared to the results of the CT analyses.

2.2 Data Sources

2.2.1 Statistics Canada

To classify different areas of Ottawa-Gatineau, the study will use data from the 2016 Statistics Canada Census of Population. This is a reliable, robust data source because census data is publicly available, has a high response rate, and undergoes extensive quality evaluation and error checking. Furthermore, since the census is completed at regular intervals using identical methods across Canada, census data is both geographically and longitudinally statistically comparable. Statistics Canada, Canada's national statistical office, conducts the Census of Population every five years in the month of May. The census collects information on the demographic, social, and economic characteristics of people in Canada at a variety of

scales. All households in Canada receive a mandatory short-form questionnaire, and 25% of Canadian households receive a mandatory long-form questionnaire.

For the purposes of this report, the census data will be analyzed at the CT level for the Ottawa-Gatineau CMA. Statistics Canada defines CTs as small, relatively stable geographic area with a population between 2,500 and 8,000 persons. CTs generally match what people consider to be neighbourhoods, and they are delineated to ensure their population is as homogenous as possible in terms of its socioeconomic characteristics (Statistics Canada, 2017d). The CT is an appropriate level of analysis for urban planning purposes at the neighbourhood level (Leung, 2003), and their boundaries rarely change. When their population significantly exceeds 8,000, they are split, making it possible to re-aggregate them for time-series analyses (Statistics Canada, 2017d).

A CMA is an area with one or more municipalities located around an urban core; for an area to be considered a CMA the urban core and CMA must have minimum populations of 50,000 and 100,000 respectively. The outer boundary of a CMA is defined by the outer bounds of CTs within which over 50% of the employed labour force living in the CT works in the core or at least 25% of the labour force working in the CT lives in the core (Statistics Canada, 2015).

2.2.2 Canadian Suburbs Research Project

Gordon and Janzen (2013) used Statistics Canada data from the 1996 and 2006 Censuses of Population to classify the CTs of all 33 Canadian CMAs as suburban, urban, or exurban using identical methods to this study. The results of the analysis of the 2016 data were compared with the results of Gordon and Janzen's analysis of the 1996 and 2006 Census of Population for the Ottawa-Gatineau CMA.

Gordon and Shirokoff (2014) applied the same methodology to data from the 2011 Census, however a comparison will not be done with their analysis as their data source was less reliable: In 2011, the long-

form census was made voluntary, and as such its results cannot be compared accurately with the results

of the other, mandatory, censuses (Hulchanski, Murdie, Walks, & Bourne, 2013).

2.2.3 MacOdrum Library, Carleton University

GIS files for OC Transpo Transit Routes were downloaded from Carleton University's MacOdrum library,

which digitized OC Transpo transit routes from 1929-2015 and made the vector files publicly available

(Carleton University, 2015). These transit routes were indicated on maps demonstrating the results of CT

classification (see Maps 3.1-3.3) to allow for comparison of the location of transit suburbs relative to

transit routes. Since 2016 transit route information was not publicly available, 2015 transit route data

was used for comparison with the results of the 2016 CT classification. No GIS information was publicly

available for Gatineau's public transport routes. The GIS file of the boundaries of the Ottawa Greenbelt

was also downloaded from MacOdrum Library.

2.2.4 City of Ottawa Official Plans

The 1997 Regional Official Plan for the Region of Ottawa Carleton, the 2003 Ottawa Official Plan, and the

2013 and 2016 Ottawa Official Plan amendments were reviewed to determine their quantitative targets

relating to suburban growth management and intensification. These targets were then to be compared

to the results of the CT analysis in 1996, 2006, and 2016 to determine if these targets are being

accomplished, however, as explained in section 3.7, this comparison was not possible. Only the CTs

located within the Ottawa political boundary were used for the purposes of this comparison, as due to

time constraints, it was not possible to conduct a policy comparison for la ville de Gatineau.

2.3 Inclusion Criteria

There is currently no standard definition of the term 'suburb'. Statistics Canada developed several

definitions for the purposes of estimating the size of rural populations using census data, and

recommends that researchers and analysts use the definition most closely fitting the problem they are

addressing (Turcotte, 2008). This is an appropriate approach for the term 'suburb,' and so for the

purposes of this report, the working definitions of 'suburb' developed by Gordon and Janzen (2013) will

be used to classify CTs as active cores, exurbs, transit suburbs, or automobile suburbs.

- Exurbs were defined as areas with gross population density less than 150 people per square

  kilometre and more than 50% of workers commuting into the metropolitan area. These

  quantitative thresholds were based on OECD and Statistics Canada definitions (du Plessis et. al

  2001).

- Automobile Suburbs were defined as CTs with a gross population density greater than 150

  people per square kilometre, transit use less than 150% of the metro average, and active transit

  less than 150% of the metro average.

- Transit Suburbs were defined as CTs with transit use greater than 150% of the metro average for

  journey to work, active transit less than 150% of the metro average, and transit use at least

  greater than 50% of the national average.

- Active Cores were defined as CTs with active transit greater than 150% of the metro average for

  the journey to work and active transit use greater than 50% of the national average.

(Gordon and Janzen, 2013).

The Active Core classification is meant to delineate both inner cities and secondary city centres which

formed outside of the downtown area. The definition is active transit-based because many individuals

living in a core area can walk or cycle to their place of employment, rather than take a private

automobile or public transit. Gordon and Janzen tested combinations of active transit with other

variables like the ratio of apartments or households with children, but found that this did not add to the

credibility of the results. Basing the definition on proportions of the metropolitan average creates

consistent results across CMAs with different sized centres. Furthermore, requiring that the core have

active transit greater than 50% of the national average creates a 'absolute minimum' value to remove nonsensical results in areas where the average CMA proportion of active transit is quite low.

The Exurb classification is meant to capture the population living in the CMA's outer CTs. These areas are a form of suburb since most people live in single-detached homes at very low densities and commute by automobile. The outer bounds of the CMA are defined by the areas in which over half of the labour force commutes to the core city for employment, and so most people in the 'exurbs' are not engaged in rural activities like agriculture as their full-time employment.

Automobile suburbs and Transit suburbs encapsulate the areas with low rates of active transit usage and high rates of automobile and transit use, respectively. Again, basing the definitions on the metropolitan and national averages produces consistent results across cities of different sizes and removes nonsensical results from cities with low transit or active transit modal shares.

Given the above definitions, for the purposes of this report, exurbs and automobile suburbs will be considered to be less sustainable forms of development, while active cores and transit suburbs will be considered to be more sustainable.

Gordon and Janzen tested and reviewed multiple other suburban classification methods examining different dimensions of suburbs before arriving at the above journey-to-work and density-based model, which was found to be the most reliable across all Canadian CMAs.

Turcotte (2008) proposed distinguishing inner city from suburb using a fixed or proportional distance from a city centre, as one of the most fundamental aspect of a suburb is that they lie outside of a town or city, but belong to it (Frost, 1991). However, location-based classification models yield issues in that inner cities vary in proportional size across cities, and cities are increasingly polycentric, necessitating the need to also define what constitutes city centres.

Ley and Frost (2006) defined inner cities based on their proportion of pre-1946 housing stock relative to the metro average, however Gordon and Janzen (2013) found that age-of-dwelling based definition would not work well due to the recent rise in infill and redevelopment in many urban centres. Furthermore, though suburbs are often considered to be composed predominantly of single-detached homes, many suburbs have clusters of townhomes or apartment buildings, and inner-city areas often have townhomes or stacked townhomes rather than apartments (Gordon & Janzen, 2013).

Suburbs are often perceived as having large areas of low-density detached houses, but suburban definitions based solely on density gradients are also problematic. Gross density poses issues as often areas have many non-residential uses, such that their residential areas are quite dense in terms of population or number of housing units, but the overall area is not (Turcotte, 2008). In its efforts to define the term 'rural', Statistics Canada constructed a definition of low-density as an area in which at least two thirds of the occupied housing is single, semi-detached, or mobile homes (Turcotte, 2008). However, even this definition poses issues as across North America suburbs vary significantly in their housing mix and densities (Forsyth, 2012).

2.4 Census Tract Classification

First, population, population density, dwelling unit, and journey-to-work data from the 2016 Statistics Canada Census for each CT in the Ottawa-Gatineau CMA was downloaded into an spreadsheet. Calculations were conducted based on the inclusion criteria outlined above to classify each CT as an exurb, automobile suburb, transit suburb, or active core. The digital boundary files for the 2016 CTs were then imported into ESRI's geospatial processing program ArcMap 10.5, and were reprojected into the North American Datum of 1983 (NAD 83) coordinate reference system, the official geodetic reference system used in North America. File projection historically differed across censuses, so this reprojection allowed ArcMap to perform calculations and ensured that comparisons could be made over time. The geographic information in the spreadsheet was then spatially joined with the CT map using

ArcMap. The absolute and proportional population of the Ottawa-Gatineau CMA living in the active

core, suburbs, and exurbs was then calculated. The absolute and proportional number of dwelling units

in each of the four categories was also calculated.

Anomalous results were identified using the author's personal knowledge of the Ottawa area, and by

comparing results with those of the classifications made using 2006 census data. The 2016 classifications

were overlain onto satellite imagery using the Google Earth mapping service, and the identified

anomalies were visually compared with the satellite images to check for errors. Google Street View was

also used to resolve anomalies as needed.

2.5 Classification Comparisons

Once the CTs have been classified according to 2016 data, the proportional population living in each of

the 4 classifications was then compared geographically and longitudinally. Geographic comparisons

were made between Ottawa West and Ottawa East and between Ottawa inside the Greenbelt and

Ottawa within or outside of the Greenbelt. The Rideau River is a significant east/west dividing feature on

the landscape, and its bounds correspond with those of CTs, so it was used as the border line

distinguishing between Ottawa East and Ottawa West (see Appendix G for a map of the Rideau River

and the Greenbelt boundary lines used for analysis). Longitudinal analysis was also conducted by

calculating the population growth rate from 1996-2006, 2006-2016, 1996-2016, and for each the four

classifications for Ottawa-Gatineau, Ottawa, Gatineau, Ottawa West, and Ottawa East, Ottawa inside

the Greenbelt, outside the Greenbelt, and comparing the results.

2.6 Limitations

The following section describes the limitations thought to be possible prior to beginning the analysis

portion of this project. Section 4.3 reflects on additional limitations discovered after completion of this

project, and provides insights and advice for those conducting similar projects in the future.

First, the definition of suburbs used in this report is meant to be a working definition only. For the

purposes of this project, suburbs were defined geographically as areas within a CMA in which public

transit and automobile use are the dominant forms of transit. The term suburb, however, encompasses

many more dimensions, has different meanings to different people, and is a social construct which

evolves over time. Care must therefore be taken when interpreting the results of this study to be aware

of how suburb was defined for the purposes of this project. This will avoid misinterpretation of results

based on a different perception of what constitutes a suburb.

Furthermore, using CTs to define areas is imperfect as neighbourhood form may vary across CTs.

Nevertheless, there is no better alternative, as like many CMAs, Ottawa has no officially defined

neighbourhoods, and there is no better publicly available, long-term, reliable data.

3.0 Analysis and Results

3.1 Suburban Population in 2016

The first objective of this report was to determine the proportion of Ottawa-Gatineau residents living in automobile suburbs and exurbs, which are considered to be less sustainable forms of development. The analysis of 2016 Statistics Canada Data indicates that, in 2016, 1 million individuals were living in automobile suburbs or exurbs. This means that, of Ottawa-Gatineau's 1.3 million residents, 76% of them were living in less sustainable forms of development (Figures highlighted in blue in Table 3.1).

3.2 CMA CT Classification Maps

Maps 3.1-3.3 provide a graphical representation of the classification of CTs, and the changes in classification over time. The CT classification is overlain with OC Transpo's BRT and LRT system to demonstrate how transit suburbs are related to the location of transit networks; Appendix A presents the same maps with the addition all OC Transpo express, regular, and peak hour routes. This provides a more nuanced understanding of how transit shapes development.

No GIS files were publicly available for Gatineau's public transit routes, so they were not included on these maps.

Appendix B provides a written description of the general pattern of CT classification, and how this pattern evolved over time. There were several unique variations in the general pattern of CT classification evolution described above: Some CTs switched back and forth between being classified as automobile suburbs and transit suburbs, and no CTs were classified as transit suburbs in Gatineau despite significant public transit infrastructure investment. Appendix C explains the factors causing

these variations, and the map in Appendix D summarizes the changes in CT Classification over the study period.

3.3 Temporal Trends in Suburban Population Growth

For the past two decades, Ottawa and Gatineau have been working to promote compact development that supports the use of active and public transport through policies in their Official Plans (Gatineau, 2015; Ottawa, 2011; Ottawa, 2003; Gatineau, 2000). In terms of the classification system used in this report, this indicates that both municipalities wish to move towards having more people living in transit suburbs and active core areas, as opposed to automobile suburbs and exurbs. If they are being successful at achieving these aims, temporal trends should indicate that growth is moving away from the traditional automobile suburbs and exurbs, and towards transit suburbs and active cores.

Classifying CTs using 1996, 2006, and 2016 Statistics Canada data revealed the following trends, displayed in Table 3.1.

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Map 3.1: 1996 CT Classification

Legend
— Rapid Transit Network
■ Active Core
■ Transit Suburb
□ Auto Suburb
□ Exurban
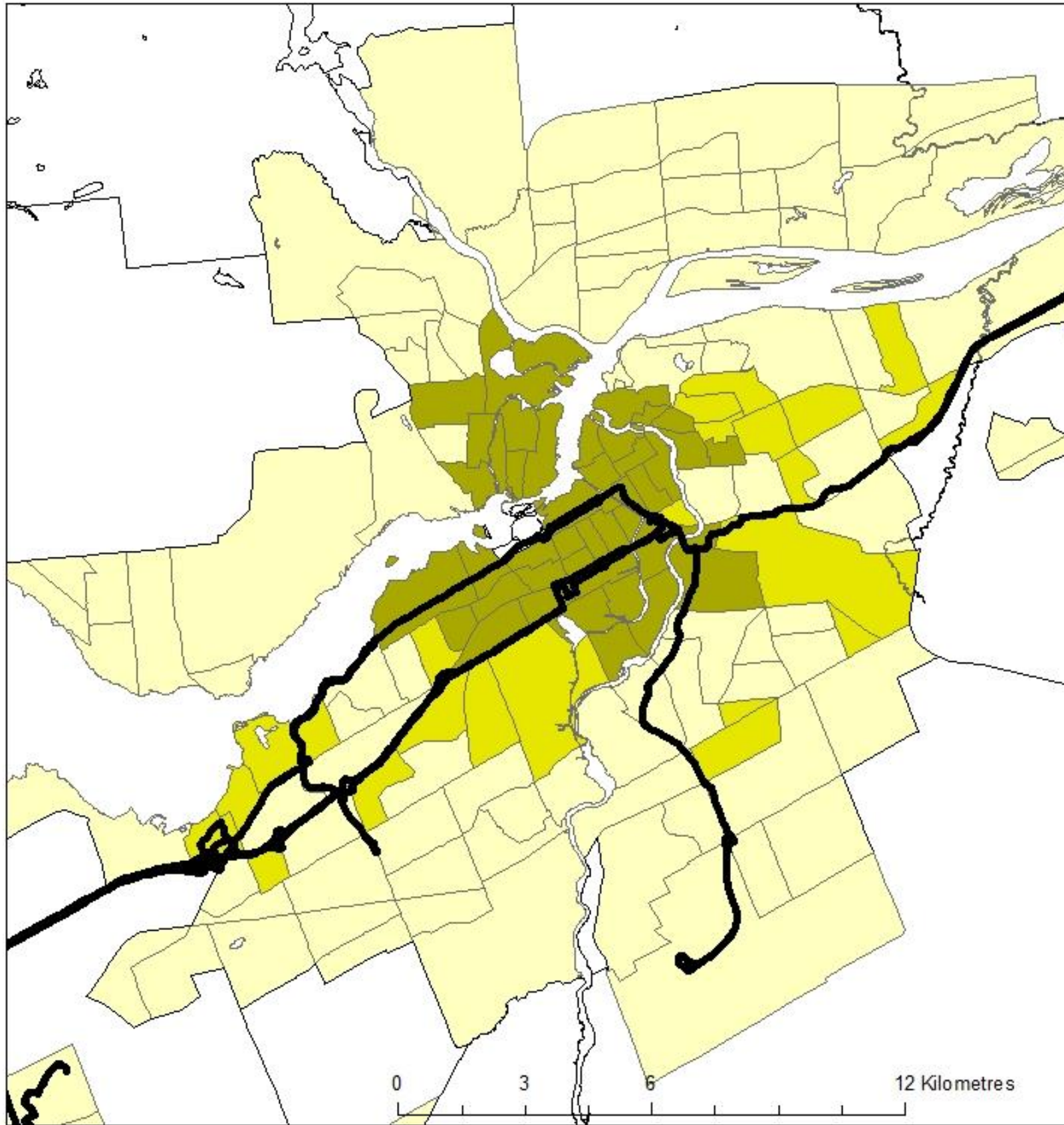
Ottawa-Gatineau
Active Core 15%, Auto Suburb 61%,
Transit Suburb 12%, Exurban 13%

