FINDING THE MISSING MIDDLE: THE POTENTIAL AND CAPACITY FOR MISSING MIDDLE GROWTH IN TORONTO

by

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ABSTRACT

Interest in and action to add missing middle to cities across North America has seen a recent increase, with mixed success. Toronto City Council has recently requested a staff report on potential ways to add different housing options to Toronto's neighbourhood, suggesting changes may be in progress here. Missing middle has the potential to reduce Toronto's reliance on mid/high-rise apartments for new housing, and create more housing supply especially for middle-income family households. The need for and impact of regulatory changes must be evaluated to create appropriate reforms and communicate them with stakeholders and the public. This research paper provides initial housing type growth projections, maximum densities for housing typologies, and upper limits on the capacity of missing middle to add housing to Toronto's neighbourhoods.

KEY WORDS: missing middle; land use planning; housing; gentle density; Toronto.

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Table of Contents

List of Tables

List of Figures

List of Appendices

1. Introduction

The push to encourage and allow missing middle housing in low-density neighbourhoods has recently gained traction in several jurisdictions in North America. In the City of Toronto there has been very little movement in this area, however the 2019 request by city council for a staff report on ways to create diverse housing options in Toronto neighbourhoods suggests this may be about to change.

The objective of this research is to estimate the potential impact that adding missing middle to Toronto's Yellowbelt would have on meeting future housing demand. The approach taken to answer this question has three components: modelling the projected demand for different housing typologies out to 2046 for the City of Toronto and surrounding regional municipalities; finding the maximum achievable density for different housing types such as missing middle, detached housing, or mid/high-rise apartments; and combining the projected demand and density of housing types to project the difference between demand and supply if different portions of the Yellowbelt was intensified to different building type densities.

The methodology used to project housing demand by structure type was to convert the Ontario Ministry of Finance cohort-based population projections into cohort-based head of household by structural type of dwelling projections, using 2016 census headship rates and head of household structural type of dwelling rates. To find the maximum achievable density of different structural types of dwellings a combination of example census tracts from the Toronto, Montreal, and Vancouver Census Metropolitan Areas (CMAs), or median-lot based density calculations were used depending on the quality of the example census tracts. The answer of how much density can be added cannot be found precisely with currently available public data, but a rough estimate of the ceiling on additional density can be calculated. The household projections and maximum density values were then combined with the area of different residential zones in the city of Toronto to calculate the capacity of each zone if intensified to the maximum possible for each structural type of dwelling.

The resulting household projections indicate that Toronto will continue to concentrate almost all growth into apartments with 5 or more stories, while almost every surrounding upper-level municipality will continue to see most of their growth occur in both single-detached and missing middle housing typologies. This shows there is demand for missing middle typologies in the GTA housing market, but that the City of Toronto us unable to meet almost any of this demand. The results of the maximum density and capacity components indicate that this inability to meet demand is not limited by current density, as intensifying the Yellowbelt to the density of the type of missing middle found in much of Montreal would provide enough housing to fit the entire projected population of Toronto in 2046 into just the residential detached zone – with enough spare capacity for one in six households to have a second home. While this scenario is neither feasible nor desirable, it shows that the Yellowbelt has capacity to spare.

The next steps to understanding the potential of missing middle in Toronto is to refine the models used and find more granular data in order to accurately project the effects of up-zoning different areas of Toronto. These models will need to incorporate accurate distributions of housing types by zone and area of the city, as well as the uptake rate of missing middle in response to changes towards more permissive zoning and official plan (OP) regulations.

2. Missing Middle Context

The challenges associated with urban sprawl and rising housing prices are not new to North American cities. What is new is the increased interest in gentle intensification of low-density neighbourhoods, and the corresponding push for regulatory changes seen in several jurisdictions in North America. However, the City of Toronto has shown little appetite for this type of sweeping reform and there is limited evidence this may be about to change. Toronto city council passed a Mayor Tory-led request for a staff report on options council can consider to create range of housing options in Toronto’s neighbourhoods (Tory, 2019). While this is far from a ringing endorsement or call to action, it indicates that change is not out of the question. There are two definitions and two major areas that first need to be examined through the literature to understand the context of this issue: what is the missing middle; what is the

Yellowbelt; why is adding missing middle in Toronto important; and how have other jurisdictions approached this issue.

2.1 What is the Missing Middle?

Within the field of urban planning the term "missing middle" was coined by California Architect Daniel Parolek in 2010 to describe residential structures that are denser than single-detached housing, but less dense that mid/high-rise apartment towers as shown in Figure 1 (Evenson, Cancelli, & Matthews-Hunter, 2018; Opticos Design, 2019). These types of housing generally include the following types (Opticos Design, n.d., 2019):

- duplexes;
- triplexes;
- fourplexes;
- multiplexes;
- courtyard apartments;
- bungalow courts;
- townhouses/rowhouses;
- live/work forms; and
- carriage houses.

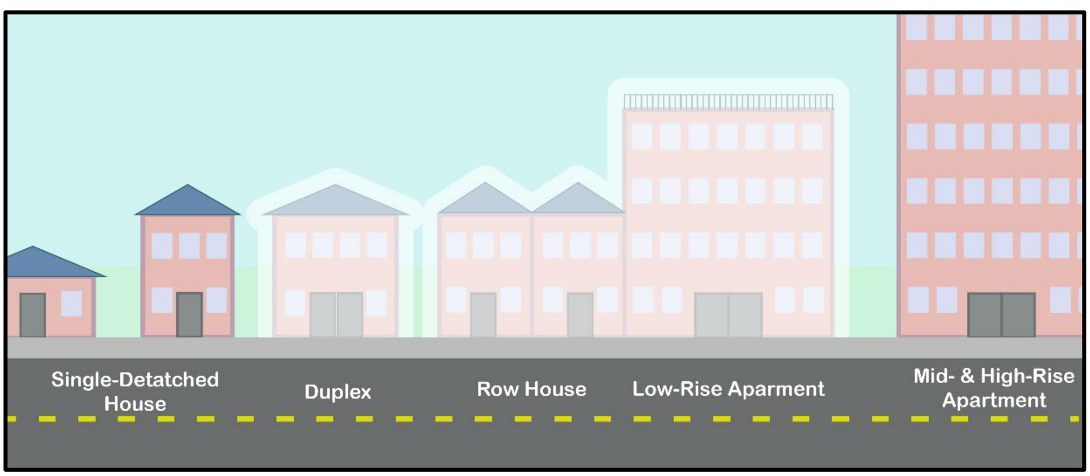

Figure 1 - The relative size and massing of select missing middle structure types (outlined in white) compared to less dense and more dense built forms. This graphic does not include all types of missing middle.

The precise limits of the definition are context dependant, and in Toronto it is frequently considered to include midrise apartments and some level of affordability for middle-income households (Evenson et al., 2018). As this paper heavily relies on census data of dwelling type counts, the Statistics Canada structural type of dwelling classifications are used (Statistics Canada, 2017e):

- single-detached house;
- apartment in a building with five or more stories;
- other attached dwelling;[1]
  - semi-detached house;
  - row house;
  - apartment or flat in duplex;
  - apartment in a building that has fewer than five stories;
  - other single-attached house; and
- mobile home.

The other attached dwelling subtotal group and its component categories are considered missing middle for the purposes of this research paper; this excludes mid-rise apartments which are normally considered missing middle in Toronto.

2.2 Why do We Need the Missing Middle?

A lack of missing middle housing is one of many causes contributing to the housing affordability crisis in Ontario (Webber, 2019). In Toronto housing costs are rising faster than household income, with average rents increasing by 6.9% and house prices rising by 38% between 2006-2017, while incomes only grew by 3% (Evenson et al., 2018). The increase in rents has accelerated rapidly in the GTA over the last 4 years (2018-2019) reaching an annual increase of 6.1% in 2019, with the average rent hitting $1452.(CMHC, 2020) Low vacancy rates in the

[1] The other attached dwelling subtotal group is NOT included in the referenced 2016 census reference guide, however it is used in many census datasets that include structural type of dwelling datasets, such as: Statistics Canada, 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016015.

Toronto rental market contribute to rising rents, with a 2019 GTA vacancy rate in the primary rental market of just 1.5%: for reference a rate of 3% is considered healthy and leads to rents rising with inflation, while 4% is needed for significant rent decreases (CMHC, 2019; Evenson et al., 2018; Hogue, 2019). Relevant to the discussion of who might benefit the most from missing middle housing, vacancy rates vary significantly with both unit size and if it is a purpose built rental or secondary market rental (e.g. rented condo unit). A 3+ bedroom apartment in the City of Toronto primary rental market had an average vacancy rate of just 0.9% in 2019, while bachelor units had a rate of 2.1%; and the 2019 GTA secondary rental market had a vacancy rate of 0.8% (CMHC, 2019, 2020). This indicates that rental housing for families that need multiple bedrooms is much harder to find than for households with fewer members.

2.3 Missing Middle Housing Benefits

Most of the benefits of adding missing middle housing are related to reducing the problems caused by a lack of supply, especially for middle-income family households. Increasing density in the Yellowbelt has been cited as a way to justify putting more transit in these areas in order to reduce dependence on cars and improve access to the rest of the city, increase the viability and number of local businesses, and reduced housing costs for middle income households (Coffey, 2018). In the GTHA missing middle housing is generally more affordable than detached houses but larger than apartments, and has been cited as a solution to providing housing which is affordable for both low and middle income households (Burda, Collins-Williams, & Kingdon, 2016; Evenson et al., 2018).

2.4 What is the Yellowbelt

Toronto has 2 primary forms of housing stock: low density detached houses with 3 or more bedrooms, and high-rises with 2 or less (Evenson et al., 2018). This pattern of development has been described as “tall and sprawl” (Coffey, 2018), with areas zoned for low-density housing or designated as neighbourhoods in Toronto’s official plan being described as the “Yellowbelt” (Coffey, 2018; Fudge, 2019; Weatherburn & Davis, n.d.). In Toronto around 70% of residential areas are zoned for detached or semi-detached houses (Kalinow, 2019).

2.5 Causes of the Yellowbelt

The origins of the Yellowbelt have been attributed to patterns of development in the 1940's when large portions of the city was farmland, and traffic wasn't a problem, resulting in developers creating large lots with detached houses (Coffey, 2018). This initial pattern of development was then frozen in place with the idea of "stable neighbourhoods" that was first enshrined in planning documents in the 1960's after public opposition to plans to include apartments in neighbourhoods during the 1950's (White, 2019). The perceived failure of redevelopments of built-up areas like Regent Park and St. James Town then led to NIMBYism towards redevelopment while politicians allowed communities to legally entrench this in city regulations (Coffey, 2018). The concept that neighbourhoods should be static and unchanging can still seen in Toronto's Official Plan (OP) today, with language describing neighbourhoods as "physically stable areas" (4.1.1) and requiring development to "respect and reinforce the existing physical character" (4.1.5) of the area which includes characteristics like street layout, lot size and setbacks, building height and massing, and dwelling type (City of Toronto, 2019e). There is a notable lack of rationale for this policy, as well as no clear criteria for how common a building type needs to be before it is part of the character.

The overall result has been that the construction of missing middle housing that is between 12m-35m tall in Toronto declined rapidly between the 1940's and 1980 with a small increase since 2001 (Lister, 2018). Going back to previous missing middle apartment built forms is generally not an option with current policy, as previously constructed missing middle apartments built before 2010 don't match the Toronto Mid-Rise building Performance Standards (Lister, 2018).

2.6 Missing Middle Reform Case Studies

There are three insights that can be gained from looking at case studies of jurisdictions where regulatory reforms to allow missing middle have been proposed or implemented: the range of reforms available, the process of creating the proposed reforms, and how these two factors affected whether the changes were successfully passed. As proposed changes to low-density neighbourhoods often face local opposition, addressing the role of content and process to overcoming this, is vital for implementing change (Webber, 2019). The lessons learned can be used to craft missing middle best practices and recommendations for Toronto. These best practices and approaches must extend beyond built form guidelines to include public opinion and engagement with regulatory change, and how support has been obtained.

While the market, demographics, and governance in each case study are different, the rationale of increasing housing affordability is a very common theme. Likewise, public opposition is often based on similar complaints. A summary of characteristics of the case studies is shown in Table 1.

Table 1 - Summary of missing middle reform case studies

Jurisdiction	**Description of Current or Proposed Regulation**	**Engagement Approach**	**Level of Public Support**
Vancouver	Incremental changes over the years have legalized secondary suites, and many types of attached housing throughout much of the city	NA	NA
Oregon	Allows attached housing everywhere that allows detached housing.	Top-down approach by the state	Low
Minneapolis	Sweeping changes across most of the city allow 3 units per property everywhere, and many gradients of density, though specific zoning rules still need to be developed	Coalition of extremely diverse stakeholders assembled in multi-year consultation process, with focus on equity	High
California	Large changes, including making adding up to 4 units within current regulations permitted through state application, cutting out municipalities in restricting this.	Highly controversial with many special interest groups trying to sway public opinion	Mixed
Houston	Lack of “zoning” but regulations include equivalent limitations like setbacks. Places majority of burden for preventing nuisance on residents and court system, leading to equity concerns.	NA	NA
Edmonton	Sweeping changes to zoning, including allowing secondary suites, laneway suites, and removing a cap on number of dwelling units, instead relying on setbacks, height, and lot coverage.	1.5-year public consultation process, with accessible and visual descriptions of changes	Little public reaction to changes.

2.6.1 Vancouver

Vancouver is currently experiencing a very severe housing crisis: the average market rent for apartments has increased 75% between 2001 and 2017 while the median income only increased by 18% (City of Vancouver, 2018), with 20% of all households in 2016 in core housing need (City of Vancouver, 2017). Similar to other cities in Canada, 53% of households rent their homes, and 62% of the city is zoned for single-family houses (City of Vancouver, 2017). In the City of Vancouver there are 3 recent changes which have promoted missing middle housing typologies in low density areas of the city: Secondary Suites as of 2004, Duplexes as of 2018 (City of Vancouver, 2019a), and laneway suites as of 2009 (City of Vancouver, 2019b). These changes mean that 3 units are permitted on many lots as a secondary suite and a laneway suite are allowed on the same lot (City of Vancouver, 2019c), with up to 4 units allowed for a duplex with secondary suites depending on the lot area, though duplexes are not permitted to have laneway suites (City of Vancouver, 2019e). These reforms have been done in a piecemeal and incremental fashion, rather than through sweeping land use and zoning reforms. While this has led to the ability to consider and carry out minor changes to the programs based on feedback, it is a slow process which has taken over 10 years to get this far.

Each of these changes have had very different impacts on the supply of missing middle housing that they target. According to the City of Vancouver over 3000 laneway suite permits have been issued since 2009 (City of Vancouver, 2019b). Based on the 2008-2017 average housing starts, (City of Vancouver, 2018) this is around 6% of new starts. Duplexes have had much lower uptake, with just 77 permits issued in the year following their legalization in low-density residential areas (City of Vancouver, 2019d). One possible reason for this is that a duplex requires 2 or 3 parking spaces based on if there are secondary suites (City of Vancouver, 2019e), while a house built before 2004 with a secondary suite only needs a single parking space (2 for post-2004) (City of Vancouver, 2019f). The rationale for the duplex or new-build home with secondary suite parking space requirements is unclear given that less than 50% of City of Vancouver residents travel by vehicle (Mchanney & Mustel Group, 2018). On top of this basement secondary suite construction costs are only $75,00 to $150,000 (Draft On Site, 2017), while a duplex costs $350,000 to $420,000 per side (Bula, 2018). In contrast to the effect of the previous 2 measures, secondary suites are a massive part of the housing supply in Vancouver. In 2016 there were an estimated 30,125 secondary suites in the City of Vancouver, which is 8.7% of the total housing supply and more units than there are condo rentals (City of Vancouver, 2017). Secondary suites are clearly the most successful option for low density missing middle options in Vancouver.

While all these changes are very regulated there is a case example for what can happen when there is no regulation. In Vancouver the Squamish Nation is planning a 3000 unit development in the downtown area on traditional land: because it is on indigenous land municipal zoning laws don't apply and as a result this development has hardly any parking, no podiums for the tower, will use a profit sharing model between the developer and the indigenous community, and requires a referendum to proceed (Bula, 2019). If this development moves forward it will be a natural experiment on the effects of development without parking restrictions, and using a more "towers in the park" design which promotes open space and parks, as well as using profit sharing and local democracy to promote local support and buy-in. While this is much higher density than missing middle buildings, if successful it will be a strong argument for reducing parking requirement in downtown cores and shows the potential of using developer-driven financial incentives and local democracy to combat NIMBYism against development. Reduced parking requirements could make many forms of missing middle buildings more financially feasible to build. This development also indicates the current demand for high rises and suggests that removing all regulation may push the structure type of new development towards forms that are denser than missing middle.

2.6.2 Oregon

On July 3 the Oregon House Bill 2001 (HB2001) was signed by the president of the Oregon State senate, completing the last step to pass it into law (OregonLive, 2019). HB2001 will force all municipalities with a population over 10,000 to allow duplexes in any area where detached houses are permitted by June 30 2021, and forces all municipalities with a population of over 25,000 to allow duplexes, triplexes, quadplexes, cottage clusters, and townhouses anywhere single detached houses are allowed by June 30 2022 (ODOT, 2009). This effectively eliminates exclusively detached single-family housing zoning throughout the entire state and transfers more control over the housing types created to the market. This case study shows a much more top-down sweeping approach than that taken by Vancouver, which forces local municipalities to be responsive to broader housing needs rather than local NIMBY concerns. An equivalent type of approach in Toronto would be the Ontario government changing provincial policies to remove the ability of municipalities to create zoning bylaws that don't allow low-density missing middle structures in areas that allow detached houses, combined with enforcement of this change.

In order to assist and guide Oregon municipalities in creating compliant ordinances, the Land Conservation and Development Commission and the Codes Division of the Department of Consumer and Business Services will develop a model zoning law by December 31, 2020, with municipalities that don't meet the implementation deadline having this model zoning applied until compliant rules are implemented by the municipality (ODOT, 2009). This section strongly encourages municipalities to be proactive in developing local zoning in order to avoid losing all control of developing missing middle housing within their borders. The bill also adds analysis of market forces to existing housing supply calculations that municipalities are required to perform; several sections pre-emptively block municipalities from circumventing the intent of the bill by using restrictive zoning requirements such as off-street parking or occupancy requirements; and encourages municipalities to consider measures to reduce the cost of missing middle housing such as reduced administrative costs like taxes and charges (ODOT, 2009). To encompass all potential loopholes and ensure new municipal ordinances are compliant with HB2001's goals, some of the sections of the state law are very broad. This may make it difficult to enforce or evaluate whether a municipal zoning ordinance contravenes state law.

Unsurprisingly the bill is being opposed by some municipalities which claim it will promote density in areas without sufficient transit service, and that the new housing will not be affordable – in Lake Oswego the city council is considering discouraging the conversion of housing to duplexes and townhomes by imposing fees of up to $18,000 to demolish an existing home (Jaquiss, 2019). This clearly flies in the face of the requirements to consider affordability measures and the section outlawing overly onerous requirements, but this does not appear to be a strong deterrent. Local opponents claim the bill will encourage gentrification and do nothing to reduce housing prices, instead increasing developers profits while reducing the size of units - this impression was likely not helped by the support of the bill by real estate agent and developer groups (Gallagher, 2019; Gusinow, 2019). This shows that if there is opposition to increasing the stock of missing middle housing at the local level, changes at upper levels of government can be potentially circumvented and thwarted by increasing (locally imposed) barriers to development. Trying to close loopholes may work but carries the risk of being so prescriptive that changing market or demographic conditions cannot be adapted to without the slow process of legislative change. The top-down approach used also reduces the chances of widespread local support and makes implementation more difficult.

2.6.3 Minneapolis

Minneapolis saw a peak population of just under 522,000 in 1950, which declined to 368,000 in 1990 (City of Minneapolis, 2019), after which it grew to an estimated 435,403 in 2018 (U.S. Census Bureau, 2018). The recent growth has outpaced increases in the housing supply and caused prices to increase more rapidly than wages (City of Minneapolis, 2019). After over 2 years of public consultation Minneapolis city council has created and approved Minneapolis 2040, the new Comprehensive Plan which focuses on undoing historic barriers and fostering equity in housing, jobs, and investments with a focus on racial inequality (Minneapolis, n.d.). As expected from a comprehensive plan, it deals with a wide range of issues beyond housing and land use, such as transportation, environmental protection, economic policy, and education, though changes to housing are some of the most specific areas of the plan (City of Minneapolis, 2019). The comprehensive plan is generally comparable to an OP in Ontario and requires zoning changes to implement it.

In Minneapolis over 53% of households rent, but tenure type follows racial lines very strongly: while 40.7% of white non-Hispanic household heads rent, 79.3% of African American household heads rent (City of Minneapolis, 2019). The plan directly cites the impact of discriminatory zoning and regulations in creating inequality, and has the explicit goal to provide affordable and accessible housing through greater housing options especially in well-serviced and amenity-rich areas (City of Minneapolis, 2019). This focus on equity and the acknowledgement of the role of government in creating existing inequality is core aspect of the goals and approach of the plan, while the sweeping changes ensure that the city is considered as a whole rather than as individual neighbourhoods.

While single-family zoning is generally seen as bad policy, it has also been viewed as impossible to change because of strong opposition. However in Minneapolis advocates for the proposed housing reforms used 3 main arguments: making the city more affordable, reducing racial inequality, and fighting climate change – and used this to get a very wide range of groups and activists to support it (Hahlenberg, 2019).

Like Toronto, land use in Minneapolis is dominated by low-density housing, which occupies 49% of the city, while medium and high-density housing occupies only 2.76% and 2.34% of land area (City of Minneapolis, 2019). When only looking at the residential zones, 70% is exclusively for detached single-family housing (BADGER & BUI, 2019). Minneapolis 2040 sets out general built form guides for 14 categories that apply to specific areas of the city, and includes a full range of different housing densities from 1-2.5 storeys with a maximum of three units per lot in the least dense areas, to the central business district (CBD) which has a minimum height of 10 storeys and no maximum (City of Minneapolis, 2019). In contrast Toronto's downtown secondary plan TOcore has no specific height guidance, instead using language such as "the permitted height, massing, scale and intensity of development will be informed by the local existing and planned context" (City of Toronto, 2019a, p14), while the zoning for the Toronto downtown, and in indeed the entire city, is a patchwork of different height limits (City of Toronto, 2019f) which appear to be driven more by lot-specific appeals and zoning amendment applications than a coherent policy. Minneapolis 2040 sets a target of changing the zoning to comply within 5 years, and as of January 1, 2020 has already changed the zoning to allow duplexes and triplexes to the lowest density areas and passed inclusionary zoning requirements for new developments. (City of Minneapolis, 2019) The next test will be whether the plan accurately matches market demand and the profits developers can realize in the different zones, or if reducing regulation across the city results in less profitable typologies being ignored by developers.

2.6.4 California

Like many other jurisdictions, California is currently undergoing a housing affordability crisis, and this has spurred the creation of bill SB-50 in order to add more housing supply (Schatz, 2019). California has very high levels of exclusively detached single-family zoning: 80% of all neighbourhoods are zoned this way (Bliss, 2019), with some cities like San Jose having 94% and 75% of all residential areas zoned exclusively for detached single-family housing (BADGER & BUI, 2019). Not only does California have a large amount of restrictive zoning, currently planned growth is greater in more rural areas instead of urban areas with the highest prices and demand (Monkkonen & Friedman, 2019).

On January 29, 2020, California's planning and zoning senate bill SB-50 failed to pass, by a narrow 18 -15 margin, with the same results when it was reconsidered and voted on again the next day (Brinklow, 2019; State of California, 2019). The bill first started working it's way through the senate in December of 2018, over a year from when it was finally rejected (State of California, 2019).

This bill would have created a state-wide streamlined development application process for developments of up to 4 units that did not require significant exterior changes and meet zoning requirements as of July 1 2019, and limited local governments' ability to apply parking standards or reject approvals unless there was a risk to public health or safety (SB 50, 2019). The bill also would have had impacts for higher density development, enforcing minimum inclusionary zoning requirements and allowing higher densities in job or transit-rich areas, however the scale of these developments is well outside what is considered missing middle housing (SB 50, 2019).

Supporters of the bill included real estate and pro-development groups, while opponents included anti-development and tenant rights groups, the former whom oppose development and latter who worry about the effect it would have on gentrification and are supply skeptics (Matthew, 2019). One of the opposition groups, Livable California frames their position as promoting local self-determination and talk about how the bill will destroy and gentrify neighbourhoods, and reduce affordability (Livable California, n.d.). Similar to Oregon, the top-down approach is associated with increased local opposition especially in specific local areas.

