

GEOB 270 Final Project - Group 30
Rental Housing Affordability of Four Canadian Universities

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We would like to acknowledge that this paper was written on the unceded, ancestral, traditional, and occupied territories of the hən̓q̓əmin̓əm̓ speaking xʷməθkʷəjəm (Musqueam) people.

1. Abstract

This project compares the rental housing affordability of four Canadian universities: The University of British Columbia (UBC) (Vancouver, BC), University of Alberta (UA) (Edmonton, AB), McGill University (MGL) (Montréal, QC) and York University (YU) (Toronto, ON). A Geographic Information System (GIS) was used to visualize rental housing affordability surrounding each university, defined in this project as the ratio between median income and median cost of rented dwellings. Specific attention is given to areas within 8 km of each university, as research shows many students prefer to live within this commuting distance. To compare the four cities, maps were created to display the concentration of university-aged students (defined broadly as ages 15-29) in each city compared to the wider population. The spatial distribution of university-aged students and rental housing affordability in those areas was compared. Average annual tuition costs at each university were also compared, as an additional factor influencing overall university affordability. This analysis shows that McGill is the most affordable university to attend in terms of rental housing affordability, followed by the University of Alberta, and York University, with the University of British Columbia being the least affordable.

2. Description of Project

How affordable is rental housing for Canadian university students? With tuition, textbooks, rent, and groceries, going to university is a significant financial burden for many young people. This project assesses the affordability of rental housing surrounding four different Canadian universities, focusing specifically on off-campus rental housing affordability and tuition cost. Using Canadian Census data, we visualize affordability by mapping the ratio between median income and the median cost of rental housing surrounding each university. A map is provided for each city that maps the concentration of university-aged students (15-29), to indicate where most students tend to live, and how that relates to housing affordability in those areas. Tuition costs at each university are also used to support and provide additional context for this GIS analysis, as rent and tuition are the two major expenditures for students (Macleans, 2018).

For each city, we mapped Census data on median income, median monthly rent, and age onto the city boundaries (Vancouver, Edmonton, Toronto and Montréal). After identifying each university with a point, we examined areas located within an 8 km radius. To add another factor to our assessment of affordability, we compared average tuition costs at each university.

These four universities selected for analysis for the following factors:

- Similar scale of student population (See Appendix A)
- At least one central campus, as opposed to smaller campus units distributed throughout a large metropolitan area
- Similar proximity to suburban and urban areas, which would influence the types of rental housing students would have access to

3. Methodology

As the methodology for each city was the same, we will show as an example the steps taken to assess the rental housing affordability and age distribution of the 8 km buffer surrounding UBC in Vancouver. We repeated this process for Edmonton, Toronto, and Montréal. A flowchart illustrating the steps taken to complete each map can be found in Appendix B.

A. Acquire

We acquired the following data from the 2016 Canadian Census¹ database:

¹ The 2016 CT data includes Canadian citizens, permanent residents, and non-permanent residents (including those holding a study permit) (Statistics Canada, 2016).

- Cartographic Boundary Files of Canadian Census Tracts² (CTs)
- Median monthly shelter costs for rented dwellings (by city)
- Age data: 15-19, 20-24, 25-29³ (by city)
- Age data: CT distribution of all persons aged 15 or above (by city)
- Median Income (by city)

B. Parse and Filter: Provide structure and order, and filter for data of interest

Preparing the City Map - UBC

- 1. Extract out Vancouver from Canada CT boundary files:**
 - a. Query for CTs with a CMANAME of Vancouver in CanadaCT attribute table
 - b. Export this selection into a new feature class titled **VancouverCT_2016**
- 2. Change projection** to NAD 1983 UTM Zone 10 for Vancouver
- 3. Create point feature** to place university on the map
 - a. Obtain coordinates of university (we used a single point, obtained from Google Maps),
 - i. UBC: 49.2606° N, 123.2460° W
 - b. Start editing session and select 'create new feature'
 - c. Press F6 or ensure "Point" is selected in the Construction Tools window
 - d. Right-click and select "Absolute X, Y", type coordinates and enter
 - e. Rename point to UBC
 - f. Save and close edit session
- 4. Create 8 km buffer⁴** in the VancouverCT_2016 layer
 - a. Analysis Tools > Proximity > Buffer
 - b. Set distance to 8 kilometres and Dissolve Type = All
- 5. Clip** the buffer to the project area if it extends off the project area⁵

Affordability Map - UBC

- 1. Join** median cost of rented dwellings to VancouverCT_2016
 - a. Right click VancouverCT_2016 layer > Joins and Relates > Join
 - b. Field: CTUID
 - c. Table: vansheltcost
 - d. Field in table: COLO
 - e. Keep only matching records
- 2. Repeat join** for median income with vanincome as the table.
- 3. Create new field**
 - a. Open attribute table of VancouverCT_2016 > Table Options > Add Field
 - b. Rename field "rent_div_income"

²CTs were used as they should be as homogeneous as possible in terms of socioeconomic characteristics (ex. economic status and social living conditions) and are updated every 5 years to account for changing physical and socioeconomic landscapes (Statistics Canada, 2016)

³The age range of 15-29 was used as over 75% of college and university students are in the age range of 17 to 27 years old (Statistics Canada, 2006). Since age data in the Census is separated by 4 years, we used the 15-19, 20-24, and 25-29 data sets. In the context of this analysis, we assumed the 15-29 age range were all students.

⁴We selected an 8 km analysis range based on a report on 5,016 student and faculty commutes at McGill, which found that the majority of individuals live within 7-11 km of campus, which corresponds with the optimal distance at which individuals choose to use active transport or public transit (Jacques et al., 2011). The 8 km range also includes the majority of neighbourhoods suggested by UBC for off-campus living. These locations were based on factors such as living costs and transit routes.

⁵This was only done for Vancouver, where the buffer extends into the ocean. Other 3 cities did not require clipping as they were fully in-land, or in the case of Montréal, extended over a small river with two traffic bridges). To remove the irrelevant land areas included inside buffer (ex. West Vancouver): Select by location > Selection tab > Interactive selection can be used for removal from buffer.

- c. In attribute table, enter the following query to exclude null median income values and null rental cost values:
 - i. "vansheltcost" <> 0 AND "vanincome" <> 0
- d. Use Field Calculator to calculate vansheltcost/(vanincome/12)*100. Income is divided by 12 because cost of rented dwellings is provided per month, whereas median income is annual.

4. Classification

- a. Use Symbology > Quantities > Classification Method: Manual Breaks to visualize the Value "rent_div_income" in equal percentage categories

Affordability Map for 8 Km Buffer Zone Around UBC

1. Select by Location:

- a. Select features from
- b. Target layer: VancouverCT_2016
- c. Source layer: University of British Columbia
- d. Spatial selection method for target layer feature: are within a distance of the source layer feature
- e. Apply a search distance: 8 km

2. Create layer from selected features

3. Clip selected layer to buffer layer

4. Classification

- a. Use Symbology > Quantities > Classification Method: Manual Breaks to visualize the Value "rent_div_income"

5. Open Attribute Table and query for "rent_div_income" <= 0.30 to highlight fields where 30% or less income is spent on rent each month

Age Map for 8 Km Buffer Zone Around UBC

1. Join the 3 columns from downloaded age data table to VancouverCT_2016

2. Add new field

3. Field Calculator

- a. Sum values from COL1 + COL2 + COL3 of age data to obtain one column that contains ages 15-29
- b. Rename new column to university_age

4. Remove 3 individual columns of student age data

5. Join column of *all* age data to VancouverCT_2016

- a. Rename column to all_age

6. Add new field

7. Field Calculator

- a. Divide university_age by all_age to obtain percent student concentration in each CT
- b. Rename column to percent_university_age

8. Classification

- a. Use Symbology > Quantities > Classification Method: Manual Breaks to visualize the value "percent_university_age"

C. Mine: Apply Statistics, Classification and GIS Analysis to discern patterns

Affordability map for 8 km buffer zone around the university - UBC

1. **Open Attribute Table and query for “rent_div_income” ≤ 0.30** to highlight fields where 30% or less income is spent on rent each month⁶:
 - a. 0/36 fields comprising an area of 0 m²
 - b. Total project area within 8 km buffer zone = 55,827,703.16 m²
 - a. 0% of the CTs within the buffer zone fall under the 30% income to shelter costs ratio
 - b. 0% of the total area within the buffer zone falls under the 30% income to shelter costs ratio
 - c. Mean rent within 8 km buffer = Mean: \$1466.22 per month
 - d. Mean income within 8 km buffer = \$39,814.53 per year, per month = \$3317.88
 - e. Highest percent of income spent on rental housing in 8 km buffer = 133.85%
 - f. Lowest percent of income spent on rental housing = 31.07%
 - g. 4 of the CTs with over 60% of income spent on rent were within the 8 km buffer of UBC

Age Maps - UBC

1. **Open Attribute Table and query for “percent_university_age” ≥ 0.30** (Other universities used 0.40. At UBC, the highest was <40%) to highlight fields where >30% of the CT population is aged 15-29.
 - a. 6/468 in Vancouver have >30% concentration of people 15-29 years old.
 - b. Within the 8 km buffer zone, 3 out of 37 have CT populations in which $\geq 30\%$ (ranging from 32.09-39.96%) of the population is between 15-29 years old. The highest percentage was 39.96%. No fields are null or have unavailable data.
 - c. Area of age 15-29 years old 30% or more in entire Vancouver = 16,107,046.116 m²
 - d. Within buffer: 5,430,096.124 + 9,042,831.221 = 14,472,927.345 m²
 - e. 14,472,927.345 / 16,107,046.116 = 0.8985*100 = 89.85% (majority) of the student population is within 4km of UBC.

D. Represent: Choose visual model maps, charts, graphs

- We created four maps for each of the four universities to visualize affordability:
- An affordability map that shows the ratio between median income and cost of rented dwellings
- An affordability map that focuses specifically on the areas within the 8 km buffer zone surrounding the university
- An age map showing the concentration of university-aged students (aged 15-29) surrounding the university
- An age map showing the concentration of university-aged students (aged 15-29) within the 8 km buffer zone

Affordability maps

Following best principles of map design and dimensions of colour, we selected a colour ramp where the midrange value⁷ (30%) was in a neutral yellow.

1. Use Symbology > Quantities > Manual Breaks to visualize the Value “rent_div_income”
 - a. Manual Breaks for percent of median income spent on rental housing per month:
 - i. 0-15%
 - ii. 15-30%
 - iii. 30-45%

⁶Housing is typically considered affordable if a household spends less than 30% of its income on rent (Canadian Rental Housing Index, n.d.).

⁷We selected the midrange to be 30-45% because housing is typically considered affordable if a household spends less than 30% of its income on rent (Canadian Rental Housing Index, n.d.).

- iv. 45-60%
- v. 60%+

Age maps

We selected our midrange⁸ to be 20-30% with a neutral colour following best principles of map design.

1. Use Symbology > Quantities > Manual Breaks to visualize the Value “percent_university_age”
 - a. Manual Breaks for percentage of CT population between 15 and 29 years old
 - i. 0-10%
 - ii. 10-20%
 - iii. 20-30%
 - iv. 30-40%
 - v. 40%+

E. Table of Datasets

Corresponding datasets for income, rental costs, and age were downloaded from the CHASS Data Centre for each of the four cities, except for one unique dataset in Montréal used to locate McGill, which is listed below.

Table 2. Datasets used in the process of creating rental housing affordability and age maps.