Statistics Canada 1996 Census

0   5   10   20 Kilometres

N

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0   3   6   12 Kilometres

19
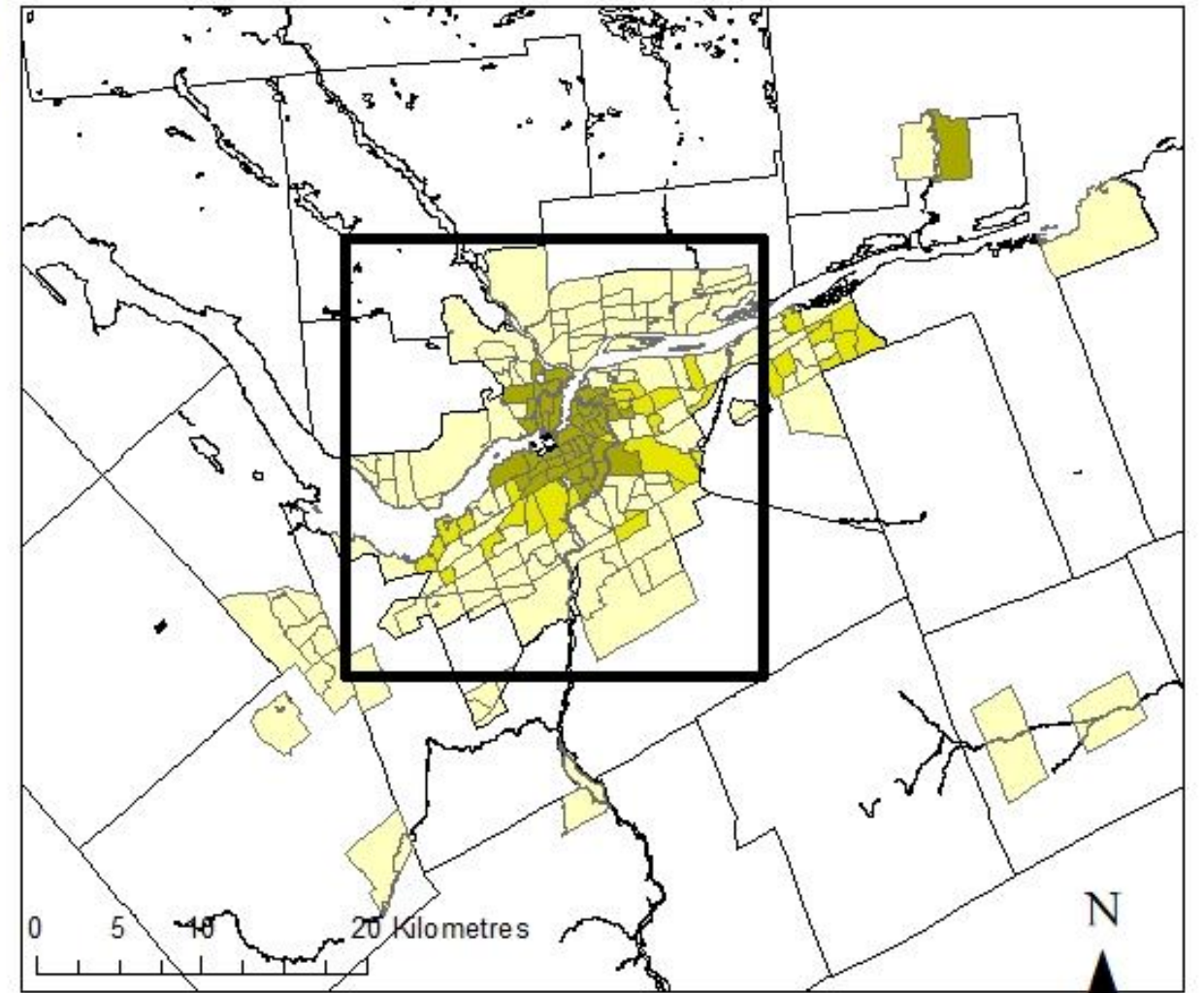
Map 3.2: 2006 CT Classification
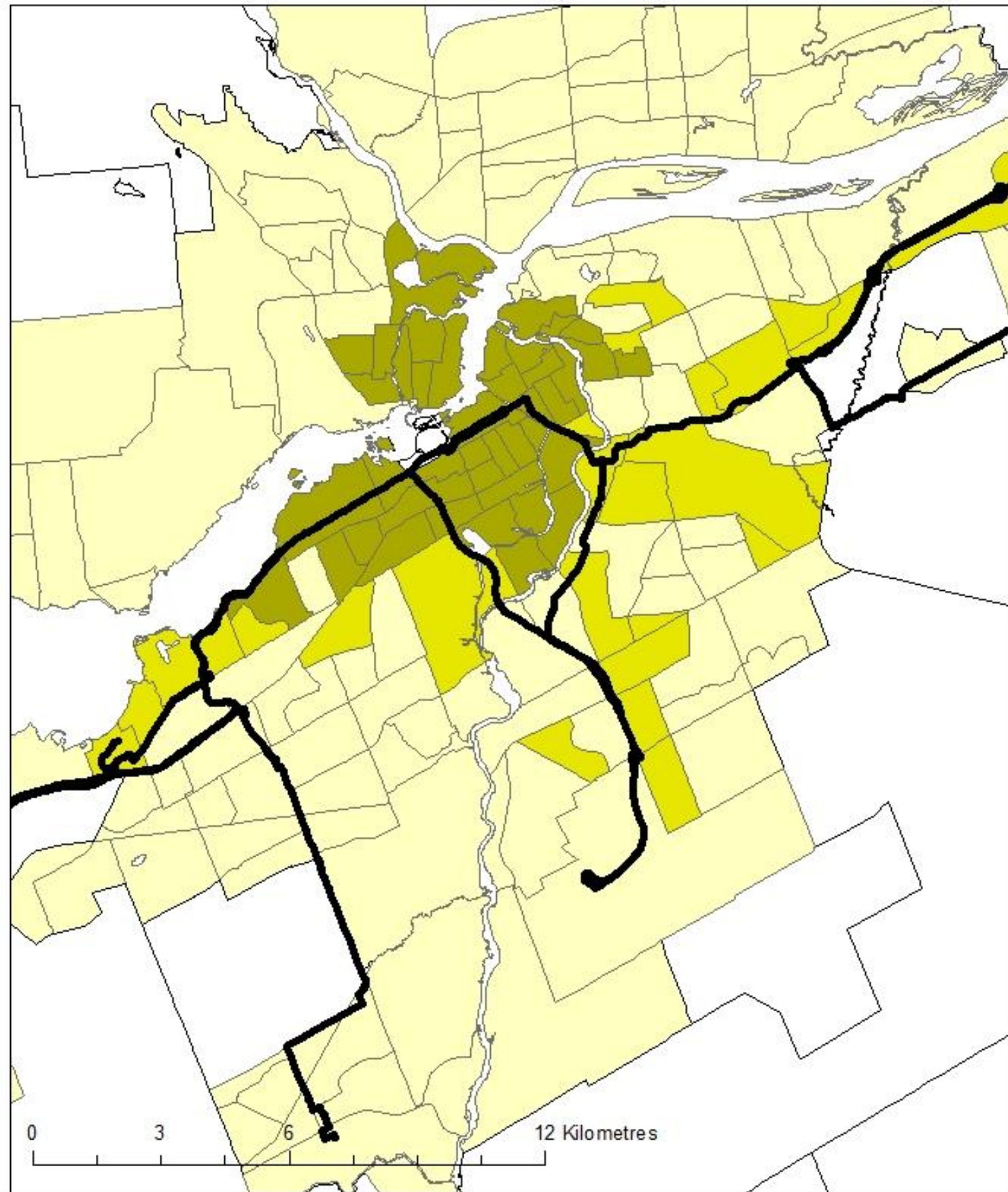
Legend

— Rapid Transit Network

- Active Core
- Transit Suburb
- Auto Suburb
- Exurban

Ottawa-Gatineau

Active Core 13%, Auto Suburb 63%,
Transit Suburb 11%, Exurban 13%

Statistics Canada 2006 Census
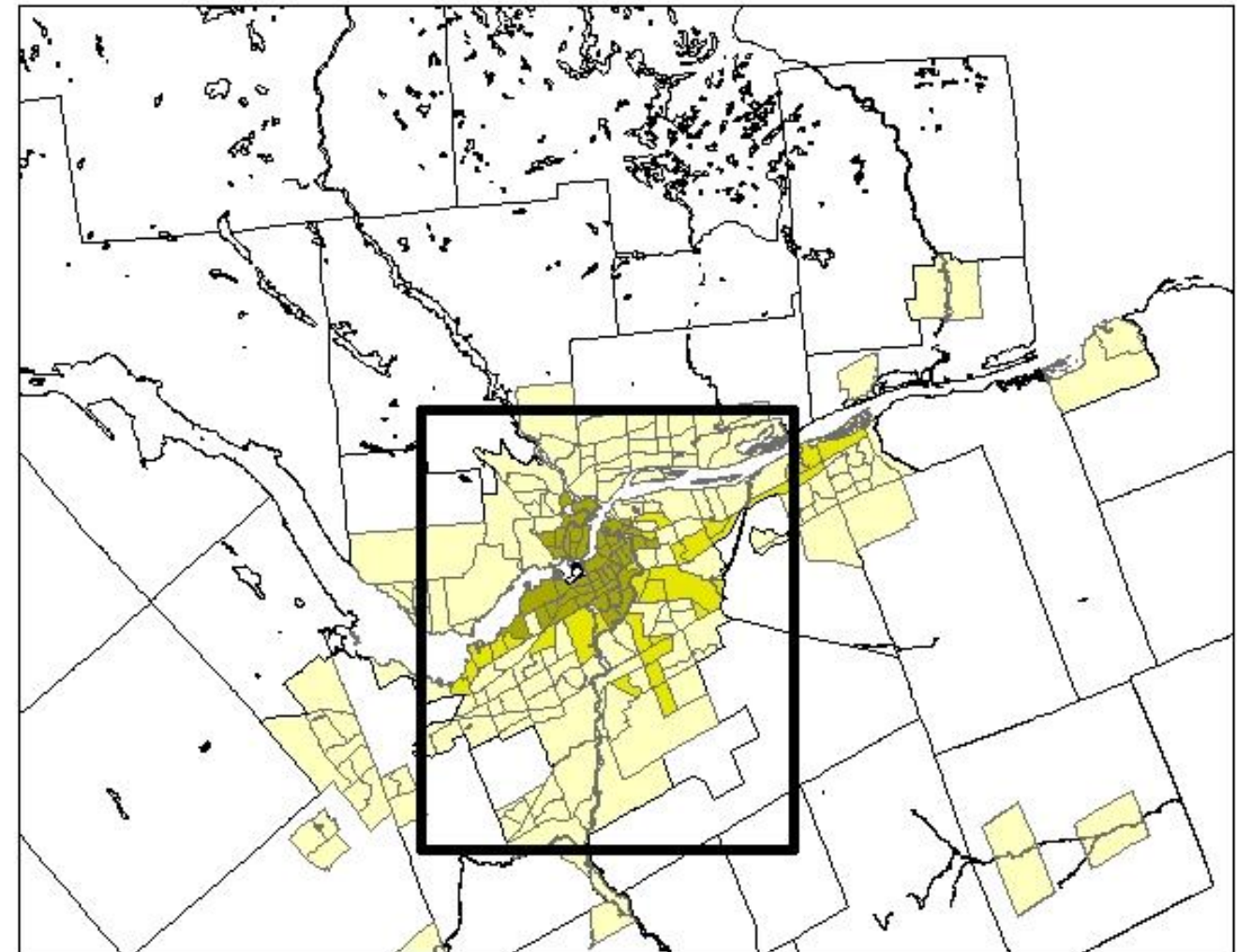
0   3   6   12 Kilometres