2.6.5 Houston

The city of Houston is an interesting case because officially they do not have any official cohesive or centralized zoning rules (City of Houston, 2019). Despite this, the city regulates the urban fabric in many of the same ways as other municipalities, with ordinances controlling minimum lot sizes, minimum setbacks, buffers between high-rise and single-family buildings, parking requirements, lot-specific street-widths and open spaces, and minimum distances between sensitive structures like schools and nuisance uses (Marcano, Festa, & Shelton, 2017). These restrictions can be very limiting: apartments require 1.25 parking spaces for the smallest units, while single-family homes require 2 parking spaces per dwelling unit and 1 parking space per secondary dwelling unit (City of Houston, 2018).

In 1999, Houston reduced the minimum lot size from 5,000 square feet to 1,400 square feet (Hertz, 2016). This change, combined with no requirements for side setbacks resulted in townhouses, duplexes, and other missing middle typologies replacing many single-storey houses (Tennant, 2011). Despite the addition of these missing middle typologies , the intense parking requirements and mandated 600 foot long blocks for greenfield development encouraged sprawl and reduced walkability (Gray, 2016),

2.6.6 Edmonton

In August of 2019, the City of Edmonton amended their zoning bylaw as a result of the “Missing Middle Zoning Review”, which aimed to remove barriers to missing middle development (City of Edmonton, 2019c). Out of the 16 different residential zones found in the Edmonton Zoning bylaw (City of Edmonton, 2019b), 12 are modified by the missing middle amendment (City of Edmonton, 2019a). This represents a large portion of the residentially zoned area of the city and represents a sweeping change to the residential land use policies of Edmonton. One of the largest changes is allowing both a secondary suite and “garden suite” (accessory dwelling unit) in addition to the main house in the three lowest density urban residential zones, which represents the bulk of the city’s area, along with other important reforms such as removing limits on the maximum number of dwelling units allowed (City of Edmonton, 2019c). Instead the form of housing is regulated by setbacks (reduced for some zones), maximum site coverage, height, and minimum lot dimensions (City of Edmonton, 2019d). This approach acknowledges the ways zoning restricts missing middle in many areas without explicitly mentioning it. As the building envelope and appearance are mainly affected by the listed restrictions, by reducing these requirements they allow greater density and floor space to be built in a larger number of flexible configurations, while removing the household caps allows the market and households to decide what trade-offs between space, cost, and private amenity space they want.

Public engagement on this zoning change was started in early 2018, including consultations with industry groups and community groups, but city staff and politicians were working on allowing missing middle since at least 2017 (City of Edmonton, n.d.; Neufeld, 2017). Edmonton is a unique case in that these changes appear to have largely slipped under the radar both in terms of public awareness, as there was virtually no opposition or support. There has been very little media coverage of the changes, with the rare piece constrained to impartial descriptions of the changes without any community reactions, or discussions of the proposals submitted to the associated missing middle infill design competition (Canadian Architect, 2019; Skapin, 2019). Whether this is because of the engagement approach used, or the lack of public interest in this topic that allowed the reforms to pass is unclear.

3. Methods

There were two components to the methods: household population projections to estimate the growing demand for housing; and finding the maximum density and distribution of missing middle, mid/high-rise apartments, and detached house structure types. Household projections were based off Ontario Ministry of Finance population projections and the distribution of cohorts of households in structure types as found in census data. The density and distribution of structure types was found by mapping out census tract level cross-tabulation census data, and selecting example tracts which were used to calculate maximum densities.

3.1 Household Projections

Projections for the number of households in each category of structural type of dwelling from 2018 to 2046 were created for the City of Toronto and surrounding Census Divisions (CDs). These projections were then combined with historical data and graphed. The methodology for this is outlined in the process diagram illustrated in Figure 2. In order to model the potential demand for different housing types, a cohort-component model was used, with households as the basic unit. A pre-existing population projection was transformed into household projections using the headship rates for each age cohort and the distribution by structural type of dwelling group for each cohort, to get total projected households by structure type. These projections assume the overall effects of available supply, cost, and personal preferences are modelled by past trends, but do not independently model them. As such these projections model the overall outcome but do not indicate what the preferred housing type distribution is for any cohort. Two variants of this model were used: one where each cohort's household preferences for housing types were assumed to remain constant (model A), and one were the change in distribution in housing types per cohort seen between 2006 and 2016 continued (model B).

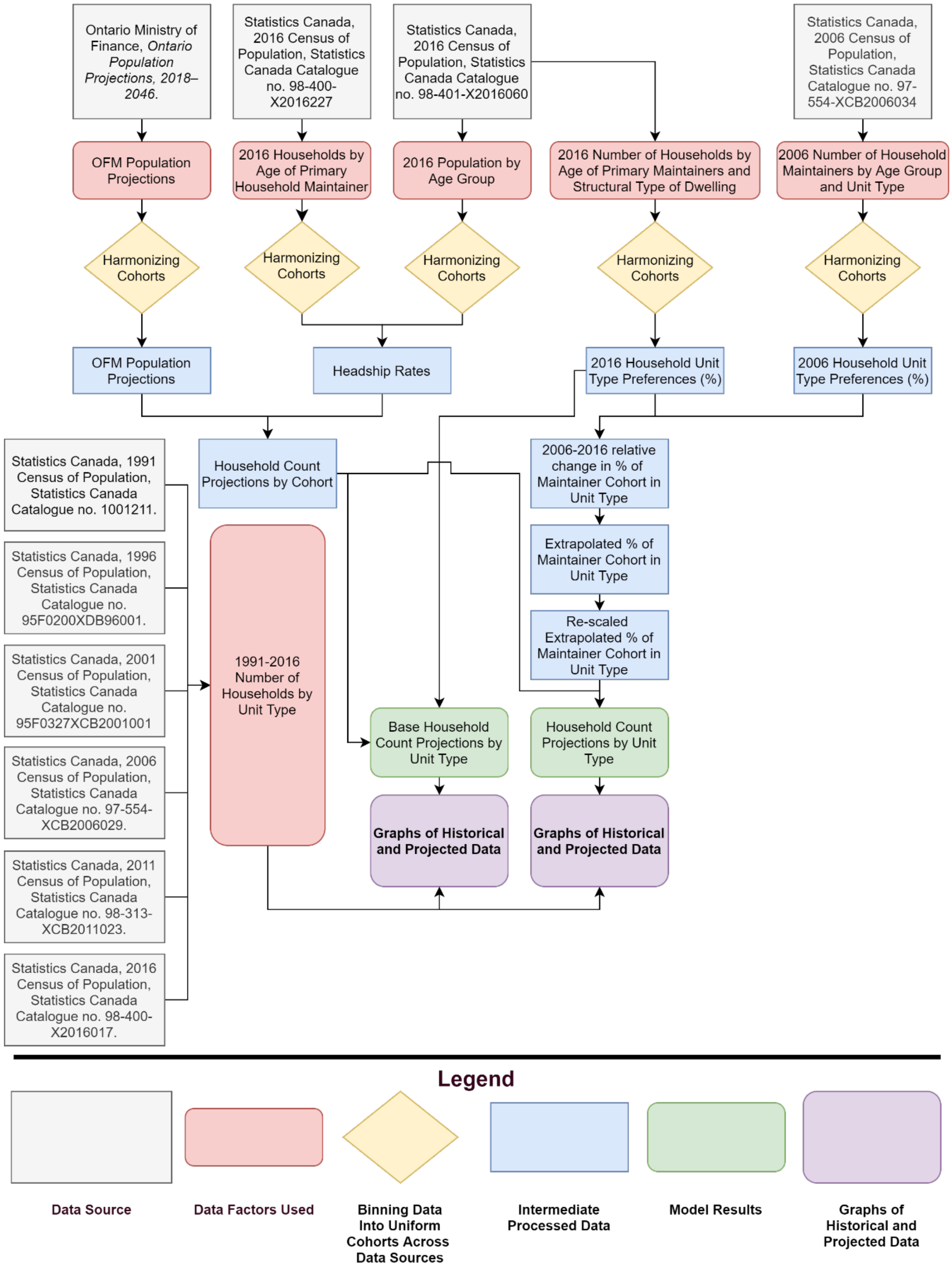

Figure 2 - Process diagram for household projections by structural type of unit. Created in Draw.io. The graphs using the only 2016 household preferences are not included in this report, as they made less realistic assumptions and predictions.

Projections were calculated for the five major CDs within the Toronto CMA, and all divisions summed (called GTA in this report) – note that the five census divisions have different geographies than the Toronto CMA, and the two geographies are not interchangeable. The CDs used were:

- Durham (Geographic Code: 3518)
- York (Geographic Code: 3519)
- Toronto (Geographic Code: 3520)[2]
- Peel (Geographic Code: 3521)
- Halton (Geographic Code: 3524)

All calculations were carried out for each of the six geographic regions (five CDs and GTA). The household projections were carried out for census divisions around Toronto and the GTA aggregate, as the Toronto housing market does not stop at the regional borders. By examining the larger geographic picture, broader trends can be identified and differences between the Toronto and GTA housing market can be examined and contextualized in order to properly interpret model results.

Population projection data for the five census divisions was obtained from table 10 in the Ontario Ministry of Finance (OMF) population projections for 2018 – 2046 (Ontario Ministry of Finance, 2019). The number of heads of household (primary household maintainer) in each age cohort by structural type of dwelling for each census division was obtained from the Statistics Canada data catalogue for both 2006 and 2016, along with population by age group for each Census Division from the Statistics Canada 2016 Census Profile Data Table (Statistics Canada, 2007, 2017b, 2017c).

[2] The Toronto Census Division is equal to the City of Toronto borders.

All cohorts for these 4 data sources were binned into the following age groups to ensure they were consistent (based on the 2006 groupings, which had the least granular cohorts):

- Total
- 15 to 24 years
- 25 to 34 years
- 35 to 44 years
- 45 to 54 years
- 55 to 64 years
- 65 to 74 years
- 75 years and over

The categories of Structural Type of Dwelling in the census datasets were:

- Total - Structural type of dwelling
- Single-detached house
- Apartment in a building that has five or more storeys
- Other attached dwelling
- Semi-detached house
- Row house
- Apartment or flat in a duplex
- Apartment in a building that has fewer than five storeys
- Other single-attached house
- Movable dwelling

Note that “other attached dwelling” group contains the Semi-detached house, Row house, Apartment or flat in a duplex, Apartment in a building that has fewer than five storeys, and Other single-attached house groups. For the purposes of this MRP “other attached dwelling” and its sub-categories are considered missing middle housing typologies. For detailed definitions and data collection information on these structure types see the Statistics Canada Dictionary for the 2016 Census, under “Structural type of dwelling” (Statistics Canada, 2017d).

For all equations subscripts denote the variable is calculated for each cohort group (C) and/or year (Y).

Headship rates for 2016 for each CD and the GTA were then determined by dividing the number of primary household maintainers in each age cohort by the population for that cohort, giving the ratio of any cohort that is head of a household. This is done as the model assumes that at the population level the range of factors contributing to which structural type of dwelling a household lives in are stably tied to the age of the head of household.

$$Headship\ Rate_C = \frac{\#\ Primary\ Household\ Maintainer_C}{Population_C}$$

The estimated number of households in each cohort for each year 2018 to 2046 was estimated by multiplying the headship rate by the projected population from the OMF data.

$$\#\ of\ Households_{CY} = Headship\ Rate_C \times Population_{CY}$$

There were 2 models used to project the number of households in each unit type - they were identical except for the assumption about the stability of the distribution of each cohort between the different structural type of dwellings. Model A assumed that the distribution in 2016 would remain constant throughout the projection time range (2018 – 2046). This is unlikely to be true, as there is evidence that the distributions are changing as seen in model B. Model B assumed that the change in distribution between 2006 and 2016 for each cohort would continue.

For model A the preferences of heads of households from each cohort was calculated by dividing the number of households in each structural type of dwelling by the total number of households in that cohort, to give the percent of households in each structure type.

$$\%\ of\ Households\ in\ Structure\ Type_C = \frac{\#\ Households\ in\ Structure\ Type\ 2016_C}{\#\ Households\ 2016_C}$$

For model B the percent distribution of households for each cohort was calculated by dividing the number of households in each structural type of dwelling by the total number of households in that cohort, to give the percent of households in each structure type for both

2006 and 2016 as above. The of rate change in distribution was calculated by dividing the 2016 percent of cohort households per unit type by the 2006 percent of cohort households per unit type.

$$Ratio\ of\ Rate\ of\ Change = \frac{\%\ of\ Households\ in\ Structure\ Type\ 2016_C}{\%\ of\ Households\ in\ Structure\ Type\ 2006_C}$$

The choice to use a proportional rate of change rather than a linear rate of change was done to both model more extreme changes in preferences in contrast to model A, and prevent negative or 0% values which are unlikely to occur in reality. The percent distribution of households by structure type per cohort was calculated for each year from 2017 – 2046, by multiplying the previous years' percent distribution by the rate of change.

$$Unadjusted\ \%\ of\ Households\ in\ Structure\ Type_{CY} =$$

$$Rate\ of\ Change \times \%\ of\ Households_{(Y-1)}$$

As many of the resulting percentages did not sum to 100%, all components of each cohort were adjusted by the same ratio, so they summed to 100%.

$$\%\ of\ Households\ in\ Structure\ Type_{CY} =$$

$$\frac{1}{\sum Unadjusted\ \%\ of\ Households\ in\ Structure\ Type_{CY}} \times \%\ of\ Households_{CY}$$

The percent of household cohorts for model A and model B were then multiplied by the projected number of households in each cohort, to calculate the number of households in each age cohort and structural type of dwelling. Note that for model A the percent distribution by structure type are equal for all years, while for model B they are different for every year.

$$\#\ of\ Households\ in\ Structural\ Type\ of\ Unit_{CY} =$$

$$\%\ of\ Households\ in\ Structure\ Type_{CY} \times \#\ Households_{CY}$$

The results of each model were then joined with historic data from previous censuses (1991-2016), and graphed (Statistics Canada, 1993, 1998, 2002, 2008, 2012, 2017a). In order to account for the lack of space for new single detached housing in Toronto, alternative missing middle numbers were calculated by taking the increase in the number of single detached households and summing with the projected number of missing middle households, assuming that substitution of single detached housing preferentially occurs with missing middle housing over mid/high-rise apartment buildings.

As previously mentioned, there are several limitations to this modelling approach, which can be roughly divided into uncertainty in source data, combination of different data sources with different methodologies, and accuracy of assumptions in the model.

While the OMF population projections and Statistics Canada Census data are very high-quality data sources, there is nevertheless uncertainty in the data - however as error propagation is beyond the scope of this MRP, the exact effects of this uncertainty are unknown. The OMF population projections have uncertainty in the assumptions they use, which are modelled by the OMF by using 3 different scenarios (low scenario, reference scenario, and high scenario). Only the reference case projection numbers were used for this project, so if future conditions are different than this scenario, the household projections for this MRP will be inaccurate. Additionally, as the OMF projections use Statistics Canada demographic data any uncertainty there will propagate to the models in this MRP. The Statistics Canada datasets used directly in this project are rounded to the nearest 5 units, which while insignificant for large numbers can dramatically alter the relative accuracy of fields with low numbers; for example the preferences for movable dwellings are highly uncertain as these dwelling types have extremely low counts in all geographic boundaries used. This also results in subtotals not always adding to the value shown in a totals field.

There are several datasets used which are not directly comparable. The OMF population projections use Statistics Canada population estimates as their historical data on which they base their projections: this data adjusts census data for under-coverage, and as such provide different population numbers than census profile data (Ontario Ministry of Finance, 2019; Statistics Canada, 2020). Limitations on available datasets required both Census Profile data (in the form of number of households by structural type of dwelling, population by age, and heads of household by age) as well as the OMF projections as inputs for the model, but these two data sources are not directly comparable. As a result of the error introduced, there is a slight increase on the resulting graphs between the historical number of households by structure type (census data) and the projected number of households by structure type (based on OMF data).

The housing projection models make several assumptions. Both model A and model B assume that headship rates in 2016 will continue in the future, however changing family structure and size, as well as affordability of housing could potentially have a large impact on this. The models also make the implicit assumption that age of primary household maintainer is a good predictor of household housing choices, which is a simplification of a complex array of factors that may remain constant. While model A assumes that housing preferences will remain the same as they were in 2016 in the future, this is not an accurate assumption: in some areas there are very rapid shifts in distribution of cohorts in structure types. For example, in Toronto between 2006 and 2016 the 25 to 34-year-old head of household cohort saw an increase in the percent living in high rise apartments by 10.3%, and a drop in every other category. This likely reflects that mid/high-rise apartments were the dominant form of new construction built. To more accurately model housing type preferences, these changes were incorporated into model B and extrapolated out by assuming the proportional rate of change will remain constant. This assumption will still very likely be violated if changes in the typology of new housing construction, affordability, or demographic changes occur. As such, the results of both models must be narrowly interpreted within the current environment of the Toronto and GTA housing market. The assumption that single detached housing is substituted by missing middle before mid/high-rise apartments is another assumption made as a sub-scenario within both models.

While there are several limitations in the modelling of demand for different housing typologies, they do not impede the use of projections to understand the number of new households needed. Both the large geographic areas modelled, and the use for housing numbers and not the driving factors of housing supply or demand make a more detailed and accurate model unnecessary, as long as the results are not applied outside of this scope.

3.2 Missing Middle Archetypes

In order to find the capacity of missing middle to add housing in Toronto's Yellowbelt, the maximum density of different types of housing in the Canadian context needed to be identified. To make these results comparable to the household by structure type modelling as well as zoned areas, density was measured in households per square kilometre. This was done by taking the number of households living in each structural type of dwelling in every census tract within the Toronto CMA, Vancouver CMA, and Montreal CMA, joining this data to the Statistics Canada census tract shapefile in QGIS, and using the area of each tract to calculate the density of each unit type. The resulting data was then sorted by density for each category of structure to identify the densest tracts. For categories where the densest concentration of a housing type was in a tract where it made up less than 90% of all households, the densest tract within the City of Toronto was used to manually select the appropriate property types to calculate the density. All three CMAs were chosen due to the availability of households by unit type at the census tract level, and to increase the chance of finding denser tracts of each typology in areas outside of the City of Toronto with different regulations and histories, which could potentially allow greater densities. A process flow diagram of this methodology is shown in Figure 3.

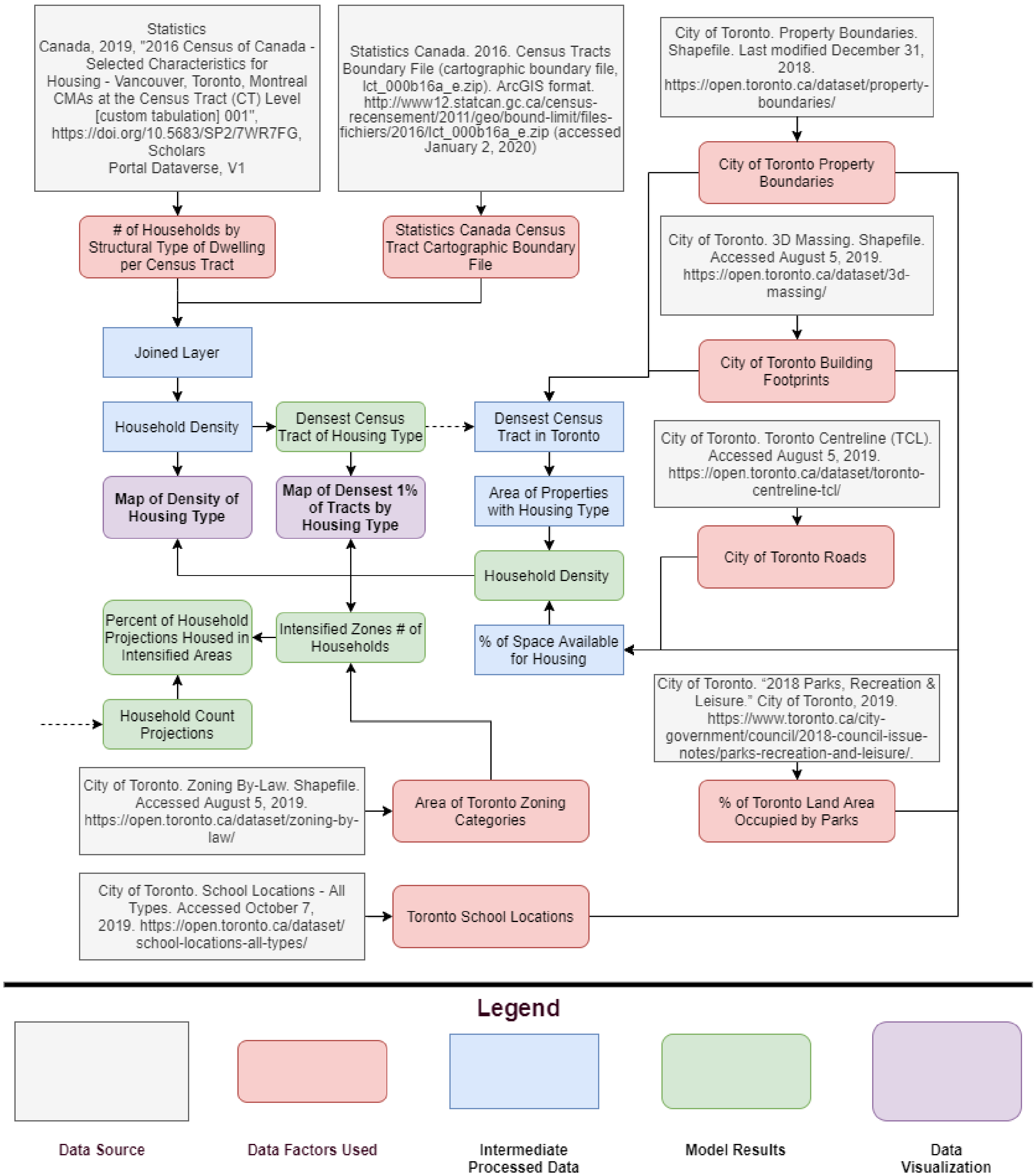

Figure 3 - Process flow diagram for calculating density of housing typologies. Created in Draw.io. Note that the census division shapefile was used in the creation of maps for context, but is not listed in this diagram. The maps of densest 1% of tracts is also not shown in this paper for brevity.

It is important to note that the while the definitions of structural type of dwelling groups are the same as those used in the housing demand projections, the level of granularity of the categories is different, as the available datasets binned several types of missing middle housing together. The definitions for all housing types are the same, as the data originated from Statistics Canada as well. The groups used were:

- Single Detached House
- Semi-Detached House, Row House, or Other Single Attached House
- Apartment or Flat in Duplex
- Apartment in a Building that has Five or More Stories
- Apartment in a Building that has Fewer than Five Stories
- Missing Middle (Semi-Detached House, Row House, or Other Single Attached House; Apartment or Flat in Duplex; Apartment in a Building that has Fewer than Five Stories) – created by summing other groups in QGIS

Data containing the number of households in each structural type of dwelling for each census tract, was downloaded from a publicly available custom cross-tabulation of Statistics Canada 2016 census data, made available by the Housing Research Collaborative at the University of British Columbia (Statistics Canada, 2019). The Cartographic Boundary file for census tracts, Cartographic Boundary file for Census Divisions, City of Toronto property boundary file, City of Toronto 3D Massing file, City of Toronto Centreline file, City of Toronto all school location shapefile, and City of Toronto Zoning bylaw shapefile were downloaded and opened in QGIS (City of Toronto, n.d., 2018a, 2018b, 2019c, 2019d; Statistics Canada, 2016a, 2016b).

All census tracts in the Toronto, Vancouver, and Montreal CMAs were then selected and copied to a new layer, and the dataset containing the number of households in each category of structural type of dwelling for each census tract was joined to the new layer. There were 38 census tracts which failed to join, as they were not present in the cross-tabulation data, and these tracts are not shown in the maps. All structure types in the missing middle category were summed for each tract in a new field to get the number of missing middle households. The area of each census tract was then measured using the *$area* function, and the density of each type of housing in households per square kilometre calculated with both values entered in new fields. Maps visualizing each structural type of dwelling in each tract were then created for all CMAs. Densities of the number of households per square kilometer for each structure category were visualized by colouring each tract on a density gradient in increments of 10%. Maps displaying the densest 1% of tracts in red were also created and used to more clearly distinguish the locations of just the densest tracts to look for unusual patterns of clustering, however no significant trends were found so these maps are not shown for brevity.

All census tracts were then sorted by the density of each housing type in order to identify the maximum density achievable for each building typology. The geographic code, density, percent of households in that housing type, and location was recorded. If the census tract was not in Ontario information on the densest tract within Ontario was also collected, to account for limitations on density caused by the Ontario building code. As both the densest single detached and other attached example tracts had below 90% of households living in these housing types, the density was significantly lower than the maximum obtainable. In order to compensate for this, the density was calculated by manually selecting and measuring the lots with that housing type. Because of a lack of publicly available property shapefiles for the City of Richmond, densest tract of attached houses could not be adjusted. Instead the densest tract within Toronto was used to calculate the maximum density.

