Livability Index: A Micro-level Analysis of Livability within the City of Vancouver's 22 Diverse Neighbourhoods

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Abstract

Attempting to build a livability index for a municipality poses a rather challenging task, mainly due to subjectivity in scoring and differing points of view on what is considered 'livable'. In reality, constructing a representation of what 'livable' represents requires numerous assumptions, and thus bias enters the conclusions.

Vancouver has widely been named "one of the most livable cities in the world" during recent years, mainly being praised for its "commitment to preserve green spaces, investment in rapid transit and attention to labour markets and employment" (Hutton, 2011). Therefore, this study looked to effectively test this livability hypothesis within the City of Vancouver by comparing measures on a neighbourhood level, rather than on a city-wide basis in comparison with other global urban cities. Our index is composed of data gathered on the spatial proximity between residential areas and Vancouver's transit hubs, greenspaces, bikeways, community centres, schools, libraries, and commercial areas - qualities which we believe enhance prosperity and opportunity for citizens. Furthermore, consideration of the crime rates and housing affordability within each census tract was applied in this index to include the dimensions of citizen security and financial prospects. Our livability study revealed a disparity between many of Vancouver's neighbourhoods. While the city has many assets that leverage its livability, these assets are not equally divided for use by all citizens.

Project Description

Livability is conventionally tied to perceived quality of life, and today, the achievement of sustainable development is a complementary measure. Urban development interests and typical planning design paradigms have made it difficult to fully implement the ideals of livability, and as such, the same cities top the rankings year after year (Ling, Hamilton and Thomas, 2006). Vancouver is one of these cities that often finds a place on the top of livability indexes, and was ranked the third most livable city in 2016 (EIU 2016). At the same time that news reports circulated celebrating Vancouver's livability success, the city's housing market was dubbed the third most unaffordable in the world (Demographia 2017).

The City of Vancouver has a strong global brand of being clean, green and environmentally sustainable, with the 2010 Winter Olympics helping to raise the profile of this 'young' city (City of Vancouver, 2017). Vancouver is bounded by the Coast Mountain Range to the north and east, the

American border to the south, and the Pacific Ocean to the west. A population of 603,502 people (Statistics Canada, 2011) is much below Vancouver's counterparts in the above-noted livability studies - geographic limitations to urban expansion has plateaued growth, and thus a relatively small urban population exists.

This analysis is designed to make a micro-level assessment of livability within the City of Vancouver, rather than view the city as a whole. The contradiction between the high livability and low affordability rankings of Vancouver is common amongst many of the world's great cities. The weight given to affordability ultimately determines the overall score assigned to a city; Vancouver ranks high on lists when low weighting is assigned to affordability. Inspired by the global-scale livability index from The Economist and taking into consideration Vancouver's assets, proximity to transit hubs, greenspaces, bikeways, community centres, schools, libraries, and commercial areas are used as measures of livability. This vector data, representing features as discrete points, lines, and polygons, is obtained from the City of Vancouver's Open Data catalogue. Affordability and crime data is also included in this analysis and assessed at the census tract (CT) scale, with the 2011 National Household Survey and City of Vancouver Police Department providing the respective data.

By looking at the factors that determine livability at a local scale, our analysis hopes to reveal if discrepancies exist between neighbourhoods; and ultimately to help inform future policy and planning decisions regarding neighbourhoods that lie within the spectrum.

Methodology

To carryout our geo-spatial analysis, we used Ersi's ArcGIS. This livability ranking comprises of ten factors (see Table 1), and each factor was assigned a weight of relevance. The

Results and Discussion section below explores why each factor was assigned its given weight. The highest possible score in this ranking is 10 points.

For seven of our study's livability factors (all factors excluding crime, affordability, and transit), we acquired Ersi shapefiles from the City of Vancouver's data catalogue. The shapefile for schools in Vancouver was divided into separate elementary and secondary school layers using the 'create a new layer from selection' tool. The transit layer was created using the shapefile of Translink stops from the Abacus database. Then, we used 'select by attribute' to select all of the stops of Skytrain or B-line bus routes by using the query 'stop_id=[id number] OR stop_id=[id number] OR...'. We created a layer of frequent transit from this selection. We created a buffer for each of these seven layers using dissolve type 'all' (see Table 1 for buffer sizes). We clipped all the layers to a Vancouver Local Area Boundary as some shapefiles extended beyond the City of Vancouver's neighbourhoods. Corresponding weights for each layer were assigned to the area within the buffer. For example, the value in the frequent transit buffer's 'transit_score' field was 1.5; area outside the buffer was given a value of 0.

For the housing affordability layer, we joined census tract (CT) boundaries with housing price and income data from the 2011 National Household Survey 2011. Using the field calculator, a new field was created with a housing price to income ratio (housing affordability). We assigned each CT a score from 0-3 for ranges within the housing affordability ratio. Similarly for the crime later, we joined population data from the 2011 National Household Survey with a shapefile of vector crime statistics in the City of Vancouver. Using the field calculator, a new field was created with a ratio of crimes per 100,000 people and assigned a score ranging from 0-0.5 for different levels of crime in each CT.

To calculate the total score of each neighbourhood in Vancouver, each layer in this livability ranking was combined using the 'union' tool; this included the 8 clipped buffer layers, the affordability layer and the crime layer. This union layer created a series of polygons that had an associated score for each of the 10 livability factors (as found in its attribute table). Then, a new field in the attribute table was created, which summed the scores using the field calculator. This assigned each polygon a livability score out of 10.