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N

Map 3.3: 2016 CT Classification
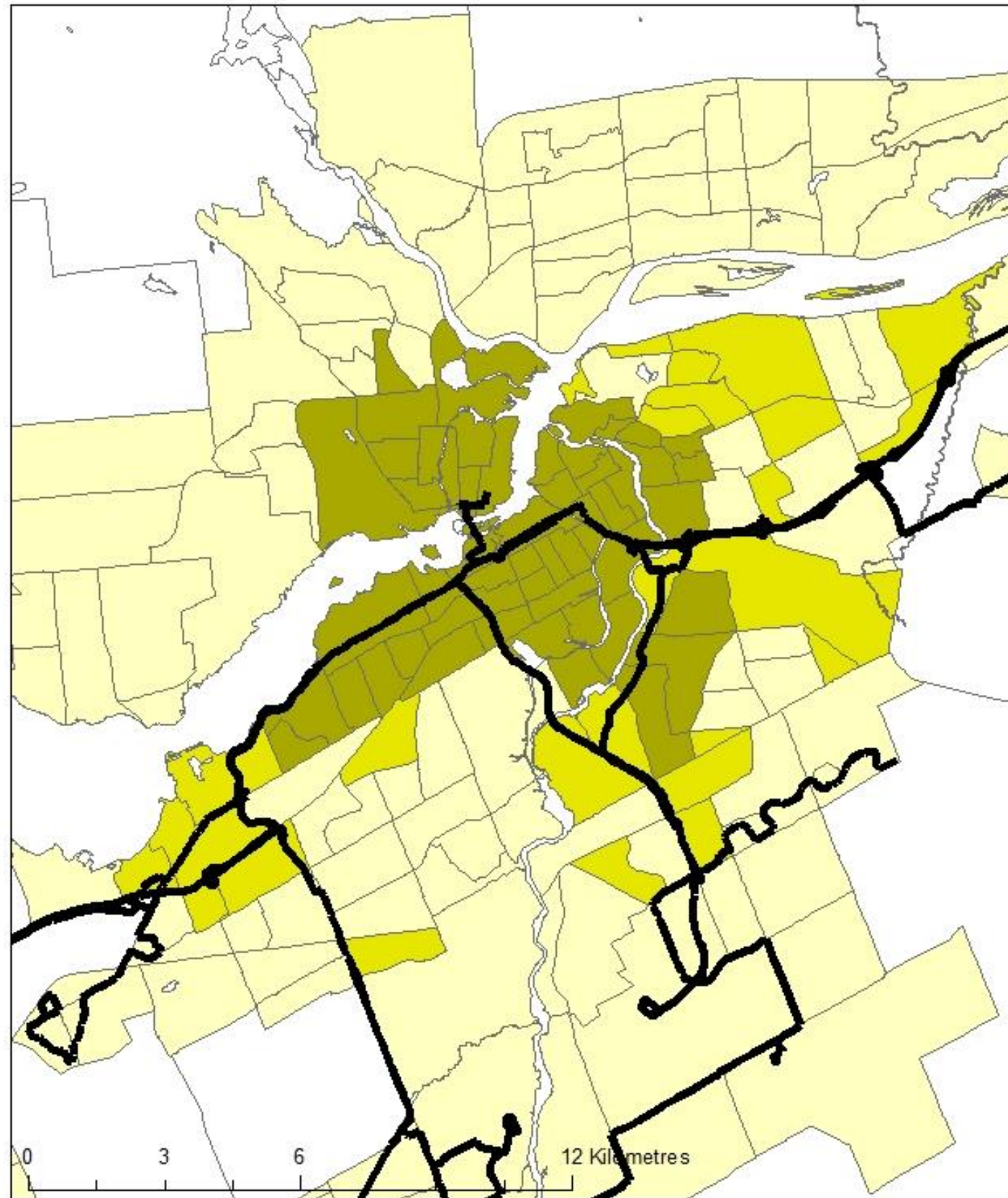
Legend

— Rapid Transit Network

▨ Active Core

▨ Transit Suburb

▨ Auto Suburb

□ Exurban

Ottawa-Gatineau

Active Core 15%, Auto Suburb 62%,
Transit Suburb 9%, Exurban 14%

Statistics Canada 2016 Census

0   5   10   20 Kilometres

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N

0   3   6   12 Kilometres
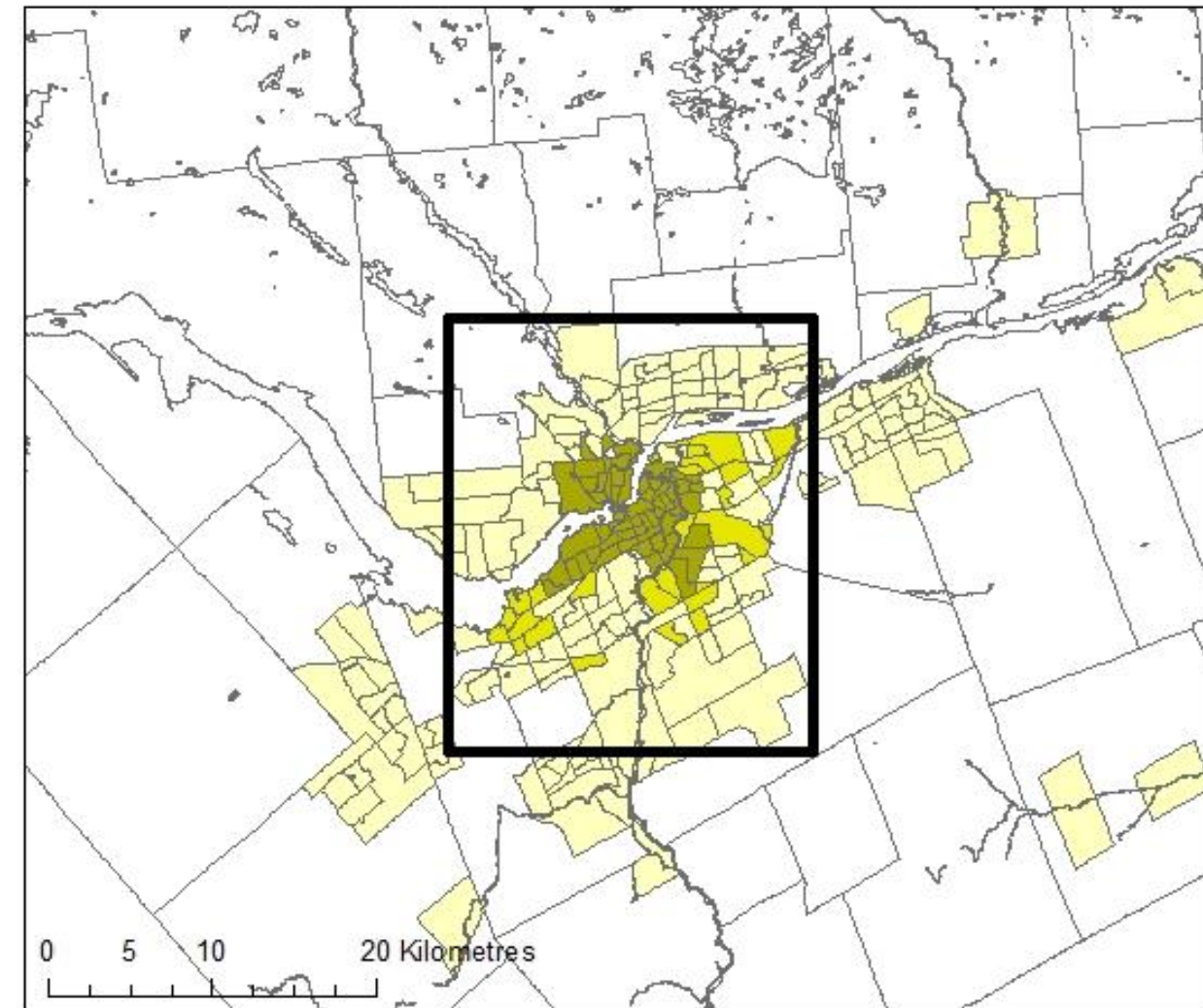
Table 3.1: Population Growth from 1996-2016 in the Ottawa-Gatineau CMA by CT Classification

	Population (Share of CMA Total)						Population Growth (Growth Rate)						Share of CMA Population Growth		
	1996		2006		2016		1996-2006		2006-2016		1996-2016		1996-2006	2006-2016	1996-2016
Exurban	149,405	15%	147,830	13%	180,800	14%	-1,575	-1%	32,970	22%	31,395	21%	-1%	17%	10%
Automobile Suburb	613,305	61%	711,615	63%	820,355	62%	98,310	16%	108,740	15%	207,050	34%	82%	56%	66%
Transit Suburb	120,015	12%	127,180	11%	123,897	9%	7,165	6%	-3,283	-3%	3,882	3%	6%	-2%	1%
Active Core	127,775	13%	143,155	13%	198,731	15%	15,380	12%	55,576	39%	70,956	56%	13%	29%	23%
Total CMA	1,010,500	100%	1,129,780	100%	1,323,783	100%	119,280	12%	194,003	17%	313,283	31%	100%	100%	100%
Ontario	10,753,573		12,160,282		13,448,494			13%		11%		25%			
Canada	28,846,761		31,612,897		35,151,728			10%		11%		22%			

Table 3.2: Dwelling Unit Growth from 1996-2016 in the Ottawa-Gatineau CMA by CT Classification

	Number of Dwelling Units (Share of CMA Total)						Dwelling Unit Growth (Growth Rate)						Share of CMA Growth		
	1996		2006		2016		1996-2006		2006-2016		1996-2016		1996-2006	2006-2016	1996-2016
Exurban	50,055	13%	52,235	12%	74,550	13%	2,180	4%	22,315	43%	24,495	49%	3%	18%	13%
Automobile Suburb	223,200	58%	267,395	60%	322,452	56%	44,195	20%	55,057	21%	99,252	44%	69%	45%	53%
Transit Suburb	49,175	13%	55,920	12%	59,102	10%	6,745	14%	3,182	6%	9,927	20%	11%	3%	5%
Active Core	62,580	16%	73,280	16%	115,042	20%	10,700	17%	41,762	57%	52,462	84%	17%	34%	28%
Total CMA	385,010	100%	448,830	100%	571,146	100%	63,820	17%	122,316	27%	186,136	48%	100%	100%	100%
Ontario	3,924,510		4,555,025		5,598,391			16%		23%		43%			
Canada	10,820,050		12,437,470		15,412,443			15%		24%		42%			

Data source for both Table 3.1 and 3.2: Statistics Canada 1996, 2006, and 2016 Censuses

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3.3.1 The share of CMA population growth of the automobile suburbs is decreasing, and that of active core areas is increasing

From 1996-2006, 98,000 of the CMA's 119,000 new residents (82%) lived in automobile suburbs, while from 2006-2016, only 109,000 of the CMA's 194,000 new residents (56%) lived in automobile suburbs. (Figures highlighted in green in Table 3.1). This represents a decrease in the share of CMA population growth of 26%.

For active core areas, the share of CMA population growth increased by 16%, from 13%, or 15,000 of the 119,000 new CMA residents over 1996-2006 to 29%, or 56,000 of the 194,000 new residents from 2006-2016 (Figures highlighted in yellow in Table 3.1). This is likely due to an increase in infill and intensification in inner-city neighbourhoods like Sandy Hill, LeBreton Flats, and Centretown. It may also reflect the adoption of Ottawa's Complete Streets policy in 2013, which aims to promote the development and maintenance of streets which are safe and comfortable for all users, including cyclists and pedestrians (Ottawa, 2013b).

This trend is positive, and indicates that the planners' efforts to reverse the long post-war tradition of automobile suburb development are having success. It also indicates that CMA is moving towards a more sustainable form of development.

However, despite the changing growth rates, active core neighbourhoods still represent a small fraction of the population relative to that of the automobile suburbs. In 2016, 199,000 people lived in active cores, representing only 15% of the metropolitan population, while 820,000 people, representing 62% of the CMA population, lived in automobile suburbs.

Over the 20-year study period, the proportion of the population of the Ottawa-Gatineau CMA living in each of the four categories remained relatively constant over time (See Table 3.1). The proportion of the population living in the less sustainable exurban and automobile suburbs has remained stable at

76%, while the more rapid growth of active core neighbourhoods has been offset by slower population growth in transit suburbs.

While planners in Ottawa-Gatineau can be encouraged by the change away from the traditional trend of automobile suburb development, they must continue to promote active core development, slower development in automobile suburbs, and convert existing automobile suburbs to more sustainable forms. The actions are necessary to catalyze a significant decrease in the proportion of the population living in less sustainable forms of development, and to build a more sustainable future for the Ottawa-Gatineau CMA.

3.3.2 The share of CMA population growth of the transit suburbs is decreasing, and that of exurban areas is increasing

The share of CMA population growth in the low-density exurbs increased by 18% from 2006-2016, with growth in the exurbs representing 17% of the CMA's new residents over that time period (Figures highlighted in orange in Table 3.1). This increase is likely due to a combination of new construction within existing urban areas and of exurban CTs being newly included within the CMA as more people commute long distances by automobile from rural areas.

From 1996-2006, 7,000 of the CMA's 119,000 new residents (6%) lived in transit suburbs, while from 2006-2016, the population living in transit suburbs decreased by 3,000 individuals, such that transit suburbs represented -2% of the CMA's 194,000 new residents (Figures highlighted in purple in Table 3.1). This represents a decrease in the share of CMA growth of 8%. This likely indicates that the construction of new residential units in many transit suburbs did not offset the long-term decline in household size across the region. Furthermore, the number of CTs which were classified as transit suburbs declined from 28 in 2006 to 26 in 2016, as their proportion of transit use declined. For more on the anomalous decline in transit suburb population, see Appendix E.

Both the increase in exurban and decrease in transit suburb population are unfortunate, and must be reversed to create a more sustainable urban form in the metropolitan area. These trends indicate that despite Ottawa and Gatineau's policies to promote transit-oriented development, which have existed since the early 2000s, the cities may be failing to achieve transit-oriented development around the existing bus rapid transit stations. Planners should therefore intensify efforts to build new transit-supportive developments, and endeavour to convert existing automobile-dependent neighbourhoods into ones which better support the use of public transit.

However, it should be noted that this study considers journey-to-work data only, and not data on the location of employment. Shifts in employment location to the outer suburbs could also have exacerbated the decrease of the population of the transit suburbs, as employers may be relocating to areas inconvenient to access via transit. Residents may therefore be living in neighbourhoods well served by transit, but working in areas accessible only by personal automobile.

3.4 Trends with Respect to Dwelling Units

Overall, comparing the results of the analysis of CMA dwelling unit growth with that of CMA population growth shows similar trends (See Tables 3.1 and 3.2). However, comparing CMA dwelling unit growth with that of CMA population growth also demonstrates that, relative to population, there is less growth in dwelling units in automobile suburbs and exurbs, and greater growth in dwelling units in active core and transit suburb areas (See Table 3.3). This is logical, as the growth in automobile suburbs and exurbs is primarily single detached homes which can house more individuals than the rental and condominium apartments which are predominantly built in active cores and transit-oriented areas.

Table 3.3: Decline in the umber of people per dwelling unit over time in the Ottawa-Gatineau CMA by CT classification

	1996	2006	2016
Exurban	2.98	2.83	2.43
Automobile Suburb	2.75	2.66	2.54
Transit Suburb	2.44	2.27	2.10
Active Core	2.04	1.95	1.73
Total CMA	2.62	2.52	2.32

Data Source: 1996, 2006, and 2016 Statistics Canada Censuses

Calculating the average number of people per dwelling unit, as shown in Table 3.3, illustrates that there are generally fewer people per unit in the transit suburbs and active core areas relative to exurbs and auto suburbs. It also demonstrates that the number of people per unit overall is declining over time in all categories.

In the 2011 amendment to their Official Plan, the City of Ottawa defines residential intensification targets for the existing urban area based on the proportion of new residential dwelling units that constitute residential intensification over a given time period (Ottawa, 2011). The results of this study's analysis, however, indicate that population growth does not necessarily correlate with unit growth, and that that the many dwelling units which are being built in active core and transit suburb areas are being occupied by less people per unit relative to automobile suburbs and exurbs.

When evaluating the success of their intensification efforts, the City may therefore claim that they are successfully intensifying- however, so long as intensification is defined in terms of dwelling units and not population, this 'successful intensification' could still result in overall population decline in the neighbourhoods where the long-term decline in household size is not offset by new unit construction.

3.5 CMA Active and Public Transit Use

3.5.1 Temporal Changes in Modal Share

The previous section described the general pattern of changes in CT classification across the Ottawa-Gatineau CMA. Due to the CT classification method used in this study, whether a CT was classified as a

transit suburb, active core area, or automobile suburb depended on the proportion of residents using active transit or public transit to get to work (See Chapter 3).

The threshold values defining each of these three categories depended on the metropolitan averages for public transit usage and active transit usage, which changed over the study period (See Table 3.4). For the 1996-2016 period, the proportion of Ottawa-Gatineau residents biking or walking to work declined by 0.3%. Though the absolute number of CMA residents commuting via active transit increased, the proportion of active transit commuters declined because most of the CMA's population growth was in automobile suburbs and exurbs, where commuting via active transit is difficult.

Table 3.4: Change in Transportation Modal Share over Time

	Ottawa-Gatineau			Canada		
	Active Transit	Public Transit	Automobile	Active Transit	Public Transit	Automobile
1996	9.0%	17.1%	73.1%	8.1%	10.1%	80.7%
2006	8.9%	19.5%	70.7%	7.7%	11.0%	80.0%
2016	8.7%	18.3%	72.1%	6.9%	12.4%	79.5%

Data from the Statistics Canada 1996, 2006, and 2016 Censuses

The proportion of CMA residents taking public transit to get to work increased by 2.4% from 1996-2006, then decreased by 1.2% from 2006-2016. This was concurrent with a 2.4% decrease, then a 1.4% increase in the proportion of residents commuting by automobile. There are several factors which may explain the increase then decrease in the proportion of Ottawa-Gatineau residents using public transit for their journey to work:

Gatineau has fewer transit users than Ottawa. In 2016, 23,075 Gatineau residents took transit for their journey-to-work, compared to 91,920 Ottawa residents (Statistics Canada, 2017b; Statistics Canada, 2017c). As such, the subsequent discussion of the rationale behind the above changes in the proportion of CMA transit usage will focus on Ottawa and its public transit agency, OC Transpo.

First, proportional public transit usage may have increased from 1996-2006 because of changes in fare prices. From 1984 to 1996, adult fares for OC Transpo increased by 41%, accounting for inflation (Bank of Canada, 2018; Wikipedia, 2018)[1]. There was a corresponding decrease in ridership in 11 of those 12 years. Following a transit strike in 1996, fares were brought in line with inflation (Raaymakers, 2010; Wikipedia, 2018). More modest fare increases from 1996 to 2006 may have made transit more competitive.

However, the proportion of CMA commuters using transit declined from 2006-2016. The decline in public transit use was likely due to people switching to commute via automobile, not active transit, as proportional active transit use declined over the study period, while automobile use increased.

It is unlikely that this change was also due to changes in fare prices. Accounting for inflation, fares increased by 32% from 1996-2006, but only by 3.6% from 2006-2016 (Raaymakers, 2010; Wikipedia, 2018; Bank of Canada, 2018). Given that there was a ridership increase over the former period despite the large fare hike, all else equal the relatively smaller fare increase across the latter time period should have catalyzed an even greater increase in ridership.

