Got the Green? An Analysis of Greenspaces in Vancouver, B.C.

GEOB 270 Final Project

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Abstract

With a goal of becoming the greenest city by 2020, an understanding of the areas lacking and needing greenspace within the city of Vancouver will be vital to achieving this target date. The key is determining areas of current greenspaces in Vancouver, the accessibility the public has to these greenspaces, and areas of high priority needing reachable greenspace. While many greenspace analyses have been done for the Vancouver area, our analysis represents not just accessible park spaces, but greenways as well as community gardens that are within a 400m walkable distance. To do this we use the ArcGIS software ArcMap to develop a map that identifies areas within Vancouver that lack greenspace access and prioritized these areas based on their land use classification. From this analysis we determined that areas totalling 9.96 km^2 within Vancouver are lacking greenspace, more than half of this area was found to be high priority. Greenspace and its accessibility is vital to the health of cities and its inhabitants as they create spaces for the residents of urban landscapes to live, play, socialize, and connect with nature, all the while strengthening the sense of community.

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Description of Project, Study Area, and Data

In 2011, Vancouver, British Columbia announced that it aims to be the greenest city in the world by the year 2020 (Greenest City, 2014). With this goal in mind this projects strives to identify areas within city limits that currently lack greenspaces. Areas lacking greenspace will be classified based on proximity (400 metres) to nearby greenspaces. Greenspace types that will be included in this analysis are community gardens, city parks, and greenways. Community gardens are garden plots within the city that are located in City parks, on City land or on non-City land (e.g. church, school or hospital property) and are administered by local community groups (Community gardens, 2016). Public community gardens do not restrict access to their plots and only require that an individual sign up on the appropriate waitlist before being eligible. This analysis will not include private community gardens that restrict access to their plots based on predetermined criteria. City parks include all parks maintained by City of Vancouver Parks and Recreation or Metro Vancouver Regional Park Board that are located within Vancouver, as well as those that are on the University of British Columbia campus (which are maintained by the University). Greenways are areas within the city that connect multiple features such as parks, nature reserves and neighbourhoods for both pedestrians and cyclists in order to enhance the experience of nature, community and city life for Vancouverites (Greenways, 2015).

Data for this analysis will include layers for Vancouver boundaries, Vancouver roads, land use and the current location of parks, community gardens, and greenways. All data are projected in UTM Zone 10 NAD83, and are vector files. The data for boundaries, roads and land use were gathered from the G drive and therefore did not have to be obtained from a third party source for this analysis, while the remaining data was obtained from the Open Data catalogue provided by the City of Vancouver. According to the catalogue, the data for the community garden layer was originally collected in 2010 and it is updated every 6 months; the data for the parks layer was originally collected in July 2009 and is updated weekly based on the Parks and Recreation website; and the extract for the greenway data is updated weekly (Open Data catalogue, 2016).

Methodology of Analysis

This analysis included six layers that had to be acquired, parsed, filtered, mined and finally represented in a series of three maps. As previously mentioned, three of the six layers were available from the University of British Columbia's Geography Department's G drive, these included the Vancouver roads, boundary, and land use layers. The remaining layers were acquired from the Open Data catalogue provided by the City of Vancouver. All layers were in the appropriate projection, UTM Zone 10 NAD 83, and therefore did not require any pre-processing prior to further manipulation.

A geodatabase was created and all six of the aforementioned layers were imported into it. All layers were then renamed so that they adhered to a consistent naming convention in ArcCatalogue, before being added to ArcMap. The layers were then clipped to the Vancouver boundary layer, using the Clip tool; the resulting layers were renamed within the suffix "_clip".

The individual clipped layers were then further manipulated independently to facilitate individual and group analysis. The first layer to be mined further was the Vancouver roads layer. A detailed road map was not necessary for this analysis so the data was mined using the select by attribute tool so that only major roads (e.g. road types 1, 2 and 4) were shown. Next, the community gardens layer was processed using the select by attribute tool so that only non-private gardens were represented; a new layer with the suffix "_pub" was added to the map. The land use layer was used in two ways during this analysis. First, it was mined to produce a layer that would only show the parks and recreation category (layer named "UBCparks") and second as a clipped layer with new categories in the final map. The first representation (Map 1) was produced using the Vancouver boundary, major roads,

clipped greenway, clipped city parks, and the public community garden layers. The parks layer and UBC parks layer used the same colour so that all parks were represented as a single unit.

The mined layers (i.e. public community gardens, clipped city parks, clipped greenways, and UBC parks) were then buffered (using a 400-metre buffer), clipped and dissolved. A 400-metre buffer was chosen because it denotes the distance that an average person can walk in 5-minutes (Condon, 2010), therefore any area within this buffer did not lack access to a greenspace. A second map was produced to communicate how each greenspace type is dispersed throughout the city and how they overlap. Map 2 used the buffered and clipped public community gardens layer but this layer was not dissolved for its individual representation. This was done because the pre-dissolved layer provided a better illustration of the number of community gardens within the city.