Since the map produced by the union had many polygons with livability scores, we decided to display our livability scores per census tract. To do this, we converted the union layer to raster and used the 'zonal statistics' tool to calculate the average livability score per census tract. Therefore, our final Livability map is a raster layer with neighbourhood boundaries.

Layer Name	Weight (out of 10)	Attributes/Tabular Data
Frequent Transit	1.5	800m
Parks	0.5	500m
Bikeways	0.5	300m
Community Centres	0.5	1000m
Commercial Areas	2	800m
Elementary Schools	0.5	1000m
Secondary Schools	0.5	1500m
Libraries	0.5	1000m
Crime	each CT given a value of 0, 0.1, 0.2, 0.3, 0.4 or 0.5 (0.5 = least crime)	Crime Rate (per capita)
Housing Affordability	each CT given a value of 0, 1, 2 or 3 (3 = more affordable)	Housing Cost (per individual income)
Total	**10**	

Table 1. Livability factors included in this study (column 1). The weight of each layer (column 2) is associated with the factor's comparative relevance to livability. For the geospatial analysis, vector data was given a distance buffer (column 3). Area within each buffer was assigned a score (noted in column 2) and area outside the buffer was give a value of 0. Additionally, crime and affordability is ranked throughout the entire city, and each census tract (CT) was assigned a score (as noted in column 2).

Result and Discussion

Each census tract in Vancouver was given a rating of either Very Unlivable, Unlivable, Moderately Livable, Livable or Very Livable (Figure 1). In this section, reference to neighbourhoods, rather than CTs, is made to simplify the discussion. The weight of each livability factor was determined by how important the authors believed each layer contributed to livability. Transportation access, including transit and bikeways, makes up 20% of the weight for this score; low reliance on cars significantly contributes to sustainability and public health. Housing affordability comprises 30% of our score; an equitable and diverse city relies on this. Walking distance to various public assets and amenities encompasses 45% of the weight; beyond that distance, transportation is required and the assets are less visible and accessible. Crime rate (per capita) was given a weight of 5% of our score; if people do not feel safe in their own neighbourhood, the proximity to public amenities is diminished as an livability asset.

The most livable neighborhoods according to our ranking are Kitsilano, Fairview, Mount Pleasant, the West End, and Grandview-Woodland. All but three of the CTs in these neighbourhoods are “Livable” or “Very Livable”, meaning they have scores above 6.8. Each of these neighbourhoods have access to frequent transit in common. Due to access to transit’s heavy weighting (30%), very few census tracts were in the “Livable” range or better if they were not near frequent transit.

These highly livable neighbourhoods also have affordable housing and are located in close proximity to commercial corridors. It is worth noting, however, that we scored affordability relative to other Vancouver neighbourhoods. Demographia classifies a housing cost to income ratio of 5.1 or more as “severely unaffordable,” while we assigned a score of 2 or 3 for ratios between 5 and 10. This decision was made as most CTs in Vancouver are considered severely

unaffordable by Demographia. If we used their measure, it would not be useful for comparing neighbourhoods within Vancouver.

The least livable neighbourhoods were in Southwest Vancouver, namely, Dunbar-Southlands, Shaughnessy, Arbutus Ridge, and Kerrisdale. Their poor scores are largely due to a lack of access to transit and unaffordable housing. These areas also have lower access to amenities, particularly high schools and commercial areas. Despite these areas having very high incomes, the equally high property values make it unaffordable (based on our affordability ratio). Since high incomes are common to these neighbourhoods, people can typically afford private vehicles. Therefore, less public transit and fewer amenities are within walking distance, this is generally a function of lower population densities. In order to increase overall livability within the City of Vancouver - based on the classification of 'very livable' and 'very unlivable' neighbourhoods in our study - it is necessary to focus on adding affordable housing and frequent transit in South Vancouver.

Housing Affordability

Housing affordability has been a trending topic in Vancouver during recent years. Some locals argue that the housing market will definitely crash in the foreseeable future because of the extensive Asian investment in residential units in the region, which cause the average housing prices to increase constantly, and thus become unaffordable for local residents. Therefore, our group felt that it was important to not only consider, but to put emphasis on the importance of housing affordability within Vancouver's context. For this, we assigned a unit weight of 30% to our normalized data of income and mean housing cost in the Vancouver. The map results (Figure 2) show that most of the 'unaffordable area' (i.e. score equal or smaller than 1) is mainly concentrated in the southern districts of the Greater Vancouver Area, such as Arbutus Ridge,

Shaughnessy and Kerrisdale; the most affordable districts from our results were situated around the downtown area, Fairview, and Kitsilano. However, since our affordability index is based upon the income of the residents that live in these areas, we were expecting such results, since areas such as Shaugnessy and Arbutus Ridge are greatly composed by students who mostly do not have a direct income to support their lifestyle independently, even though housing cost in these areas are far less than those in downtown and Kitsilano.