Rather, the decline in proportional public transit use from 2006-2016 was likely partially attributable to customer dissatisfaction with Ottawa's public transit service, OC Transpo. There was a 51-day worker strike in winter 2008-2009 in which all transit service was halted (Pierosara, 2009). Furthermore, construction on Ottawa's new LRT line began in 2015, leading to significant route changes, re-routings, and delays. Indeed, in 2016, when census data was collected, 18% of OC Transpo regular routes were late, up from 9% in 2014 before LRT construction began (von Scheel, 2017). These two inconveniences to transit users may have catalyzed a shift from transit use to the personal automobile.

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[1] The Bank of Canada's 'Inflation Calculator', which uses monthly consumer price index data from 1914 to the present, was used to account for inflation when calculating changes in fare prices.

The rise then fall in transit usage may also be tied to investment in public transit infrastructure.

Ottawa's BRT system, the Transitway, began service in 1983. Its initial planned 31 km length was

completed in 1996, with further minor extensions to Fallowfield (2000), Terry Fox (2005), Bayshore

(2009), and Barrhaven South (2011), and the opening of the O-Train in 2001 (OC Transpo, 2018b). The

initial completion of the Transitway likely caused a significant decrease in average trip time via public

transit, and, by decreasing the temporal cost of taking transit, likely caused an increase in CMA public

transit use. After the Transitway was opened, no further large investments were made in public transit

until the construction of the Confederation Line of the LRT, expected to open in 2018. Therefore, most

of the CMA's population growth from 1996-2016 occurred in automobile-dependent areas where it is

difficult to use transit. This lack of investment in combination with growth in automobile-dependent

neighbourhoods also likely contributed to the decline in the proportion of CMA public transit users from

2006-2016.

3.5.2 The Potential Future Effects of the LRT on Public Transit Use

Ottawa aims to promote transit use and transit-oriented development (TOD), and passed TOD design

guidelines in 2007 (Ottawa, 2011; Ottawa, 2007). However, despite the existence of these guidelines

and the continuing expansion of the BRT network, many suburbs along the network remain automobile

suburbs (see Maps 3.1-3.3), and the proportion of city residents using transit to get to work declined

from 2006-2016. This indicates that Ottawa has not yet successfully promoted public transit use or

transit-oriented development along its BRT network. Indeed, in a comparison of 44 global cities, Ottawa

ranked 31st in terms of which city had the most public transit passenger-kilometres per capita in 2005-

2006, and was found to be underperforming relative to other global cities (Newman & Kenworthy,

2015). Ottawa had only 849 transit passenger-kilometres per capita, while the top Canadian city,

Calgary, had 1,130 (Newman & Kenworthy, 2015). Ottawa was actually the only one of Canada's 8

largest municipalities to see a decline in the proportion of public transit ridership (Chan, 2017).

However, this situation may soon change. Ottawa is currently building its LRT system, and plans to open

Phase 1 of the system in 2018. Phase 1 will extend 12.5 km east-west through the downtown core, and

will replace the existing surface on-road reserved bus lanes. The LRT is projected to reduce average

commute times by 10-15 minutes, largely due to the installation of a tunnel through the downtown

core, which will allow it to bypass traffic. It is also projected to increase the number of transit users by

76% from 2006-2031 (Ottawa, 2012). That projection would be well in excess of Ottawa's projected

30% population growth (Ottawa, 2017), and, if realized, would result in much higher proportional CMA

transit use.

Phase 1 of the LRT will replace part of the existing BRT network, and so will serve only areas which

already have good public transit service. However, it may still result in an increase in public transit

ridership. Since urban Canadians consider the average acceptable one-way commute length to be 30

minutes (Oxford Properties and Environics, 2013), and since the average 2013 commute in Ottawa

already approached this maximum, at 29 minutes (Oxford Properties and Environics, 2013), this 10-15

minute reduction in trip length could result in more suburban residents being willing to take transit. The

LRT could therefore not only grow the population of existing transit suburbs, but also catalyze the

conversion of existing automobile suburbs to become transit suburbs. However, whether these time

savings will be realized in practice remains to be verified, and may well depend on bus-LRT connections.

Many suburbanites will have to take a bus to connect to an LRT station, rather than simply getting on a

bus which goes straight downtown, as is their current situation. This may result in less time savings, and

thus a smaller increase in ridership than anticipated, which would correspond to less population growth

in transit suburbs.

Scheduled to be completed by 2023, Phase 2 of Ottawa's LRT is to extend LRT service to Ottawa South,

East to Trim, and West to Moodie Drive. Unlike Phase 1, Phase 2 will extend service to areas which are

currently not included in Ottawa's BRT system (Ottawa, 2015). As such, Phase 2, even more than Phase

1, as the potential to catalyze an increase in public transit ridership, and thus in the population of transit suburbs.

Furthermore, Ottawa has developed zoning provisions and official plan policies to promote transit-oriented residential, office, and commercial growth around LRT stations (Ottawa, 2012; Ottawa, 2011; Ottawa, 2007), and many proposals for mixed-use developments around future LRT stations have emerged. This could result in the development of new active core areas or employment hubs outside of the existing downtown core, which in turn could yield more suburbanites using transit to access suburban jobs.

3.6 Location of CMA Growth

Table 3.5 presents a detailed examination of the location of population growth from 1996-2016 in Ottawa-Gatineau. A map showing the new CTs delineated over the study period is presented in Appendix F, and the map in Appendix G indicates the boundary line used to delineate the Greenbelt and the dividing line (the Rideau River) used to distinguish between Ottawa East and Ottawa West.

3.6.1 Location of Growth relative to the Greenbelt

Over the study period, the proportion of the population living inside the Greenbelt has decreased, and the proportion of the population living outside the Greenbelt has increased (Figures highlighted in blue in Table 3.5). Indeed, most of the CMA's population growth is concentrated in Ottawa, outside of the Greenbelt. Over time, the share of CMA population growth increased in Ottawa inside the Greenbelt, remained relatively constant in Ottawa outside the Greenbelt, and decreased in Gatineau (Figures highlighted in green in Table 3.5). This indicates that despite efforts to promote infill and intensification (Ottawa, 2011), most of the CMA's population growth is still occurring outside the Greenbelt. All the CTs outside the Greenbelt in Ottawa were classified as automobile suburbs or exurbs, indicating that this growth is concentrated in low-density, automobile-dependent areas.

3.6.2 Location of Growth relative to cardinal directions

Temporal analysis the populations of Ottawa East, Ottawa West, and Gatineau reveals that the greatest

share of CMA population growth is in Ottawa West. Ottawa West's population growth rate and share of

CMA population growth both increased from the 1996-2006 period to the 2006-2016 period (Figures

highlighted in yellow in Table 3.5); further research is needed to determine if this is a trend which will

continue. The share of CMA growth likewise increased in Ottawa East, however decreased in Gatineau.

Why might growth be greater in Ottawa West as opposed to Ottawa East? Ottawa East has historically

had cheaper real estate, but relative to the West End has been perceived as having lower incomes,

poorer services, and worse infrastructure (Egan, 2012). Furthermore, Ottawa West has a high-tech

.

Table 3.5: Location of Population Growth in the Ottawa-Gatineau CMA

	Population (Share of CMA Total)						Population Growth (Growth Rate)						Share of CMA Growth		
													1996-2006	2006-2016	1996-2016
Location	1996		2006		2016		1996-2006		2006-2016		1996-2016		2006	2016	2016
Inside Greenbelt	450,967	45%	451,080	40%	466,255	35%	113	0%	15,175	3%	15,175	3%	0%	8%	5%
Outside Greenbelt	312,423	31%	394,670	35%	525,471	40%	82,247	26%	130,801	18%	130,801	68%	69%	67%	68%
Gatineau	247,110	24%	284,030	25%	332,057	25%	36,920	15%	48,027	17%	48,027	34%	31%	25%	27%
Ottawa West	402,023	40%	452,450	40%	539,454	41%	50,427	13%	87,004	19%	87,004	34%	42%	45%	44%
Ottawa East	361,367	36%	393,300	35%	452,272	34%	31,933	9%	58,972	15%	58,972	25%	27%	30%	29%
Gatineau	247,110	24%	284,030	25%	332,057	25%	36,920	15%	48,027	17%	48,027	34%	31%	25%	27%
Total CMA	1,010,500	100%	1,129,780	100%	1,323,783	100%	119,280	12%	194,003	17%	313,283	31%			
Ontario	10,753,573		12,160,282		13,448,494			13%		11%		25%			
Canada	28,846,761		31,612,897		35,151,728			10%		11%		22%			

Table 3.6: Location of Dwelling Unit Growth in the Ottawa-Gatineau CMA

	Dwelling Units (Share of CMA Total)						Growth (Growth Rate)						Share of CMA Growth		
													1996-2006	2006-2016	1996-2016
Location	1996		2006		2016		1996-2006		2006-2016		1996-2016		2006	2016	2016
Inside Greenbelt	189,860	49%	198,345	44%	227,931	40%	8,485	4%	29,586	15%	38,071	20%	13%	24%	20%
Outside Greenbelt	100,580	26%	134,590	30%	190,257	33%	34,010	34%	55,667	41%	89,677	89%	53%	46%	48%
Gatineau	94,570	25%	114,895	26%	152,958	27%	20,325	21%	38,063	33%	58,388	62%	32%	31%	31%
Ottawa West	160,620	42%	185,090	41%	235,996	41%	24,470	15%	50,906	28%	75,376	47%	38%	42%	40%
Ottawa East	129,820	34%	148,845	33%	182,192	32%	19,025	15%	33,347	22%	52,372	40%	30%	27%	28%
Gatineau	94,570	25%	114,895	26%	152,958	27%	20,325	21%	38,063	33%	58,388	62%	32%	31%	31%
Total CMA	385,010	100%	448,830	100%	571,146	100%	63,820	17%	122,316	27%	186,136	48%			
Ontario	3,924,510		4,555,025		5,598,391			16%		23%		43%			
Canada	10,820,050		12,437,470		15,412,443			15%		24%		42%			

Data source for both Table 3.5 and 3.6: Statistics Canada 1996, 2006, and 2016 Censuses

employment hub located in Kanata and, as of 2017, is home to a new 8,500-worker campus for the

federal Department of National Defense, while Ottawa East lacks a major employment hub (Egan, 2012).

This disparity between Ottawa East and Ottawa West is perhaps also a reflection of Ottawa's industrial

past: Like most cities in the Northern Hemisphere, Ottawa West was upstream and upwind of the

pollution spewing from Ottawa's downtown factories. Those with the income to do so likely chose to

locate themselves in Ottawa West, and over time, prosperity begat prosperity (Benedictus, 2017).

Analyzing Ottawa's location of growth with respect to dwelling units, rather than population, reveals the
same trends.

Table 3.7: Top 10 fastest growing CTs by absolute change in population, 1996-2016

	Area	Population Increase	Population Growth Rate
1	Greenbelt West	60,978	644%
2	Navan	23,699	441%
3	Leitrim/Findlay Creek	21,936	500%
4	Plateau/Aylmer North	15,586	184%
5	Hull West	15,377	286%
6	South March/Shirley's Bay	14,318	286%
7	Stittsville	13,501	208%
8	Bridlewood-Emerald Meadows	9,860	231%
9	Kanata Lakes	8,562	8562%
10	Orleans	7,798	355%

Data from the 1996 and 2016 Statistics Canada Censuses

In the Ottawa-Gatineau CMA, from 1996-2016, absolute population growth was most rapid in the 10 CTs

listed in Table 3.7 and displayed on Map 3.4. The fastest growing area overall was in Ottawa West,

encompassing new developments in Barrhaven and Kanata like Chapman Mills, Bridlewood, Stittsville,

and Stonebridge. These, like all the other CTs listed above, are automobile suburbs developed on areas

which were constructed on formerly undeveloped rural greenfields, yielding rapid population growth.

CT splits were accounted for when making growth calculations by adding the populations of new CTs and subtracting the population of the CT from which they were split.

Appendix H contains a table showing the fastest growing CTs by population growth rate, and a map demonstrating the fastest growing CTs by population growth rate. These maps and figures are somewhat misleading, due to several CTs- for example LeBreton Flats - having initial populations that were very small or zero. Though these areas did not grow by many people, their small initial population led to a large percentage growth.

3.6.3 Growth in Ottawa as compared to Gatineau
Examining Tables 3.5 and 3.6 reveals that Gatineau comprises only approximately a third of the CMAs population and dwelling unit growth, and that Gatineau represents approximately a third of the CMAs population. That Ottawa is larger and continues to grow faster than Gatineau is likely due its historical prosperity leading to further prosperity.

When Ottawa was named capital of Canada in 1857, it spurred rapid growth due to the construction of public service buildings, and the employment and housing of new public servants. The post-WWII expansion of the federal public service, and the 1990s Ottawa high-tech boom catalyzed further population growth. Major public service buildings were not located in Gatineau until the 1970s. Furthermore, in 1900, the Hull-Ottawa fire destroyed two thirds of what is now downtown Gatineau, but only a small fraction of Ottawa (Gaffield, 1997; Taylor, 1986)