Layer/Datafile Name	Source	Uses	Entity/Data Model	Attributes	Modifications
“lct_000b16a_e” Renamed: CanadaCT_2016	UBC Abacus Dataverse Network: Cartographic Boundary Files	To get the city boundaries and tracts for symbology	Shapefile	CMANAME = City Name	Clip: Queried for Project Areas (CMANAME = desired city) to clip
“Median monthly shelter costs for rented dwellings, 2015” Renamed: vansheltcost (adjusted for other cities)	CHASS Data Centre (2016)	Rental housing costs	Tabular	COL0 as the identifier of CTs that match the CTUID, COL1 as the dollar cost	Used in the affordability calculation as dividend, 0 values were excluded
“Median total income in 2015 among recipients” Renamed: vanincome (adjusted for other cities)	CHASS Data Centre (2016)	Median income for households	Tabular	COL0 as the identifier of CTs that match the CTUID COL1 as the dollar cost (annual)	Used in the affordability calculation as divisor, 0 values excluded
“Total - Age groups and average age of the population - 100% data” Renamed: all_ages (adjusted for other cities)	CHASS Data Centre (2016)	Age of the population used in the student concentration calculation	Tabular	COL0 as the identifier of CTs that match the CTUID, COL1 as number of population that is 15 years old and over	Placed as divisor in student percentage calculation

⁸ We selected the midrange to be 20-30% because 25.3% percent of Canada’s population aged 15-34, a similar age range to the 15-29 range we’ve selected for our analysis Statistics Canada, “A Portrait of Canadian Youth” 2018,)

“15 to 19 years ; Both sexes (v14) 20 to 24 years ; Both sexes (v15) 25 to 29 years ; Both sexes (v16)” Renamed: university_age	CHASS Data Centre (2016)	University ages, used to identify the student concentration	Tabular	COL0 as the identifier of CTs that match the CTUID COL1 = 15-19, COL2 = 20-24 etc COL3 = 25-29	Summed the 3 columns into a new field for student percentage calculation
“Lhy_000h16a_e” Renamed: Ocean	UBC Abacus Dataverse Network: Cartographic Boundary Files	For improving map aesthetics and used to clip unnecessary buffer area in the ocean	Shapefile		Used as feature to clip buffer on ocean
“EqUniversitaire” Renamed: McGill_University	Portail Données Ouvertes - Ville de Montréal (2017)	University locations in Montréal	Shapefile	“NOM” as the identifier of universities in Montréal	Selected “Université McGill - Campus du centre-ville” to indicate the university location

5. Discussion and Results

See Appendix C and D for calculations and data derived from the attribute tables.

The University of British Columbia - Vancouver, BC

There are 448 CTs within Vancouver, representing 2,976,522,802.93 m² (20 CTs were excluded for having null or zero values). The mean monthly cost for rented dwellings is \$1190.72 and the mean monthly income is \$2804.70. The 8 km buffer represents 36 CTs and an area of 47,214,305.86 m² (1 CT was excluded for having null or zero values).

1. Affordability Map (Appendix E and F)

Within the 8 km buffer, 0 CTs were found to spend 30% or less of income on rental costs each month. This indicates there are no affordable areas within the buffer zone. The mean monthly rental cost within the buffer is \$1556.36 and the mean monthly income is \$3308.24.

2. Age Map (Appendix G and H)

Within the 8 km buffer, 3 (8.10%) CTs have populations in which 30% or more of the population is 15-29 years old, with a peak at 39.96% in one CT. The majority (89.95%) of the university-aged students are within 4km of the school. 6 out of 448 in Metro Vancouver has 30% or more of 15-29 years old. Within the 8 km buffer zone, 3 out of 37 have census tract populations in which 30% or more (i.e. 32.09-39.96%) of the population is between 15-29 years old. The highest percentage was 39.96%. No fields were null or unavailable data.

McGill University - Montréal, QC

There are 921 CTs within Montréal, representing 4,535,306,372.93 m² (49 CTs were excluded for having null or zero values). The mean monthly cost for rented dwellings is \$831.36 and the mean monthly income is

\$2786.03. The 8 km buffer represents 365 CTs⁹ and an area of 161,630,633.90 m² (12 CTs were excluded for having null or zero values).

1. Affordability Map (Appendix I and J)

Within the 8 km buffer, 129 CTs (35.34%) were found to spend 30% or less of income on rental costs each month, representing an area of 65,753,685.80 m². This indicates that 40.68% of the total area within the buffer zone is considered affordable. The mean monthly rental cost within the buffer is \$846.52 and the mean monthly income is \$2587.51. All 9 of the CTs that had a shelter to income ratio over 60% were located within the 8 km buffer - these areas of decreased affordability were within close proximity to the university campus (2 km distance).

2. Age Map (Appendix K and L)

Within the 8 km buffer zone, 13 CTs (3.56%) have populations in which 40% or more of the population is between 15-29 years old, with a peak of 67.74% in one CT. These 13 tracts are the only CTs within the entire city that have a value over 40% - the majority (11 out of 13) of which are within 2 km of the university. 30% or more of the population is between 15-29 years old in 35 CTs (9.86%).

Overall, 40.68% of the total area (35.34% of the CTs) within the buffer zone has a shelter to income ratio equal to or less than 30%, making McGill the most affordable option in terms of rental housing. This is particularly important for students and is reflected in the spatial distribution of the age map, given that the majority of CTs with student-aged populations are within 2 km of the university. Compared to Vancouver, which was deemed to have the least affordable housing, Montréal's monthly rental costs were \$634.86 less while monthly income was \$531.85 less.

University of Alberta - Edmonton, AB

There are 246 CTs within Edmonton, representing 9,572,427,457.03 m² (19 CTs were excluded for having null or zero values). The mean monthly cost for rented dwellings is \$1368.54 and the mean monthly income is \$3647.59. The 8 km buffer represents 114 CTs and an area of 165,345,109.04 m² (12 CTs were excluded for having null or zero values).

1. Affordability Map (Appendix M and N)

Within the 8 km buffer, 12 CTs (10.53%) were found to spend 30% or less of income on rental costs each month, representing 26,170,700.649 m². This indicates that 15.83% of the total area within the buffer is considered affordable. The mean monthly rental cost within the buffer is \$1144.18 and the mean monthly income is \$3441.65.

2. Age Map (Appendix O and P)

Within the 8 km buffer zone, 4 CTs (3.36%) have populations in which 40% or more of the population is 15-29 years old, with a peak percentage of 56.74%. These 4 CTs are the only ones within the entire city that have a value over 40%, concentrated approximately within 5 km of UA.

York University - Toronto, ON

There are 1088 CTs within Toronto, representing 6,343,082,852.87m² (29 CTs were excluded for having null or zero values). The 8 km buffer represents 122 CTs and an area of 161,630,633.90 m² (3 CTs were excluded for having null or zero values).

⁹CTs within the 8 km buffer that were across the St. Lawrence River from the McGill University campus were included as there are two bridges that would provide access to the campus (Victoria Bridge and Champlain Bridge).

1. Affordability Map (Appendix Q and R)

Within the 8 km buffer, 8 CTs were found to spend 30% or less of income on rental costs each month, representing an area of 11,646,153.19m². This indicates that only 6.56% of the total area within the buffer zone is considered affordable. The mean monthly rental cost within the buffer is \$1251.27 and the mean monthly income is \$2354.29.

2. Age Map (Appendix S and T)

Within the 8 km buffer zone, 0 CTs have populations in which 40% or more of the population is between 15-29 years old, and only 4 out of 122 CTs have a concentration of 30% or more. In the buffer zone, 20.7% of the population is university-aged, which is only slightly higher than the concentration for all of Toronto (20.31%). Unlike other cities studied, the highest concentration of university-aged students (49.48%) is found in a CT in downtown Toronto outside the 8 km buffer.

University Tuition

In addition to our GIS analysis, we compared annual tuition to see if it would be a significant factor in university affordability. Appendix U shows a breakdown of annual tuition costs for a humanities undergraduate degree. McGill University shows significant variability \$2328-\$7228 even within a humanities degree. Using the average (\$4778), McGill seems to have both the lowest tuition and most affordable rental housing. McGill's average international tuition (\$16875.5) is also significantly lower than all other universities. UA's tuition (\$5321) is lower than both UBC and YU, making it the second most affordable for tuition, both domestic and international.

Conclusions

Our results are supported by findings from Census Mapper and the Rental Housing Index, which indicated that Vancouver is the least affordable and Montréal is the most affordable in terms of rental housing within the 8 km buffer. The percentage of affordable CTs within the buffer demonstrated that Vancouver is the least affordable at 0%, followed by Toronto (6.56%), Edmonton (10.53%), and Montréal (35.34%). However, even though McGill is comparatively more affordable, 64.55% of the CTs within the buffer were still deemed unaffordable, presenting a challenge for students hoping to rent within a reasonable commuting distance.

Our results reemphasize Steele's (2010) conclusions on Canadian rental housing affordability. Affordability is a major problem in most Canadian cities and is exacerbated in urban areas where economies are driven by commodity price booms, such as in Vancouver and Toronto, which drives rents higher and vacancy rates lower. Within these cities, one reason for increasing unaffordability is dramatic population increases, which puts a strain on housing markets (Steel, 2010; Financial Post, 2018). Vancouver is quite different in terms of affordability when compared to other cities in Quebec, Alberta, and Ontario. Unaffordability in Vancouver grew much faster than in other regions when compared to 2006 and 2011 data as the housing market became increasingly detached from local incomes (Census Mapper, n.d.). Along with being the most unaffordable city in our analysis, average tuition at UBC is \$5929.5, higher than both University of Alberta and part of McGill's tuition range.

Tuition at McGill also ranges from \$2328-7228, so students who pay tuition at the higher end of the scale would face greater affordability challenges. International tuition at McGill is significantly lower than other universities, which could affect students with study permits captured in census data. Our analysis showed University of Alberta to be the second most affordable in terms of rental housing, and coupled with its relatively lower tuition (\$5321), it is comparable with McGill in terms of overall affordability.

The Age Maps corresponded to the Affordability Maps for each city. The CTs with primarily student-aged populations (40% or more of the population between 15-29 years old) were often concentrated

around the university points. Overall, the least affordable CTs tended to be directly surrounding the university. These CTs can be explained by the income-to-shelter cost ratio, since student income is typically much lower while rent remains high.

6. Error and Uncertainty

While analyzing the rental housing affordability surrounding each university, sources of error in spatial analysis includes the data collected and the production of the maps. Each time a new dataset is used, new error possibilities are introduced. For example, data may not be collected accurately, meaning it may not match real-world values. This may be a result of human error, technological or equipment areas, or not having access to recent, precise measurements. When creating maps, there are several ways to introduce error, such as formatting errors, including changes in scale and projections.

Although we did not use CTs with 0 or null values, a value of “0” for the mean value of dwelling could be due to area suppression. No census area will truly have “0” as the median value of dwelling if people are living there - the data is unavailable as a result of the census area not meeting the criteria for information to be publicly released. Statistics Canada specifies that the population size for all standard areas or aggregations of standard areas is 40, therefore no characteristics or tabulated data are to be released for areas at and below a population size of 40 (Statistics Canada, 2015). The specified population for 6 character postal codes, geocoded areas, and custom areas built from the block, block-face or LDU levels is 100 - if the population of the area is 100 or less, that data is not to be released (Statistics Canada, 2015). Data is also not collected for private households living in band housing on Indigenous lands (Statistics Canada, 2015).

Our measure of rental housing affordability could be improved by using “running shelter costs” which includes the cost of both rent and utilities. Our analysis used “total median income” data whereas affordability is usually calculated with “before-tax income on rent plus utilities”. Using the median cost of dwellings rather than the average helps avoid some error, as the extremes (higher or lower) in the data set wouldn’t influence the central tendency of the data. This is particularly important for Vancouver, which has some of the highest valued dwellings in Canada.

It would also improve our analysis if we had access to income data that is specific to university students, as the median income data we had access to not only include those aged 15-29 who do not go to university (and may have full time work), but the entire population above the age of 15. This would skew the median monthly income . We did not have access to road and transit data for cities outside of Vancouver. However, if we did, it would have provided a better way of finding where the majority of students preferred to live since ease and time of commute are important factors for students.

7. Further Research and Recommendations

Further Research:

- To more accurately map university affordability, it would be useful to have data on median income that is specific to university students, as many are not working full time jobs and may have other sources of funding (parental contribution, student loans, scholarships).
- Many universities, including UBC, have recently seen increases in food insecurity among students, which is another factor to consider in affordability assessment.
- As census data provides data for the entire population in the city, including students aged 15-29 who do *not* attend university and may be employed full-time, it would be more accurate to conduct an affordability assessment based on data collected by the universities rather than using census data.
- UBC and other universities have a large portion of students commuting daily far beyond the 8 km buffer we selected for our analysis. Further research or data collection on the factors influencing students to live further away would provide valuable insight for universities to understand rental

housing affordability. As commute times are strongly correlated with involvement in extracurriculars or professional development/leadership opportunities, addressing prohibitive housing costs surrounding the university could allow more students to move closer and enhance their student experience.