Crime

Crime occurrence was given a weight of 5% in our index. Our results show that the distribution of crime in the Greater Vancouver Area is quite unbalanced, with massive concentrations of crimes around the Downtown Eastside (DTES) and Hastings-Sunrise districts, while all other areas presented very low levels of crime (Figure 3). In contrast to most of the city, the DTES district is greatly encompassed by lower-income residents, and is the site of social harms such as drug addiction, trafficking, sex work, and mental illness. Because of such high crime occurrence, the DTES has been notoriously labelled as one of the 'worst neighbourhoods in Canada', which is quite surprising, as such a neighbourhood would not be expected to be located in one of the most livable cities in the world. One of the reasons for the DTES social deterioration is due to the mass influx of low-income immigrants who settled in the district during the early 20th century, whom were subjected to ethnic discrimination and economic disparities. Thus, their relative poverty was passed down through generations, which contributed to the social isolation experienced today. The concentrations of low end of market and social housing in DTES further this trend. Nevertheless, the index's output results from the other areas suggest that most of Vancouver's neighbourhoods are indeed safe, since the very few crimes that actually occurred were considered 'petty crimes'.

Transportation

Twenty percent of the weight from the total score was for access to sustainable transportation. Frequent transit was fifteen percent of the total score because we felt that having easy access to the whole city was a key factor in livability. While it is important to have walking access to amenities, not all transactions can be undertaken within a local area. We used a buffer of 800 meters around frequent express transit (B-Line busses and Skytrain) stations because that is the distance most people can walk within ten minutes.

This measure contributed to more population dense areas likely to have frequent transit having the highest scores. Notably, the census tracts within Kitsilano, Fairview and Mount Pleasant had high scores because of their proximity to the 99 B-Line (Figure 4).

Bikeways were weighted at 5% of the total score because although it is a healthy transportation option, it is not as accessible as transit. For example, elderly or physically disabled people are often unable to cycle. The buffer for this layer was only 300 meters because most people are unlikely to be comfortable cycling further than that on a street with no bikeway. Due to the expansiveness of the bike network, most people in Vancouver are within 300 meters of a bikeway.

Education Assets

Five per cent of the total score is given for libraries, elementary schools and secondary schools respectively, since they all belong to education assets, but are not necessary for everyone's daily lives. Elementary and secondary schools are counted separately because they target different age groups and therefore different buffers (1000m for elementary, 1500m for secondary schools).

For libraries, we created a buffer of 1000m. The location of libraries in Vancouver show a fairly even geographic distribution where every neighborhood has at least one library (Figure 5). To some degree this indicates that Vancouver is a highly developed city which pays great attention to fair access to public education.

On the other hand, the most schools are located in the east and south sides of Vancouver. It is reasonable because the downtown area, covering offices, shopping malls, museums and banks, is largely a commercial center where school sites are challenged to compete with other land uses for expensive real estate. The west side of Vancouver is wealthier and less population dense. Low population density means less schools. In addition, considering that wealthier residents can generally afford cars, they can drive children to more distant schools. The south-west area of Vancouver contains the Pacific Spirit Park and has less population than other neighbourhoods, so schools are less necessary for this area. The greatest number of schools are mainly located in the east and south part of Vancouver but the uneven distribution does not have a large impact on the total livability index because schools have a relatively small weight.

Public spaces

Community centers and parks are each given a weight of 5% . Many community centers are in Downtown and Strathcona, while the rest usually accompany parks (Figure 6). The large parks are generally found in south part of Vancouver, specifically, Dunbar, Kerrisdale and Killarney. It is interesting to note that these three areas have lowest total livability scores (2.0-4.5). The lower numbers of community centres can be attributed to lower population densities.

We gave twenty percent of the total score to commercial areas because it is important for everyday tasks. A buffer for 800m is created for this layer because a ten minute walk is

appropriate for going to a supermarket or a store. The commercial areas are mostly along rapid transit lines (B-line and Skytrain) because this is where businesses are most accessible. This is why neighborhoods such as Kitsilano, Fairview and Mount Pleasant, with both good transportation systems and commercial areas, are the most livable places in Vancouver.

Error and Uncertainty

In this study, we used 2016 boundary files for our census tracts, however, the latest housing and income data was released in 2011, as downloaded from CHASS/2011 NHS. When we joined the housing and income data into the boundary layer, one census tract data did not match because two census tracts from the 2011 Census had been combined into one for the 2016 Census. As a result, there was one area with no housing price and income data showing in the affordability layer. To solve the problem, we used the average of the values in the two census tracts on our new layer.

There is a no data of census tract area for housing price and income due to data suppression. According to Statistics Canada (2011[2]), area suppression is used to replace all income characteristic data with an "x" for geographic areas with populations and number of households below a specific threshold. The rule applies: income characteristic data are replaced with an "x" for areas where population is less than 250 or where the number of private households is less than 40. Here, the data suppression for the housing and income may be due to the private household, because the no data area is belonging to First Nation reservation land. However, to measure the livability index in the whole city of Vancouver, a median value of affordability was assigned to the area.

Further Research

As noted, determining livability of cities and of neighbourhoods within cities is a highly subjective exercise. Depending upon the preferences of the residents, there is often a difference between desirability and livability. Some residents of certain neighbourhoods may be very happy to not have certain amenities if such amenities were to create conditions they found undesirable.

Although the scoring and weighting that have been assigned to the various criteria that make up a livability index are determined by the authors in accordance with commonly accepted parameters, further insight could be gained through resident satisfaction surveys. Such surveys would ideally use the same criteria as those in this study, however, the opinions of the residents could consider certain intangible qualities of the criteria not afforded by the scoring system of this study.