As both the attached housing and detached housing example tracts were within the city of Toronto this involved loading the City of Toronto Property Boundaries file into a new layer, as well as the city of Toronto building footprint and zoning shapefiles. Features within or intersecting the selected example census tracts were then extracted. Properties were manually selected if they had a detached or attached building based on a combination of whether building footprints overlapping multiple lots, aerial photography, and excluding mixed use zoning areas. All selected residential lots were copied to a new layer for both example tracts and the area for each measured using the *$area* function, after which the attribute file was exported to Excel. The number of selected detached properties was greater than the number of detached houses in the census data (1244 vs. 1145), while in the other tract the number of attached house properties selected was significantly less than the number of attached properties in the census file (396 vs. 490). This is likely because of inaccurate shapefiles, the difficulty identifying structure type using this type of data, and the inability to easily identify the number of units in a structure. The centreline data from the city of Toronto was then used to select and copy all roads from the extracted layer, and any portions of the road properties that extended outside the census tract were manually trimmed. The area of all features was then measured using the *$area* function, and the attribute table exported to Excel. The area of both tracts was then measured, and entered into Excel, where the average and median size of an attached and detached property was calculated. A histogram of property sizes was created (Figure 4 & Figure 5), which indicated an extreme spike around the median size for detached properties (232m^2), and a more normal but positively skewed distribution around the median for attached properties (153m^2). As a result, the median property size was chosen to represent a typical household lot size, as it was closer to the peak than the average for both tracts. One was then divided by the median property size to obtain a maximum density for that unit type.

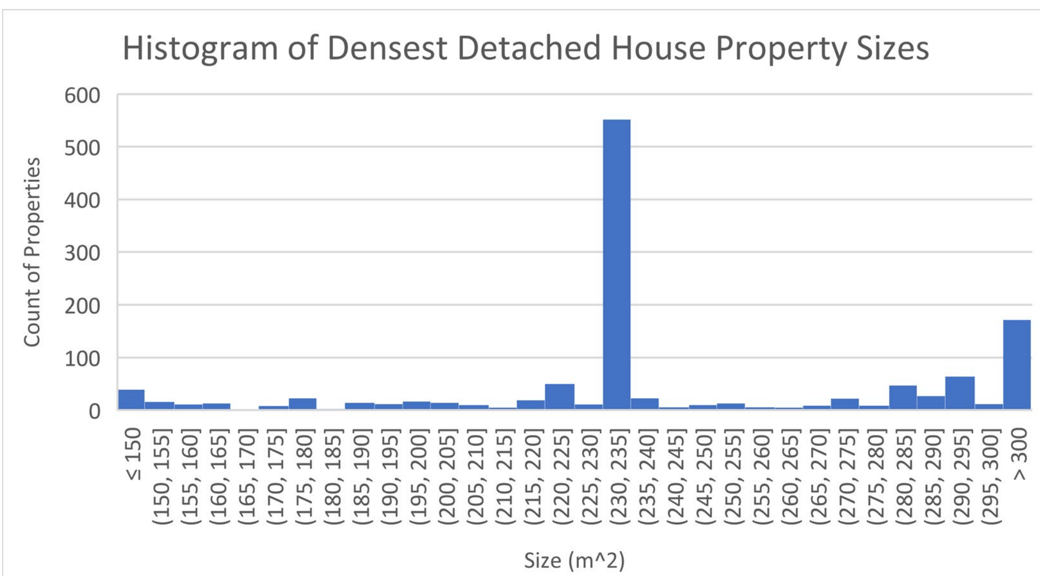

Figure 4 - Histogram of detached house property sizes

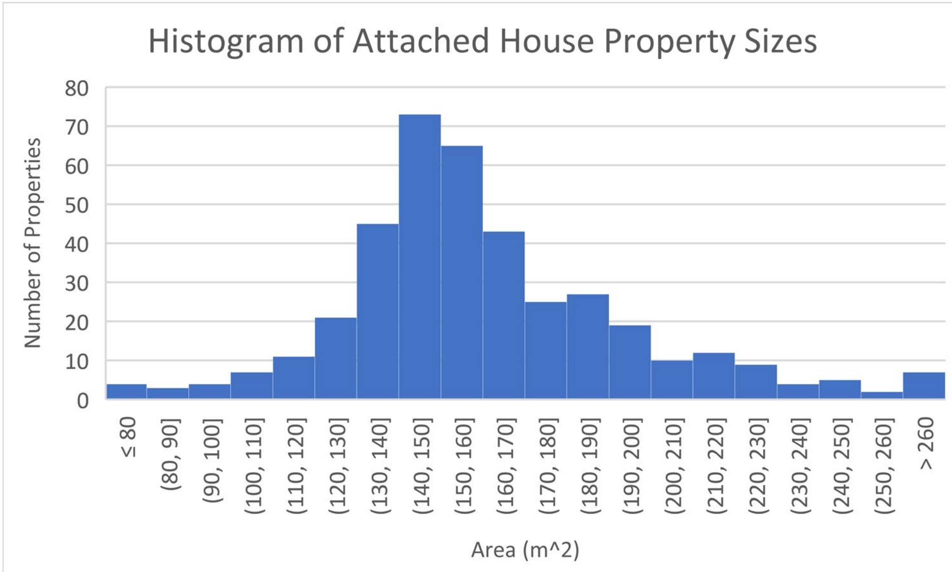

Figure 5 - Histogram of attached house property sizes

$$Raw\ Household\ Density = \frac{1}{Median\ Property\ Size}$$

The proportion of the tract taken up by roads was then calculated by summing the area of all roads, divided by the area of the census tract.

$$\%\ of\ Tract\ Occupied\ by\ Roads = \frac{\sum Road\ Area}{Tract\ Area}$$

The percent of Toronto occupied by schools was found by extracting each property boundary shapefile feature that contained any type of school location shapefile feature and calculating the area of the resulting features using the *$area* function, and then exporting the attribute table to Excel. In Excel the percent of total area occupied by schools in Toronto was found by dividing the sum of all school properties by the total area of Toronto, as measured by the *$area* function on the Statistics Canada census division shapefile (Statistics Canada, 2016a) .

$$\%\ of\ Toronto\ Occupied\ by\ Schools = \frac{\sum School\ Area}{Toronto\ Census\ Division\ Area}$$

The percent of Toronto occupied by parks was found on the City of Toronto website (13%), and this number assumed to be the average for all tracts (City of Toronto, 2019a). The raw household density was then adjusted using the percent of the tract occupied by roads and schools, and an “other amenities” factor to represent services like places of worship, community centres, and other allowed uses in a residential area. The “other amenities” was assumed to be the same percent of the tract as that of schools.

$$Adjusted\ Household\ Density =$$

$$(1 - \%\ of\ Tract\ Occupied\ by\ Roads - \%\ of\ Toronto\ Occupied\ by\ Schools\ \times 2) \times Raw\ Household\ Density$$

This density was then used as the maximum achievable density for these unit types. Intermediate values used in these calculations are shown in Table 2.

Table 2 - Intermediate values used in the calculations of maximum density for attached and detached housing

Variable	**Attached Value**	**Detached Value**
Total Road Area in Tract (km^2)	0.07	0.15
Total Road % in Census Tract	29.6%	27.1%
Total School Area in Toronto (km^2)	25	25
School Percentage of Toronto	3.9%	3.9%
Area of Toronto (km^2)	634	634
Tract Residential Area Percent	62.5%	65.0%

The area of all Single Detached, (RD) Semi Detached (RS), Townhouse (RT), and Multiple Dwelling (RM) zones in the zoning layer were then measured using the *$area* function, and the attribute table was exported to Excel. The total area of each zone was then found by summing the area of all features in that zone, and the area of all non-apartment zoned areas found by summing those values. Note that areas which still belong to the old zoning bylaws (e.g. are under appeal) are not represented by features, and the area of each zone is not completely accurate as a result.

The capacity of each zoned area if uniformly covered with the maximum density of each structure type was then found by multiplying the area of each zone by the maximum density of each housing type.

$$Capacity\ of\ Zone = Area\ of\ Zone\ \times Maximum\ Density\ of\ Housing\ Type$$

The percent of the City of Toronto's projected population in 2046 that could by housed in the intensified zone was then calculated.

$$\%\ of\ 2046\ Households\ Housed = \frac{Capacity\ of\ Zone}{\#\ of\ Toronto\ 2046\ Total\ Projected\ Households}$$

There are several assumptions and limitations with this approach. The most significant is in interpretation: this is not meant to model a realistic development or zoning scenario, but rather identify the limits and potential of maximum density with each type of built form, as well as lay the groundwork for identifying the scale of missing middle developments required to meet future growth.

Additionally, the maximum densities for tracts with above 90% of households in the selected structure types are not achievable. Features like green space, roads, community facilities, and employment all occupy space that is not accounted for when calculating densities, and it is likely the selected tracts have lower than average amounts of these amenities. Furthermore, the different methodologies used to calculate the densities for attached and detached housing and all other building typologies makes them not directly comparable. The property boundary method assumes one household per property, which likely underestimates potential capacity added by secondary suites. The properties themselves are also a source of error: other forms of housing are not easily identifiable by building footprint and property boundaries. This is why two different methods were used: the lack of high-quality exemplar census tracts for detached and attached housing resulted in low-quality estimates that the property boundary method improved on, but is still a less realistic scenario as fewer other land uses are accounted for.

Overall, the lack of lot-by lot structure type data severely impedes the ability to more accurately assess the impact of any changes to built form and zoning. If this data were available current densities and numbers of different structure types could be estimated by zone, as could the exact area of the city that could be intensified. As it currently stands, estimated of capacity only indicates the upper bounds of the specified zones with the specified built form. The fact that zones are highly heterogenous in the current built form means that using zone area cannot accurately predict the total number of housing units available.

4. Results

4.1 Housing Demand Projections

When the projected number of households living in each structural type of dwelling are graphed with historical household numbers, it becomes apparent that model A does not accurately represent historical trends compared to model B in Toronto (Figure 6 & Figure 7). Historical numbers of missing middle and single-detached houses have been relatively static, however model A predicts an increase in the numbers of both. This is unlikely to occur as there is little unbuilt area within Toronto where additional detached housing could be built, and there is no evidence of intensification of single-detached housing currently. In contrast model B predicts no change in the number of these two structural types of dwellings, and instead predicts that the growth will be shifted into mid/high-rise apartment buildings. This more closely matches historical trends and the physical limitations of Toronto, and for this reason model B was chosen as the default model.

The core difference between the two models is that model A does not assume significant changes in the proportion of total households living in structural type of dwelling, while model B does, with corresponding distributions as shown in Figure 8 and Figure 9. The differences in housing preferences between cohorts of households combined with the demographic changes in age distribution are too small over the given timeframe to cause significant changes to what type of structures the general population live in, which is the limit of complexity used by model A. In contrast, the changes in housing preference both in general and in between cohorts are significant and lead to shifting percentages of households in each structural type of dwelling, as incorporated by model B.

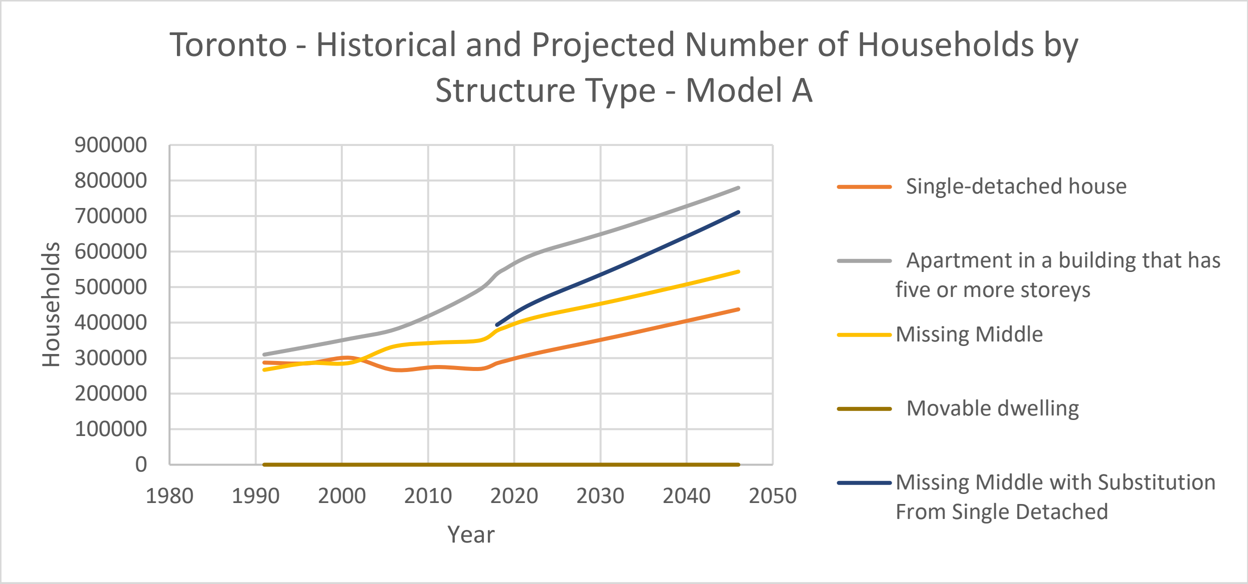

Figure 6 - Historical (1991-2016) and projected (2018-2046) number of households in the Toronto census division by structural type of dwelling. Projected numbers were calculated using model A.

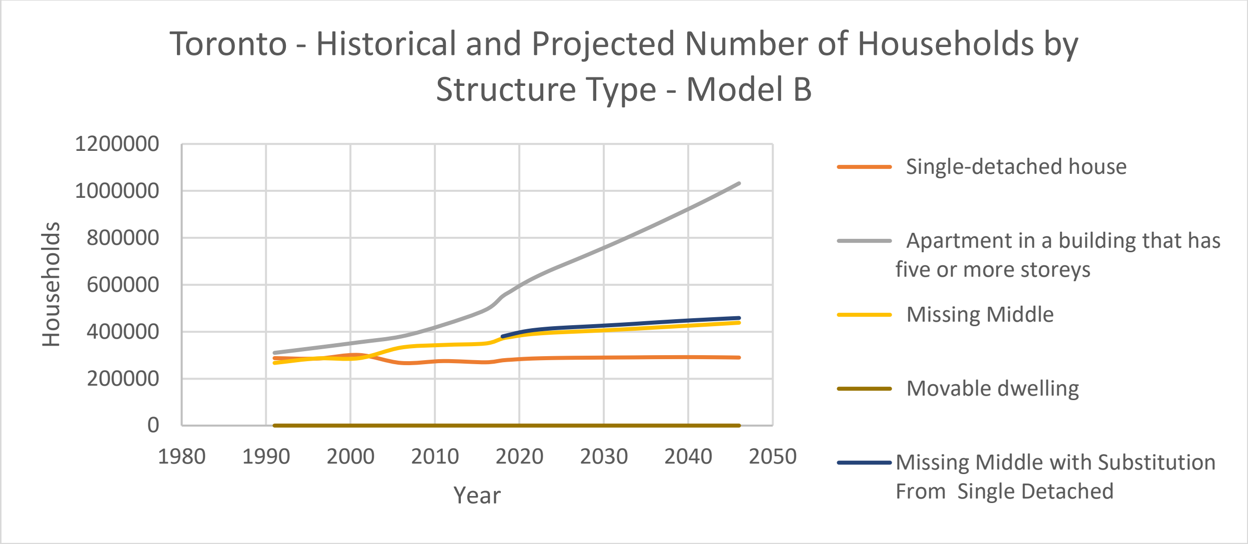

Figure 7 - Historical (1991-2016) and projected (2018-2046) number of households in the Toronto census division by structural type of dwelling. Projected numbers were calculated using model B.

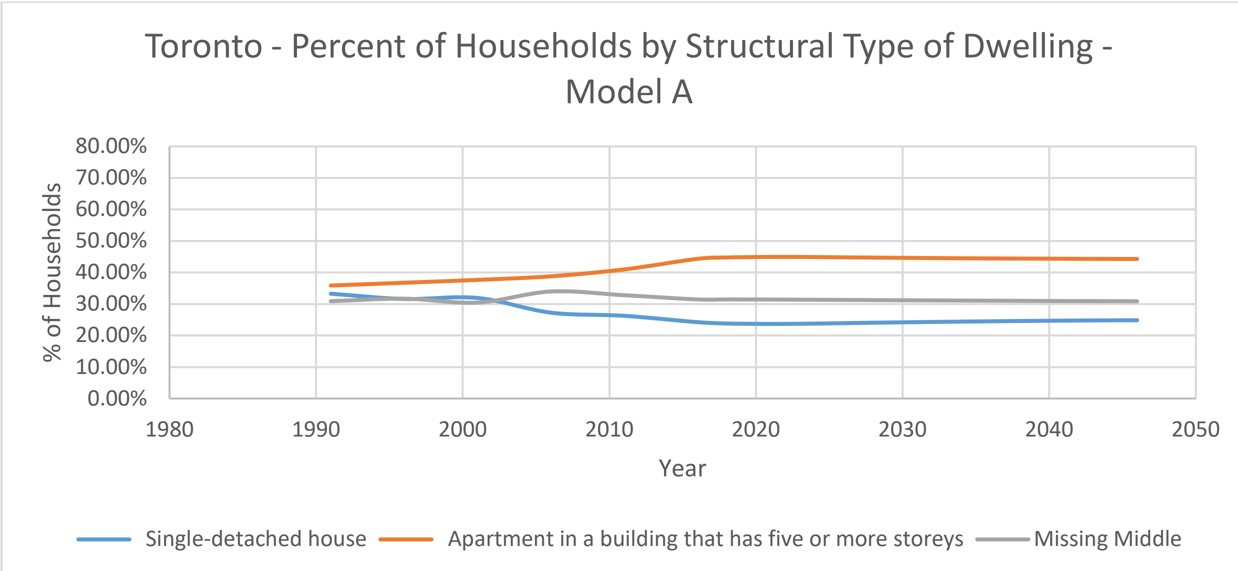

Figure 8 - Historical (1991 - 2016) and projected (2018 - 2046) percent of households in Toronto census division by structural type of dwelling using model A. Only the largest categories of structure are shown for clarity.

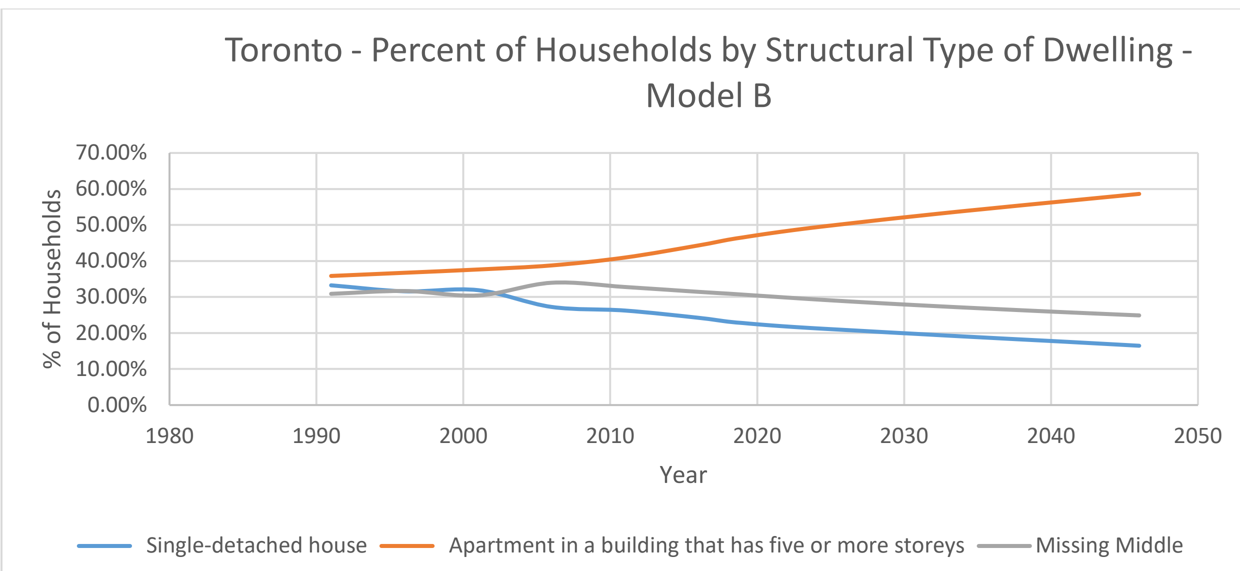

Figure 9 - Historical (1991 - 2016) and projected (2018 - 2046) percent of households in Toronto census division by structural type of dwelling using model B. Projections calculated using Model B. Only the largest categories of structure are shown for clarity.

The historical and projected number of households by structural type of dwelling in the Toronto census division using model B for missing middle sub-groups are shown in Figure 10. The number of low-rise apartments is projected to shrink while rowhouse and other attached dwellings rise, and other missing middle housing remains static. This change must be framed within the context of the overall changes in all types of housing shown earlier, and as a result are relatively small.

The census only began collecting missing middle subgroup data in 1996, so the historical data does not extend back as far for missing middle subgroups. For the first two years this data was collected (2001 and 2006) there is significant variation in the number of households, particularly in the duplex and low-rise apartment categories. This variation is present in many of the census divisions surrounding Toronto with similar patterns of change (see Appendix A for graphs comparing of historic and projected percent of households by structure type in GTA census divisions). However, identifying the causes of this variation is beyond the scope of this analysis.

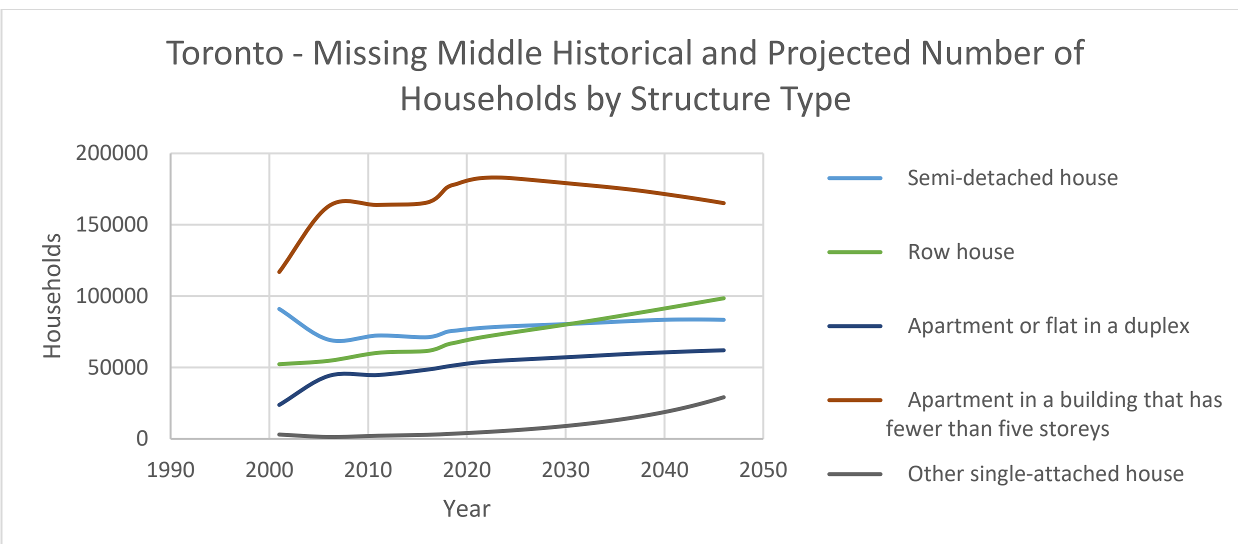

Figure 10 - Historical (2001 - 2016) and projected (2018 - 2046) number of households in missing middle sub-categories for the Toronto Area. Projections made using model B.

The overall trend of growth in the GTA is that single-detached housing and missing middle housing grows at similar steady rates, with consistently lower overall levels of missing middle housing, and mid/high-rise apartment housing growing at a much faster rate than either one (see Figure 11).