Recommendations:

- Based on our analysis, it is clear that living within 8 km of university campus is unaffordable for many students, with an income-to-rental-cost ratio of over 30%, especially in Vancouver. Solutions to address rental housing unaffordability could include rent freezes surrounding the university, increasing the availability of affordable on-campus housing, or increasing need-based scholarships and financial aid.
- Universities could also work to alleviate other financial pressures to improve overall affordability. For example, by expanding the availability of affordable food on campus, eliminating expensive required textbooks and homework software subscriptions, and advocating for eliminating unpaid internships in research and other university-affiliated programs.

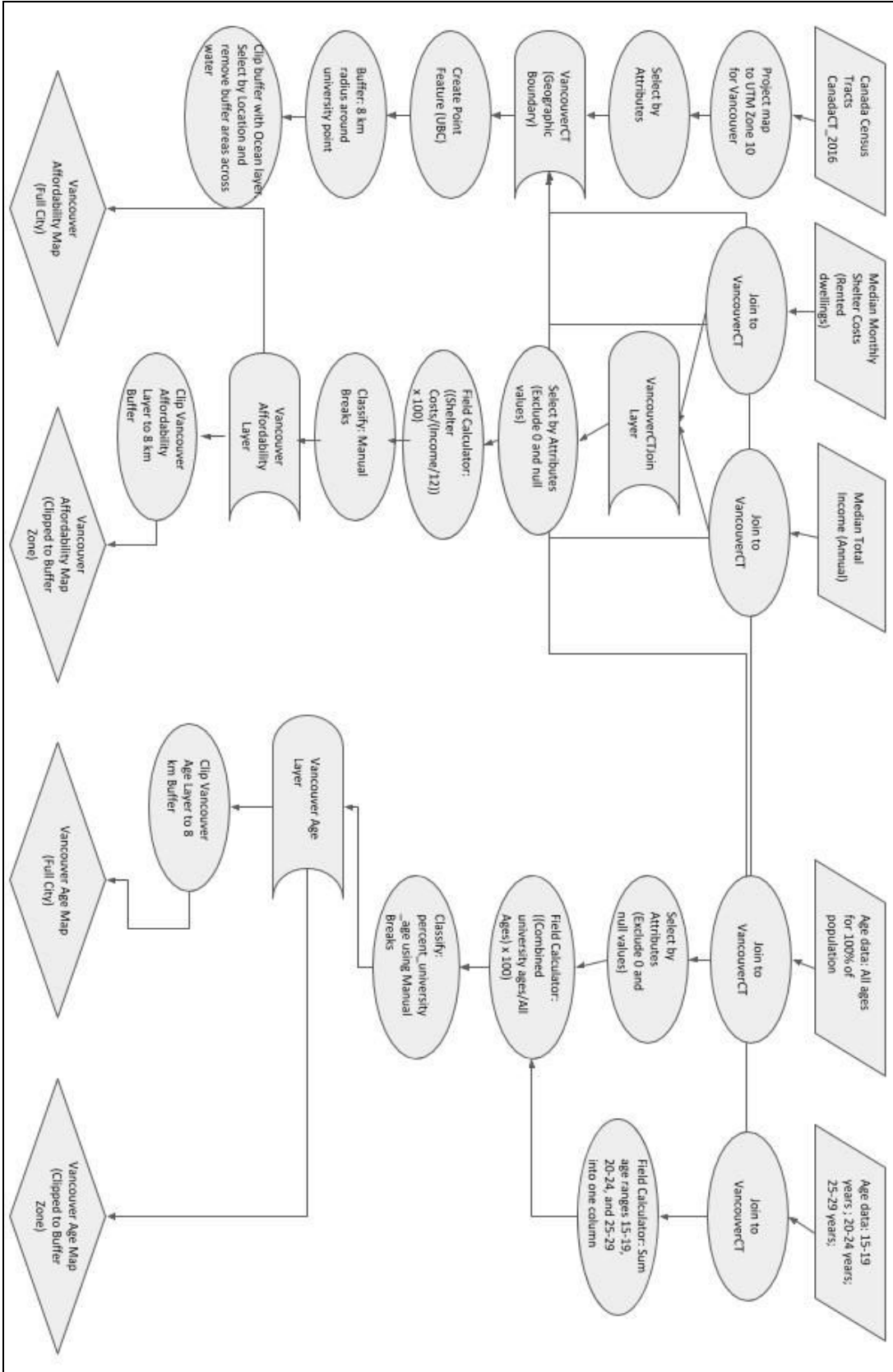
8. Appendices

Appendix A: University Information

Table 1. Location and student population of the four universities chosen for this project.

University	Initials	Location	Student Population	UTM Zone	Coordinates
University of British Columbia	UBC	Vancouver, British Columbia	61,113	UTM Zone 10	49.2606° N, 123.2460° W
McGill University	MG	Montréal , Quebec	40,493	UTM Zone 18	45.5048° N, 73.5772° W
University of Alberta	UA	Edmonton, Alberta	40,000	UTM Zone 12	53.5232° N, 113.5263° W
York University	YU	Toronto, Ontario	53,000	UTM Zone 17	43.7735° N, 79.5019° W

Appendix B: GIS Flowchart



Appendix C: Affordability Map Data

Table 3. Data from the attribute table of each city's housing Affordability Map (excluding CTs with null or 0 values).

City	University	Buffer CT Area (m ²)	CTs	CTs with ≤30% of Income Spent on Rent (Monthly)	Area of CTs (m ²) with ≤30% of Income Spent on Rent (Monthly)	Mean Monthly Rental Cost	Mean Monthly Median Income
Vancouver	University of British Columbia	55,827,703.16	36	0 (0%)	0 (0%)	\$1,556.36	\$3,308.24
Montréal	McGill University	161,630,633.90	365	129 (35.34%)	65,753,685.80 (40.68%)	\$846.52	\$2,587.51
Edmonton	University of Alberta	165,345,109.04	114	12 (10.53%)	26,170,700.65 (15.83%)	\$1,466.22	\$3,317.88
Toronto	York University	173,600,122.38	122	8 (6.56%)	11,646,153.19 (6.70%)	\$1,251.27	\$2,364.29

Appendix D: Age Map Data

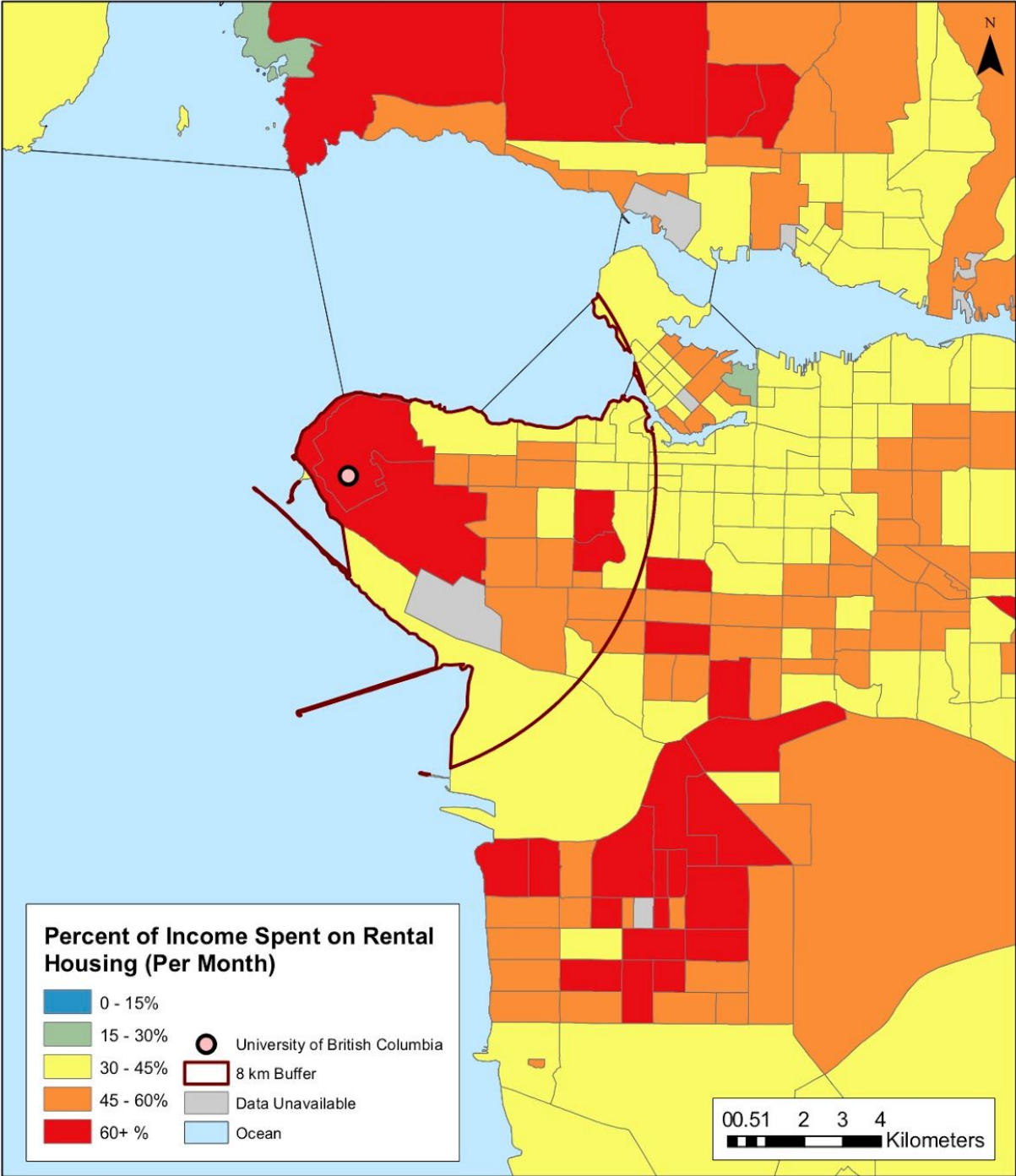
Table 4. Data from the attribute table of each city's Age Map (excluding CTs with null or 0 values).

City	University	Buffer CT Area (m ²)	CTs	CTs with ≥40% of the Population Between 15-29 Years Old.	Area of CTs (m ²) with ≥40% of the Population Between 15-29 Years Old.
Vancouver	University of British Columbia	55,827,703.16	37	3 ¹⁰ (8.10%)	14,472,927.35 (24.92%)
Montréal	McGill University	161,630,633.90	365	13 (3.56%)	4,462,426.16 (2.76%)
Edmonton	University of Alberta	165,345,109.04	119	4 (3.36%)	8,105,850.63 (4.90%)
Toronto	York University	173,600,122.38	122	0 (0%)	0 (0%)

¹⁰ Keep in mind that Vancouver queried for 30% as the highest percent for the age percentage of 15-29 was <40%.