Figure 1. Livability Score: Livability within Census Tracts in Vancouver, 2017

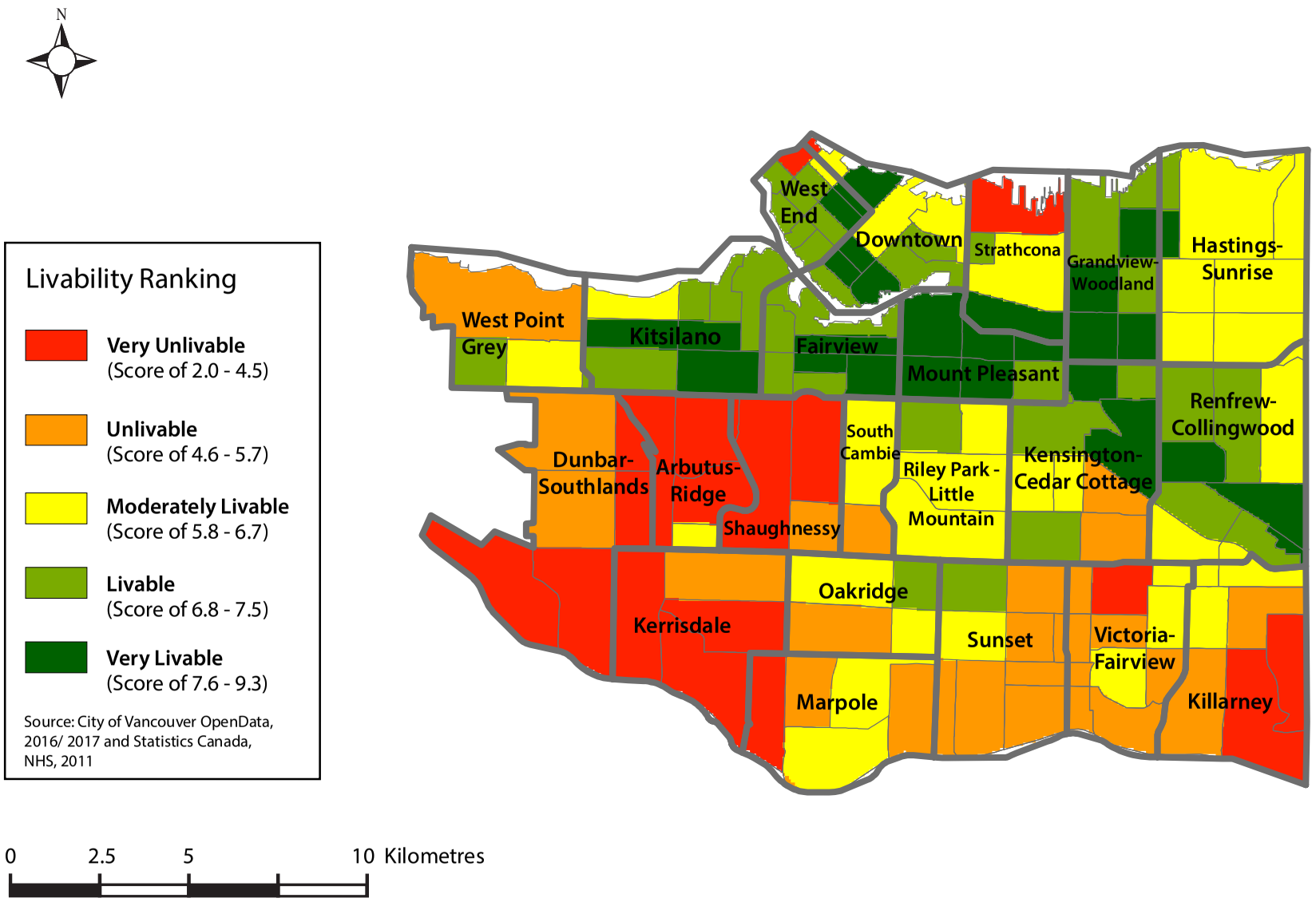


Figure 2. Affordability Score: Ranking of Affordability within Vancouver's Census Tracts by Housing Cost, 2016