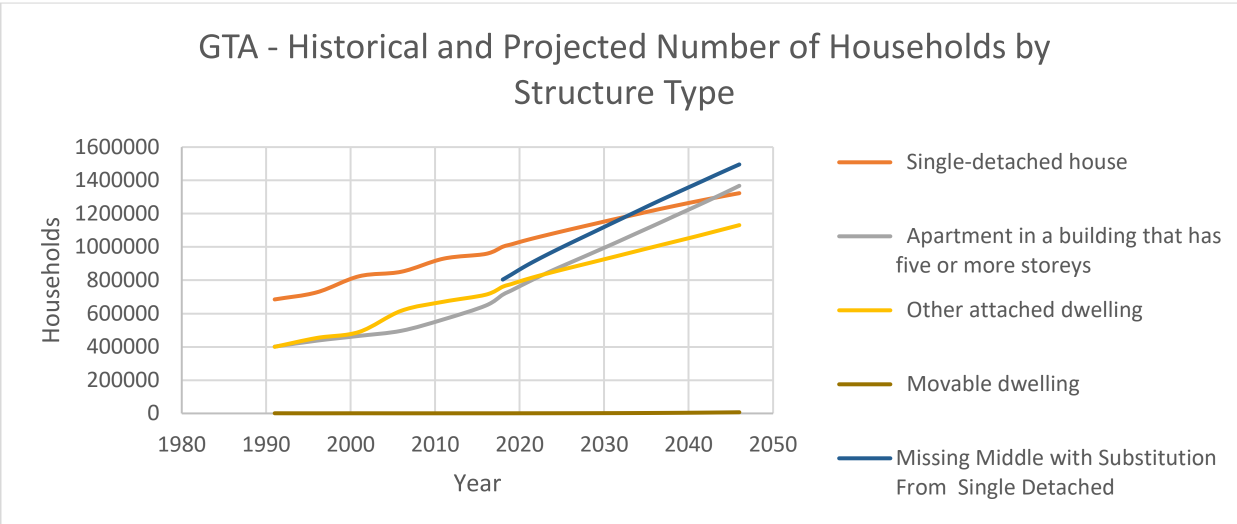

Figure 11 - Historical (1991 - 2016) and projected (2018 - 2046) number of households by structural type of dwelling in the GTA

This picture is significantly distorted by Toronto's unusual growth pattern of incredibly rapid mid/high-rise apartment growth and stagnant missing middle and single detached housing growth, which is combined with the large population in Toronto giving this pattern extra weight (Figure 7). This projected growth pattern is very concerning, as it points to an acceleration of mid/high-rise apartment construction and a shrinking proportion of households living in ground-related buildings. The regulatory approach of the City of Toronto in limiting any development or intensification in neighbourhoods is largely to blame, as gentle intensification is essentially banned. When Toronto is removed from the GTA projected mid/high-rise apartment housing becomes the least common form of housing, with lower growth than other forms (Figure 12).

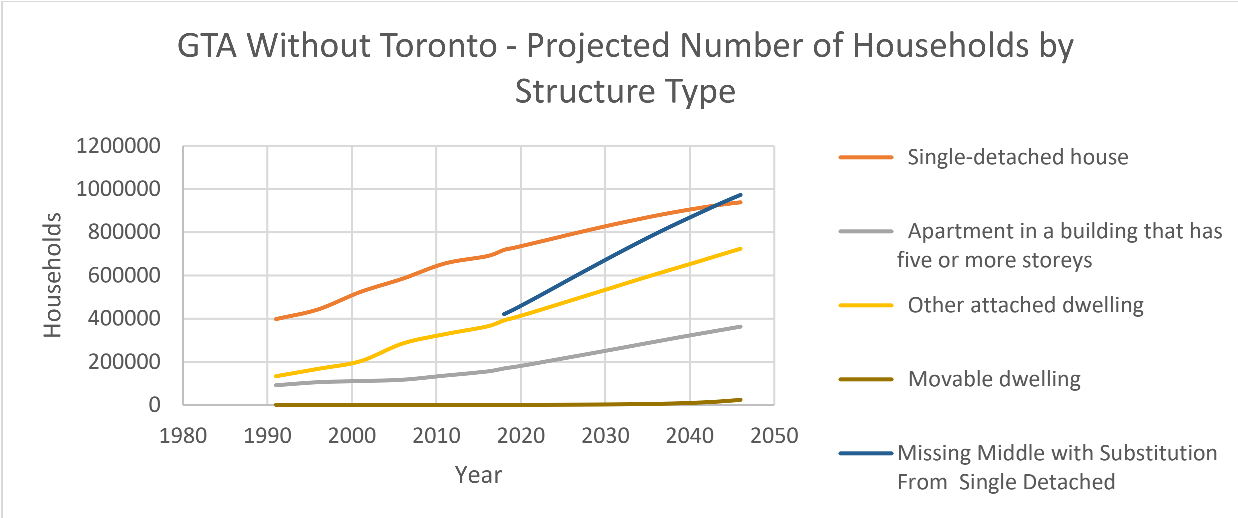

Figure 12 - Historical (1991 - 2016) and projected (2018 - 2046) number of households by structural type of dwelling in the GTA without Toronto

Without Toronto, the gap between single-detached housing and missing middle housing also widens as a result of Toronto having a large total number of households and similar number of households in both structure types. This pattern of growth is in general followed by most census divisions surrounding Toronto, however there are some significant departures (see Appendix B). For instance, the region of York has much faster relative projected growth in mid/high-rise apartment buildings than average, but it is still the least common housing type, while Halton has faster projected growth in missing middle housing, while remaining the second most common housing type. Even more significant is the projected growth of missing middle housing in Peel: missing middle and single-detached housing begin much closer than elsewhere, and missing middle is projected to overtake single-detached housing just before 2040. This shows that in the GTA there is enough demand for missing middle housing to incentivize its construction with the right regulatory framework, though the greater supply of land outside Toronto undoubtedly plays a role as well. The actual numbers of historical and projected households for all GTA geographies is listed in Appendix C.

4.3 Capacity for Growth in the Yellowbelt

The distribution of housing types across the Toronto, Vancouver, and Montreal CMAs varies significantly, as shown in Appendix D. In general, Montreal has the clearest and most regular gradient/division of residential structure types, while Toronto has the least distinct areas of structure type, with Vancouver in between.

Montreal has a small core of mid/high-rise apartments on the East side of the Island of Montreal with a few additional scattered areas surrounding this core, with most of the rest of the Island of Montreal having majority missing middle buildings. The missing middle is mostly low-rise apartment buildings with some duplex and attached housing. The areas outside the Island of Montreal are mostly single-detached housing, with a fair number of low-rise apartments as well. This geospatial distribution is closely aligned with a monocentric model of density, with very clear "rings" of different types of housing.

Vancouver has a highly concentrated area of mid/high-rise apartments in the downtown core, with a few smaller nodes further out, and a moderate ring of missing middle buildings surrounding the core. The missing middle is more evenly distributed between the three subcategories than Montreal, with two nodes of duplex dwellings to the south of the core. The outer ring of Vancouver is dominated by single detached housing. The areas of different building types overlap significantly, with large segments of the city having multiple types of buildings in relatively even proportions. For instance, even the outer areas of the city have 10%-20% duplexes.

Toronto has a core of mid/high-rise apartment buildings downtown, surrounded by a large area with significant variations in the concentration of mid/high-rise apartments between individual census tracts. There are also 2 nodes of missing middle housing to the East and West of the downtown core, with a large surrounding area with variable concentrations of missing middle housing. Most missing middle in the Toronto CMA is low-rise apartments or attached housing, while the outer edges of the Toronto CMA are largely single-detached housing. The area in between the outer ring of detached housing and the core has random concentrations of single-detached housing.

The densities of different structural types of dwellings from various sources are listed in Table 4, while the densities used as most representative are shown in Table 3 - Maximum densities of structural type of dwellings. As can be seen, there is a clear progression in density from single-detached housing to high rise apartments. As these numbers represent the maximum achievable density, all other census tracts are less dense in terms of the specific structure type and reaching these densities cannot be expected across wide areas of Canadian municipalities. With that in mind, given the large gaps between current densities and the maximum achievable density, progress is very possible. For example, the fourth densest concentration of single detached housing (CTUID: 5350805.10), located in Montreal, has 95% single detached houses with a density of 1632 households per square kilometre. However, many lots in this area are over 350m^2 (manual measurement of aerial imagery), compared to the median size of 230m^2 in the densest single detached tract.

Table 3 - Maximum densities of structural type of dwellings

Unit Type	**Household Density (HH/km^2)**
Single Detached	2796
Attached Houses	4078
Duplex	4251
Low-Rise Apartment	9792
Missing Middle	10240

Most example tracts from the Toronto CMA were within the city of Toronto Residential (R) zone, which is less restrictive than other zones. There was also a large gap between the densest tract of low-rise apartment, duplex, and missing middle between Montreal and the densest corresponding tracts in Toronto both in terms of household density, and percent of households in that structure type. This is in keeping with the analysis of the CMA heatmaps, where Toronto has a very diverse mix of housing types without as much spatial segregation between building types. To what degree these differences are due to local history, economics, municipal regulations, provincial policy, or building code is beyond the scope of this analysis, but

Montreal may have densities that cannot be achieved in Toronto simply through zoning and official plan changes.

Despite these limitations, some observations can be made about the attached and detached example tracts used to calculate densities. The detached tract has an efficient layout to maximize the use of land for housing: there are few laneways so most lots back directly onto one another, minimizing the amount of roadway per housing; the streets are laid out in a grid pattern, avoiding odd lot shapes which cannot be efficiently used; lots not as deep as elsewhere in the city (~30m) helping to reduce lot size. At the same time this area has greater side lot setbacks and wider lot widths (~7m) than other areas of the City of Toronto and is therefore unlikely to be the most efficient arrangement of properties.

The attached tract has rear laneways, which is reflected in the higher percent of the tract occupied by roads (29.5% vs 27.1%), but has a grid layout, and narrower lots (~5m) with similar depths (30m) leading to much smaller lot sizes.

Some of these factors are not very transposable, which means that this density is unlikely to be replicable across much of the city: aspects such as changing street or laneway layout and lot depth would require the complete rebuild of a neighbourhood, but incremental progress can be made by allowing similar or lower setbacks and lot widths.

The impact of converting the building structure in various residential zones to the densest forms are shown in Table 5. As can be seen converting the entire Yellowbelt into low-rise apartments or dense mixed missing middle typologies would provide enough housing for the entire city of Toronto – and this assumes all high-rises and housing outside the Yellowbelt are demolished. While such drastic change is completely unrealistic because of the physical, moral and political infeasibility, it illustrates the capacity of the Yellowbelt to add density. More realistic scenarios where less dense forms of missing middle or denser detached houses are allowed as of right, would result in much more gradual, incremental changes, and have a lower impact on housing supply. In order to maintain the 2016 proportion of households living in mid/high-rise apartments (44%), an additional 360,551 missing middle units would need to be built by 2046. This number of new units could be achieved by adding just over 35 km^2 of dense mixed missing middle housing – around 18% of the residential detached housing (RD) zone (see Appendix E for areas of zones). While this is a large area of roughly 83% the size of the currently zoned residential (R) areas, and the actual area would need to be slightly larger to replace the 32 km^2 of lost RD housing, this level of change is not unobtainable over a 25-year timescale. It is also important to note that medium density apartment buildings are grouped with mid/high-rise apartments due to data limitations, despite belonging in the missing middle category in Toronto. This housing format has a role to play that is largely overlooked in this analysis.

More detailed modelling of the impact of allowing the addition of missing middle is extremely difficult, as the actual built forms within any single zone vary widely: there are attached houses in the RD zone, and everything from bungalows to the densest area of high rise dwellings within the 3 CMAs within the R zone. This variability in density means that the exact effect of increasing density would require lot-by-lot built form data, which current publicly available datasets does not support.

Table 4 - Characteristics of densest tracts of structure type

Structure Type	Tract ID	CMA	CSD Municipality	Structure Type Density (Households/km^2)	Percent of households in Structure Type	Toronto Zoning Categories (Largest zone in Bold)
Single Detached House	5350181.01	Toronto	Toronto	2007 (Raw)	61.40%	R, RA, **RD**, RS, RT, RAC, CR
				2796 (Adjusted)	100%	
Semi-Detached House, Row House, or Other Single Attached House	9330147.04	Vancouver	Richmond	2161	29.60%	N/A
	5350019.00	Toronto	Toronto	1969 (Raw)	34.90%	**R**, CR
				4078 (Adjusted)	100.00%	
Apartment or Flat in Duplex	4620314.00	Montreal	Montreal	4251	95.60%	N/A
	5350400.17	Toronto	Markham	1070	53.80%	N/A
Apartment in a Building that has Five or More Stories	5350065.02	Toronto	Toronto	37,901	99.20%	**R,** CR
Apartment in a Building that has Fewer than Five Stories	4620223.01	Montreal	Montreal	9792	96.20%	N/A
	5350004.00	Toronto	Toronto	3884	38.70%	**R,** CR
Missing Middle (Semi-Detached House, Row House, or Other Single Attached House; Apartment or Flat in Duplex; Apartment in a Building that has Fewer than Five Stories)	4620233.00	Montreal	Montreal	10,240	91.00%	N/A
	5350019.00	Toronto	Toronto	5002	88.60%	**R,** CR

Table 5 - Maximum capacity of residential zones by type of intensification

Code for Current Zoning	Intensification Housing type	Maximum # Households in Intensified Areas	% of 2046 Projected Households
RD	Single Detached	560,745	31.9%
RS	Single Detached	37,868	2.2%
RT	Single Detached	26,446	1.5%
RM	Single Detached	97,294	5.5%
All	Single Detached	722,353	41.0%
RD	Attached Houses	817,789	46.5%
RS	Attached Houses	55,226	3.1%
RT	Attached Houses	38,569	2.2%
RM	Attached Houses	141,893	8.1%
All	Attached Houses	1,053,478	59.8%
RD	Duplex	852,499	48.4%
RS	Duplex	57,570	3.3%
RT	Duplex	40,206	2.3%
RM	Duplex	147,916	8.4%
All	Duplex	1,098,191	62.4%
RD	Low-Rise Apartment	1,963,695	111.5%
RS	Low-Rise Apartment	132,610	7.5%
RT	Low-Rise Apartment	92,614	5.3%
RM	Low-Rise Apartment	340,717	19.4%
All	Low-Rise Apartment	2,529,636	143.7%
RD	Missing Middle	2,053,537	116.6%
RS	Missing Middle	138,677	7.9%
RT	Missing Middle	96,851	5.5%
RM	Missing Middle	356,306	20.2%
All	Missing Middle	2,645,371	150.3%

Next Steps

This analysis projects the amount of new housing that will be needed in the next 20 years and provides a rough estimate for how much housing can be added by intensifying the Yellowbelt. Based on these findings the regions around Toronto are expected to see significant growth in both detached and missing middle households over the next 24 years, while Toronto will continue concentrate almost all growth in mid/high-rise apartments. Despite this, missing middle housing can achieve very high densities as seen in real-world examples, and the Yellowbelt has enough capacity to accommodate a large portion of this growth through missing middle.

However in order to bring missing middle into Toronto's Yellowbelt there are several next steps that must occur: a more detailed model of the current distribution, potential density, and capacity of missing middle in Toronto must be created; an extensive public consultation must be carried out to create a broad base of support and find appropriate reforms; and finally sweeping changes must be made to both zoning and official plan documents in order to implement significant reform.

The first task is creating a more detailed model of missing middle in Toronto. This would identify the capacity of the Yellowbelt to add additional households through the addition of missing middle households, and how much change is needed to reach target levels. The publicly available datasets used here do not have the level of detail required to accurately model the range of densities and built forms in Toronto, and to what degree each neighbourhood could have additional units added by including missing middle. The highly heterogeneous density of Toronto housing even within a single category of dwelling structure type requires highly granular data in order to understand where current housing forms are located, and what type of density they provide in different locations. In order to create the most accurate model, a Toronto dataset with 3 factors will be needed: property boundaries, structural type of dwelling, and number of households. This will allow the distribution of density of each dwelling structure type to be calculated, and the geographic distribution of different densities across Toronto to be mapped. With this, the number of additional units that can be added by intensifying with missing middle can be calculated for different scenarios – such as different uptake rates, allowing missing middle in certain neighbourhoods, or removing unit caps within a built form. While initial case scenarios should be based on accommodating future growth and reducing the growth of housing costs, they should be open to change based on feedback from the public, industry, and community groups.

The second next step is to build a broad base of support for missing middle reform and use consultation with stakeholders to refine proposed regulatory changes. As seen from the case studies, in many jurisdictions proposed changes to allow missing middle can generate a lot of opposition, and this can place proposed changes under strain. While in a few cases changes slip by unnoticed, avoiding engagement risks being unable to direct the conversation into productive results. Building a coalition of supporters can place political pressure to implement reforms and allow stakeholders to advocate on behalf of changes. Given Toronto's approach of piecemeal zoning regulations and exceptions, communicating the current rules is challenging. The serious restrictions on any change imposed by the OP make adding missing middle require significant revisions. These two factors add to the complexity of outreach, which may in turn add to the length of time required.

The final step is to craft and implement reforms to allow missing middle in Toronto, which will require political will and resources. Case studies show that deliberate, large scale changes are the most common way of creating these reforms, but incremental changes are also sometimes used. Large uniform zoning blocks are easier to both understand and communicate, which is especially important when the non-professional stakeholders like homeowners play a large role in creating new missing middle housing.

This research quantifies the growth in the number of households in Toronto and the GTA and provides a rough analysis of the distribution and capacity of missing middle to add housing in Toronto, but there is more work needed to implement this tool in the affordability toolbox.

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Appendices

Appendix A – Historical (1991 – 2016) and projected (2018-2046) percent of households by structural type of dwelling groups for census divisions in the GTA

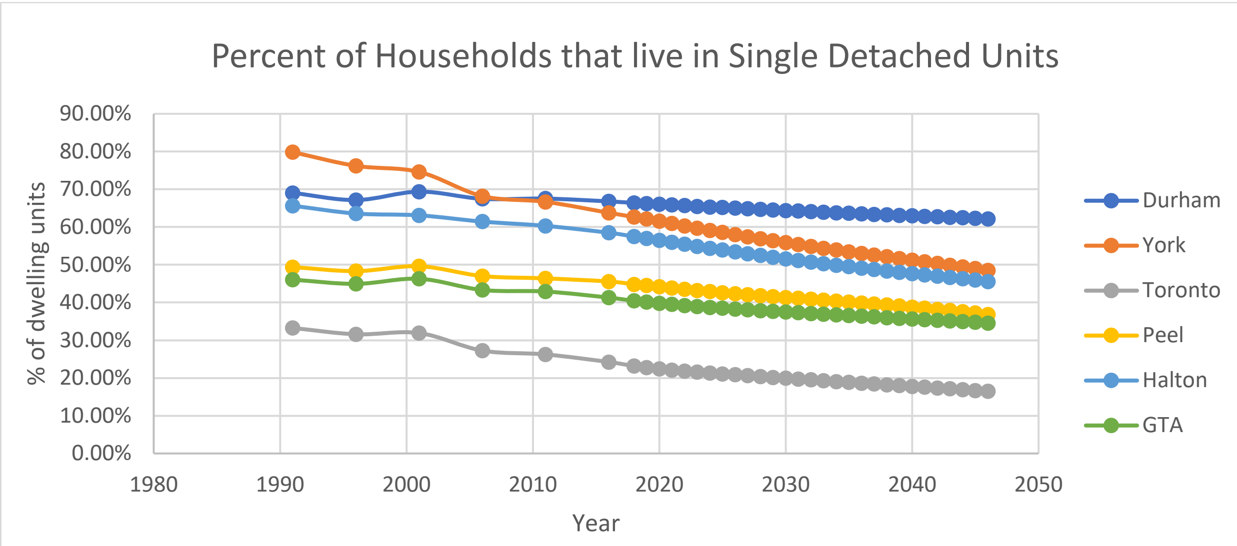

Figure 13 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in single detached units

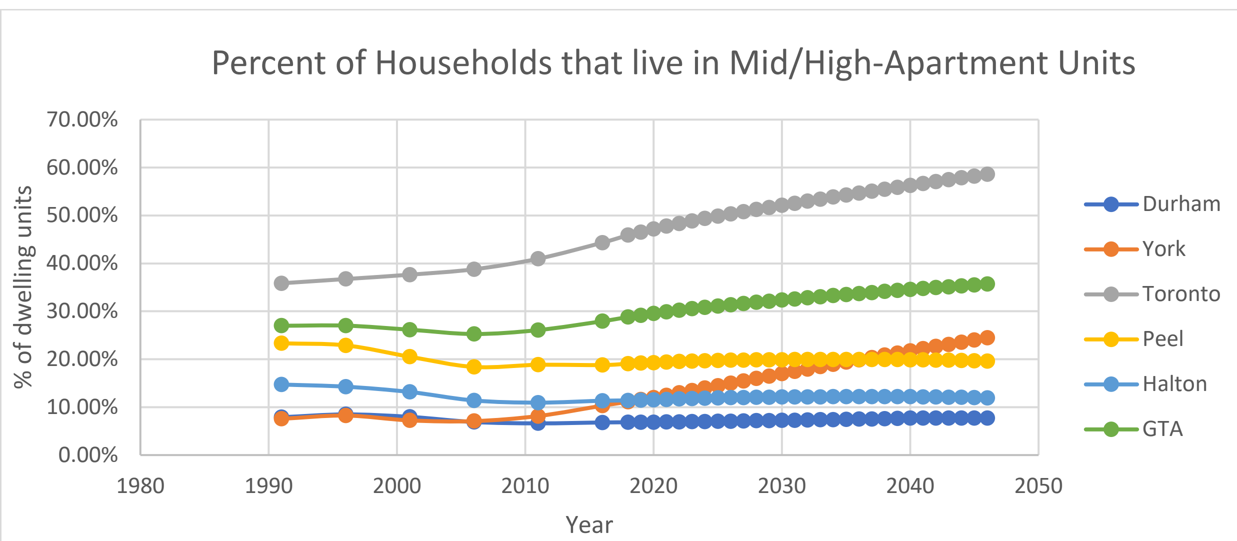

Figure 14 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in mid/high-rise (5 or more stories) units

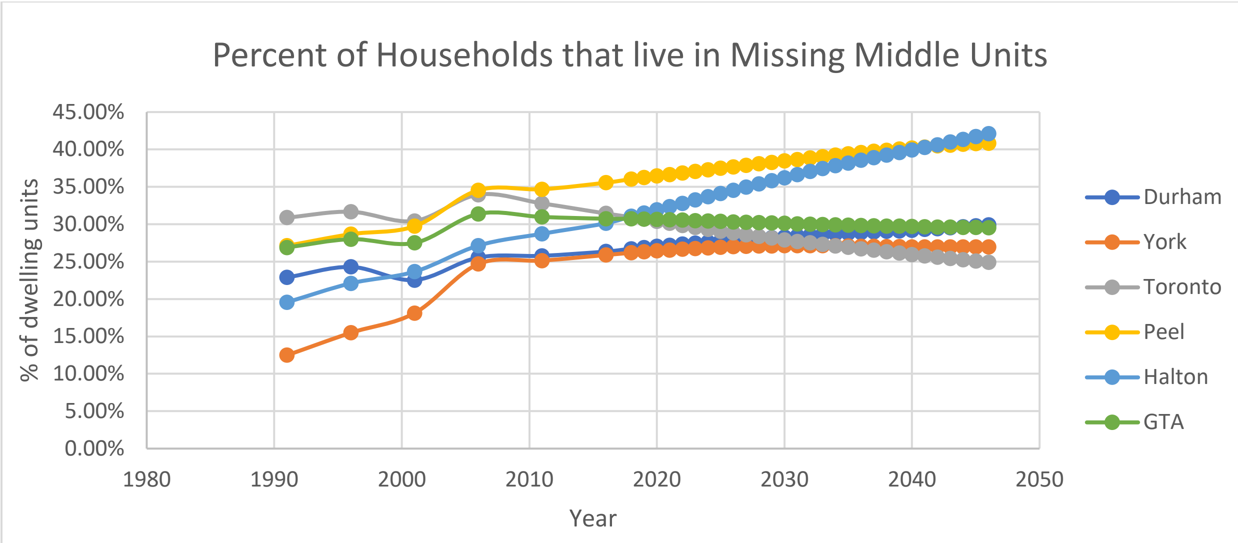

Figure 15 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in missing middle units

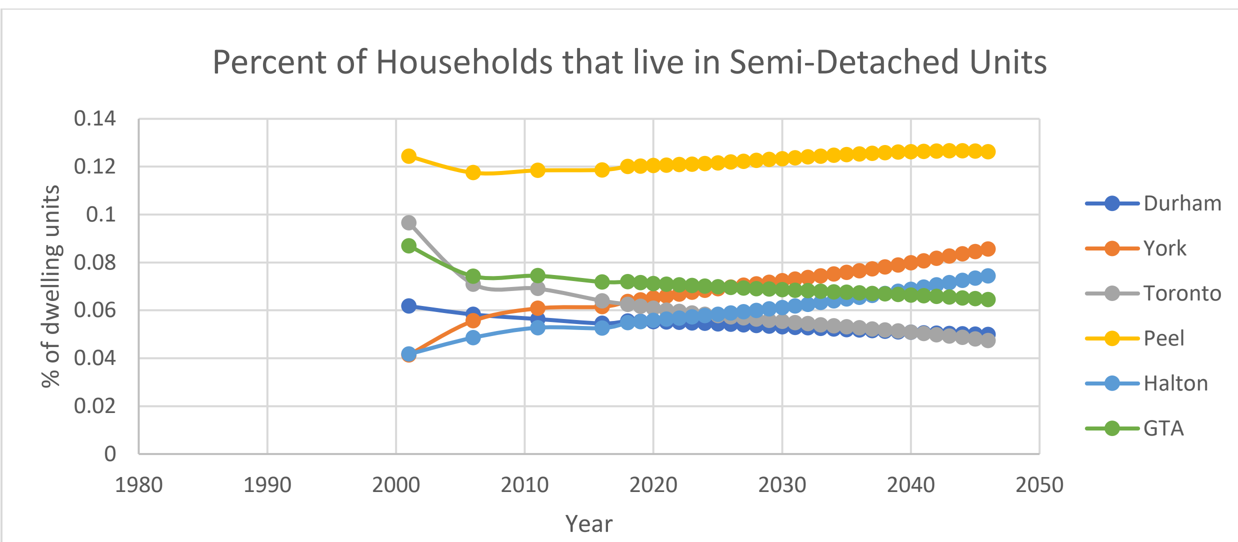

Figure 16 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in semi-detached units