Appendix E: Vancouver Affordability Map

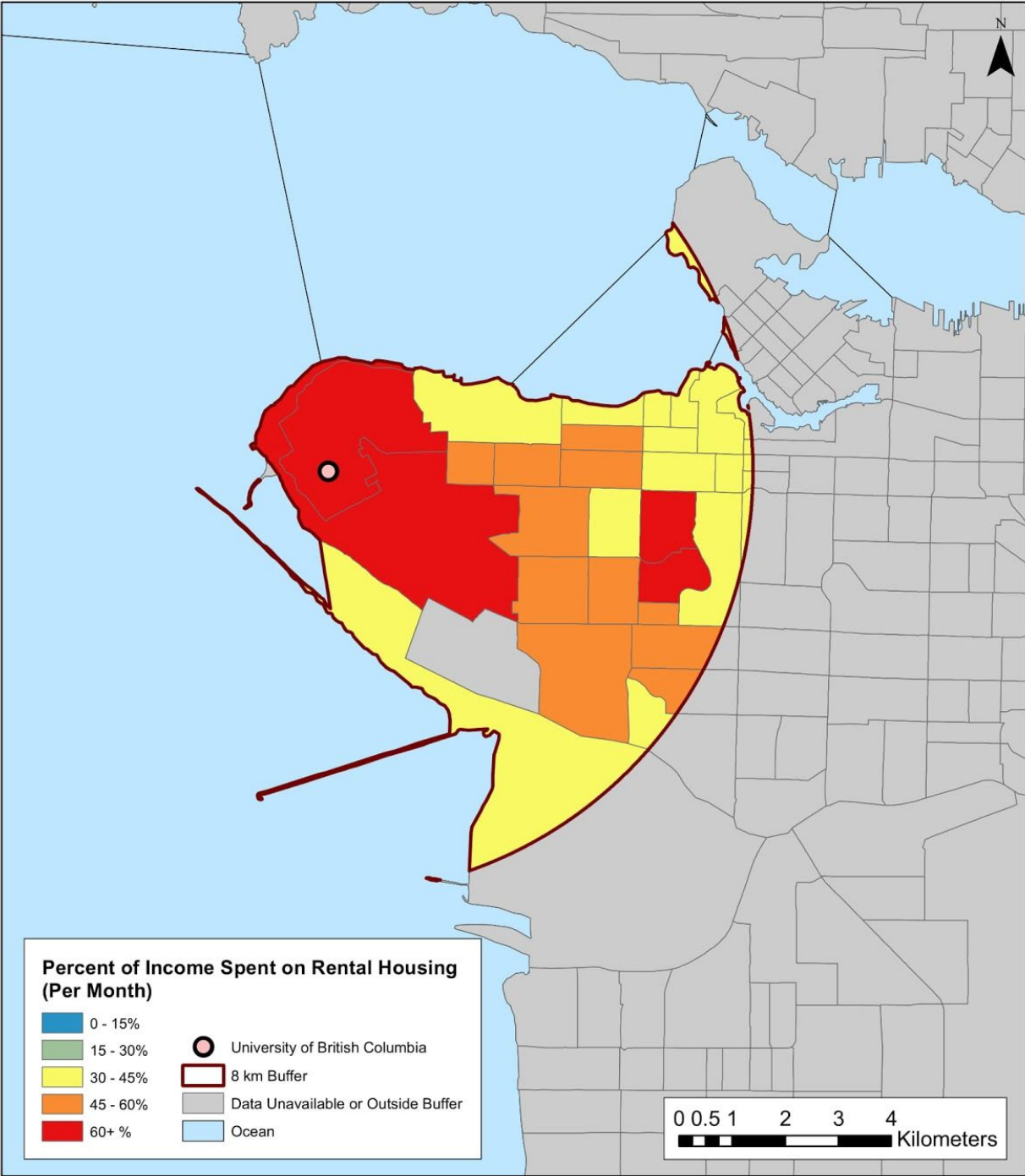
**Percent of Income Spent on Rental Housing (Per Month)
Surrounding University of British Columbia (Vancouver, BC)**



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016 and
 UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_10N
 Classification Method: Manual Breaks

Appendix F: Vancouver Affordability Map - Buffer Zone

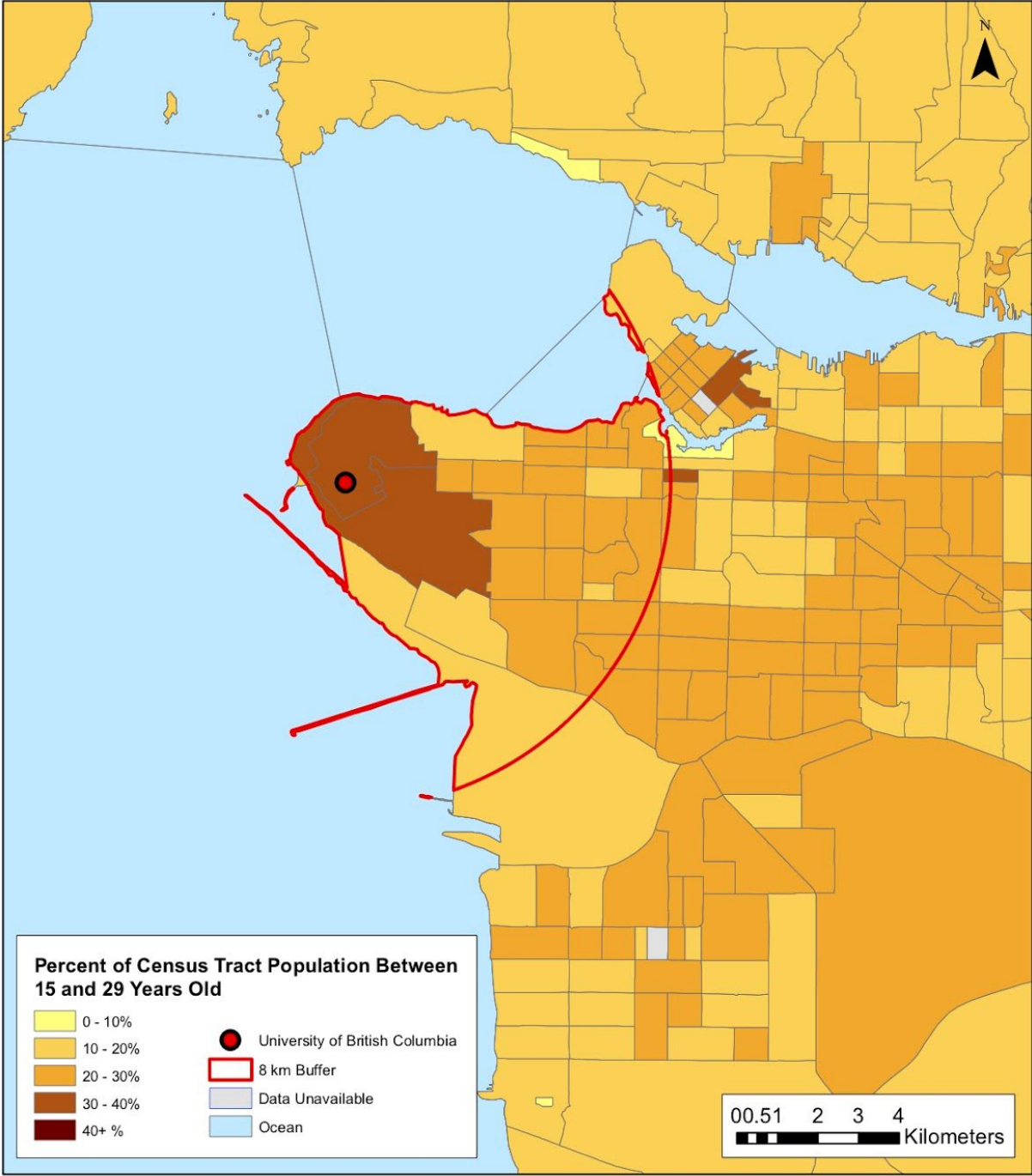
**Percent of Income Spent on Rental Housing (Per Month)
Surrounding University of British Columbia (Vancouver, BC)**



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016 and
 UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_10N
 Classification Method: Manual Breaks

Appendix G: Vancouver Age Map

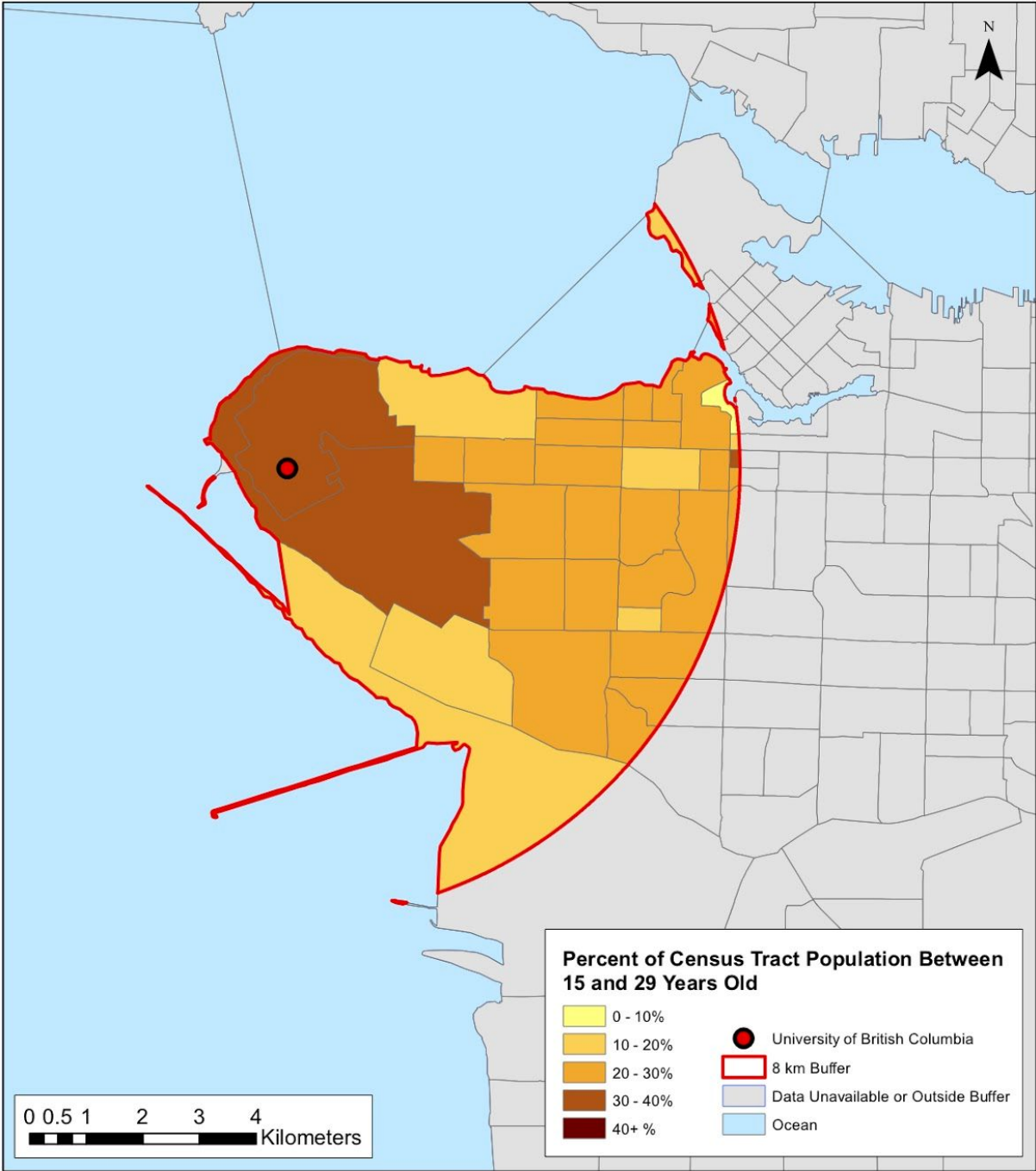
Percent of Census Tract Population Between 15 and 29 Years Old Surrounding University of British Columbia



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016 and
 UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_10N
 Classification Method: Manual Breaks