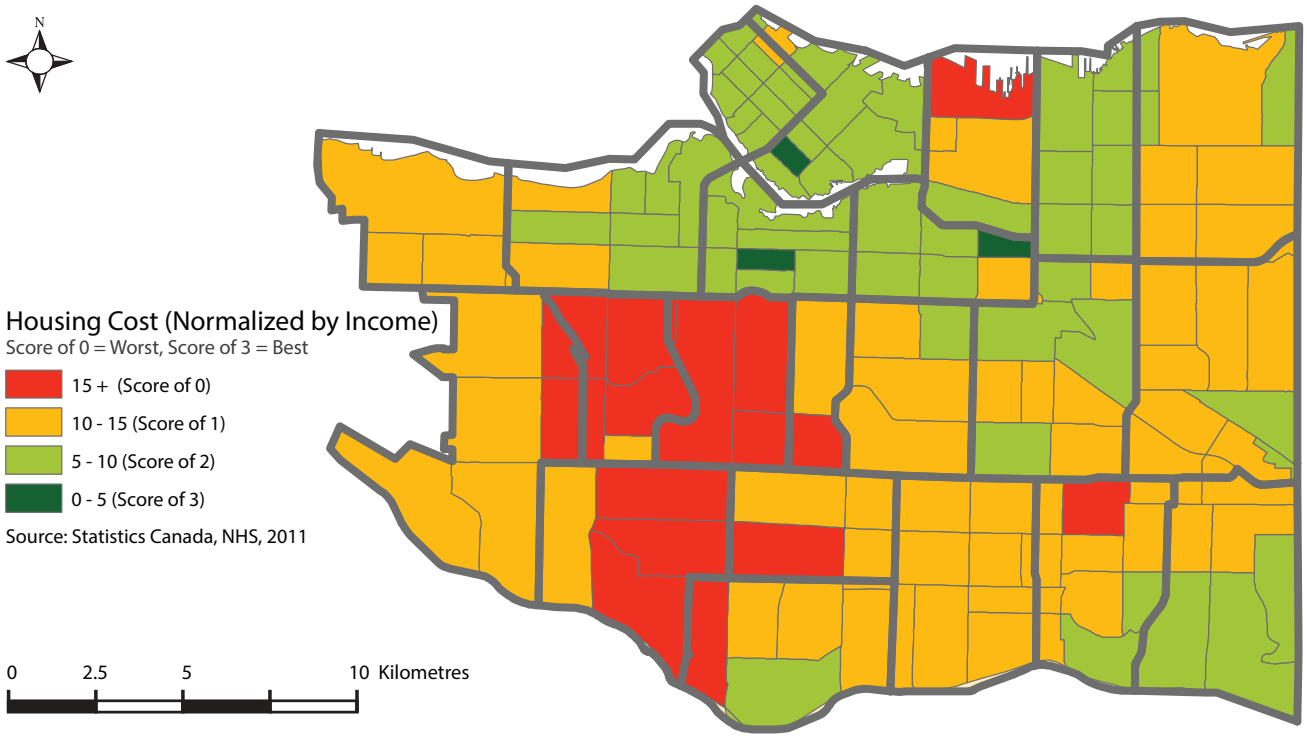


Figure 3. Crime Score: Ranking of Safety within Vancouver's Census Tracts by Crimes per Capita, 2016

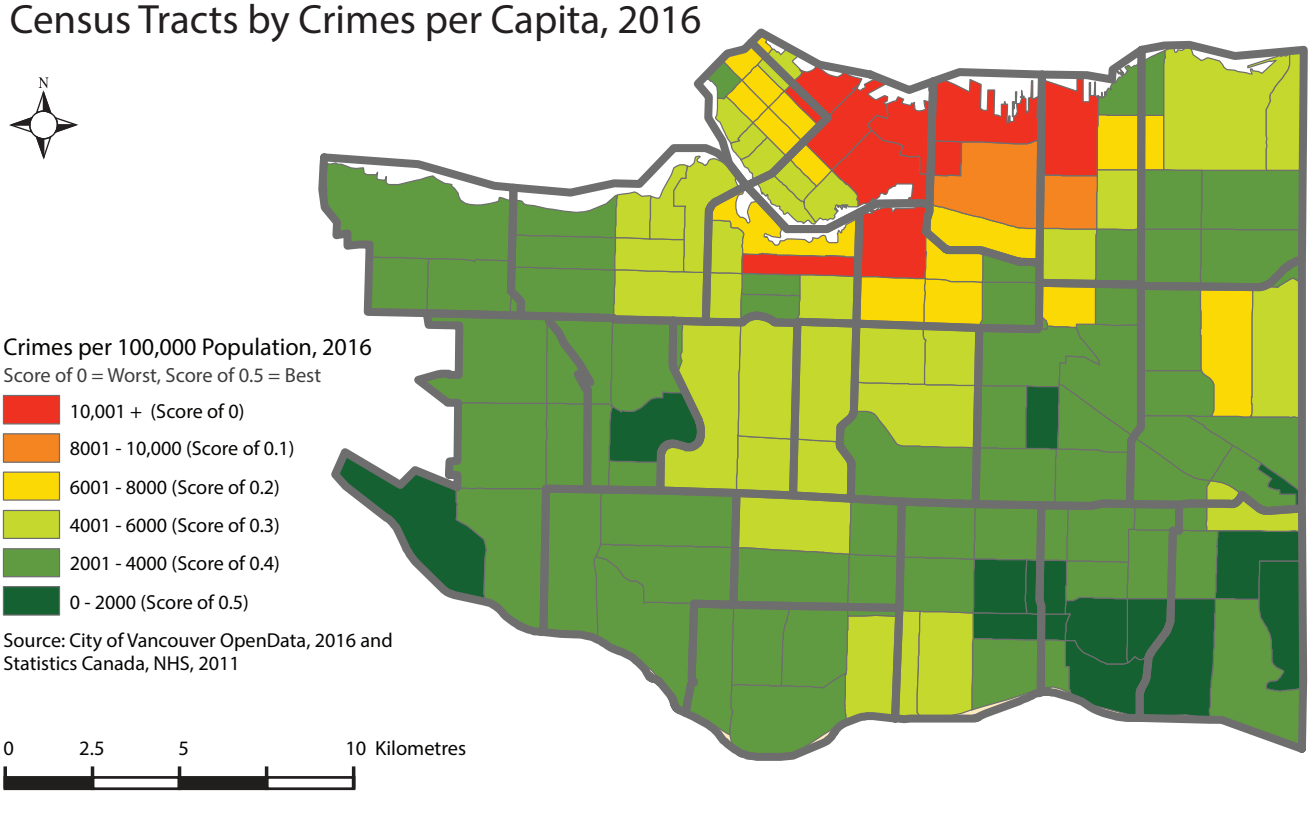


Figure 4. Transportation Scores: Bikeways and Frequent Transit Stops within Vancouver, 2016