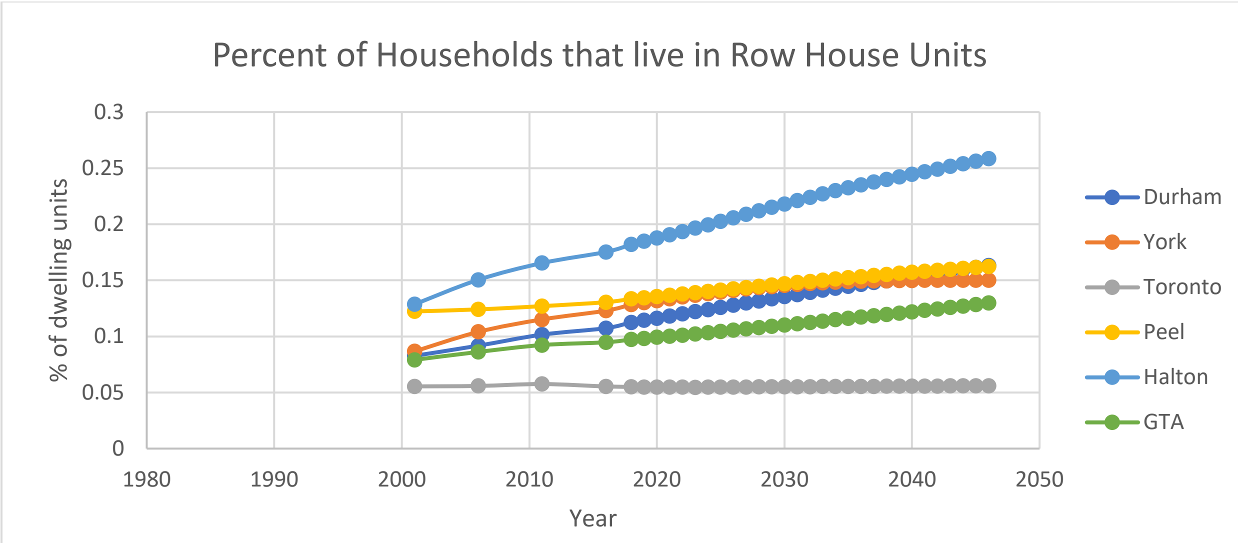

Figure 17 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in row house units

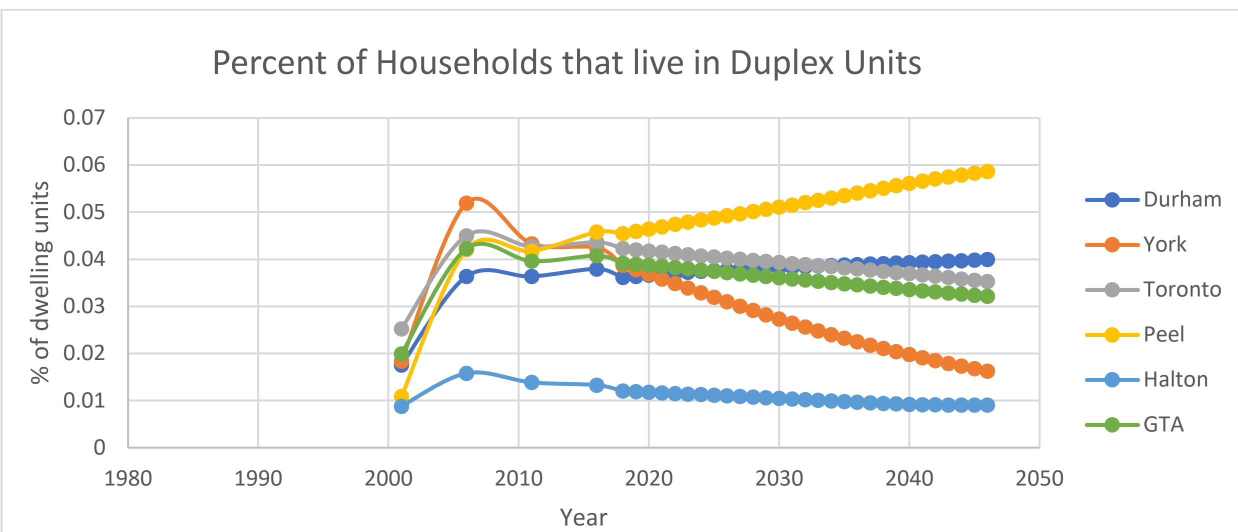

Figure 18 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in duplex units

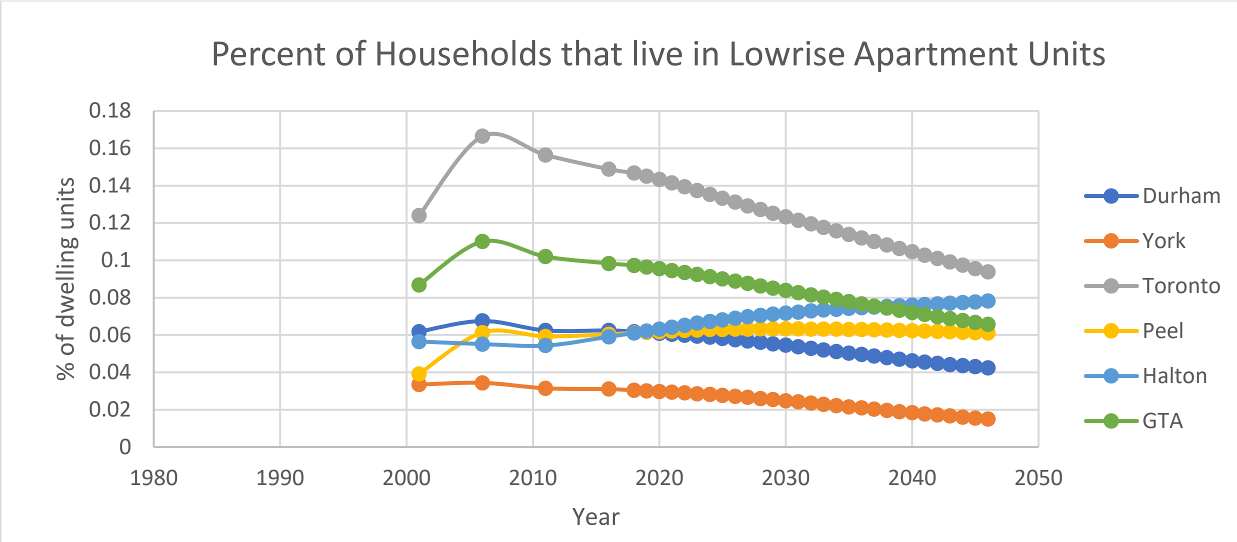

Figure 19 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in low-rise apartment (less than 5 stories) units

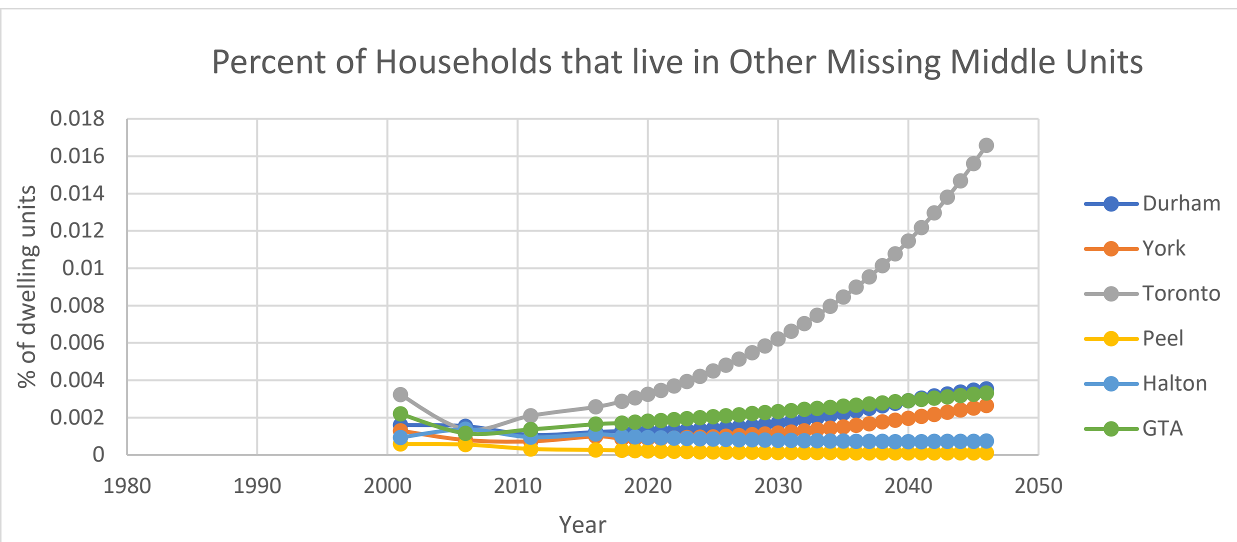

Figure 20 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in other missing middle (not in an existing missing middle subcategory) units

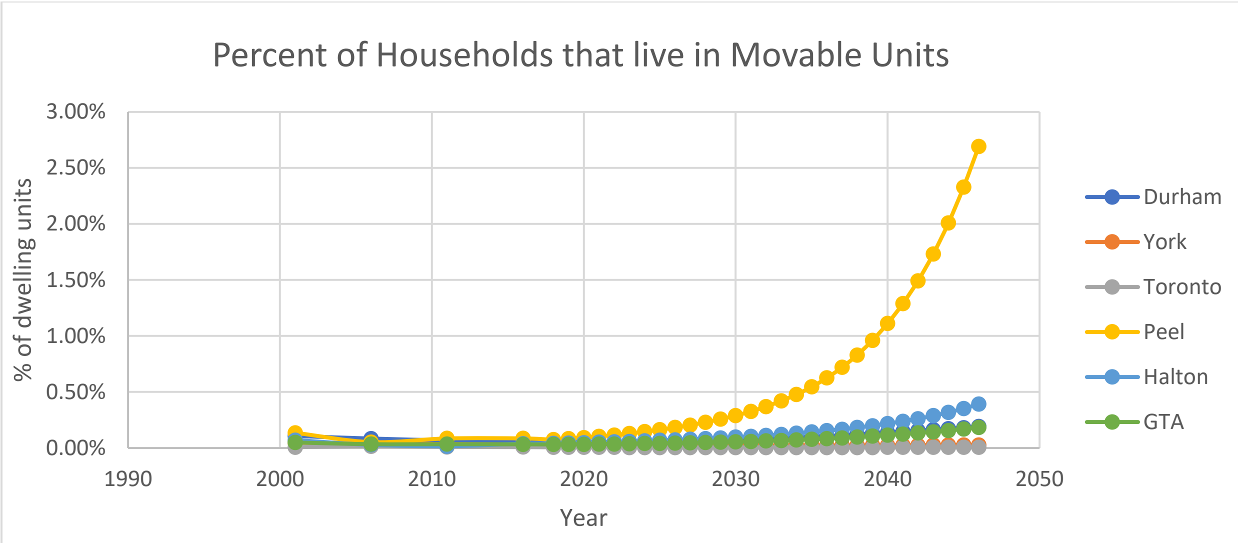

Figure 21 - Historical (1991 – 2016) and projected (2018-2046) percent of households that live in movable units

Appendix B - Historical (1991 – 2016) and projected (2018-2046) trend in housing by structural type of household for geographies not presented elsewhere in this paper

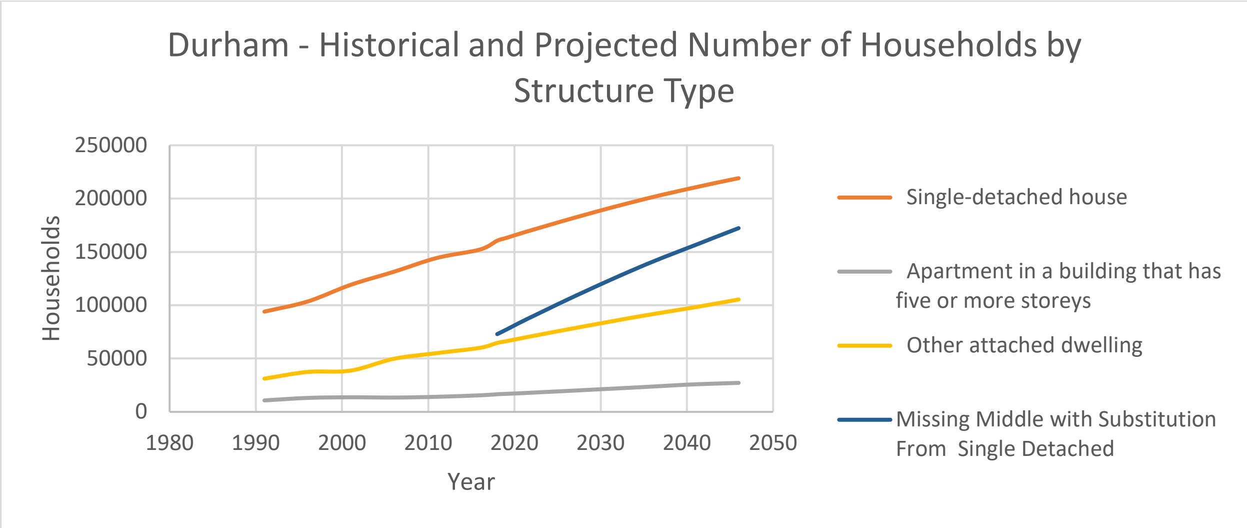

Figure 22 - Historical (1991 – 2016) and projected (2018-2046) number of households by structure type in Durham census division

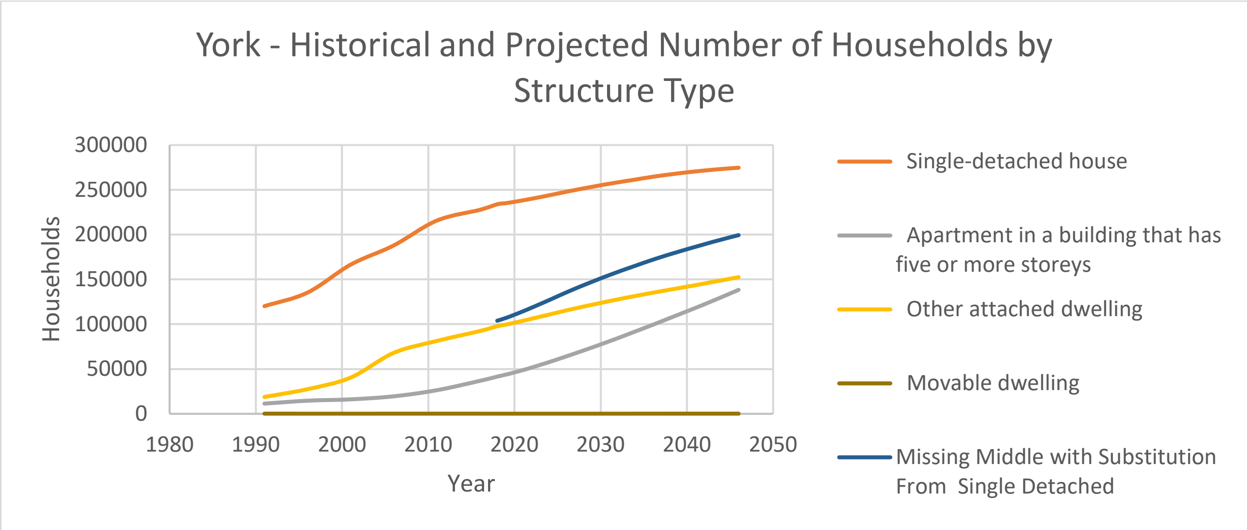

Figure 23 - Historical (1991 – 2016) and projected (2018-2046) number of households by structure type in York census division

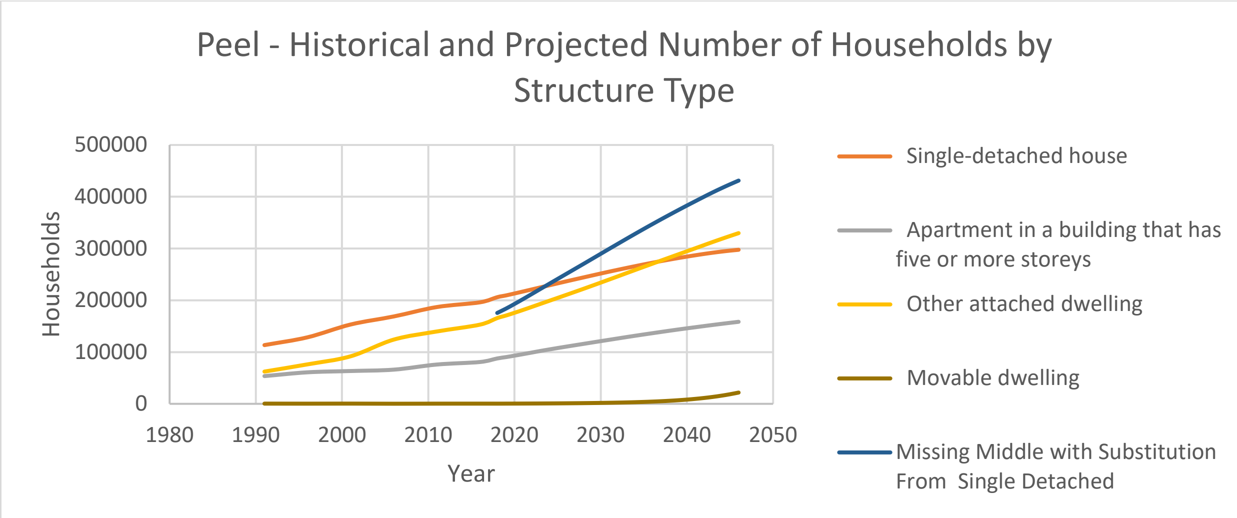

Figure 24 - Historical (1991 – 2016) and projected (2018-2046) number of households by structure type in Peel census division

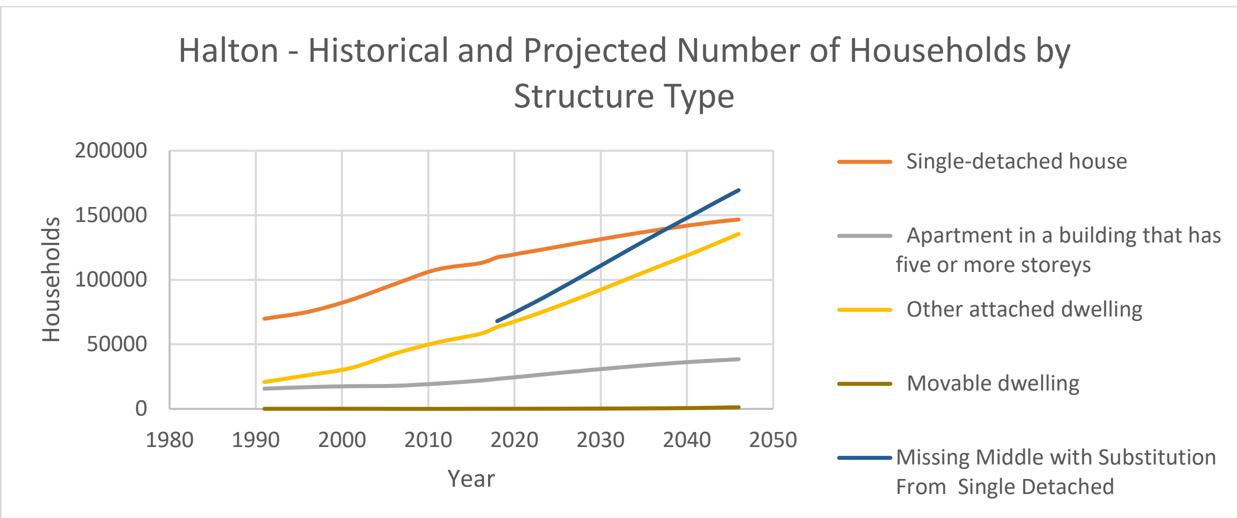

Figure 25 - Historical (1991 – 2016) and projected (2018-2046) number of households by structure type in Halton census division

Appendix C - Historical and projected (using model B) number of households: data for census years

Table 6 - Historical and projected number of households by general structural type of dwelling and geography. Projections developed by model B

Geography	Structural Type of Dwelling	Year											
		Historical						Projected					
		1991	1996	2001	2006	2011	2016	2021	2026	2031	2036	2041	2046
Durham	Total Households	136,140	154,100	171,720	194,670	213,745	227,905	255,176	276,705	297,415	317,049	335,122	352,393
York		150,485	177,575	223,185	275,675	323,540	357,085	391,124	427,383	463,673	498,971	532,565	565,813
Toronto		864,555	903,580	943,075	979,330	1,047,875	1,112,930	1,289,052	1,385,211	1,470,803	1,563,381	1,659,577	1,760,501
Peel		229,670	265,935	308,845	359,045	402,935	430,180	494,865	558,412	621,264	683,880	745,252	807,447
Halton		106,420	118,155	133,665	156,945	179,010	192,975	216,055	237,309	259,283	281,033	301,698	322,036
GTA		1,487,270	1,619,345	1,780,490	1,965,665	2,167,105	2,321,075	2,643,210	2,889,215	3,122,241	3,358,632	3,592,028	3,829,094
Durham	Single-detached house	94,005	103,480	119,135	131,345	144,355	152,225	168,065	179,865	191,055	201,364	210,592	219,141
York		120,145	135,330	166,500	187,975	215,725	227,725	238,327	247,856	256,822	264,542	270,598	274,718
Toronto		287,475	285,375	300,925	266,880	275,010	269,675	284,961	288,861	290,123	291,356	291,696	289,905
Peel		113,425	128,500	153,225	168,775	186,945	196,065	216,985	236,544	255,350	272,532	287,030	297,550
Halton		69,860	75,115	84,345	96,415	107,960	112,875	120,897	126,768	132,607	138,006	142,840	146,729
GTA		684,910	727,800	824,130	851,390	929,995	958,565	1,043,857	1,105,623	1,164,264	1,221,397	1,274,561	1,323,220
Durham	Apartment in a building that has five or more storeys	10,750	13,080	13,695	13,420	14,140	15,510	17,588	19,586	21,629	23,750	25,842	27,176
York		11,390	14,645	16,145	19,535	26,350	36,805	48,830	64,067	80,946	99,227	118,230	138,437
Toronto		309,940	331,925	354,995	379,700	429,220	493,280	615,678	696,786	772,979	854,348	940,075	1,032,202
Peel		53,570	60,875	63,375	66,025	75,895	80,780	95,966	110,469	123,702	136,417	148,010	158,437
Halton		15,665	16,860	17,600	17,880	19,590	21,890	25,105	28,396	31,419	34,252	36,641	38,484
GTA		401,315	437,385	465,810	496,560	565,195	648,265	789,646	906,450	1,017,341	1,131,888	1,247,605	1,367,632

Geography	Structural Type of Dwelling	Year											
		Historical						Projected					
		1991	1996	2001	2006	2011	2016	2021	2026	2031	2036	2041	2046
Durham	Other attached dwelling (Missing Middle)	31,155	37,435	38,700	49,740	55,100	60,050	69,385	77,080	84,497	91,596	98,194	105,399
York		18,785	27,495	40,435	68,045	81,350	92,440	103,876	115,360	125,798	135,086	143,605	152,497
Toronto		267,025	286,185	287,085	332,585	343,535	349,880	388,336	399,489	407,621	417,590	427,710	438,279
Peel		62,280	76,250	91,820	124,055	139,750	152,965	181,396	210,376	240,178	270,651	300,609	329,717
Halton		20,825	26,110	31,620	42,605	51,430	58,135	69,942	81,970	94,985	108,340	121,496	135,562
GTA		400,070	453,475	489,660	617,030	671,165	713,470	808,771	875,850	938,791	1,002,534	1,065,394	1,131,242
Durham	Movable dwelling	230	105	185	165	145	125	138	174	234	339	495	677
York		160	105	105	115	115	110	91	100	107	116	132	160
Toronto		115	90	75	165	110	95	76	74	80	87	96	115
Peel		395	315	420	190	345	370	517	1,023	2,033	4,280	9,603	21,743
Halton		70	70	95	45	30	75	111	175	272	436	721	1,261
GTA		970	685	880	680	745	775	937	1,291	1,845	2,813	4,468	7,000

Table 7 - Historical and projected number of households by missing middle subgroup structural type of dwelling and geography. Projections developed by model B. Missing middle substitution assumes all new detached housing is instead added to the missing middle housing supply