Appendix H: Vancouver Age Map - Buffer Zone

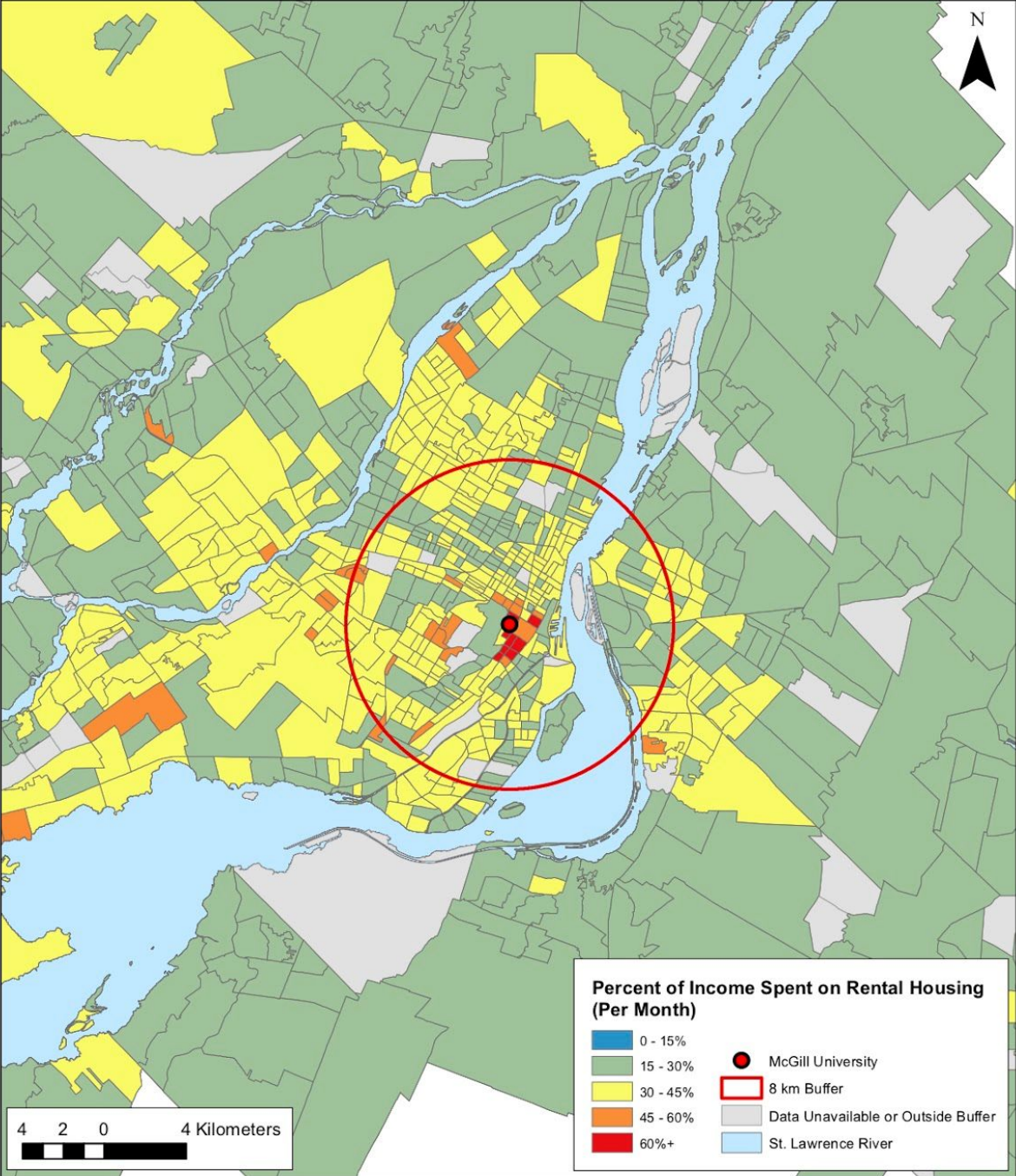
Percent of Census Tract Population Between 15 and 29 Years Old Surrounding University of British Columbia



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016 and UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_10N
 Classification Method: Manual Breaks

Appendix I: Montréal Affordability Map

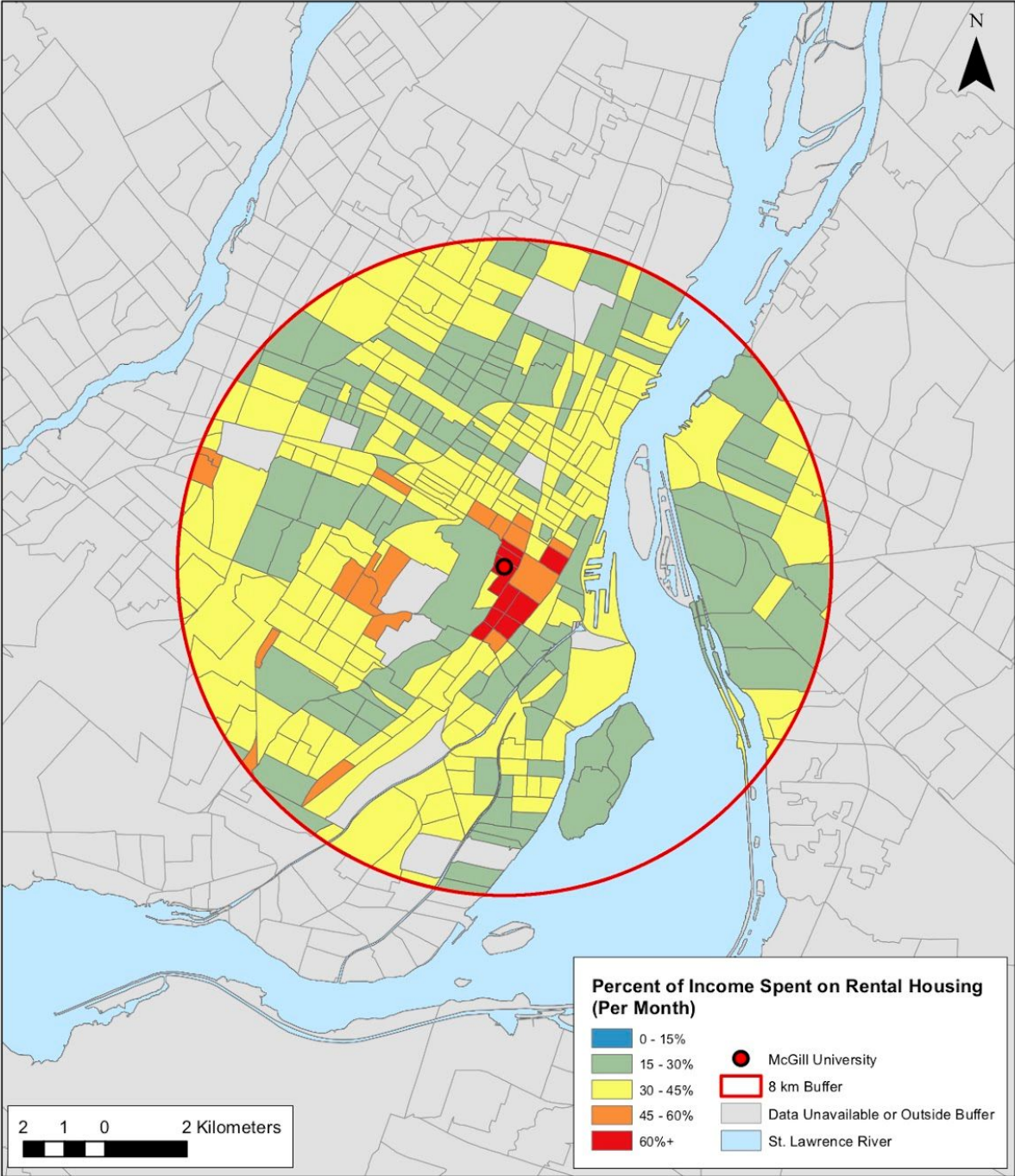
**Percent of Income Spent on Rental Housing (Per Month)
Surrounding McGill University (Montréal, Québec)**



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto (2016),
 UBC Library Abacus Dataverse Network, and Portail Données Ouvertes - Ville de Montréal (2017)
 Coordinate System: NAD_1983_UTM_Zone_18N
 Classification Method: Manual Breaks

Appendix J: Montréal Affordability Map - Buffer Zone

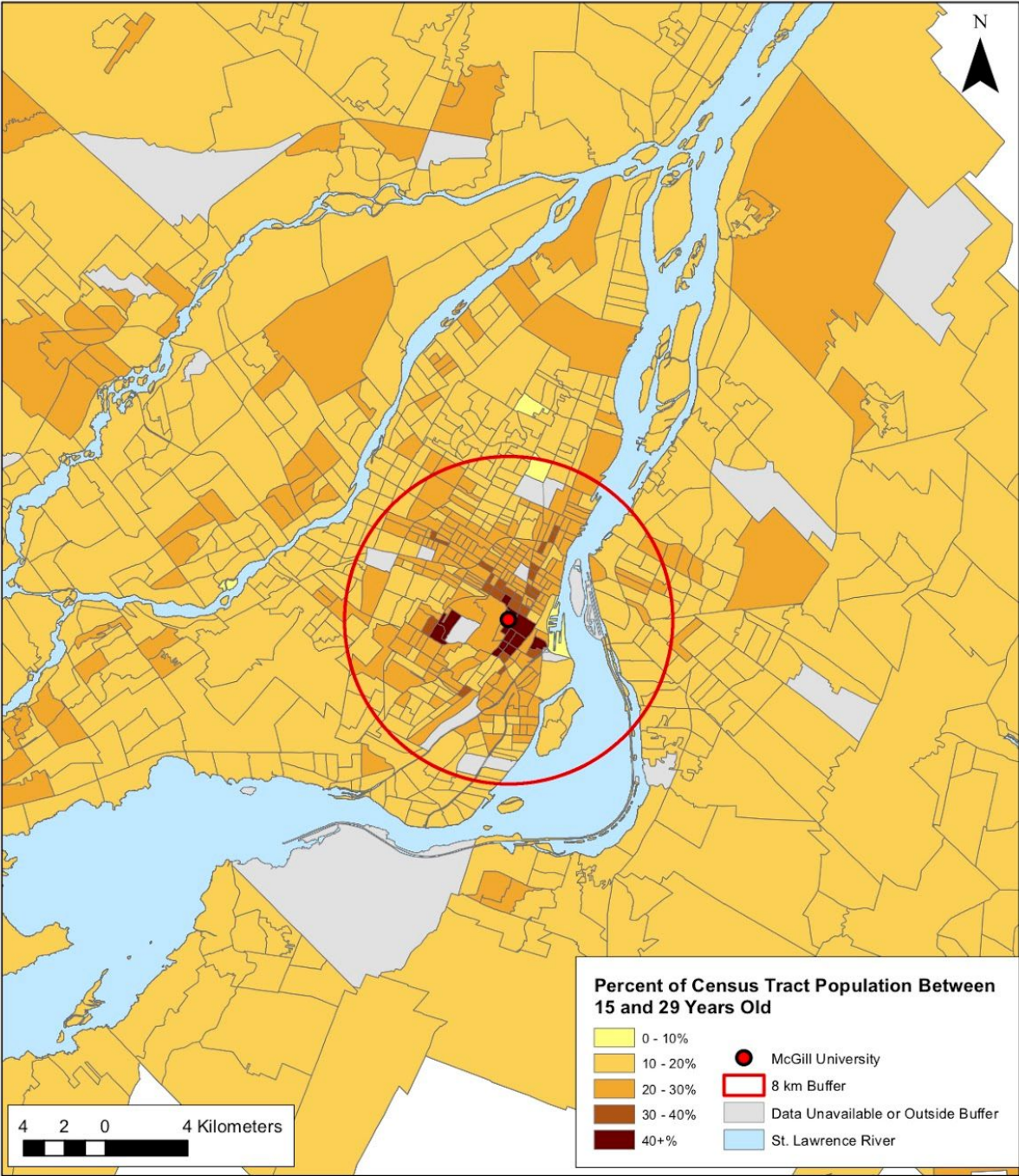
**Percent of Income Spent on Rental Housing (Per Month)
Surrounding McGill University (Montréal, Québec)**



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto (2016),
 UBC Library Abacus Dataverse Network, and Portail Données Ouvertes - Ville de Montréal (2017)
 Coordinate System: NAD_1983_UTM_Zone_18N
 Classification Method: Manual Breaks