Map 3.4: 10 Census Tracts with the Highest Population Growth, 1996-2016

Legend

PopulationGrowth

☐	<0
☐	0-500
☐	500-1,000
☐	1,000-5,000
☐	>5000
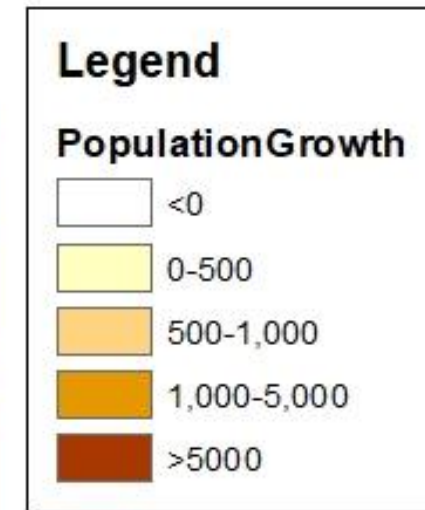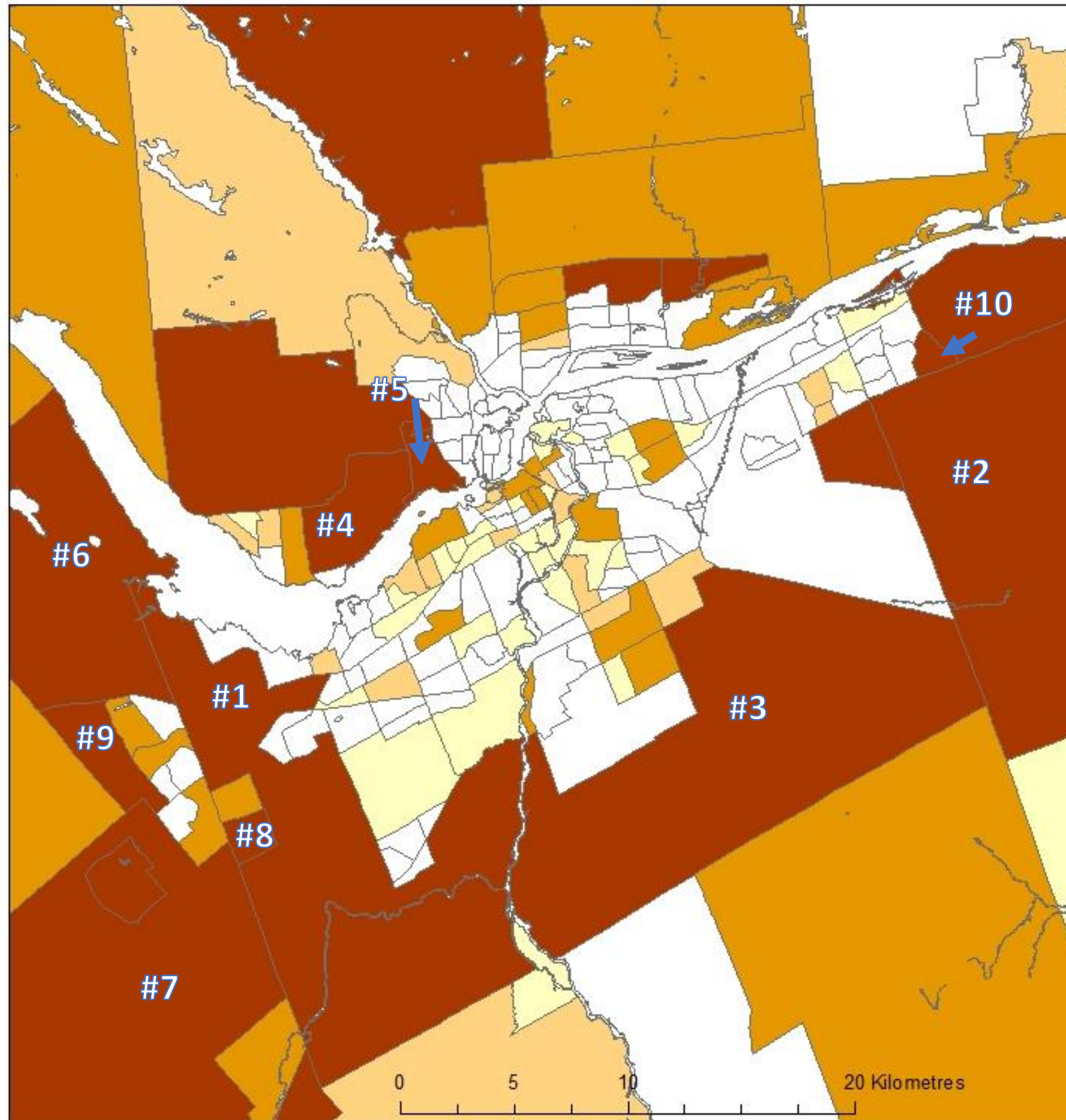
Ottawa-Gatineau
Statistics Canada 1996
and 2016 Censuses
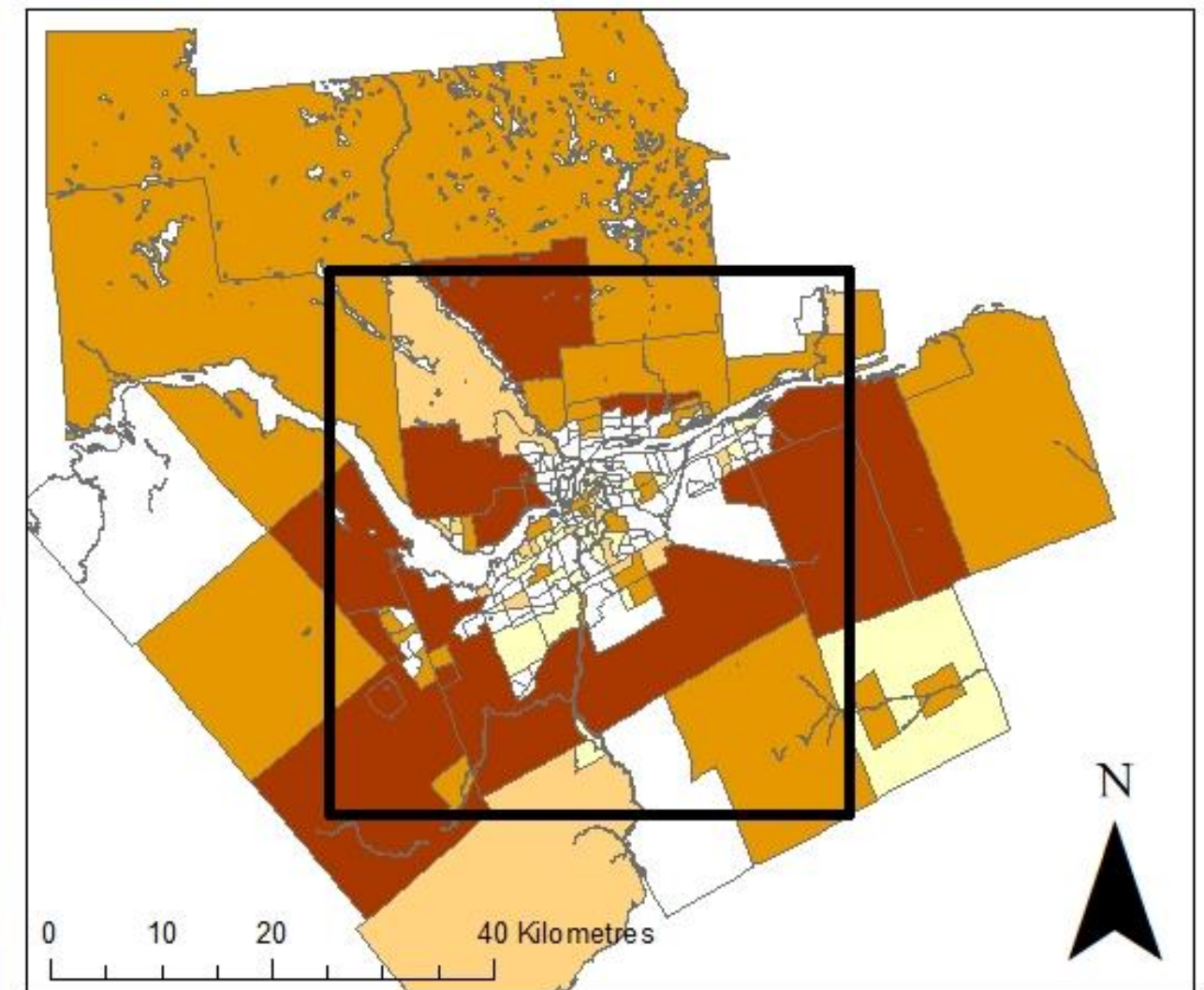
Emily Goldney
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3.7 Policy Comparison

The City of Ottawa's 2011 Official Plan Amendment defines targets for residential intensification based on the minimum proportion of new residential dwelling units and accommodation based upon building permit issuance by calendar year in the urban area (Ottawa, 2011). This information was not available via Statistics Canada census data, rendering comparison with 2011 Official Plan intensification targets not possible. The 2003 Ottawa Official Plan did provide numerical targets for the population and number of dwelling units to be situated inside the Greenbelt, in urban areas outside the Greenbelt, and in rural areas. Comparison with these statistics was also not possible, for the following reasons: This study was limited to using Statistics Canada CT data; the bounds of CTs pre-exist the Greenbelt, and so do not match with its boundary. Ottawa planners likely had access to data precisely matching with the Greenbelt when developing these targets. Furthermore, Statistics Canada defines the exterior boundary of a CMA based on the proportion of people commuting into the city for work, not based on political boundaries. The urban boundary used by Ottawa planners to calculate these target figures was located well within Statistics Canada's CMA boundary. As such, Ottawa's target population and dwelling unit figures are therefore not directly comparable to those of this study.

Nevertheless, one general policy conclusion is clear from the study: Despite policy efforts to promote walkable, transit-supportive development, the population growth in less sustainable exurbs and automobile suburbs continues to exceed the population growth in the more sustainable active cores and transit suburbs.

3.8 Chapter Conclusion

This chapter presented the results of the analysis of Statistics Canada data from the 1996, 2006, and 2016 Census at the CT level for Ottawa-Gatineau. Classifying each CT as a less sustainable automobile suburb or exurb, or as a more sustainable transit suburb or active core revealed the following conclusions:

First, most Ottawa-Gatineau residents are living in less sustainable forms of development. In 2016, 1 million residents of Ottawa-Gatineau, representing 76% of the CMA population, lived in automobile suburbs or exurbs.

Over time, the share of CMA population growth of the automobile suburbs is decreasing, and that of active core areas is increasing. The share of CMA population growth of the transit suburbs is decreasing, and that of the exurban areas is increasing. While the former trend is encouraging, the latter trend must be reversed. However, given the large proportion of existing residents living in less sustainable forms of development, these trends have not resulted in meaningful change in the proportion of residents in each category of CT over the last 20 years.

Finally, the majority of Ottawa's growth is currently situated outside of the Greenbelt and in Ottawa West, outside of the Greenbelt. Both of these growth areas are wholly comprised of automobile suburbs and exurbs.

Efforts to promote conversion of existing areas to transit suburbs and active cores, and to direct new growth towards these forms of development, must therefore be accelerated and intensified.

4.0 Conclusions and Recommendations

4.1: Study Objectives

This project had three primary research objectives: To determine the proportion of Ottawa-Gatineau

residents living in less sustainable forms of development, to determine the location and temporality of

development across the CMA, and to analyze if Ottawa's suburban growth management policies were

achieving their targets and objectives. To achieve these objectives, data from the 2016 Statistics Canada

census was used to classify CTs in the Ottawa-Gatineau CMA as exurbs, automobile suburbs, transit

suburbs, and active cores. A previously-completed classification of the CTs using 1996 and 2006

Statistics Canada Census data and identical methods (Gordon & Janzen, 2013) were compared with the

results of the analysis of the 2016 data for the determination of geographic and temporal trends.

For the purposes of this report, automobile suburbs and exurbs were considered to be less

unsustainable, while transit suburbs and active cores to be more sustainable forms of development.

4.2 Primary Findings

4.2.1 2016 Suburban Population

The classification of 2016 Statistics Canada data indicates that most Ottawa-Gatineau residents lived in

less sustainable forms of development: In 2016, 1 million people (76% of CMA residents) lived in these

automobile suburbs or exurbs. The same conclusion holds true when growth is examined in terms of

dwelling units instead of population; 397,000 dwelling units (69% of the CMA) were located in

automobile suburbs and exurbs.

4.2.3 Temporal Trends in Suburban Population Growth

As the city grows and develops, the proportion of the population living in less sustainable forms of

development may begin to change. Analyzing temporal trends in CMA growth indicated that the share

of CMA population growth of the automobile suburbs is finally decreasing, and that of active core areas

is increasing. 82% of CMA population growth was in automobile suburbs from 1996-2006, while from 2006-2016, the automobile suburbs represented only 56% of CMA population growth. This represents a decrease of 26%. For active core areas, the share of CMA population growth increased 16%, from 13% over 1996-2006 to 29% from 2006-2016. The same trend was present when growth was examined in terms of dwelling units, rather than population.

This trend is encouraging, as it indicates that Ottawa-Gatineau planners' efforts to promote active transit and compact development may be moving the city towards a more sustainable form of development. However, active core neighbourhoods still represent only a small fraction of the population relative to the vast population of the automobile suburbs: In 2016, 198,731 individuals resided in active cores, while 820,355 lived in automobile suburbs. As such, despite the recent change in the share of CMA growth, the overall proportions of residents living in active cores and automobile suburbs has remained relatively constant at 76%. Planners in Ottawa and Gatineau must therefore accelerate their efforts to promote the development of active cores and transit suburbs, and slow development in automobile suburbs in order to build a more sustainable future city.

There was also a change in the share of CMA growth of the transit suburbs and exurbs from 1996-2016. The share of CMA population growth of the transit suburbs is decreasing, and that of exurban areas is increasing. 6% of CMA population growth was in transit suburbs from 1996-2006, while from 2006-2016, the overall population of the transit suburbs decreased such that they represented -2% of CMA population growth. This represents a decrease of 8%. With respect to exurban areas, the share of CMA population growth increased 18%, from -1% over 1996-2006 to 17% from 2006-2016. The same trends were present when examining dwelling unit growth.

These trends are unsustainable: City planners must do more to promote the growth of transit-oriented suburbs and reduce exurban development. Ottawa-Gatineau failed to significantly invest in public transit

from 1996-2016, and population growth has been concentrated in areas where it is difficult to use transit. This resulted in a decline in the population of transit suburbs and a decline in the modal split of transit for the journey to work from 19.45% in 2006 to 18.33% in 2016. However, the opening of Ottawa's LRT in 2018 is projected to catalyze a significant shift in commuting patterns, and concurrently a growth in transit suburbs. Whether these effects are realized remains to be verified.

4.2.3 Geographic Trends in CMA Growth

Geographic analysis of the CT classifications over time indicated that the most of the CMA's population growth in Ottawa was located outside the Greenbelt. This is problematic, as all the CTs outside the Greenbelt were classified as automobile suburbs or exurbs. To promote more sustainable forms of outer Greenbelt development, Ottawa-Gatineau should work to build walkable, bikeable, transit-supportive 'complete communities' around existing employment centres outside the Greenbelt and outside of Gatineau's downtown. These suburban town centres have been proposed for Kanata and Orleans for decades (Gordon, 2015), but this study indicates that they are not performing as active cores or even transit suburbs.

The creation of these 'satellite downtowns' would allow residents to fulfill their daily needs on foot, on a bike, or via public transit, and would result in the conversion of currently automobile-dependent areas to active cores or transit suburbs. Ottawa-Gatineau should also aim to direct future growth to infill and intensification of existing built areas, and avoid future automobile-dependent greenfield development like that which is situated outside of the Greenbelt.

Comparing the populations of Ottawa East, Ottawa West, and Gatineau over time reveals that the greatest share of CMA population growth is located in Ottawa West. This is neither good nor bad, but planners must ensure that Ottawa East and Ottawa West continue to receive the same level of municipal service and amenity provision.

4.2.4 Policy Comparison

This project was limited to using Statistics Canada Census data, which, for the reasons outlined in section 3.6, cannot be directly compared with the numeric targets for population and dwelling unit growth situated within Ottawa's past and present Official Plans.

The results of this project can, however, be compared to the general goals and intent of the Official Plan. The plan aims to direct growth within the existing boundary, and to promote walkable, bikeable, transit-supportive communities. However, as outlined in Chapter 3, the majority of Ottawa-Gatineau's population growth remains in automobile-dependent areas, indicating that the success of these goals has been limited. As such, Ottawa-Gatineau planners must intensify their efforts to promote more sustainable forms of development.

Lastly, Ottawa and Gatineau defined their intensification targets based on a proportion of new unit construction. Planners should be cautious when defining targets in terms of dwelling units, rather than population: The results of this study's analysis indicate that the many dwelling units which are being built in active core and transit suburb areas are being occupied by less people per unit relative to automobile suburbs and exurbs, and that the number of people per dwelling unit overall is generally decreasing over time. Therefore, if intensification targets are developed according to dwelling units, rather than population, achievement of targets could still result in overall population decline in areas where the decline in household size is not offset by construction of new units.

4.3 Limitations and Future Considerations

Section 2.6 described the potential limitations of this project as perceived by the primary investigator prior to beginning the analysis portion of this project. The subsequent section elaborates on additional limitations discovered while completing this project, and provides insights and advice for those conducting similar projects in the future.

The most important limitation of this study is that the trends outlined in this report are based on two 10-year time intervals only: Caution should therefore be used in interpreting the temporal trends revealed through this study. The limited data points mean that the trends could simply represent temporal anomalies.

Further research should be done to analyze the results of censuses prior to 1996, to reveal whether the trends described in this study are in fact long-term trends. Analysis of 2001 results could also be used to evaluate the existence of the trends described in this study. However, analysis of the 2011 Census must be used with caution, as this was the only year in which the long-form census was made voluntary, and as such its results cannot be compared accurately with the results of the other, mandatory, censuses (Hulchanski, Murdie, Walks, & Bourne, 2013). Time constraints prevented this project from having a broader temporal range. This study should also be repeated at 5 or 10-year intervals in the future, to allow for the continued evaluation of the success of Ottawa-Gatineau's growth management policies, and to analyze the effect of initiatives like the LRT.

The primary researcher on this project relied extensively on their personal knowledge of Ottawa-Gatineau when analyzing results and conducting error analysis. If future researchers are unfamiliar with the study area, they should arrange to consult with or interview people familiar to the area for error checking and the resolution of seemingly anomalous results.

Furthermore, throughout this study some results were compared with national averages. However, these are imperfect comparisons, as national averages include the values of Canada's rural areas. Comparison with the averages of all Canadian CMA's or comparably sized CMA's may have been more informative; time constraints prevented this from being accomplished with this project.

A significant time issue with this project was the analysis of temporal growth trends. To the knowledge of this researcher, there is no publication describing when CTs were split, which CTs were split into

which new CTs and when the CMA boundary was extended to include new CTs. This meant that to analyze growth, Statistics Canada CT maps had to be manually examined for each CT over each time period, which was extremely time consuming. Statistics Canada should publish concordance files detailing the appearance of new CTs, to facilitate this sort of research.