Geography	Structural Type of Dwelling	Year									
		Historical				Projected					
		2001	2006	2011	2016	2021	2026	2031	2036	2041	2046
Durham	Semi-detached house	10,605	11,345	12,050	12,430	14,065	14,973	15,731	16,393	16,962	17,568
York		9,240	15,340	19,680	21,950	25,814	29,807	33,865	38,192	42,978	48,406
Toronto		91,010	69,470	72,405	71,225	77,473	79,361	80,724	82,350	83,576	83,401
Peel		38,415	42,175	47,725	51,040	59,693	68,063	76,851	85,708	94,176	101,934
Halton		5,575	7,630	9,445	10,145	12,159	13,963	16,032	18,384	21,015	23,952
GTA		154,845	145,960	161,305	166,790	187,371	200,927	213,493	225,959	237,391	246,870
Durham	Row house	14,205	17,860	21,715	24,460	30,166	35,359	40,851	46,415	51,762	57,535
York		19,335	28,685	37,255	43,890	52,218	60,269	67,881	74,436	79,869	84,909
Toronto		52,315	54,685	60,295	61,630	70,571	75,963	81,131	86,710	92,520	98,498
Peel		37,770	44,550	51,170	56,145	67,637	79,455	91,930	104,857	117,843	131,065
Halton		17,190	23,620	29,610	33,820	41,191	48,823	57,332	66,056	74,466	83,274
GTA		140,815	169,400	200,045	219,945	264,854	304,797	347,731	393,751	442,592	496,880
Durham	Apartment or flat in a duplex	3,010	7,080	7,770	8,650	9,403	10,445	11,407	12,337	13,204	14,079
York		4,100	14,320	14,010	15,170	14,021	13,253	12,274	11,228	10,187	9,184
Toronto		23,800	44,100	44,740	48,535	53,509	55,757	57,532	59,393	60,878	62,064
Peel		3,360	15,110	16,830	19,695	23,224	27,508	32,026	36,977	42,196	47,357
Halton		1,175	2,480	2,480	2,565	2,518	2,615	2,675	2,711	2,763	2,923
GTA		35,445	83,090	85,830	94,615	101,797	107,463	111,937	116,128	119,753	123,103
Durham	Apartment in a building that has fewer than five storeys	10,605	13,145	13,345	14,235	15,421	15,903	15,974	15,703	15,249	14,969
York		7,470	9,480	10,180	11,080	11,475	11,601	11,208	10,438	9,470	8,504
Toronto		116,915	162,985	163,895	165,630	182,323	181,755	178,505	175,098	170,523	165,134
Peel		12,095	22,015	23,890	25,965	30,742	35,264	39,292	43,028	46,311	49,276
Halton		7,555	8,655	9,725	11,400	13,877	16,373	18,746	20,983	23,035	25,175
GTA		154,640	216,280	221,035	228,310	249,862	256,595	258,200	257,736	254,980	251,673

Geography	Structural Type of Dwelling	Year									
		Historical				Projected					
		2001	2006	2011	2016	2021	2026	2031	2036	2041	2046
Durham	Other single-attached house	275	300	230	280	331	399	534	748	1,016	1,248
York		290	220	235	355	348	429	571	792	1,102	1,495
Toronto		3,045	1,340	2,200	2,860	4,460	6,653	9,729	14,040	20,214	29,182
Peel		180	200	130	115	100	85	79	80	84	85
Halton		125	215	170	215	198	197	201	205	216	237
GTA		3,915	2,275	2,965	3,825	4,887	6,069	7,430	8,960	10,678	12,717
Durham	Missing Middle with Full Single Detached Substitution (projections only)					85,200	104,695	123,303	140,711	156,536	172,289
York						114,447	135,461	154,865	171,873	186,448	199,460
Toronto						403,637	418,691	428,084	439,286	449,746	458,525
Peel						202,322	250,860	299,469	347,123	391,579	431,207
Halton						77,984	95,883	114,737	133,491	151,481	169,436
GTA						894,048	1,022,894	1,144,475	1,265,350	1,381,375	1,495,882

Appendix D - Maps of distribution of structural type of dwellings by census tractfor the Toronto, Montreal, and Vancouver CMAs. All maps created in QGIS Desktop 3.12.0