Appendix K: Montréal Age Map

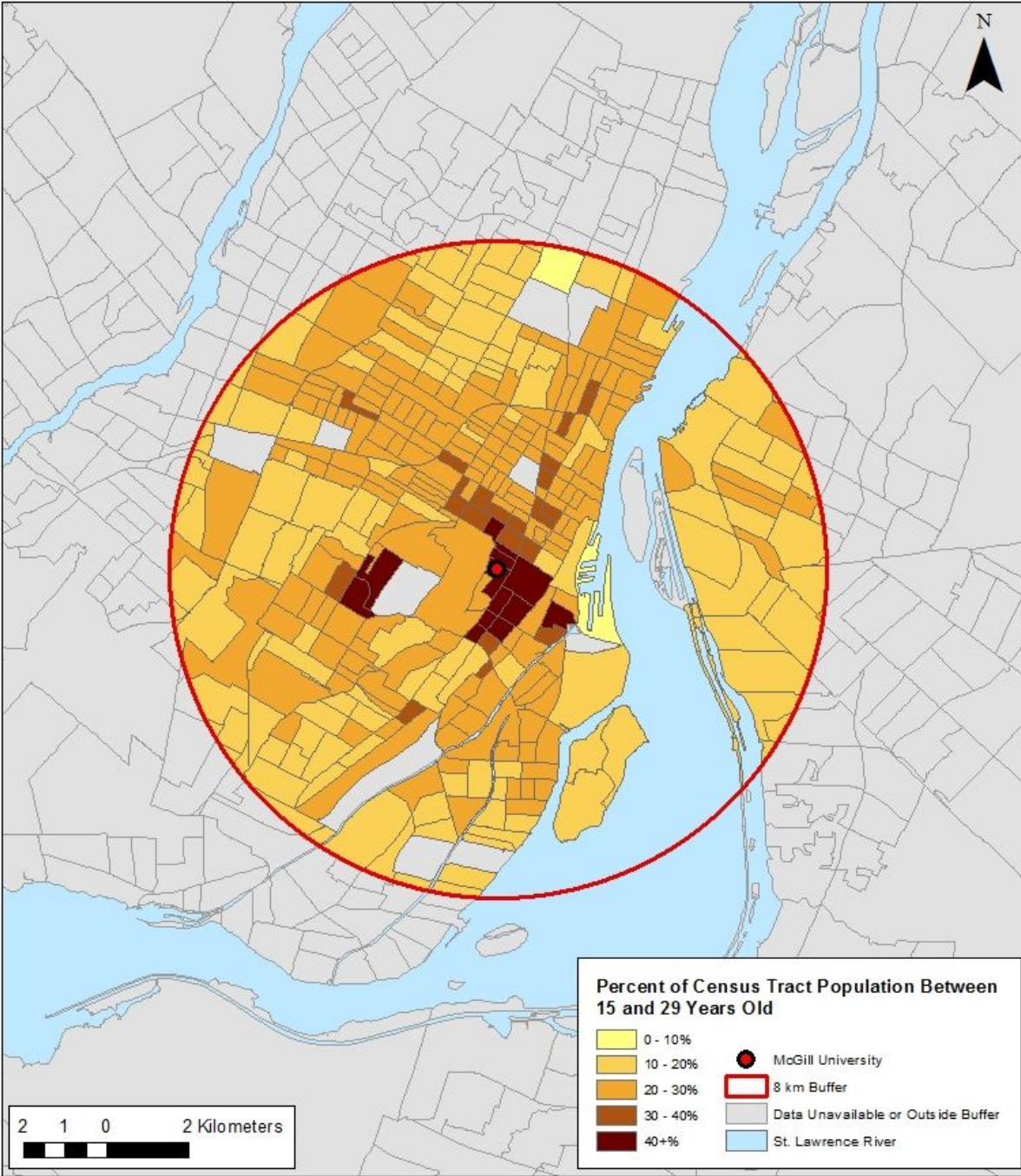
Percent of Census Tract Population Between 15 and 29 Years Old Surrounding McGill University (Montréal, Québec)



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto (2016),
 UBC Library Abacus Dataverse Network, and Portail Données Ouvertes - Ville de Montréal (2017)
 Coordinate System: NAD_1983_UTM_Zone_18N
 Classification Method: Manual Breaks

Appendix L: Montréal Age Map - Buffer Zone

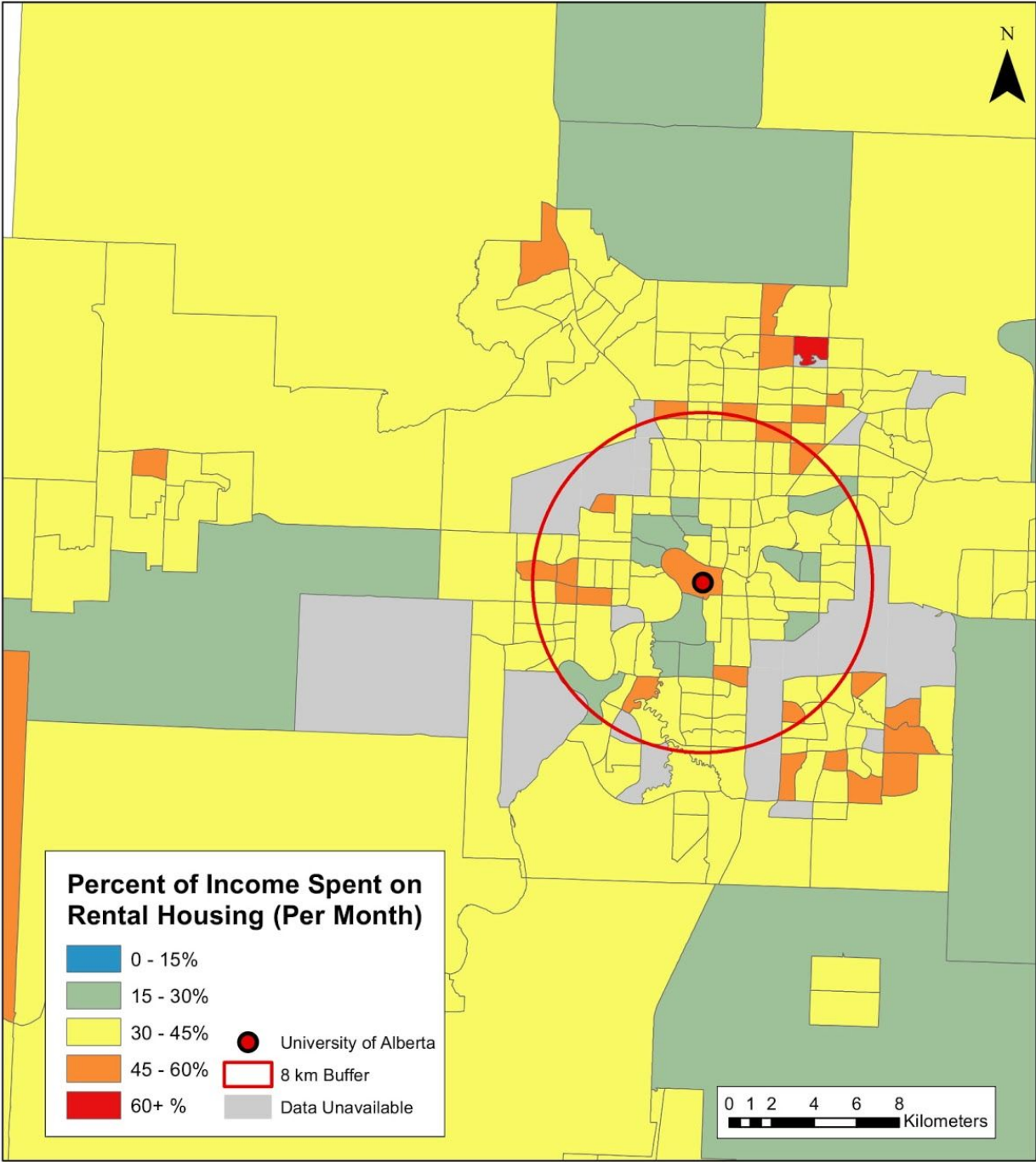
Percent of Census Tract Population Between 15 and 29 Years Old Surrounding McGill University (Montréal, Québec)



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto (2016),
 UBC Library Abacus Dataverse Network, and Portail Données Ouvertes - Ville de Montréal (2017)
 Coordinate System: NAD_1983_UTM_Zone_18N
 Classification Method: Manual Breaks

Appendix M: Edmonton Affordability Map

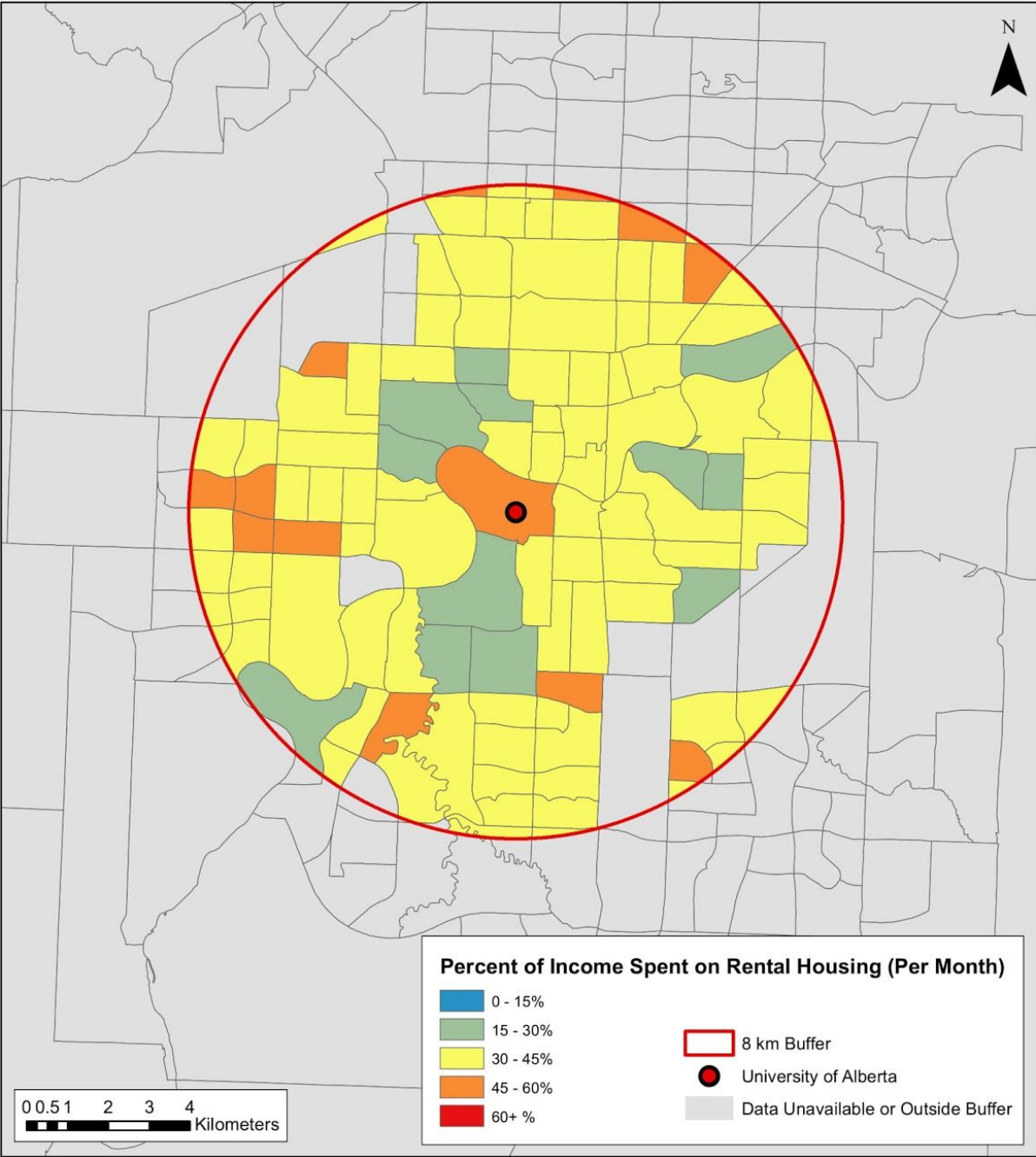
**Percent of Income Spent on Rental Housing (Per Month)
Surrounding University of Alberta (Edmonton, Alberta)**



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016
 and UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_12N
 Classification Method: Manual Breaks