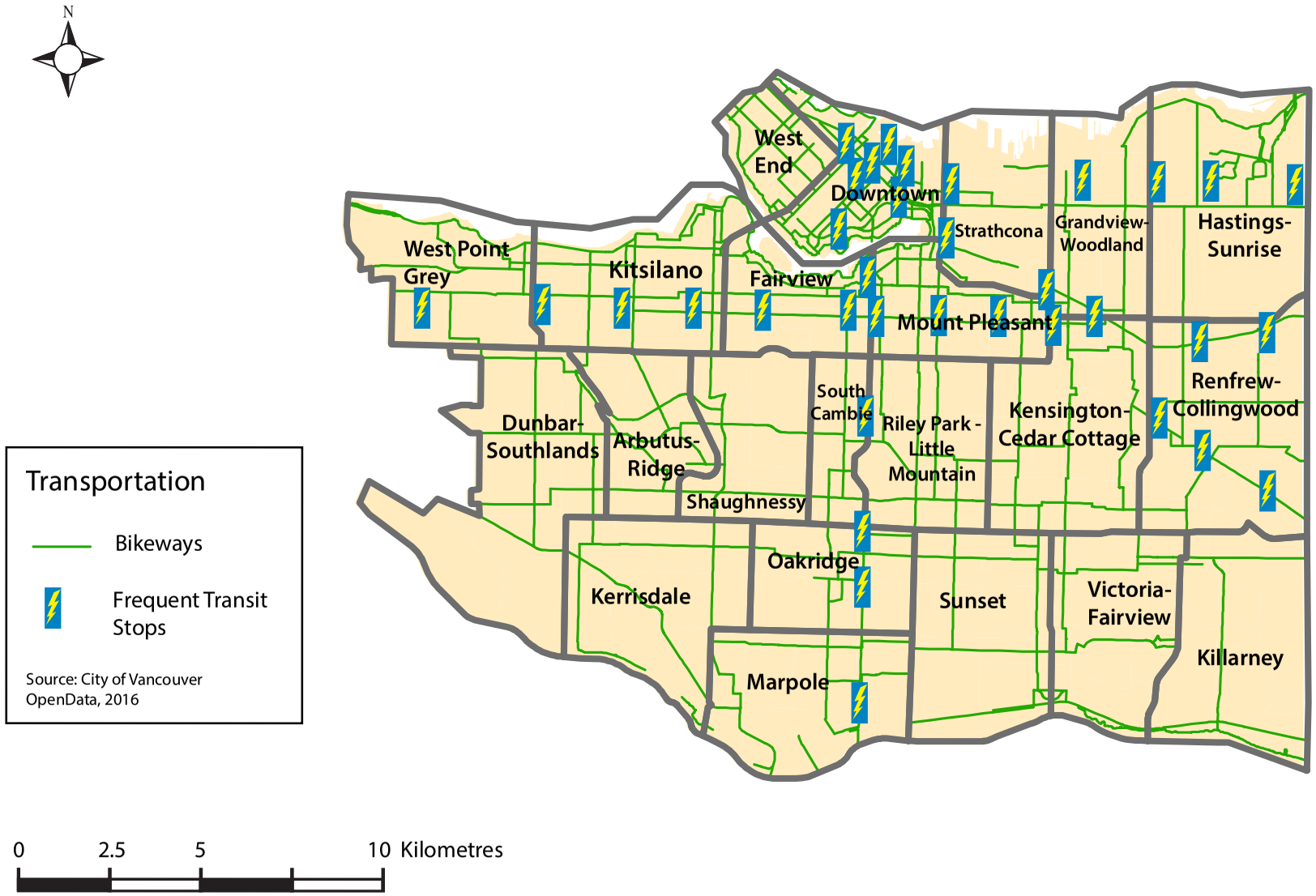


Figure 5. Education Asset Scores: Location of Elementary Schools, Secondary Schools and Libraries within Vancouver Neighbourhoods, 2016