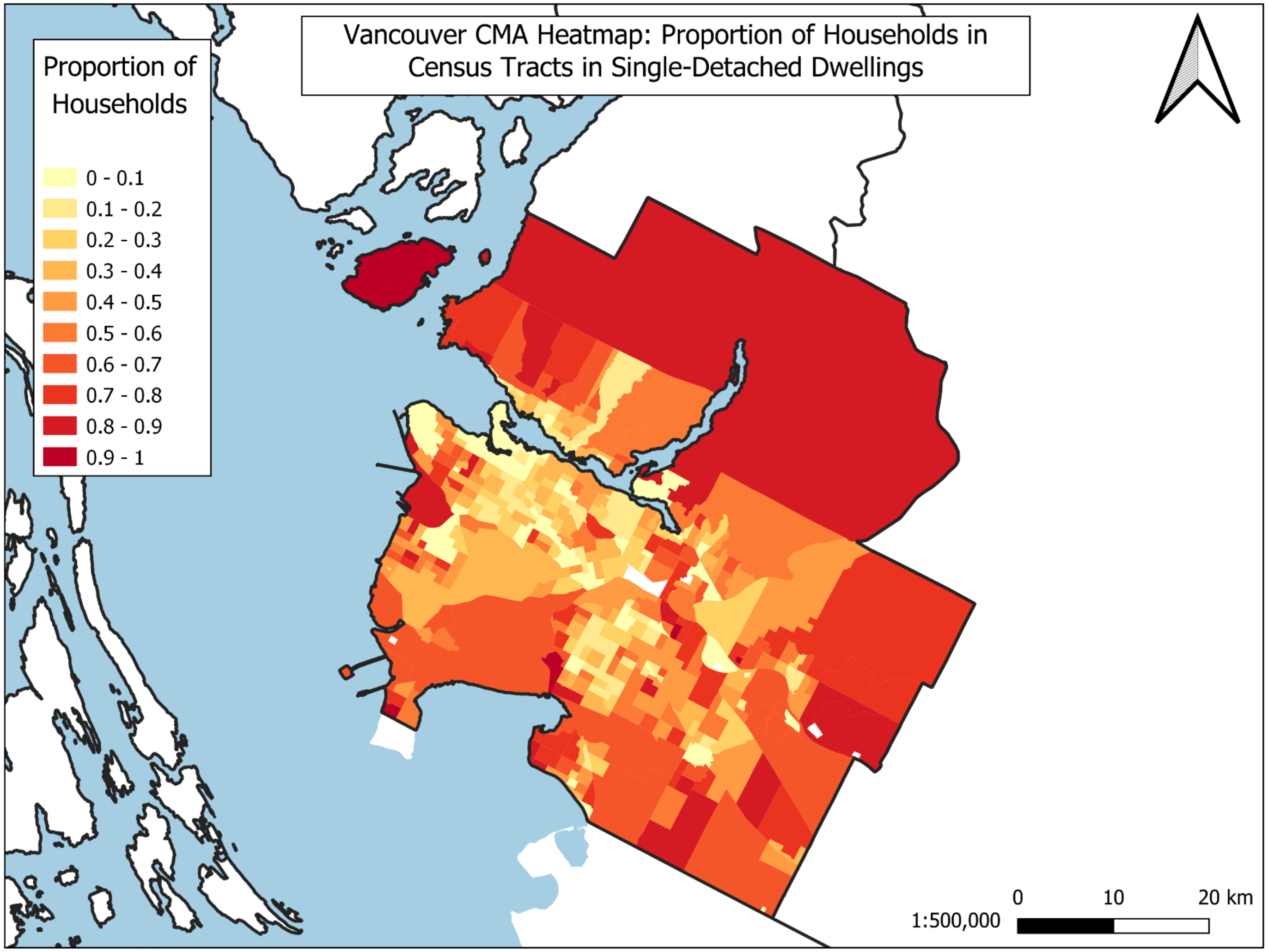

Figure 26 – Vancouver CMA heatmap for single-detached dwellings

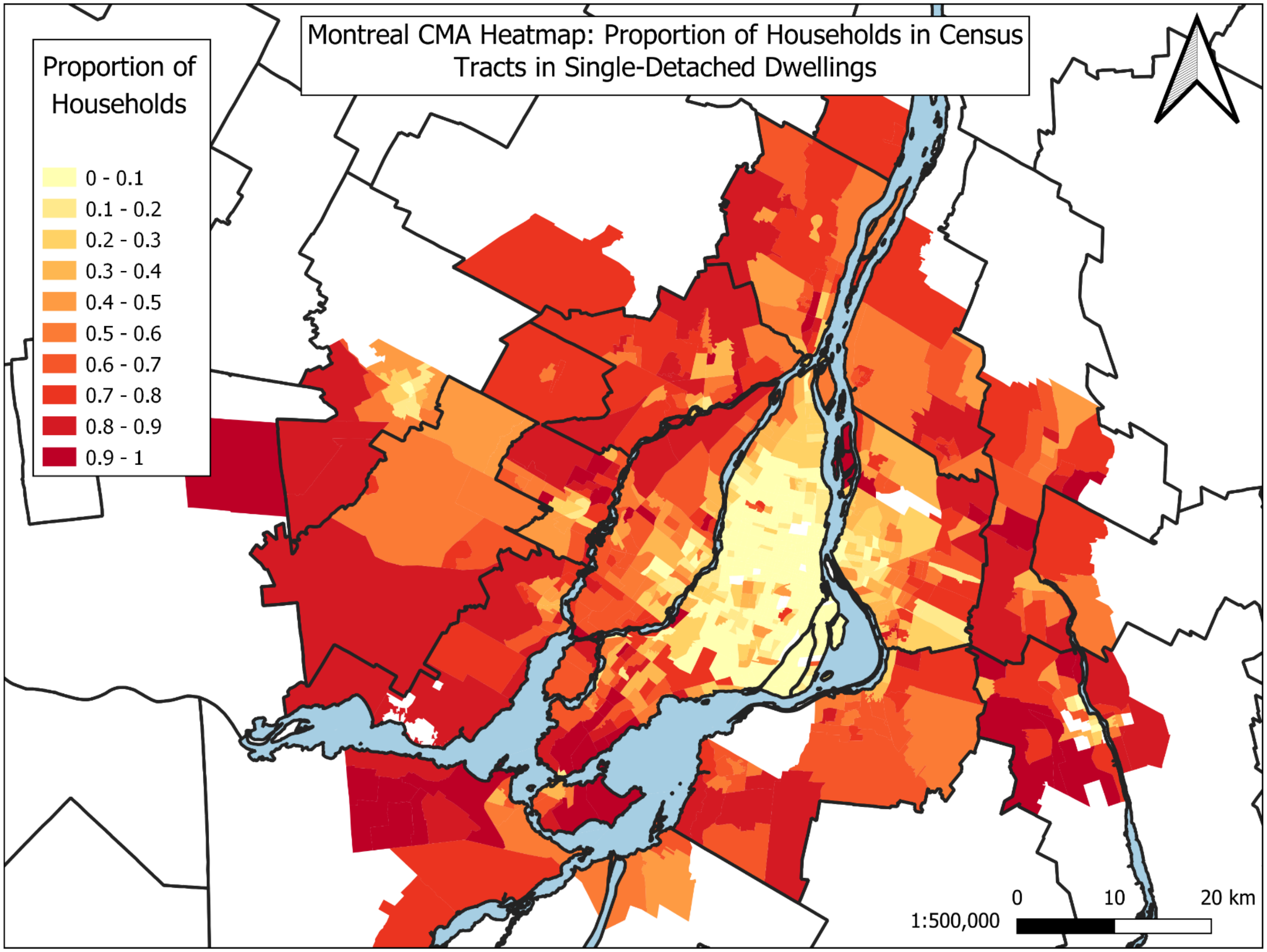

Figure 27 - Montreal CMA heatmap for single-detached dwellings

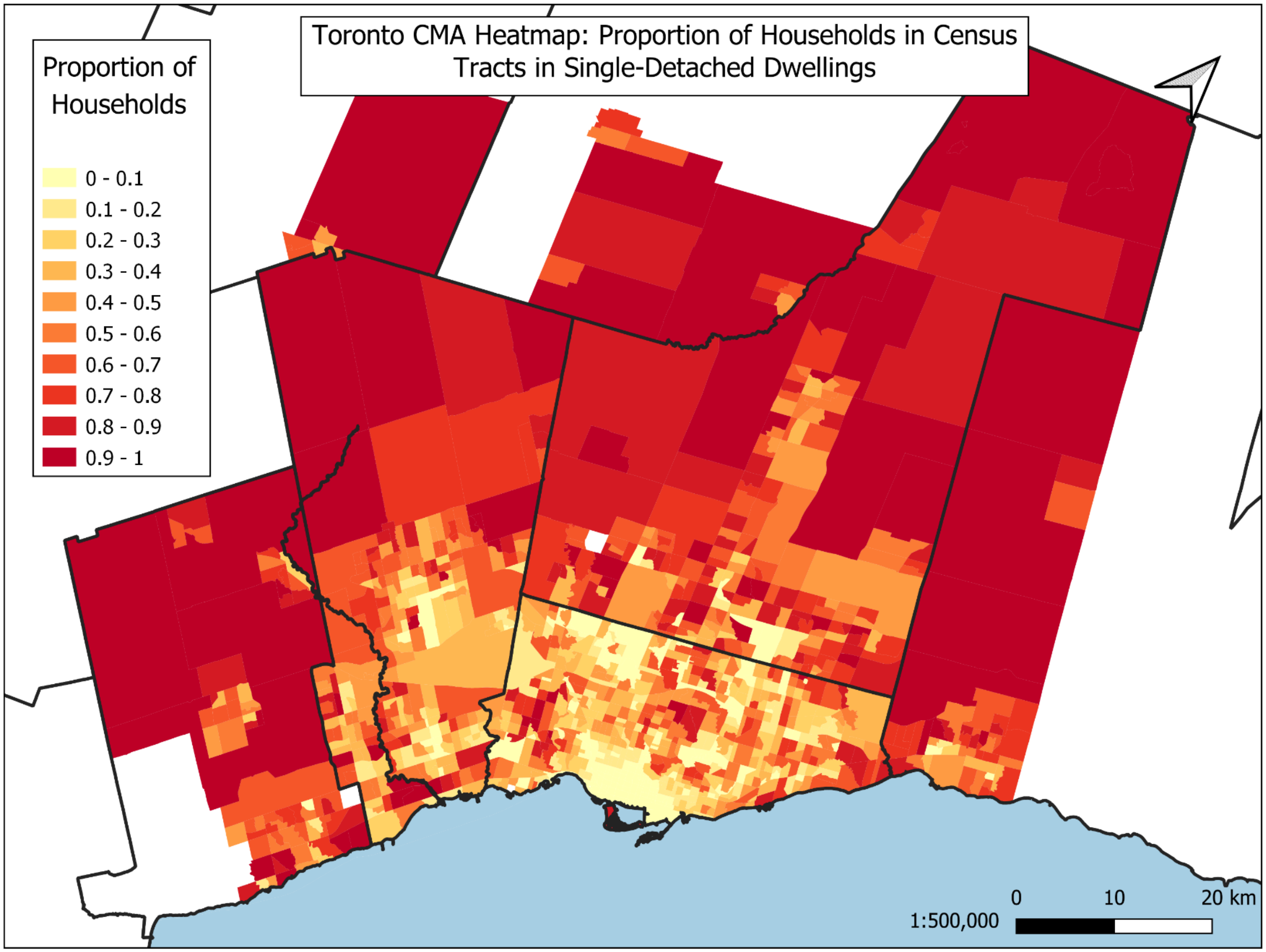

Figure 28 - Toronto CMA heatmap for single-detached dwellings

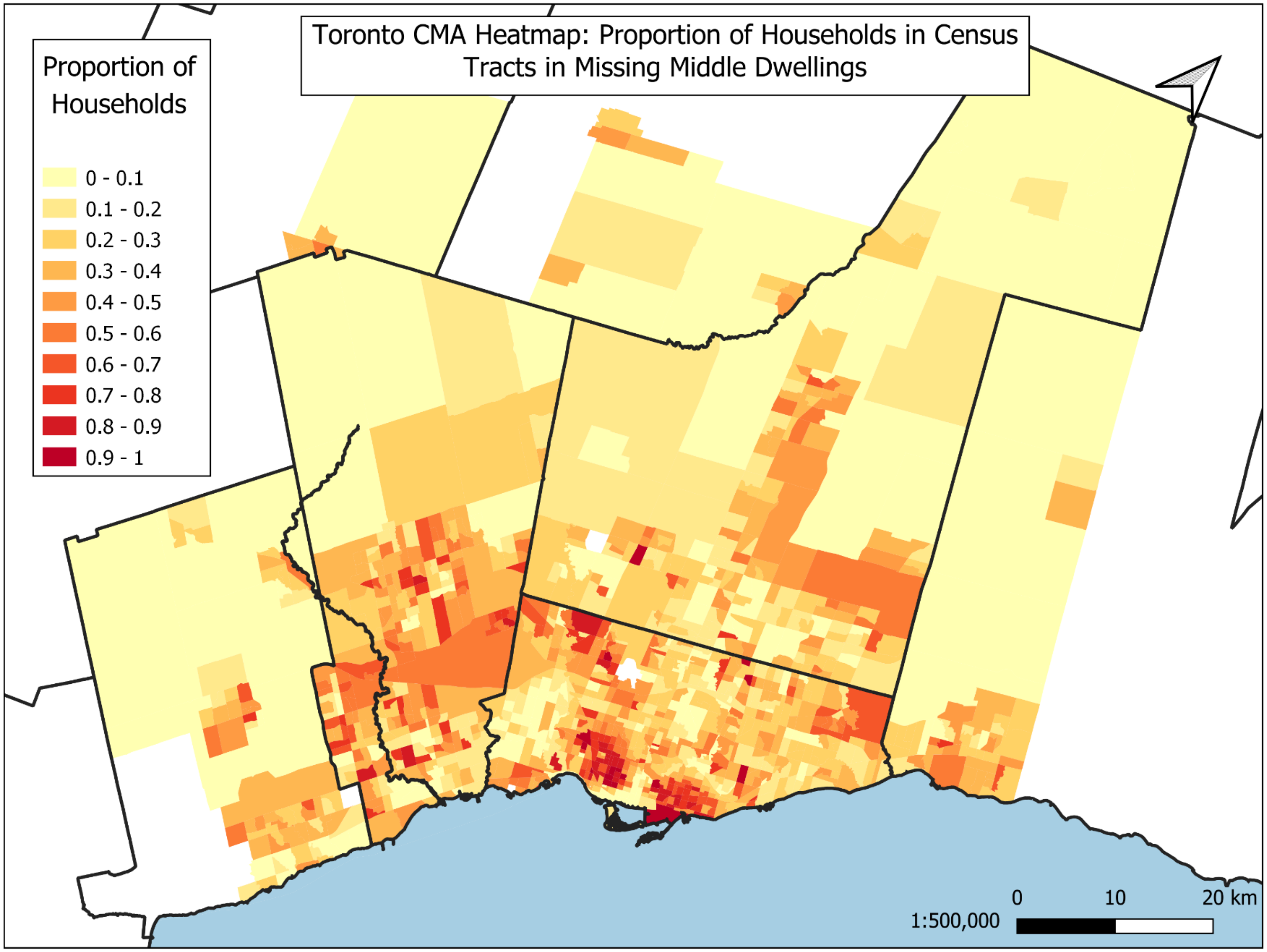

Figure 29 - Toronto CMA heatmap for missing middle dwellings

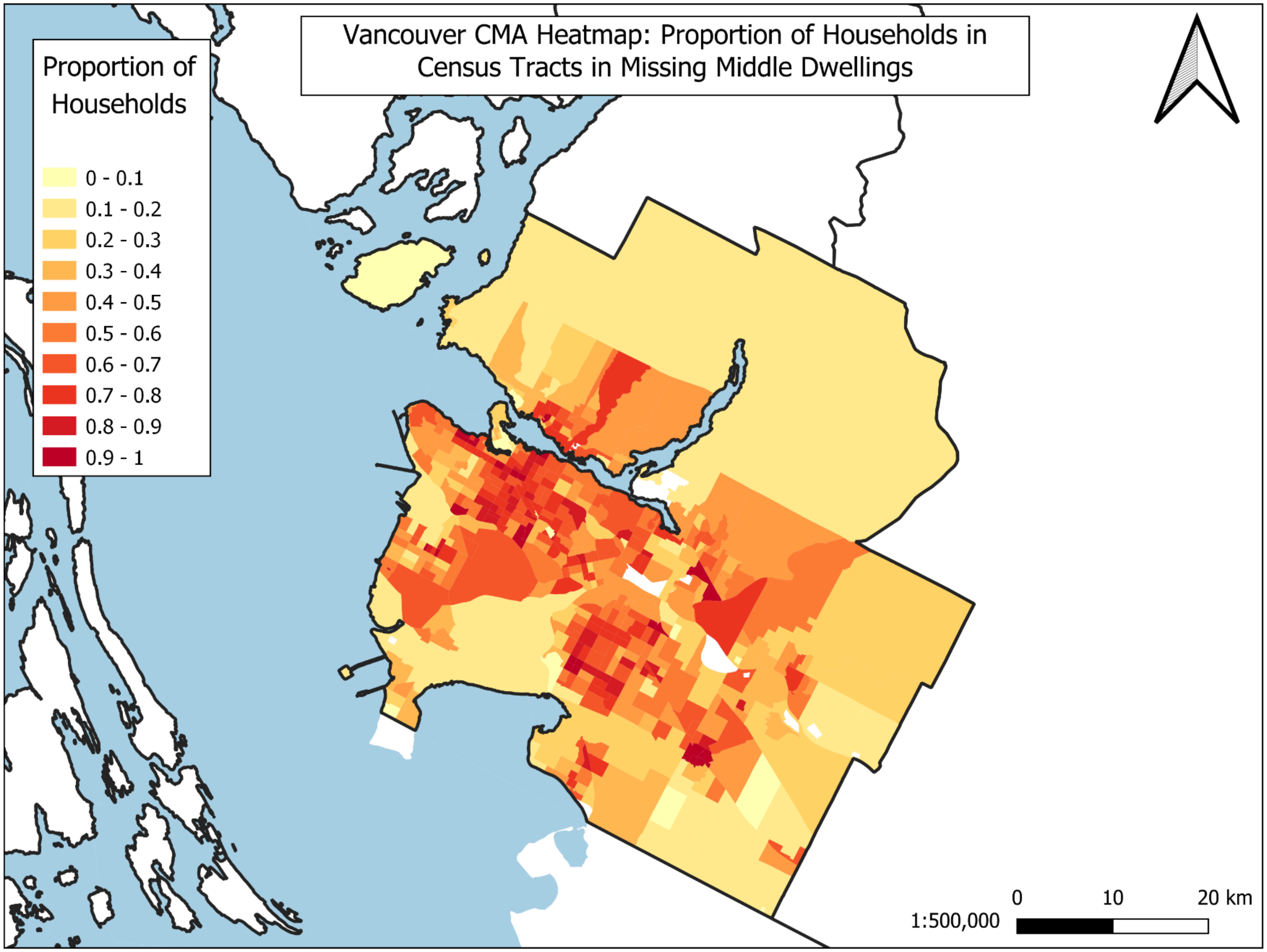

Figure 30 - Vancouver CMA heatmap for missing middle dwellings

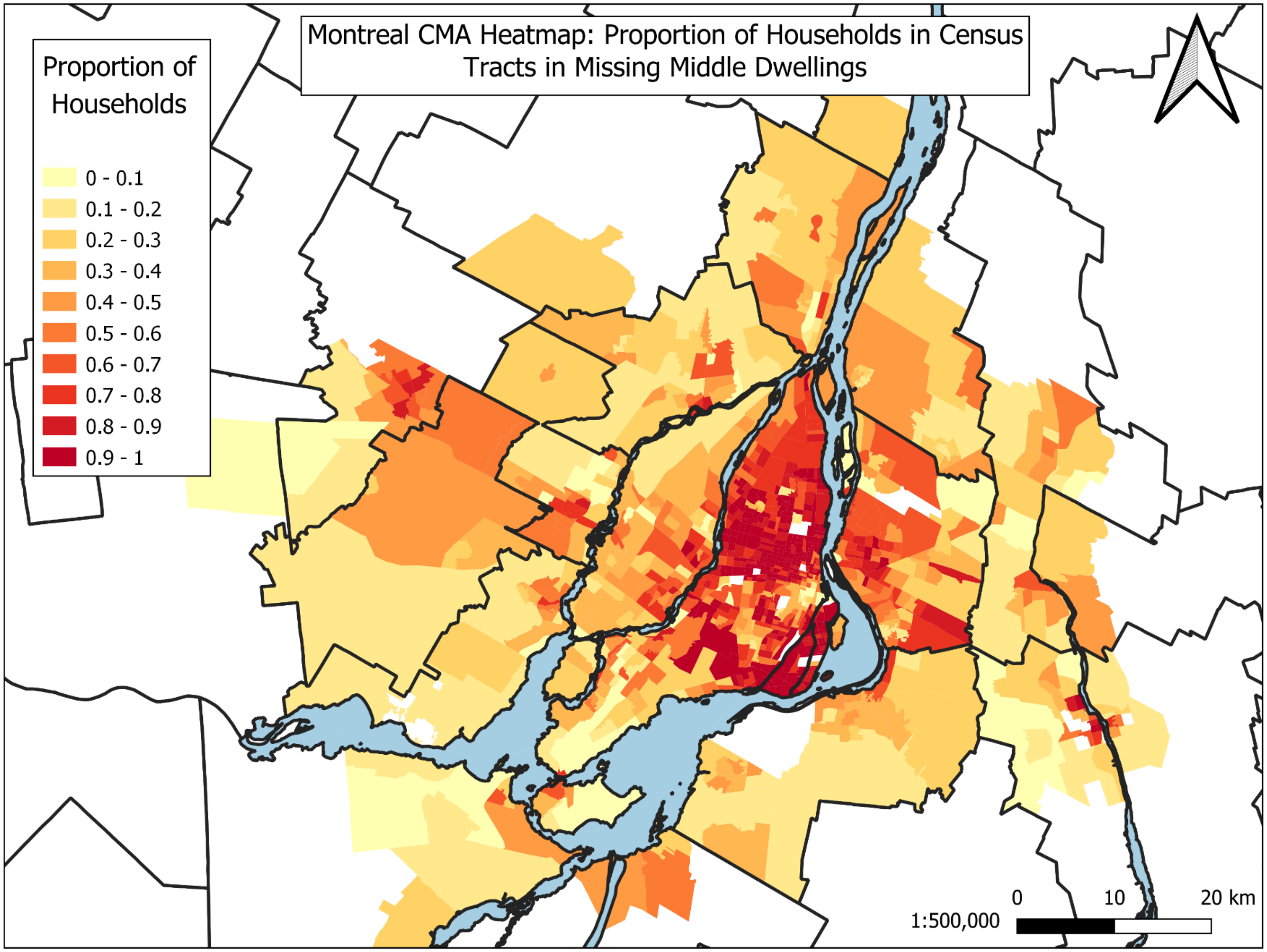

Figure 31 - Montreal CMA heatmap for missing middle dwellings

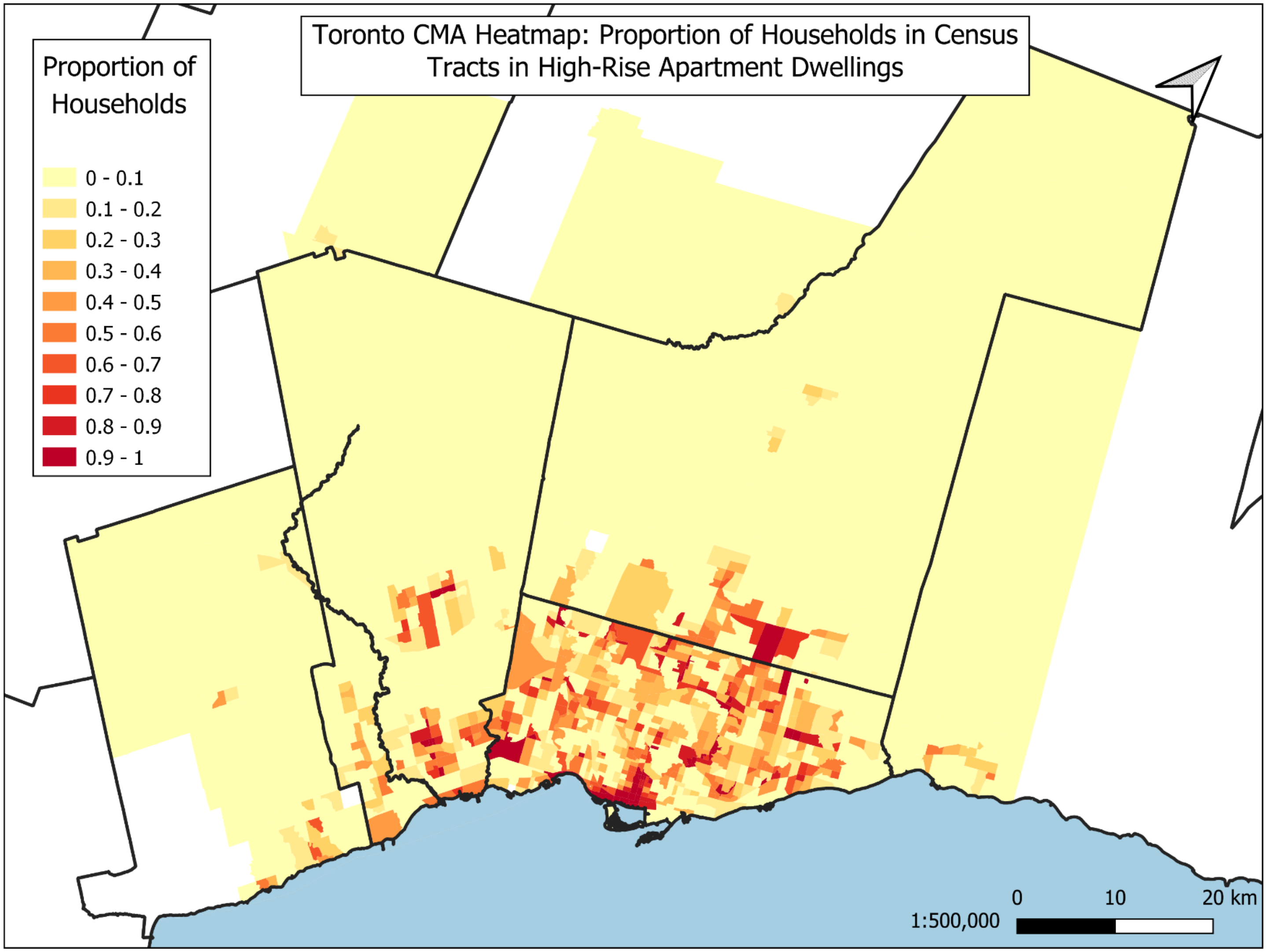

Figure 32 - Toronto CMA heatmap for mid/high-rise apartment dwellings

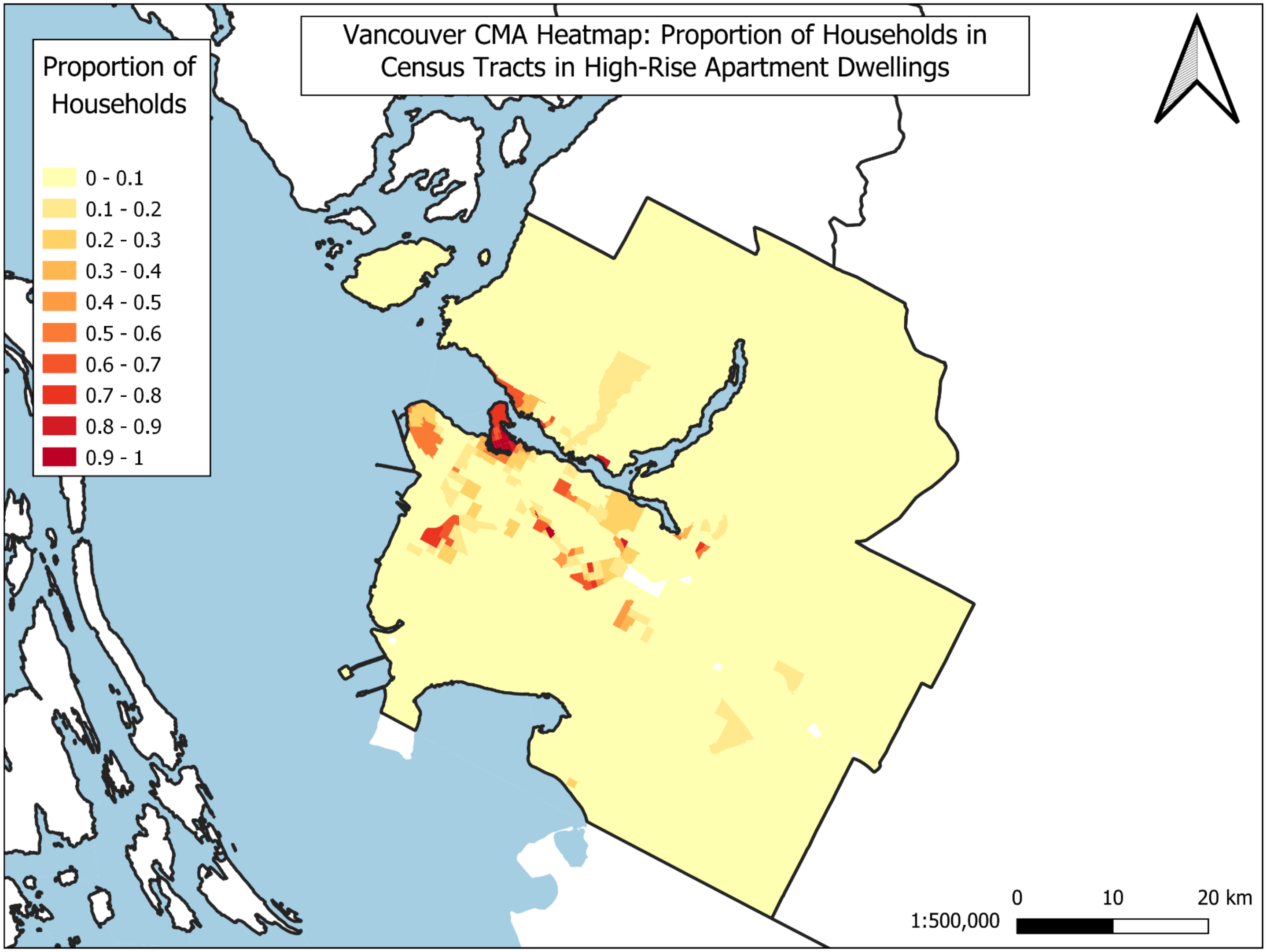

Figure 33 - Vancouver CMA heatmap for mid/high-rise apartment dwellings

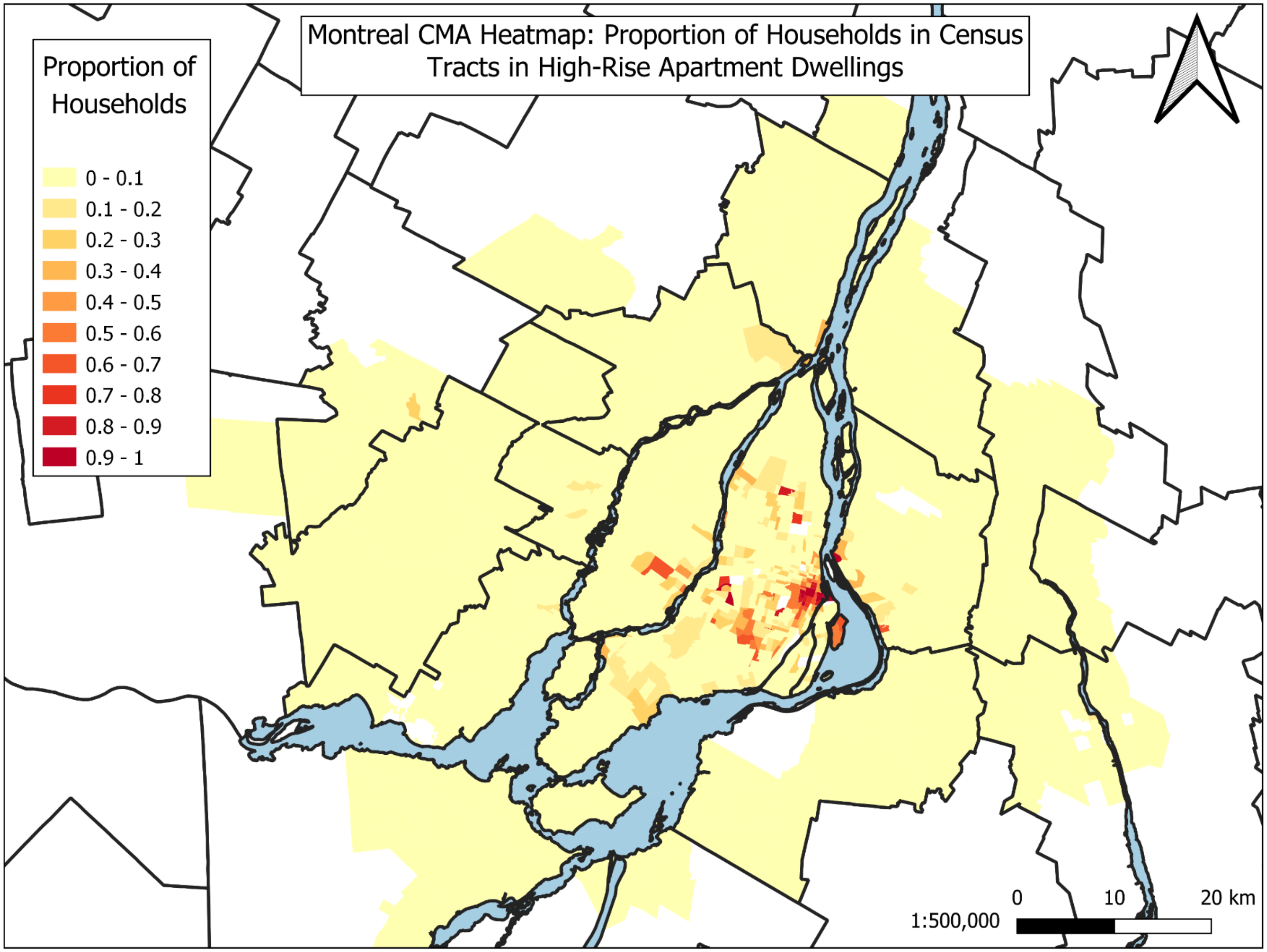

Figure 34 - Montreal CMA heatmap for mid/high-rise apartment dwellings

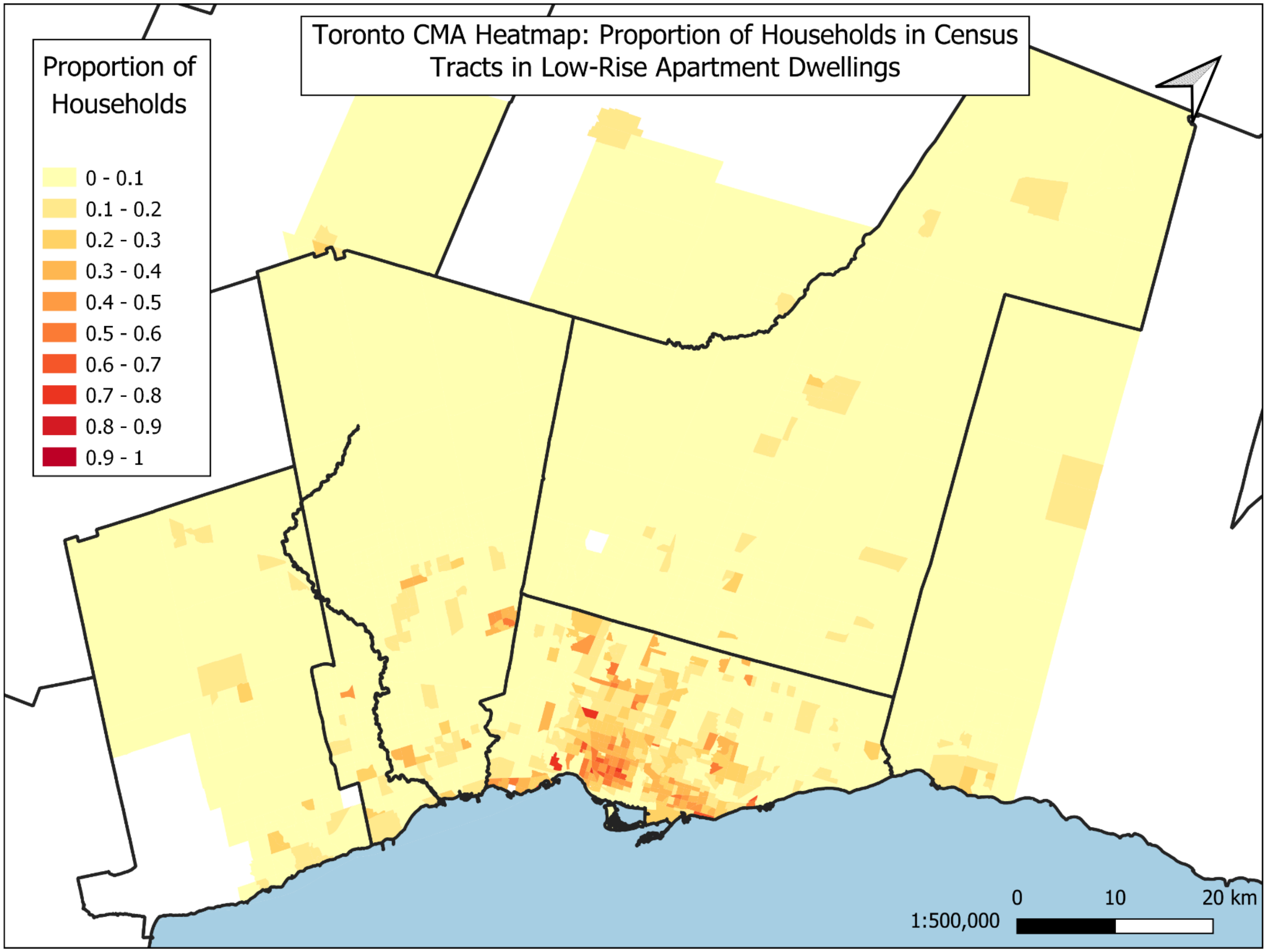

Figure 35 - Toronto CMA heatmap for low-rise apartment dwellings

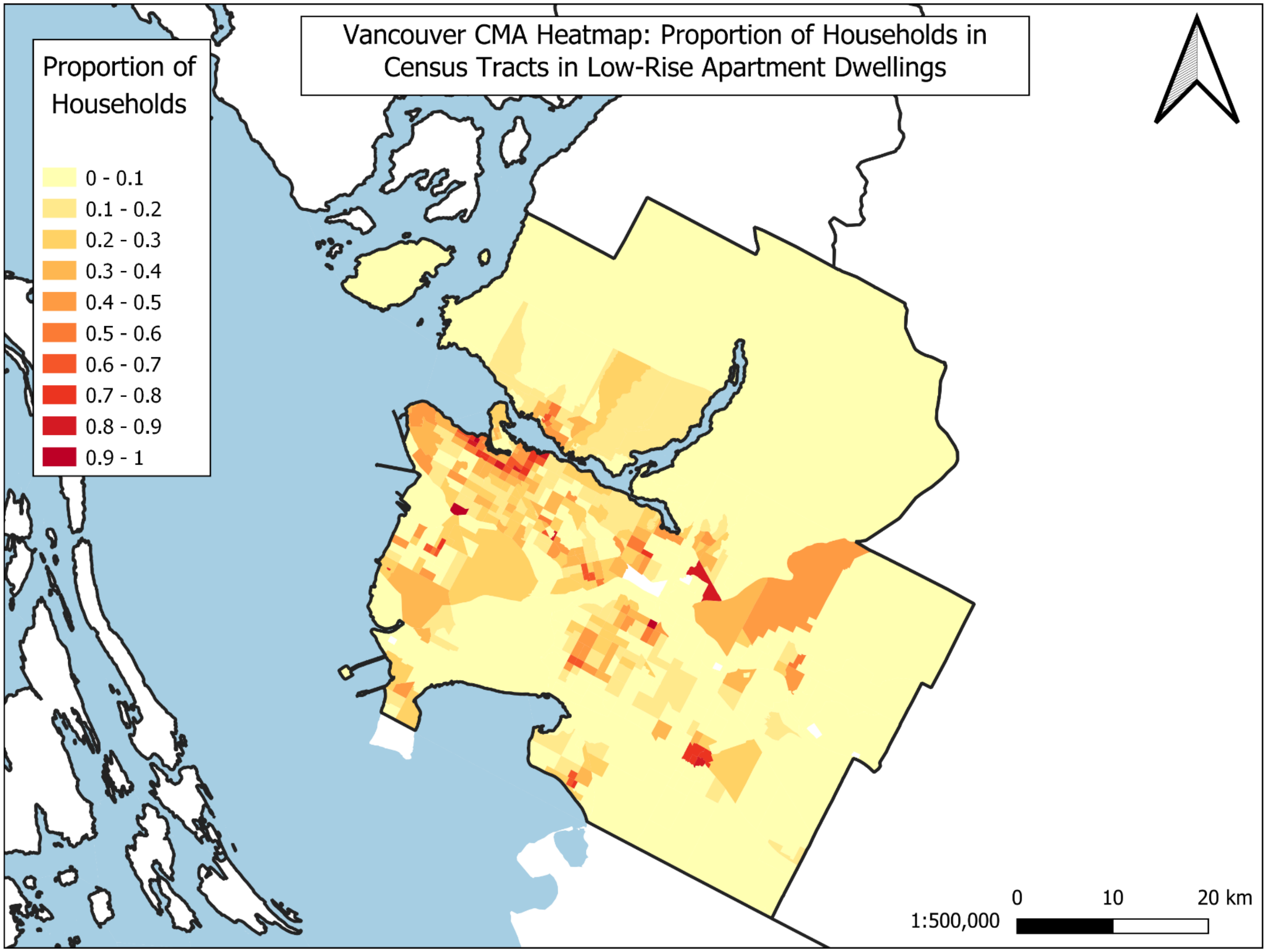

Figure 36 - Vancouver CMA heatmap for low-rise apartment dwellings

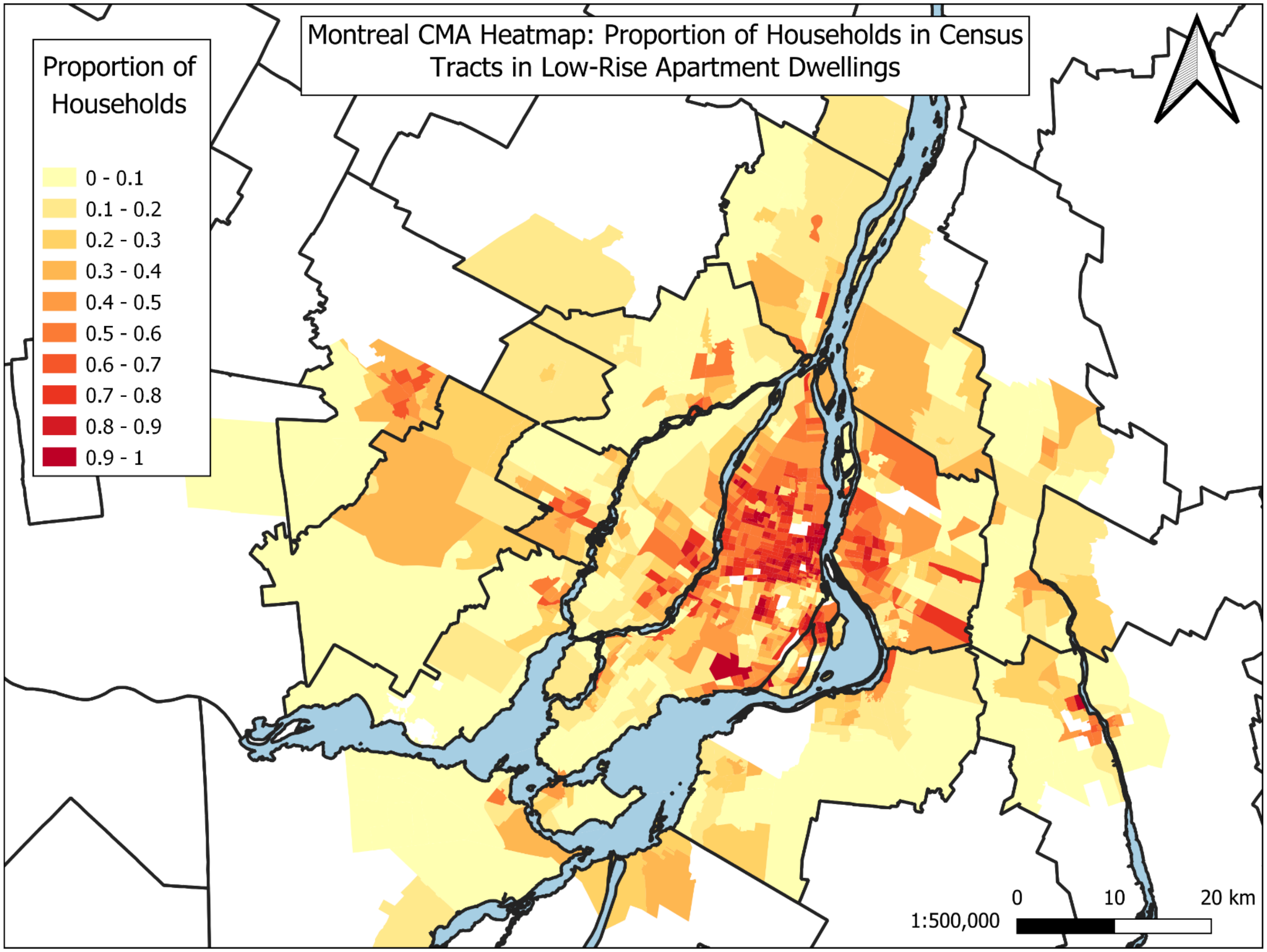

Figure 37 - Montreal CMA heatmap for low-rise apartment dwellings