Appendix N: Edmonton Affordability Map - Buffer Zone

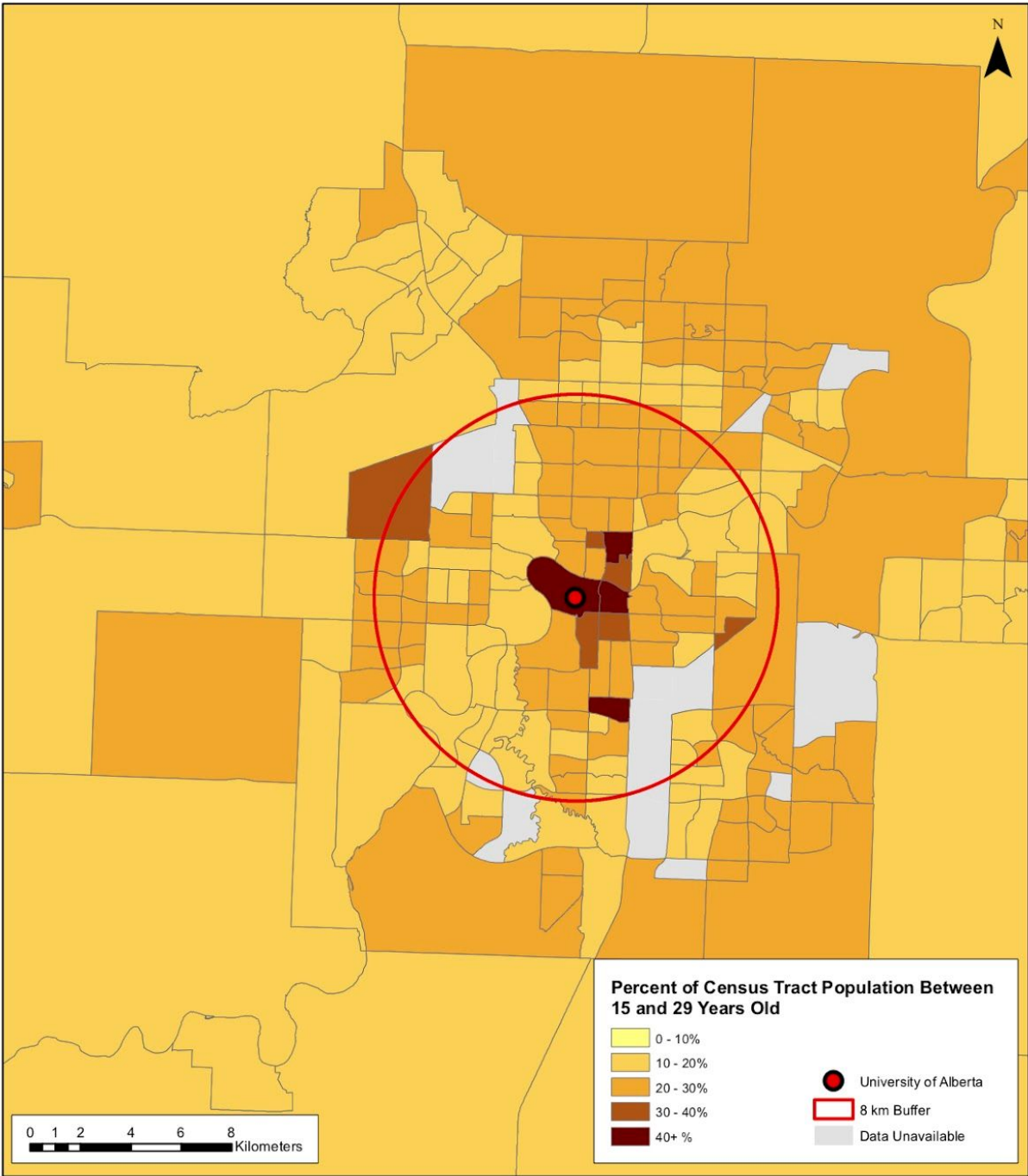
**Percent of Income Spent on Rental Housing (Per Month)
Surrounding University of Alberta (Edmonton, Alberta)**



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016
 Coordinate System: NAD_1983_UTM_Zone_12N
 Classification Method: Manual Breaks

Appendix O: Edmonton Age Map

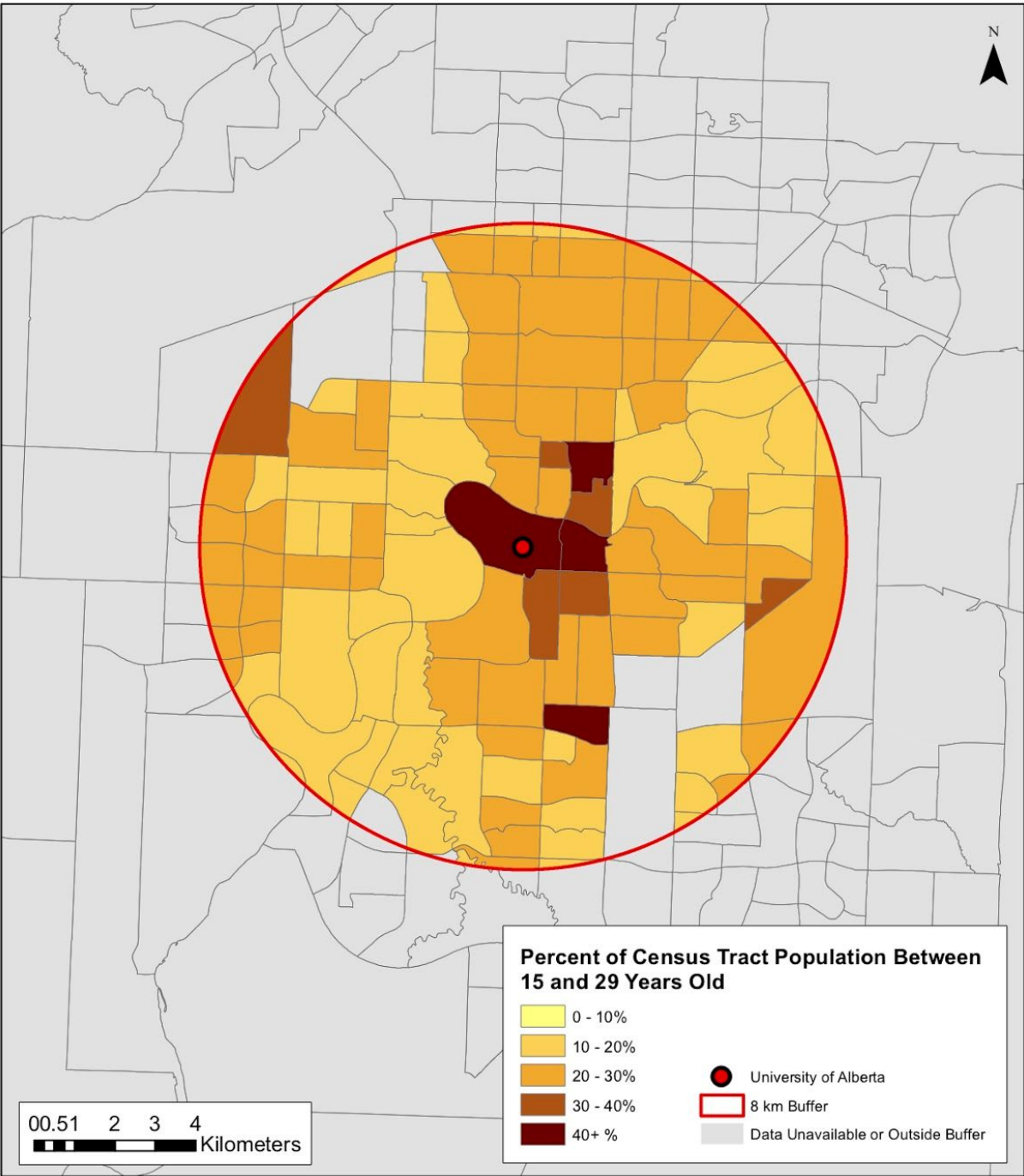
Percent of Census Tract Population Between 15 and 29 Years Old Surrounding University of Alberta (Edmonton, Alberta)



Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016 and
 UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_12N
 Classification Method: Manual Breaks

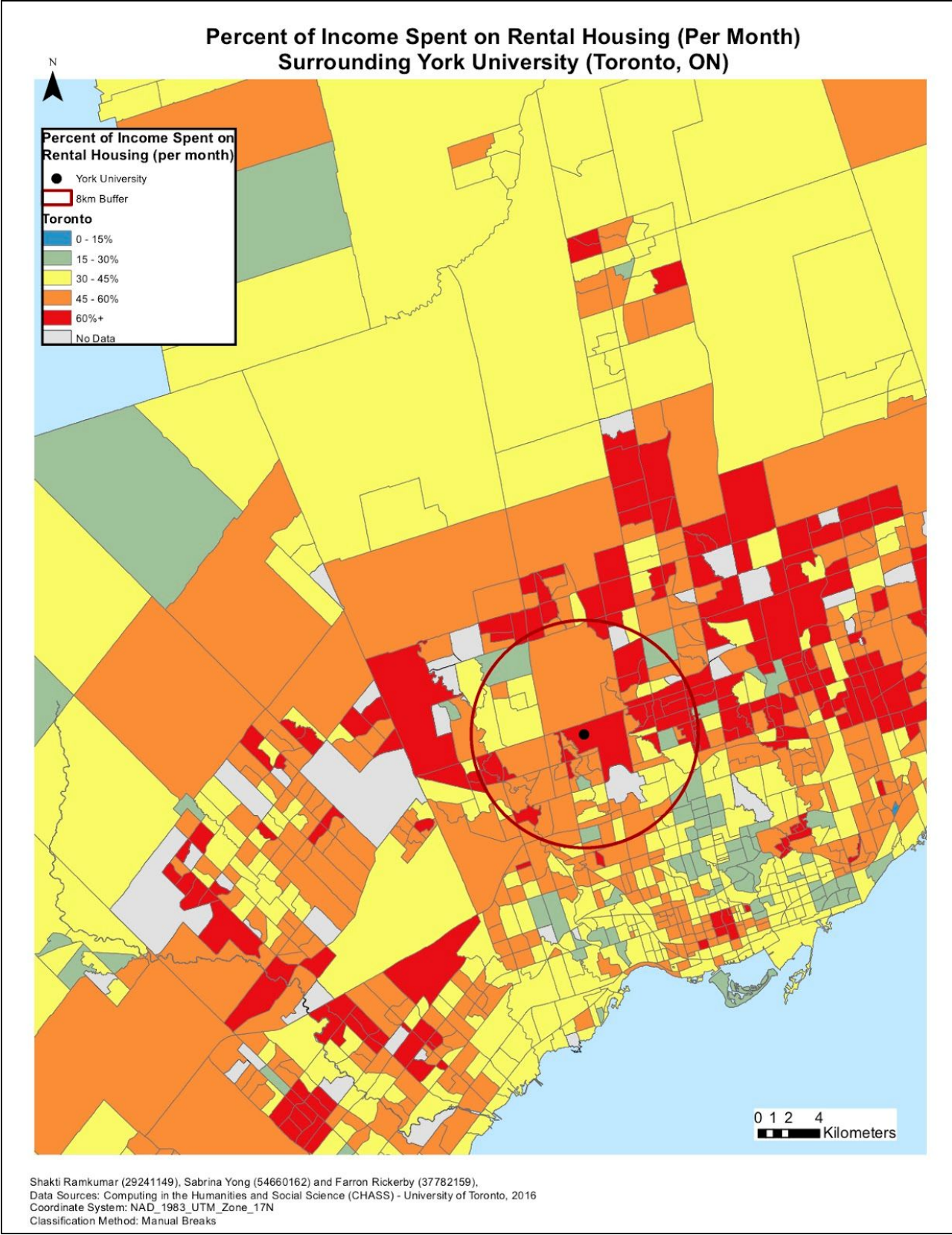
Appendix P: Edmonton Age Map - Buffer Zone

Percent of Census Tract Population Between 15 and 29 Years Old Surrounding University of Alberta (Edmonton, Alberta)