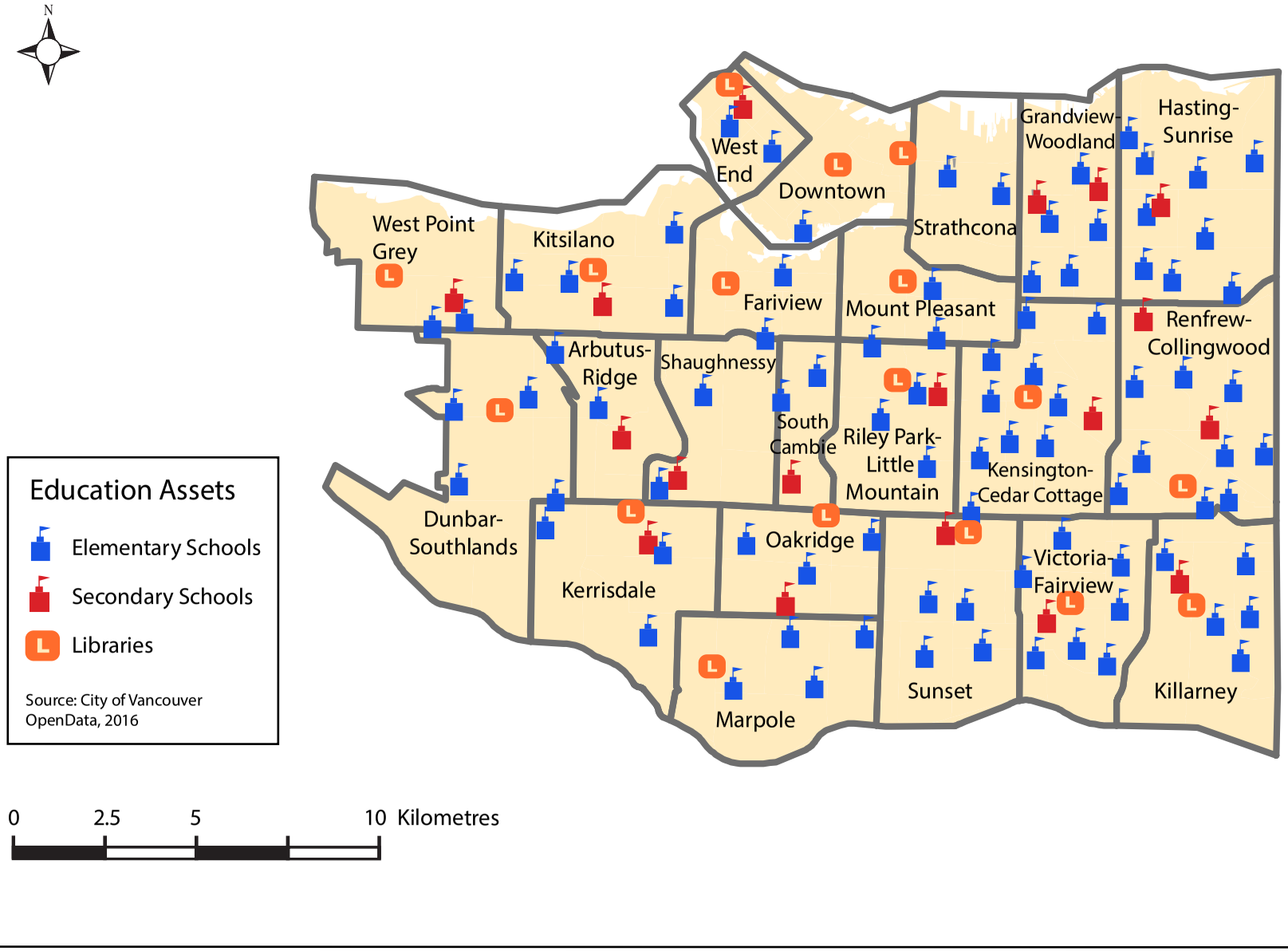
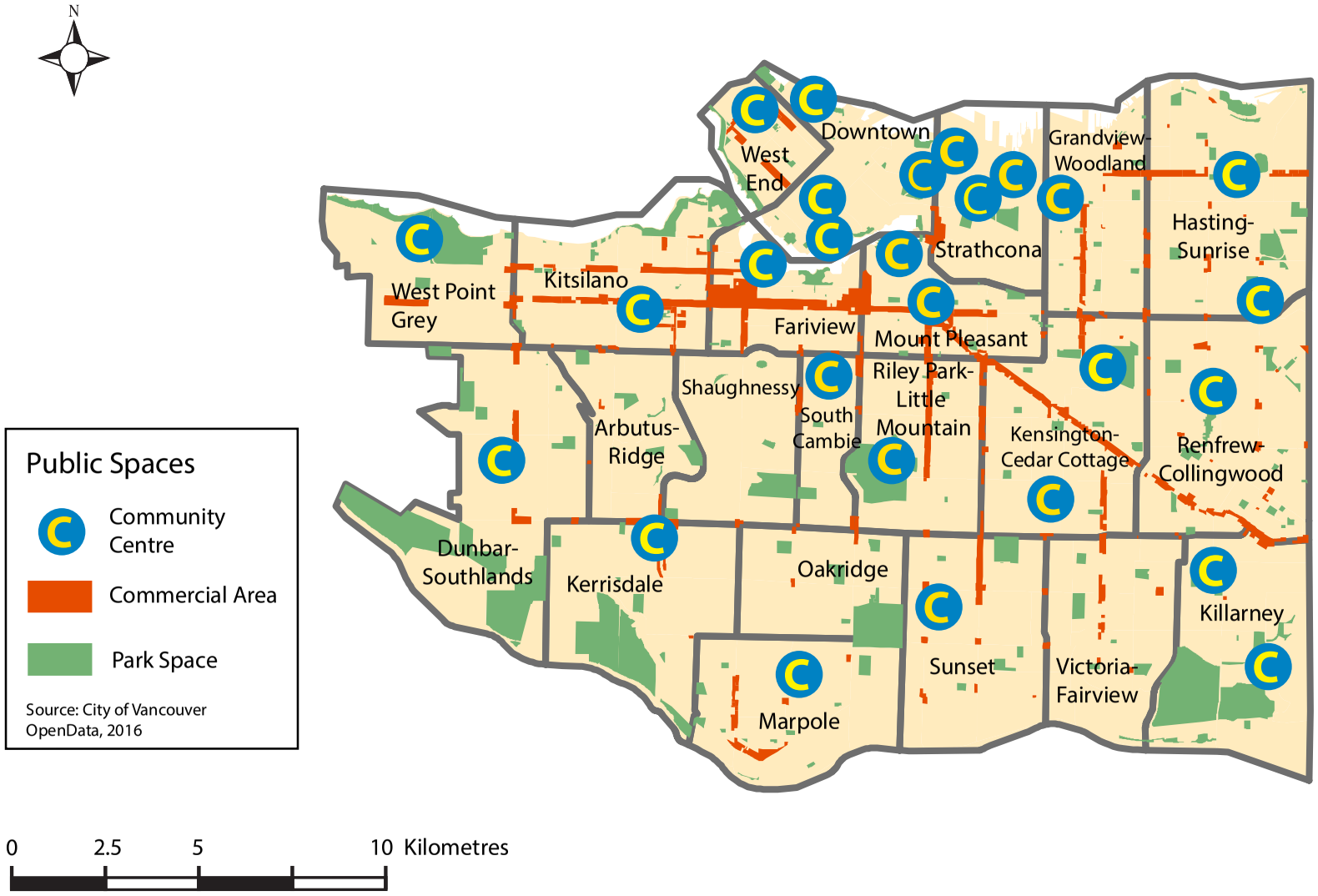
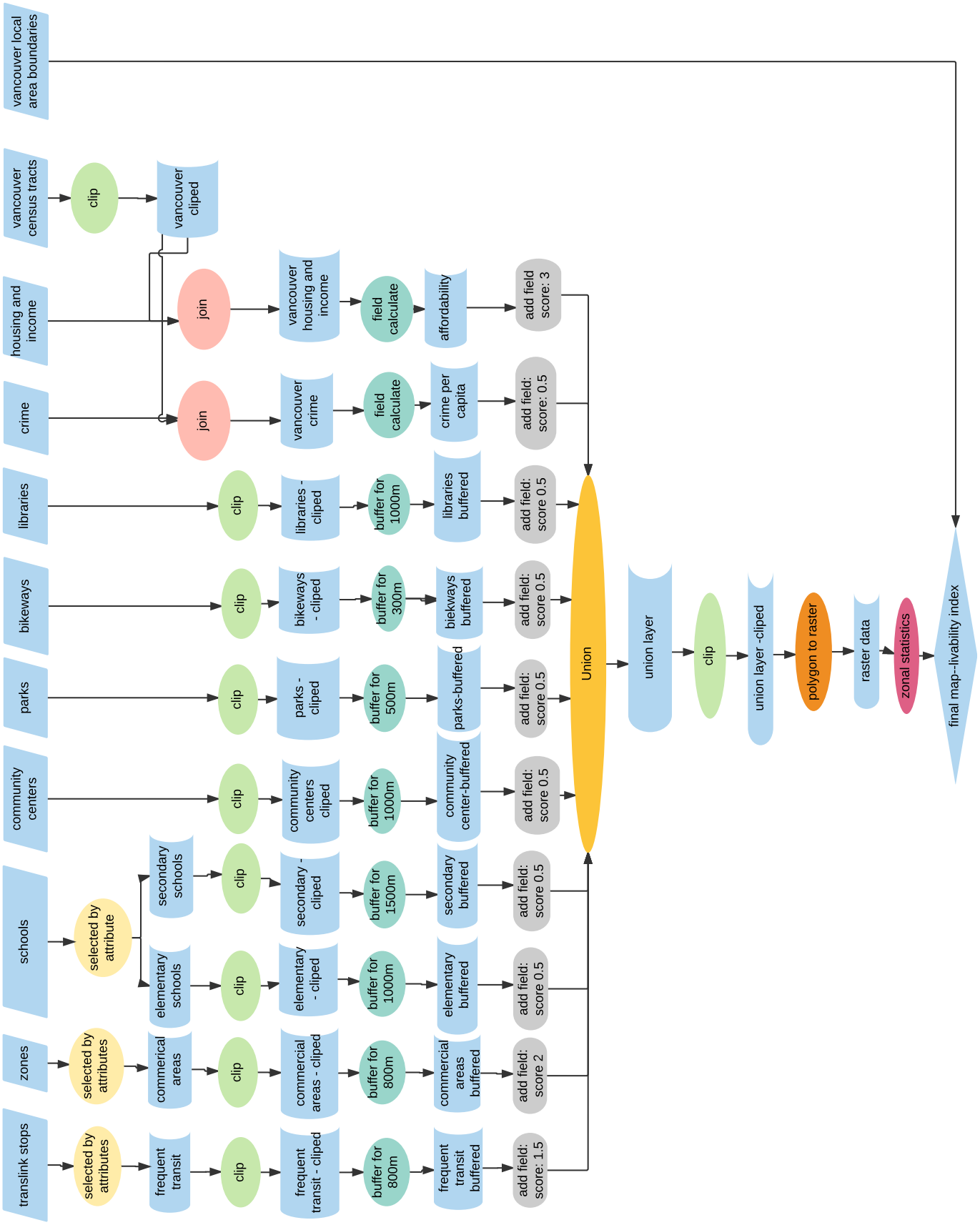


Figure 6. Public Spaces Scores: Location of Parks, Commercial Areas and Community Centres within Vancouver Neighbourhoods, 2016



Appendix II: Flowchart



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