A policy comparison with numeric targets for the location of growth was rendered impossible given the discrepancy in boundary definitions and data sources between Ottawa's Official Plan and Census information (see Section 3.6). Indeed, neighbourhood form may vary across CTs, and so using CTs as the base unit analysis is imperfect. However, there is no better alternative for publicly available, long-term, reliable data, especially for comparison with other Canadian metropolitan areas.

No GIS files were publicly available for Gatineau's public transit routes, so they were not included on the maps in this report. This could have been an issue, as comparing the locations of public transit routes with those of transit suburbs could have allowed for inferences to be drawn on the efficacy of Gatineau's public transit policies. However, of the CTs in Gatineau, none were classified as transit suburbs, rendering this potential limitation a non-issue. As explained in Appendix C, the lack of transit suburbs in Gatineau may reflect that the CMA average was used to calculate the threshold value defining what constitutes a transit suburb. As public transit ridership is generally lower in Gatineau (see Appendix C), when classifying transit suburbs future studies should use separate threshold values for Gatineau and Ottawa, rather than the CMA as a whole, to see if this results in the presence of transit suburbs in Gatineau.

Lastly, as stated in section 2.6, the definition of suburbs used for this report is meant to be a working definition only. Care must be taken when interpreting the results of this study to be aware of how suburb was defined for the purposes of this project, as the term 'suburb' carries many different meanings. This will avoid misinterpretation of results.

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Appendices

Appendix A: Classified CTs overlain with complete Transit Routes

Maps 3.1-3.3 demonstrate CT Classification, and are overlain with lines indicating the BRT and LRT

network in Ottawa. The following three maps demonstrate the same thing, with the addition of OC

Transpo express, regular, and peak hour routes to provide a more nuanced understanding of how transit

shapes development of transit suburbs. GIS files on OC Transpo routes for 2016 were unavailable, so
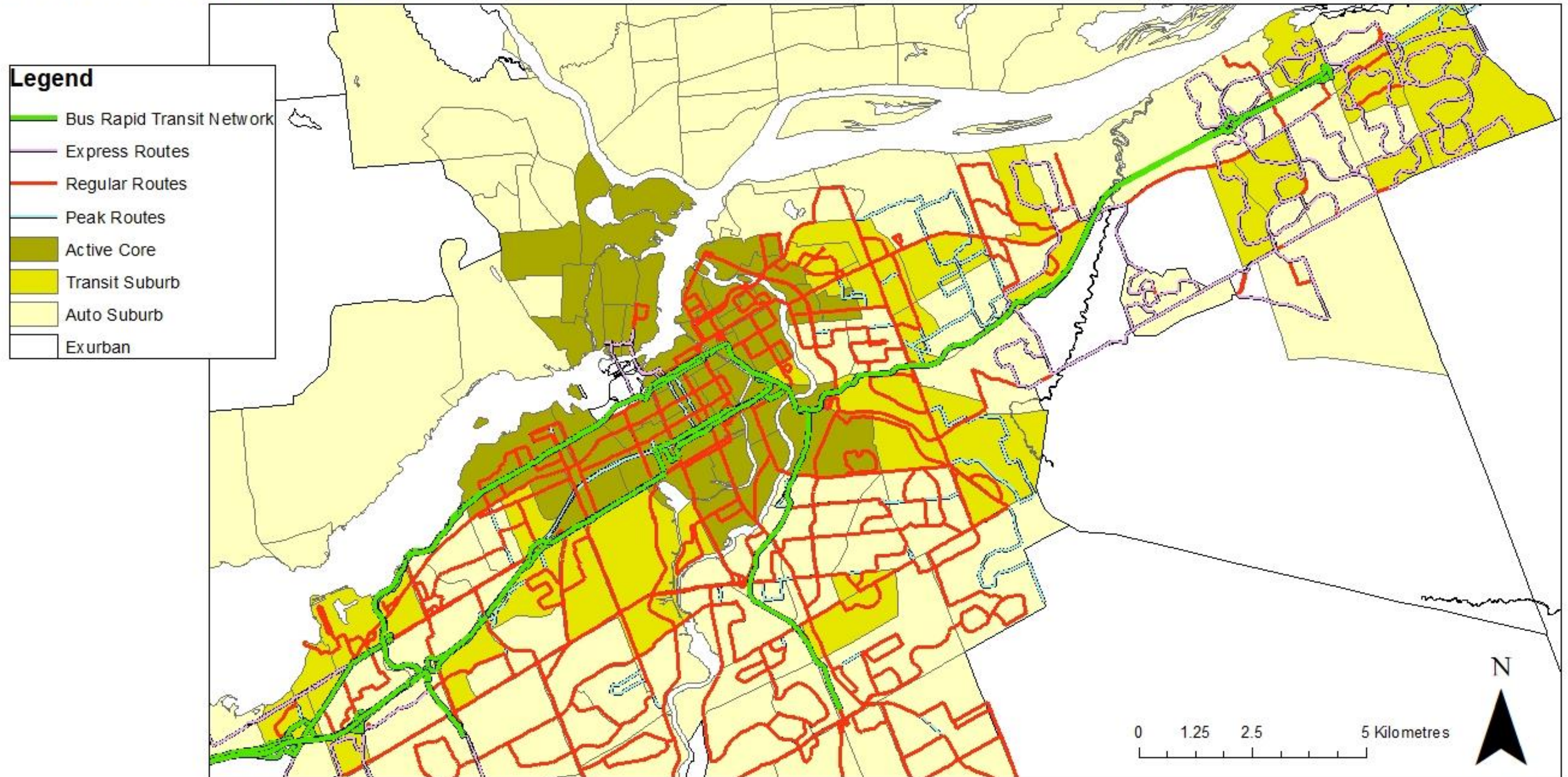
the most recent data, that of 2015, was used. 1996 and 2006 data on OC Transpo routes were used for

the 1996 and 2006 maps, respectively.

Note that despite the many OC Transpo routes servicing the outskirts of the urban area, these areas

remain wholly automobile suburbs.

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Ottawa Transit Routes- 1996

Legend

- ▬ Bus Rapid Transit Network
- ▬ Express Routes
- ▬ Regular Routes
- ▬ Peak Routes
- � green▬ Active Core
- ▬ Transit Suburb
- ▬ Auto Suburb
- ▬ Exurban

0   1.25   2.5   5 Kilometres
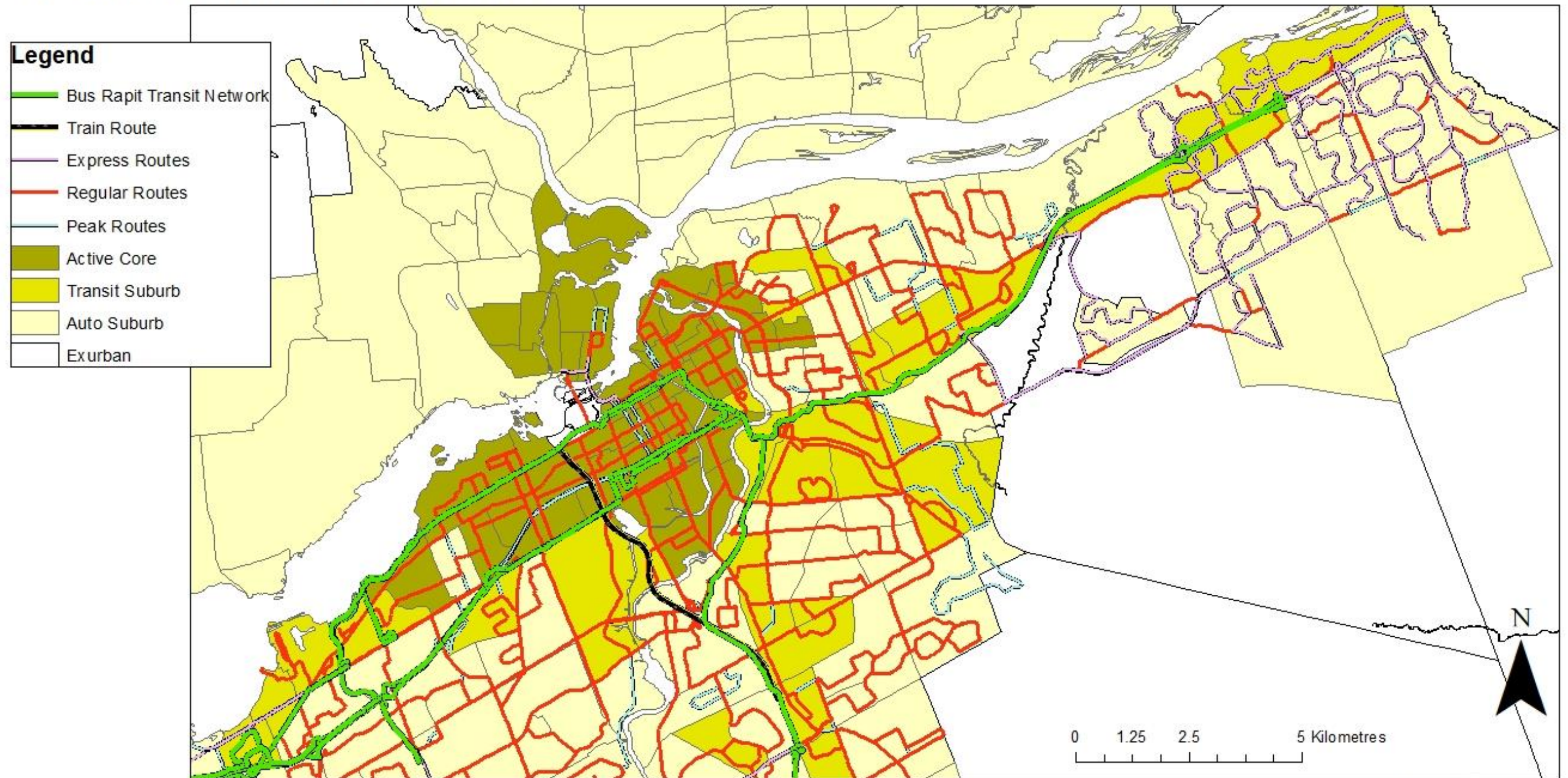
N

Statistics Canada 1996 Census
OC Transpo

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Ottawa Transit Routes-2006

Legend

- ▬ Bus Rapit Transit Network
- ▬ Train Route
- ▬ Express Routes
- ▬ Regular Routes
- ▬ Peak Routes
- Active Core
- Transit Suburb
- Auto Suburb
- Exurban

N

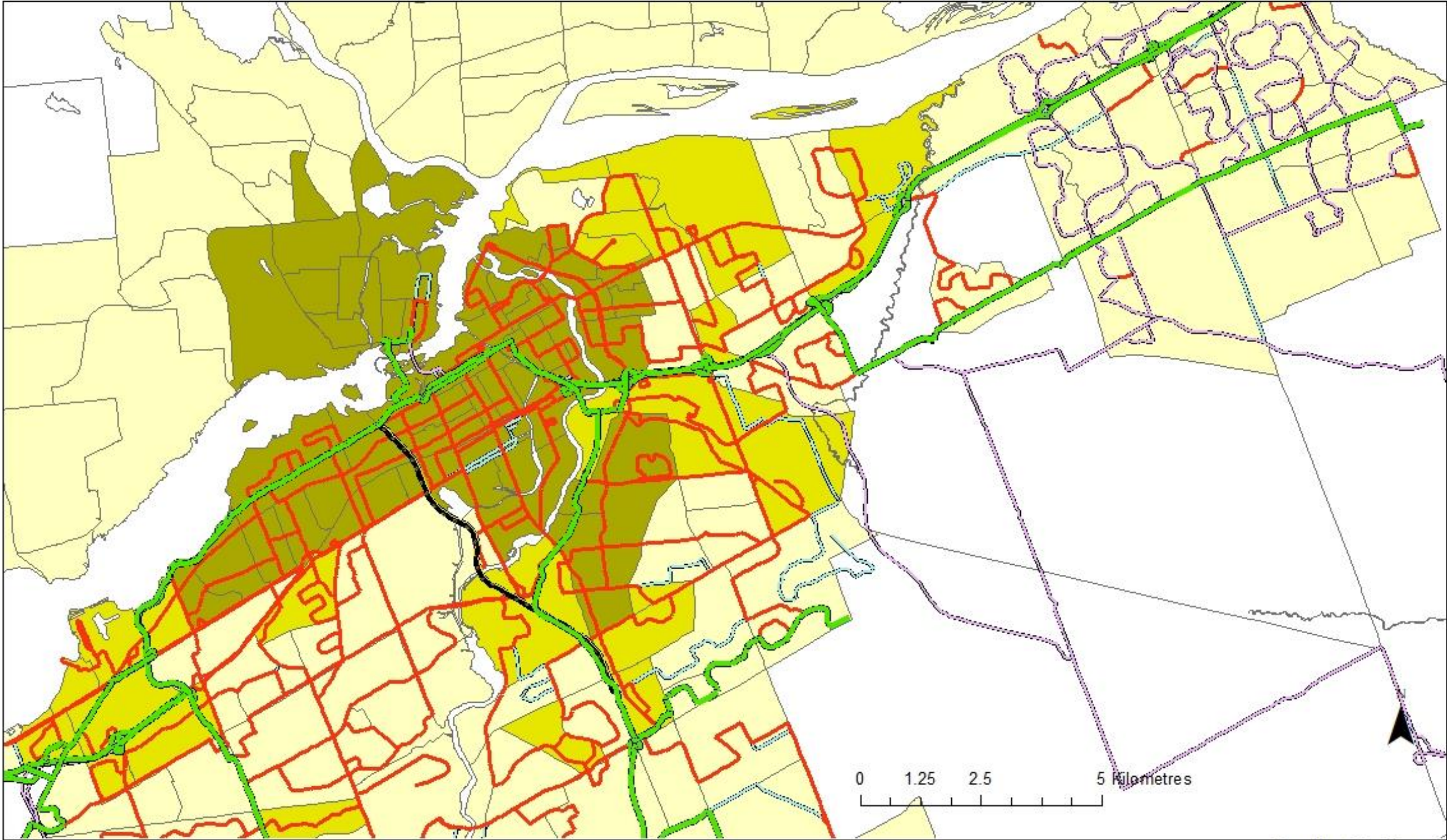| 0 | 1.25 | 2.5 | 5 Kilometres |

Emily Goldney

Statistics Canada 2006 Census
OC Transpo

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Ottawa Transit Routes - 2015/2016

Legend

- ▬▬ Bus Rapit Transit
- ─── Express Routes
- ━━ Train Route
- ─── Regular Routes
- ─── Peak Routes
- ▨ Active Core
- ▢ Auto Suburb
- ▢ Exurban
- ▨ Transit Suburb

0   1.25   2.5   5 Kilometres

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Appendix B: CT Classification Pattern

The classification of CTs and analysis of changes in CT classifications for the Ottawa-Gatineau CMA (see

Maps 3.1-3.3) reveals a general regional pattern of active core CTs concentrated in the downtown areas,

surrounded by concentric rings of auto suburbs, then exurbs. This is aligned with the general Canadian

pattern revealed in Janzen and Gordon's 2013 classification of CTs in Canadian metropolitan areas,

which was completed using an identical classification method to this report. It is logical that active cores

be found in the downtown area, as living within the central business district, where many city jobs are

concentrated, allows residents to easily walk or cycle to work. In Ottawa, transit suburbs are focussed

at the periphery of the active core and are aligned with Ottawa's BRT Network, known locally as the

Transitway (See Maps 3.1-3.3 and Appendix A). This is also logical, as these areas are too far from the

central business distract to make walking or cycling to work convenient, but the high level of downtown

congestion and strong transit access make transit an attractive commuting option.

The exception to this general pattern are the CTs located immediately east of Ottawa's downtown, in

the Vanier-Overbrook area. Under the pattern explained above, these areas may have been expected to

be classified as auto suburbs. Although these CTs are not aligned on the Transitway, they were classified

as transit suburbs. These neighbourhoods, though now gentrifying, were traditionally very low income,

and in 2011, over 40% of the population of Vanier North made under $20,000 after taxes (University of

Ottawa, et al, 2018). The residents' low-income status means that few residents can likely afford to use

their limited income on a car, explaining the neighbourhoods high public transit usage. No information

on car ownership by CT was available to verify this hypothesis.