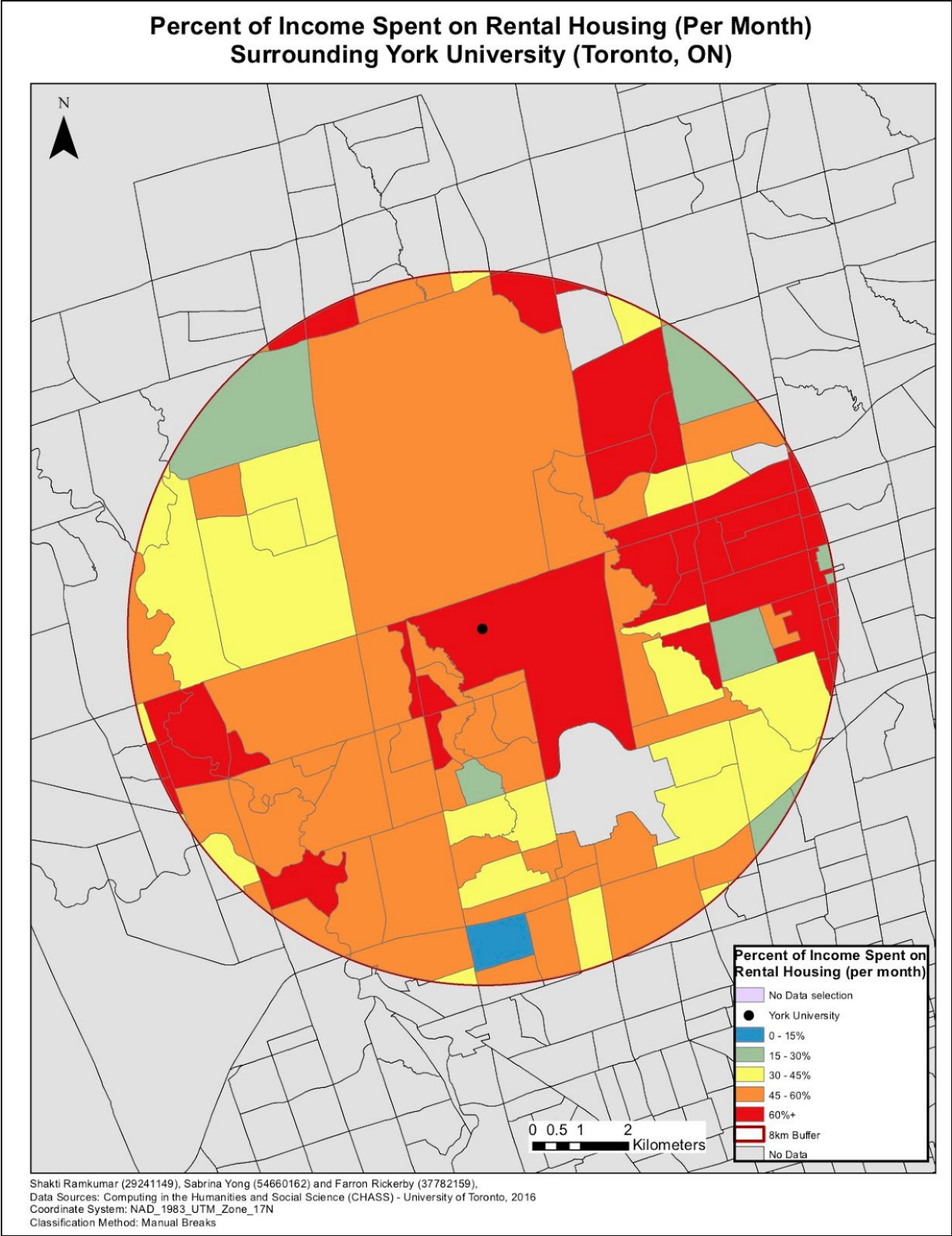


Farron Rickerby (37782159), Shakti Ramkumar (29241149), and Sabrina Yong (54660162)
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016 and UBC Library Abacus Dataverse Network
 Coordinate System: NAD_1983_UTM_Zone_12N
 Classification Method: Manual Breaks

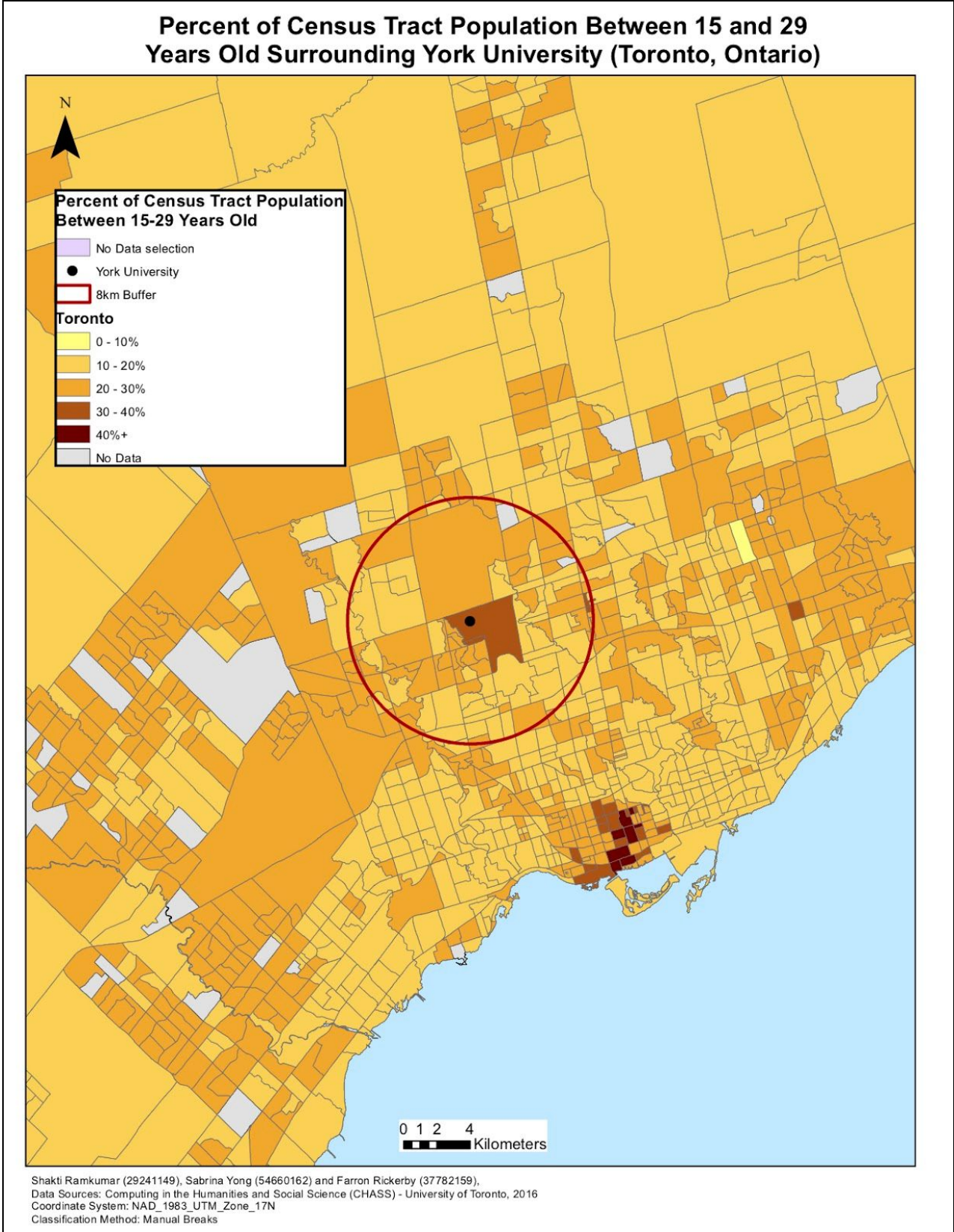
Appendix Q: Toronto Affordability Map



Appendix R: Toronto Affordability Map - Buffer Zone

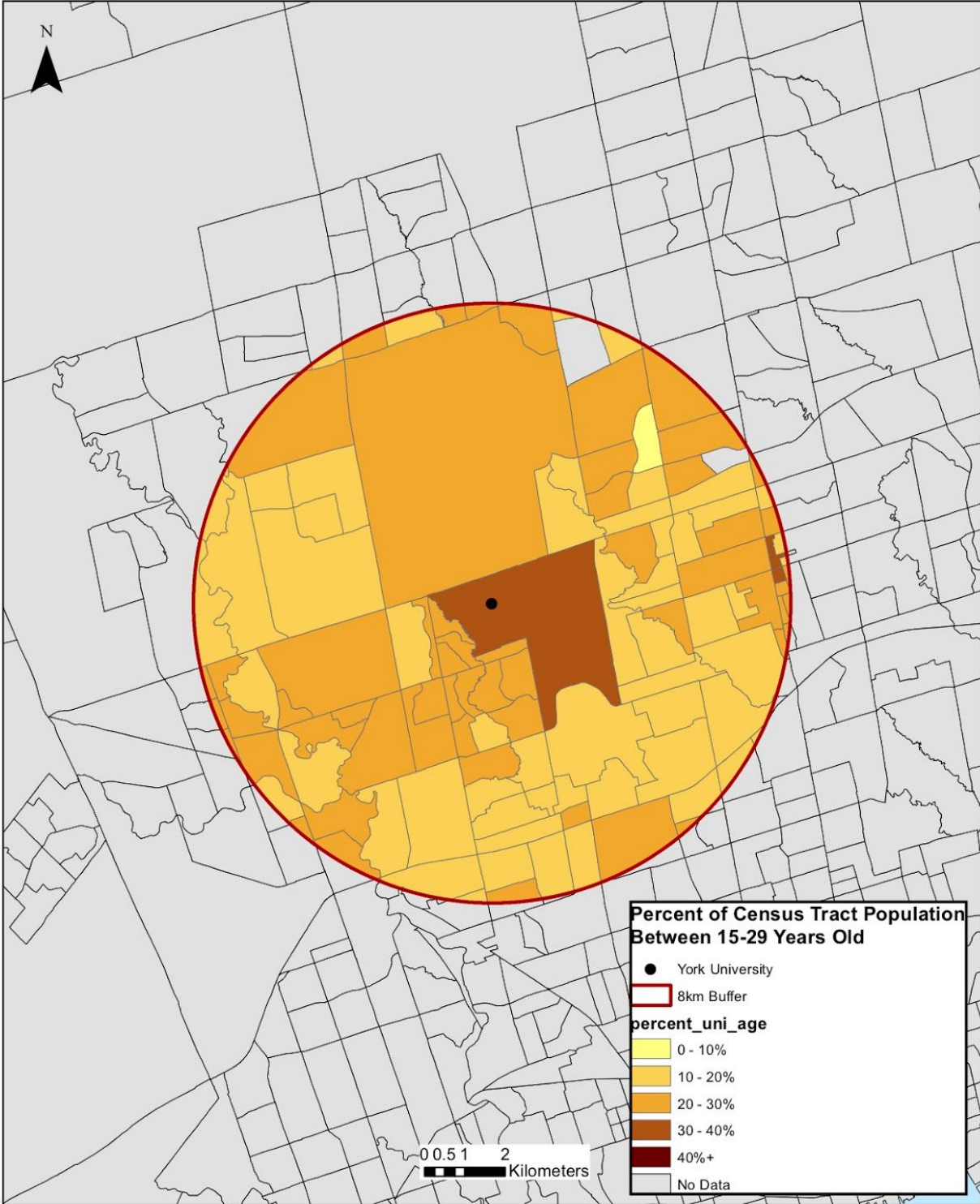


Appendix S: Toronto Age Map



Appendix T: Toronto Age Map - Buffer Zone

Percent of Census Tract Population Between 15 and 29 Years Old Surrounding York University (Toronto, Ontario)



Shakti Ramkumar (29241149), Sabrina Yong (54660162) and Farron Rickerby (37782159),
 Data Sources: Computing in the Humanities and Social Science (CHASS) - University of Toronto, 2016
 Coordinate System: NAD_1983_UTM_Zone_17N
 Classification Method: Manual Breaks

Appendix U: University Tuition Information

City	University	Domestic Students (\$CAD)	Domestic Students Mean (\$CAD)	International Students (\$CAD)	International Students Mean (\$CAD)
Vancouver	University of British Columbia	5088-6771	5929.5	24486-30359	27422.5
Montréal	McGill University	2328-7228	4778	15943-17808	16875.5
Edmonton	University of Alberta	5321	5321	20395-20395	20395
Toronto	York University	6408	6408	20632-21512	21073.5

Source: Universities Canada Facts and Statistics, data compiled from Statistics Canada. Retrieved from: <https://www.univcan.ca/universities/facts-and-stats/tuition-fees-by-university/>

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