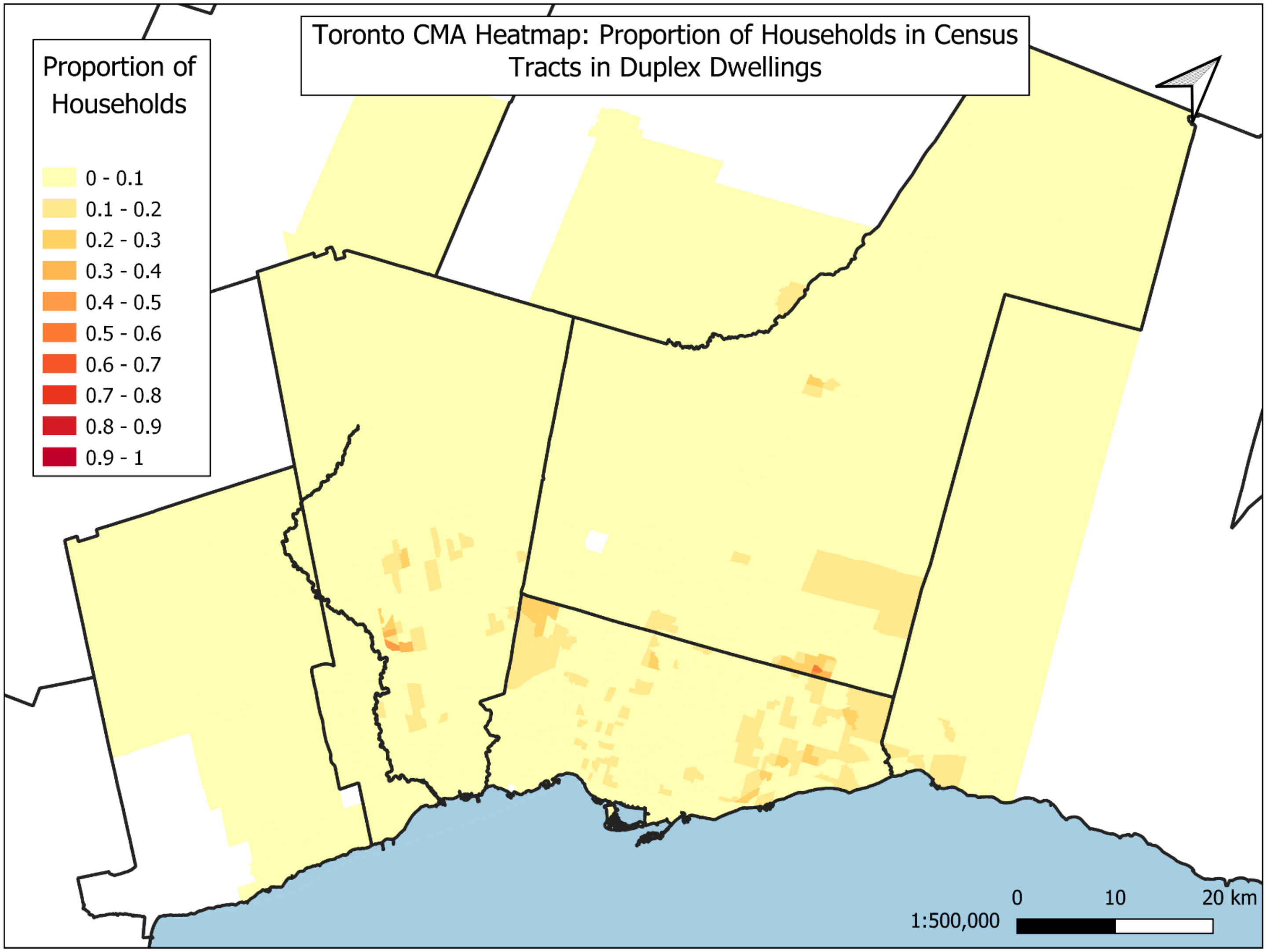

Figure 38 - Toronto CMA heatmap for duplex dwellings

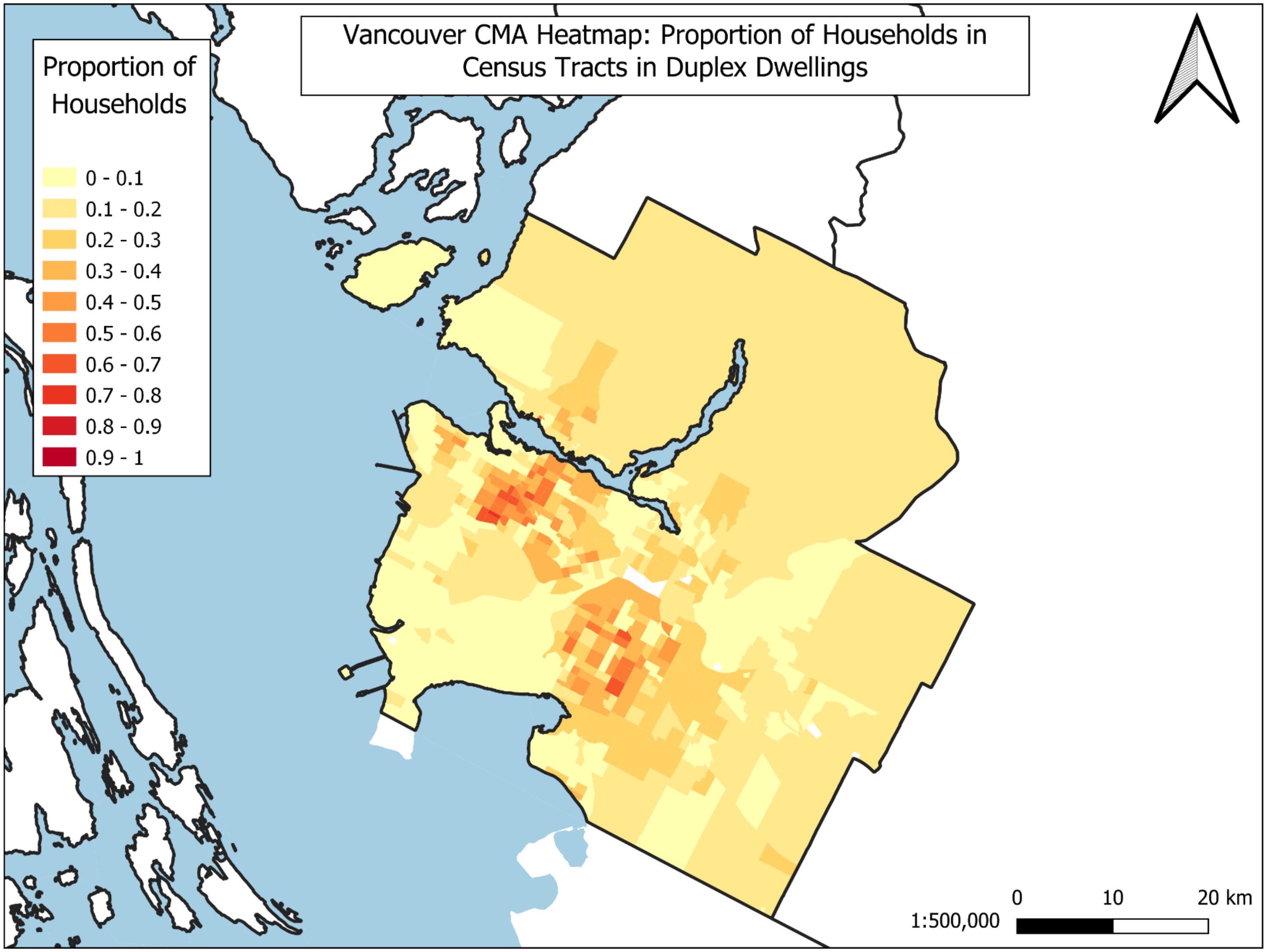

Figure 39 – Vancouver CMA heatmap for duplex dwellings

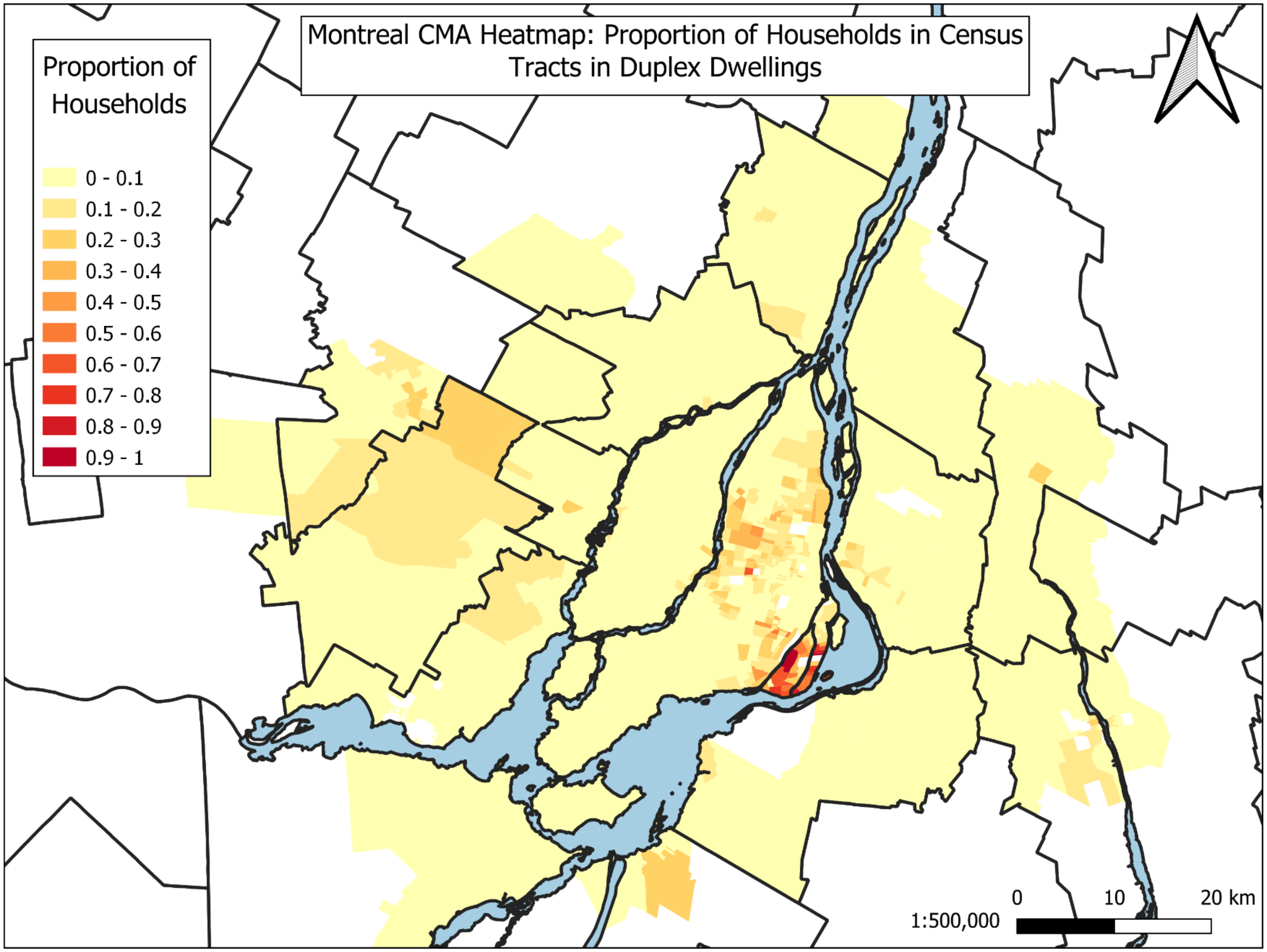

Figure 40 - Montreal CMA heatmap for duplex dwellings

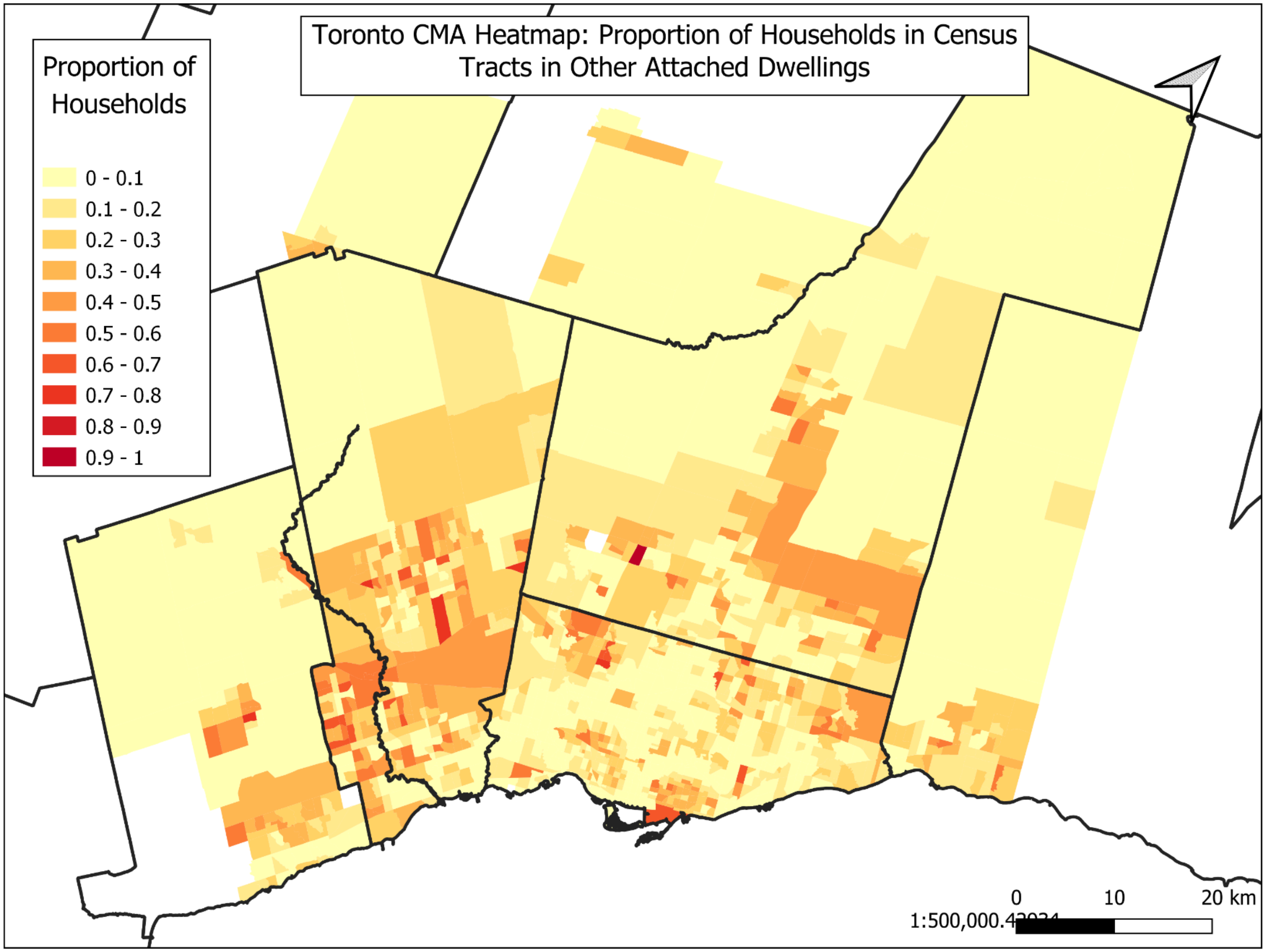

Figure 41 - Toronto CMA heatmap for other attached dwellings

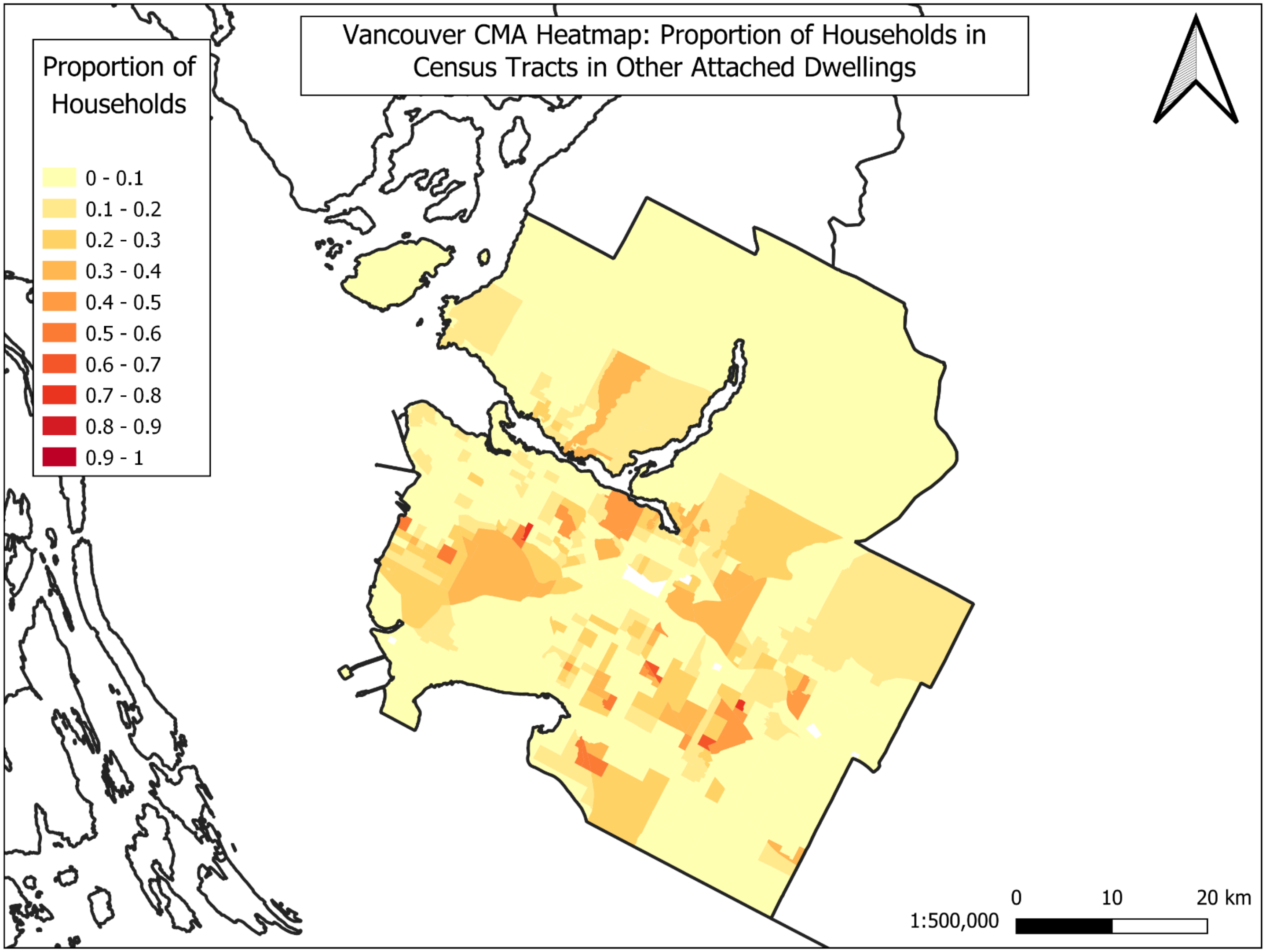

Figure 42 - Vancouver CMA heatmap for other attached dwellings

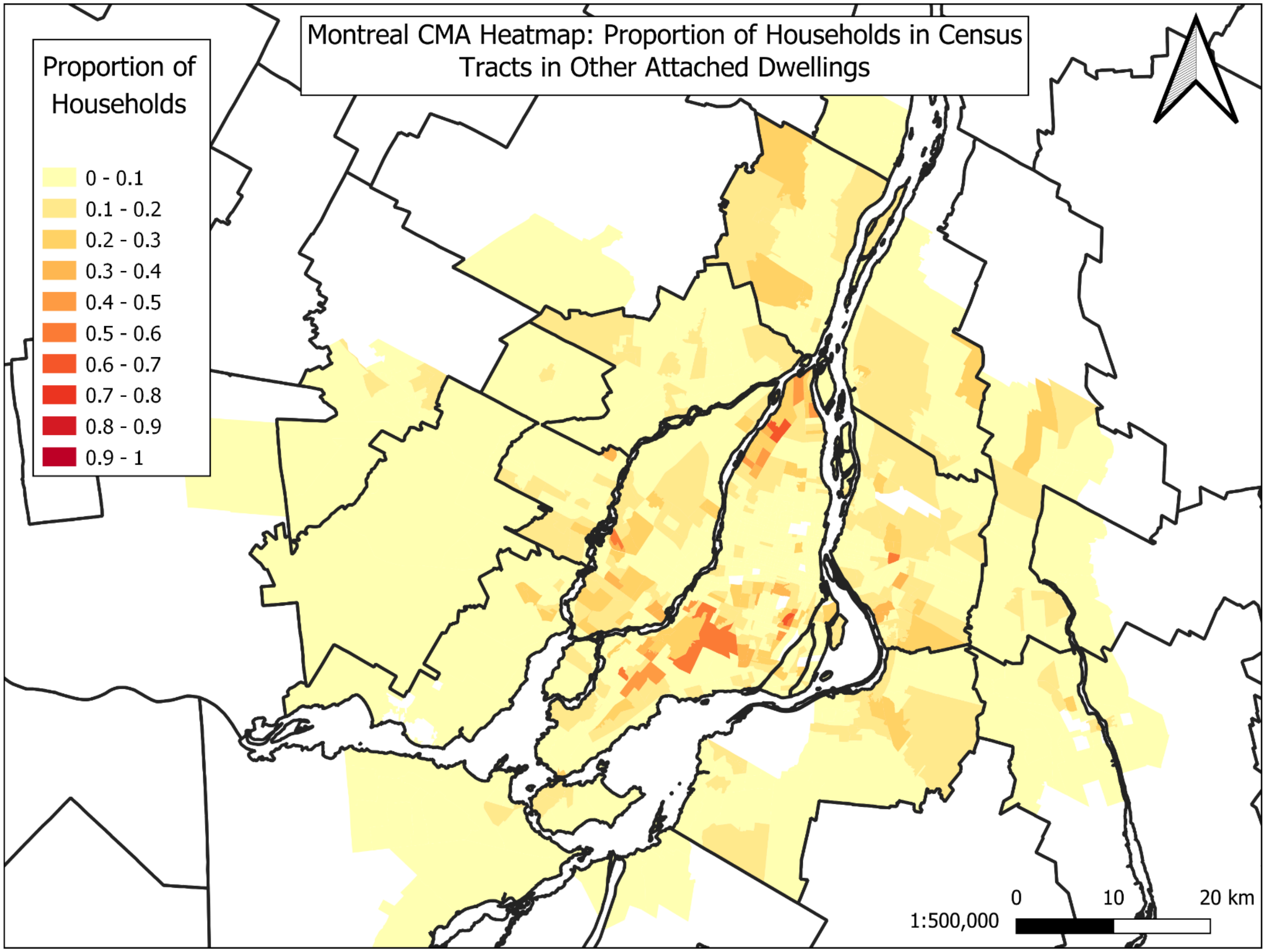

Figure 43 - Montreal CMA heatmap for other attached dwellings

Table 8 - Area of residential zones in Toronto

Zone	**Code**	**Area (km^2)**	**% of Toronto Land Area**	**% of Residential Land Area**
Single Detached	RD	200.54	31.6%	56.5%
Semi Detached	RS	13.54	2.1%	3.8%
Townhouse	RT	9.46	1.5%	2.7%
Multiple Dwelling	RM	34.80	5.5%	9.8%
Residential	R	42.26	6.7%	11.9%
All Residential Non-Apartment Zones		**300.59**	**47.4%**	**84.7%**
Single Dwellings		**265.80**	**41.9%**	**74.9%**
Residential Apartment	RA	20.97	3.3%	5.9%
Commercial Residential Employment	CRE	1.28	0.2%	0.4%
Commercial Residential	CR	31.96	5.0%	9.0%
Mixed Use Residential		**33.24**	**5.2%**	**9.4%**
Total Residential		**354.80**	**55.9%**	**100.0%**
Total Toronto Land Area		**634.43**	**100.0%**	