The following describes the general pattern of change in CT classification over time:

Exurban areas expand as low-density development continues in the city's rural areas, and as the CMA

boundary is extended further outwards.

Auto suburbs expand outwards into areas previously classified as exurban, reflecting rapid subdivision of greenfield lands at the periphery of existing auto-dependent neighbourhoods. For example, this occurred in the Kanata area of Ottawa West.   CTs located outside of the downtown core are split once their population grows significantly larger than 8,000 (Statistics Canada, 2017d). When partially built-out auto suburbs expand and their population grows beyond 8,000, existing auto suburbs are split into two or more new auto suburb CTs (Statistics Canada, 2017d), as was seen in the Barrhaven area of Ottawa-West.

New transit suburbs generally appear because of auto suburbs changing classifications, typically as a result of expansions and improvement to public transit infrastructure. For example, from 2006-2016, several CTs in Ottawa East switched classifications from auto suburbs to transit suburbs. This was likely caused by a delayed response to the extension of OC Transpo Route 1 from the downtown core to this area in 2004, and the extension of OC Transpo Route 129 from this area further towards the downtown core area in 2014-2015.

Active core areas expand outwards as the areas surrounding the existing downtown increase in residential and commercial density, allowing more people to walk or cycle to work. For example, the Carlingwood area in Ottawa West was a former transit suburb situated at the periphery of the central active core area, but was classified as an Active Core in the 2016 classification.

Appendix C: Abnormalities in the Pattern of CT Classification

There were three unique anomalies in the general pattern of CT classification changes over time described above.

First, some CTs switched back and form between being classified as auto suburbs and transit suburbs. These switches were caused by an unusual combination of factors: There was a proportional increase in CMA transit use from 1996-2006, and a proportional decrease in CMA transit use from 2006-2016, as discussed in Chapter 5. This meant that the threshold value for determining what constituted a transit suburb, which was based on 150% of the metropolitan average public transit use, increased and then decreased. Examining individual CTs reveals that most of the CTs which switched classifications had levels of public transit use very close to the threshold value, and were on the cusp of being classified as transit suburbs for the 1996, 2006, and 2016 periods. Fluctuations in the threshold value therefore led to changes in their classification.

Second, no CTs in Gatineau were classified as transit suburbs over the study period, even though Gatineau recently made a large investment in improving public transit service. In 2013, Gatineau opened the 'Rapibus', a 10-station, 12 km BRT corridor. It was built with the goal of promoting transit-oriented development, with new high-density residential and commercial buildings focussed on transit stations (Société de transport de l'Outaouais, 2013). The results of this study indicate that this has not yet occurred, and the areas around the outer limits of the Rapibus remains as auto suburbs.

The failure of the Rapibus to result in the designation of CTs as transit suburbs may be attributable to two factors: First, the system has only been in operation for 3 years, and its effects will be better evaluable over the long term. Travel behaviours change slowly over time; existing residents could adapt to the system and change their commuting habits in the future, and new transit-oriented development

could result in new people moving in to the area who choose to live on the Rapibus system so that they can commute via public transit.

Also, that there are no transit suburbs in Gatineau may reflect that the CMA average was used to calculate the threshold value defining what constitutes a transit suburb. For example, in 2006, on average 20% of commuters in Ottawa used public transit, while only 14% of Gatineau residents did the same, perhaps due to generally lower congestion levels in Gatineau (Statistics Canada, 2006). Calculating threshold values for Ottawa and Gatineau separately, rather than the CMA as a whole, may have resulted in CTs in Gatineau being classified as transit suburbs.

A third anomaly in the general pattern of CT Classification is that a downtown CT was classified as an exurban area for the 1996 and 2006 analyses, and as active core in 2016. Given the area's location within Ottawa's Central Business District, it would have been expected to have been classified as an active core over all three time periods. However, this CT is wholly comprised of the LeBreton Flats area of Ottawa. This formerly residential area was expropriated in the 1960s, was demolished, and was left vacant for decades, with its owner, the National Capital Commission, refusing to allow any development. The area is currently being redeveloped; condominium and apartment building began in the late 2000s, and residents began to move in to the new buildings in 2008. The LeBreton Flats CT had been classified as exurban for the 1996 and 2006 census analyses due to its extremely low population density; this was erroneous, and the area should have been designated as 'unclassified,' similar to other industrial areas with no population. Due to its proximity to the core and location on existing transit and active transit networks, its residents can easily walk or bike to work. Thus, after redevelopment began, the residential density exceeded the exurban threshold, and the CT switched classifications to active core.

Ottawa-Gatineau: Changes in CT Classification

1996-2006
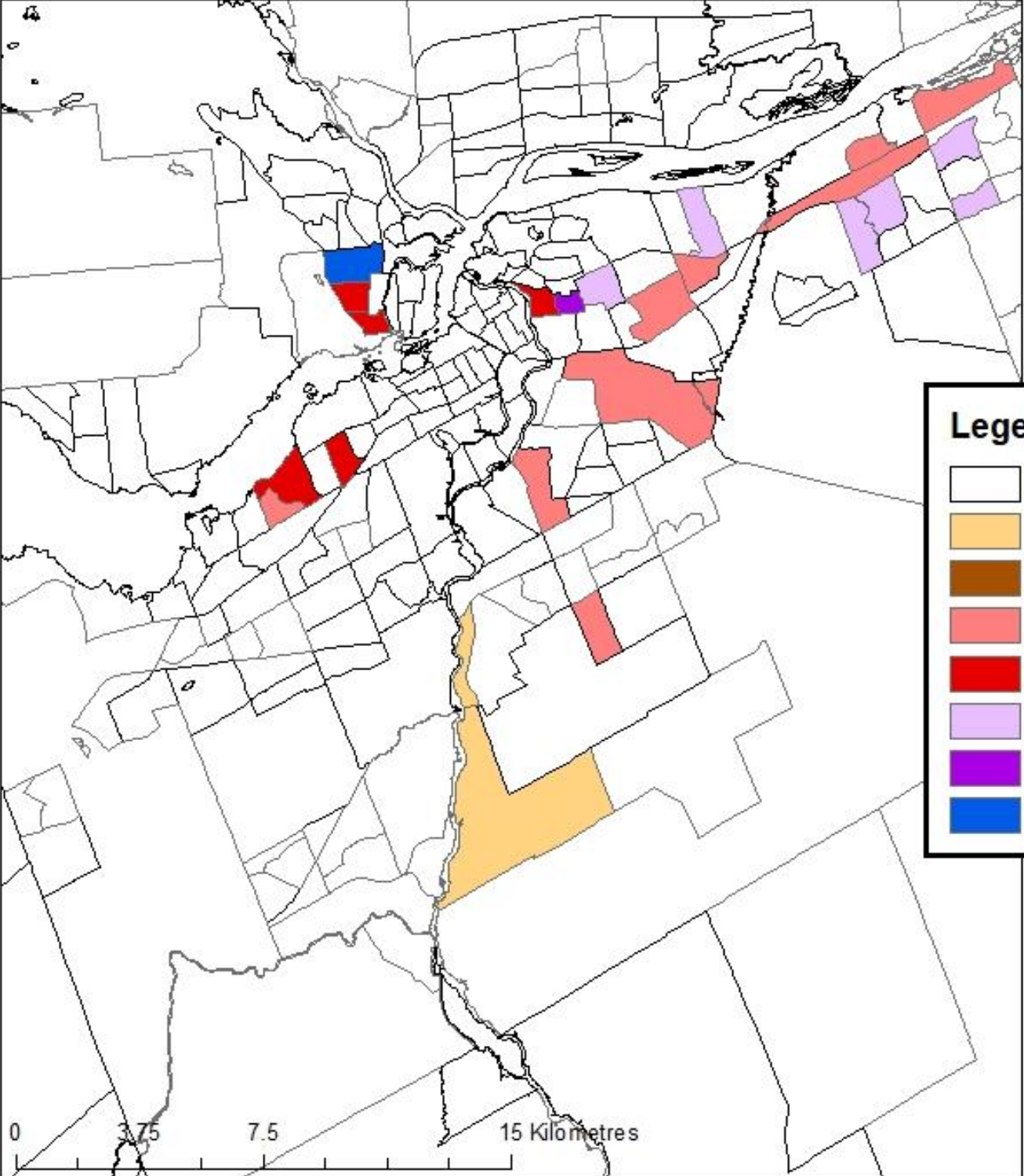
2006-2016
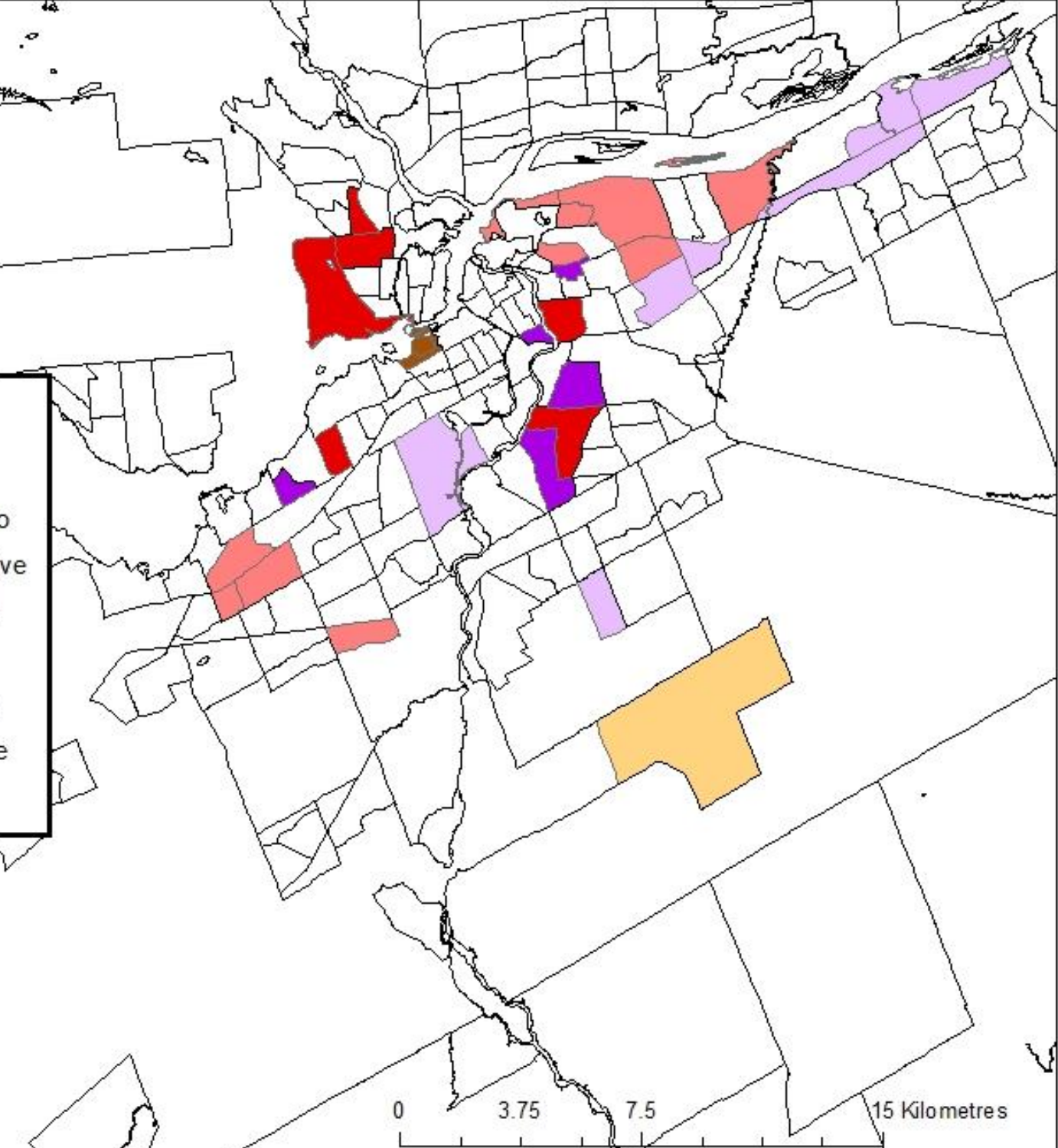
Legend

	No Change
	Exurban-Auto
	Exurban-Active
	Auto-Transit
	Auto-Active
	Transit-Auto
	Transit-Active
	Active-Auto

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Appendix E: Anomalies in Population Growth

There were two seemingly anomalous decreases in population over the study period:

From 1996-2006, the population in areas classified as exurban decreased by 1%, though increased by approximately 20% for the 2006-2016 and 1996-2016 periods. This anomalous decrease is likely due to the study's classification method, and probably reflects population growth in areas which were classified as exurban in 1996, but over the 1996-2006 time period developed into auto suburbs. Of the 89 CTs which were new or which changed in classification from 1996-2006, 16 of these represented auto suburbs emerging in areas which were formerly rural greenfields, and were previously classified as exurban.

Similarly, for the 2006-2016 period, the population decreased by 3% in the transit suburbs. This is again a reflection of the study's classification methodology: From 2006-2016, there was an overall decrease in transit use across the metro area, leading to 2 fewer CTs being classified as transit suburbs. Chapter 5 explains why transit use decreased over the study period.

Appendix F: Location of New CTs

Map F-1 indicates the location of new CTs over the 1996-2006 period and the 2006-2016 period. As described in Chapter 3, Statistics Canada is the agency responsible for CMA and CT delineation. It aims for CTs to have populations between 2,500 and 8,000 residents, to maximize homogeneity and thus comparability between tracts. As such, when the population of a CT outside of the downtown core approaches or exceeds 8,000, the tract is split into 2 or more new CTs (Statistics Canada, 2017d).

Statistics Canada avoids making changes to CT boundaries so that CTs remain historically comparable between censuses (Statistics Canada, 2017d), and so the formation of new CTs is almost exclusively due to population growth and the expansion of the CMA outer boundary.

Examining Map F-1 therefore indicates where population growth is occurring. However, it should be noted that this does not provide a complete analysis, as CTs in the central business district, major commercial or industrial zones, or peripheral areas are permitted to have populations more than 8.000 residents.
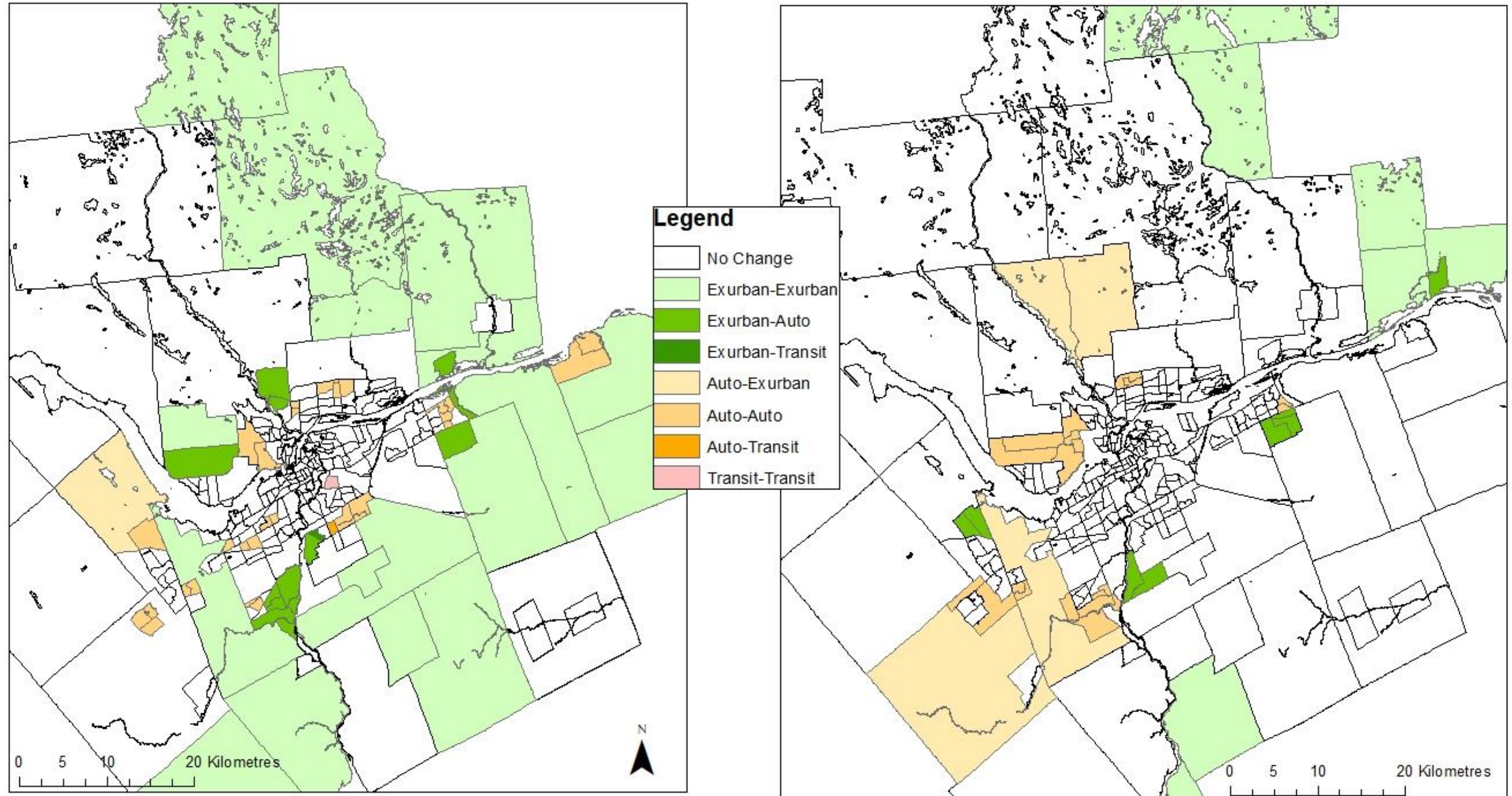
Statistics Canada also defines the outer edges of CMAs based on the location of work of their residents; areas within the CMA are defined as those with more than 50% of workers commuting into the metropolitan area (du Plessis, Behsiri, & Bollman, 2001). Over time, new exurban CTs appear within the Ottawa-Gatineau CMA, as the edges of the CMA move outwards due to more people commuting from remote rural areas into the centre city. This was the likely cause of the majority of exurban growth from 1996-2016. Extensions of the outer edge of the CMA are a useful indication of more people living in low-density rural areas and commuting long distances for employment. We can be reasonably certain that most of these people are living in single detached homes and are commuting by car, so the new CMA edge indicates the outer edge of exurban distribution.

Map F-1: New CTs in Ottawa Gatineau, 1996-2006 and 2006-2016

Ottawa-Gatineau: New CTs

1996-2006

2006-2016

Legend

☐	No Change
☐	Exurban-Exurban
☐	Exurban-Auto
☐	Exurban-Transit
☐	Auto-Exurban
☐	Auto-Auto
☐	Auto-Transit
☐	Transit-Transit

0 5 10   20 Kilometres

N

0 5 10   20 Kilometres

Appendix G: Boundary Lines for the Greenbelt and Ottawa East/West

Ottawa-Gatineau
Boundary Lines used for Geographic Analysis
Statistics Canada 2016 Census
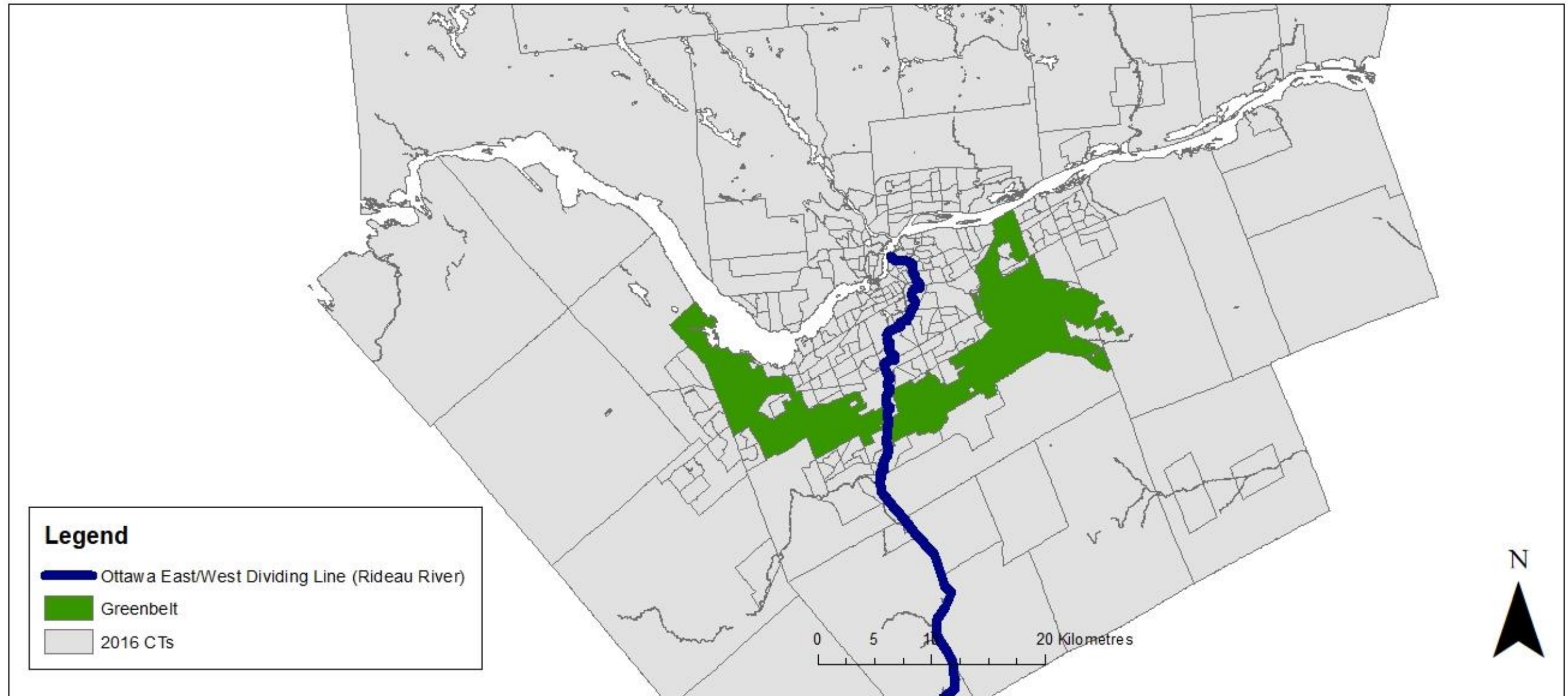
Legend
— Ottawa East/West Dividing Line (Rideau River)
■ Greenbelt
□ 2016 CTs

0 5 10   20 Kilometres

N

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Appendix H: CTs with the highest Growth Rates

Table H-1: 10 CTs with the fastest growth rates in the Ottawa-Gatineau CMA from 1996-2016

	1996-2006		2006-2016		1996-2016	
	Area[2]	Growth Rate	Area	Growth Rate	Area	Growth Rate
1	Kanata Lakes	3210%	Ottawa West-Greenbelt	735%	Kanata Lakes	8562%
2	Riverside South	2110%	LeBreton Flats	620%	Riverside South	2662%
3	East Orleans	313%	Findlay Creek	559%	LeBreton Flats	1278%
4	Barrhaven	287%	Mer Bleue	527%	Barrhaven East	644%
5	Kanata Lakes	193%	Barrhaven	342%	Findlay Creek	500%
6	Leitrim	170%	Aylmer	275%	Southeast Orleans	441%
7	Navan	153%	Cumberland	188%	East Orleans	355%
8	Shirley's Bay	135%	Kanata	167%	Central Kanata	286%
9	Aylmer North	133%	Orleans	138%	Hull West	286%
10	Bridlewood	117%	Ottawa U	98%	Kanata Lakes	243%

Some of these CTs had high growth rates because they started as low population rural areas, for example Mer Bleue, or low population urban areas like LeBreton Flats. Due to their low initial populations, modest absolute population growth in these areas led to high growth rates. CT splits were accounted for when making growth calculations by adding the populations of new CTs and subtracting the population of the CT from which they were split.
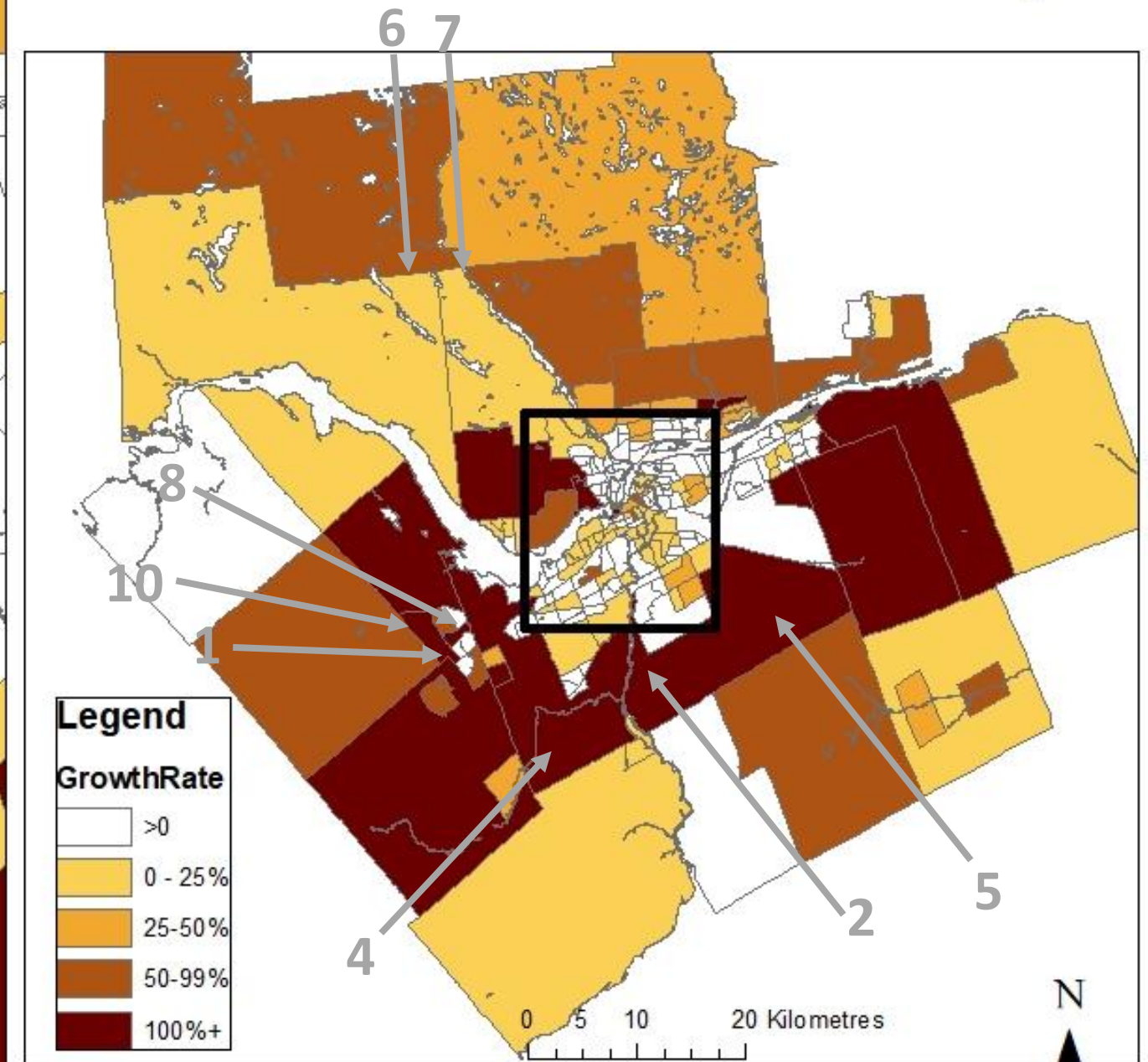
See Table 3.7 for a table of the fastest growing CTs by absolute population.

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[2] Ottawa has no officially designated neighbourhoods, so the area names located in Table H-1 are reflective of the author's personal knowledge of Ottawa and Google Maps labels.

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Map H-1: Population Growth Rates by Census Tract in Ottawa-Gatineau, 1996-2016
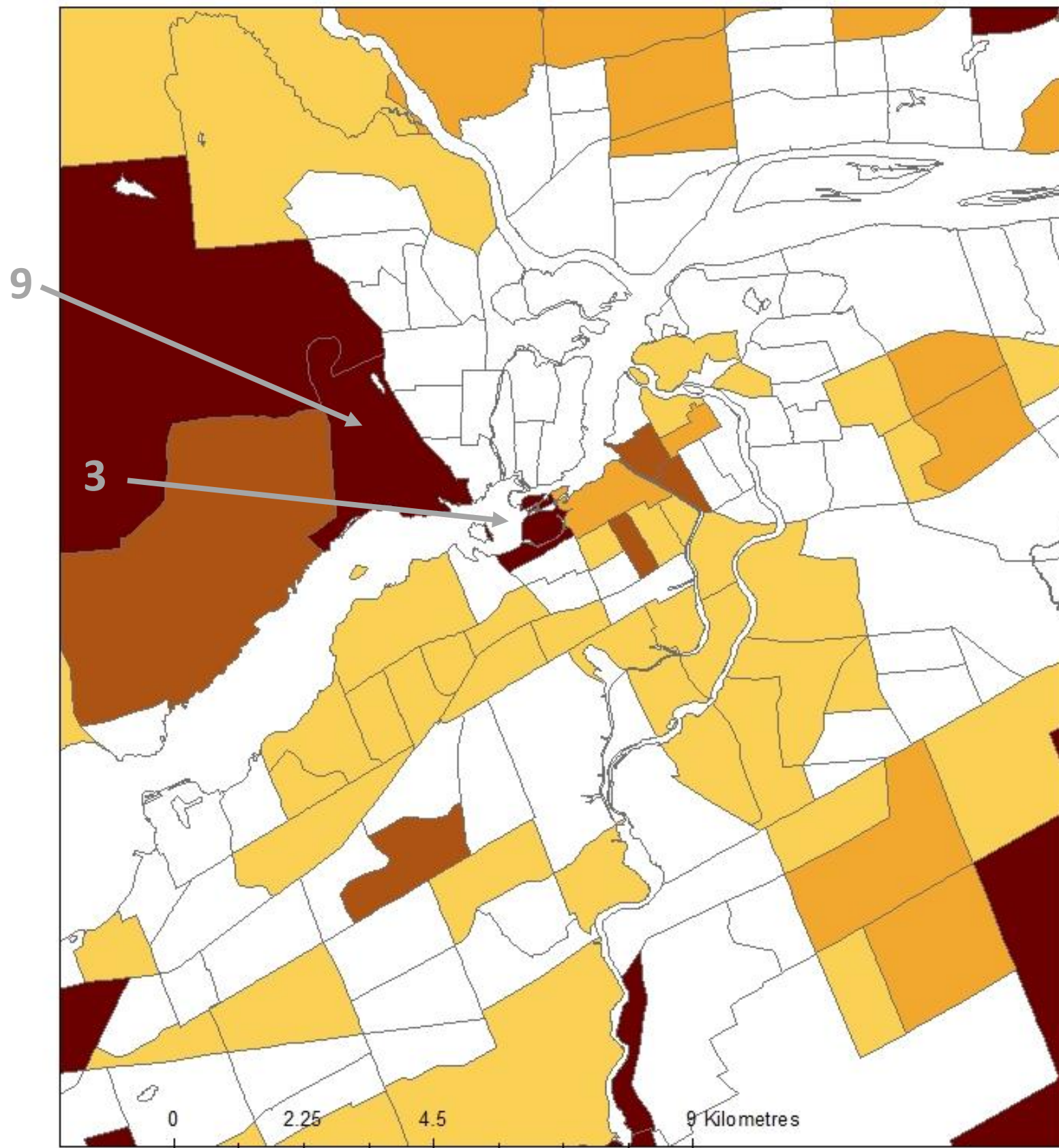
Ottawa-Gatineau
Growth Rate by CT

Legend

GrowthRate

>0
0 - 25%
25-50%
50-99%
100%+

0   5   10   20 Kilometres

N

Statistics Canada 1996 and 2016 Censuses
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0   2.25   4.5   9 Kilometres