To produce the final map, the four layers that had been buffered, clipped and dissolved were combined using the union and dissolve tools; the resulting layer was named "All_Union_Dissolve". The original clipped land use layer was also added to this representation. The original categories of land use were reclassified to demonstrate high, medium and low priority areas for new greenspaces. High priority areas were residential areas, medium priority areas were resource, industrial, government and institutional areas, and low priority was given to open and commercial areas. Residential areas were given high priority because all Vancouverites should have access to greenspaces within walking distance of their homes. Resource and government areas were given medium priority in the interest of public health; hopefully having these areas available will promote outdoor activities during break times. And low priority was given to all remaining areas as they do not have a specific purpose but would assist the city in their green city goal.

Discussion and Results

Greenspace and its accessibility is vital to the health of cities and its inhabitants. Whether these greenspaces take the form of a community garden, a city park, or a greenway, these spaces help clean the air and filter rainwater, while also providing shade cover and sheltering wildlife. Furthermore, these greenspaces create spaces for the residents of urban communities such as Vancouver to live, play, socialize, and connect with nature, all the while strengthening the sense of community.

For this analysis, as previously mentioned, spaces considered "green" are public parks, public community gardens, and greenways. As of 2009, when the data was sampled, the total area of public parks in Vancouver was 25.1 km^2 , which equals nearly 20% of Vancouver's total area of 131 km^2. Furthermore, the length of greenways in Vancouver, as calculated from our 2009 dataset, totaled 75 kilometers. Greenways in Vancouver are "linear public corridors for pedestrians and cyclists that connect parks, nature reserves, cultural features, historic sites, neighbourhoods and retail areas" (Greenways, 2015), and consist of two types: city greenways and neighbourhood greenways. The benefits of city greenways include the expansion of urban recreation opportunities, the encouragement of people to travel by means such as by foot and bike, and an enhanced experience of the combination of nature and city life. Currently, the city's goal is that every residence in Vancouver will be within a 25-minute walk or a 10-minute bike ride of a city greenway. With the completion of the city greenway network, the 17 routes will total a length of approximately 140 kilometers. When comparing the total length of greenways calculated from our 2009 dataset and the goals put forth by the City of Vancouver, the length of greenways is projected to almost double (from 75 to 140 kilometers). The third type of greenspace considered for this project were public community gardens, of which there were 147 as of 2009. The 147 public community gardens located across the various neighbourhoods of Vancouver in 2009 in parks, school yards, and other public areas, are a form of urban agriculture, which is locally-based and community-minded.

While the existence alone of greenspaces is significant, their various benefits to the Vancouver community would be compromised if they were not also accessible. To measure the accessibility of greenspaces in Vancouver, a walkability measurement of 400 meters, or roughly 5 minutes walking distance, was buffered around the various public parks, community gardens, and greenways. While definitions of what a "walkable distance" entials vary, the 400 meters, or 5 minute walking distance is used by the city of Vancouver in the Greenest City Action Plan for 2020 (2014). In this Action Plan, Vancouver aims to become the greenest city globally, and the goals for "access to nature" include two main targets: first, to ensure that every person lives within a five minute walk of a park, greenway, or other green space by 2020; and second, to plant an additional 150,000 trees in the city by 2020 (Greenest City: 2020 Action Plan, 2014). As of our 2009 dataset, 92.4% of Vancouver's land area was within a 400 meter distance of a green space, so this goal is already well underway of being achieved. The areas still in need of walkable greenspaces vary in landuse type, and will be revisited in further detail later in the discussion of results.

Vancouver is consistently rated one of the top 10 most walkable cities on a global scale, and is also ranked the number one most walkable city in Canada. According to Walk Score - a private company providing a large-scale, public access walkability index that assigns a numerical walkability score to any address located in the United States, Canada, and Australia - walkability is typically based on two things: whether most of the development happened before everyone owned a car, or whether the area has natural barriers like water that inhibit sprawl, making cities more dense and walkable (Zamon, 2013). Indicators of walkability include population density, destination accessibility, distance to transit and other amenities, and design. Using such indicators, Vancouver earned a score of 78 out of 100 on the Walk Score, meaning that it is a very walkable city in which most errands can be accomplished on foot (Living in Vancouver, 2016). Matt Lerner, the co-founder of Walk Score, notes that the entire downtown area of Vancouver is "a walker's paradise" (Zamon, 2013), with an ideal balance between urban and natural components. The health factor of walkability is also important: a study done in Utah found that the average weight of people living in walkable neighborhoods averages 6-10 pounds less than those living in non-accessible neighborhoods, and according to Maclean's, the fittest cities in Canada corresponds well, although not perfectly, to the most walkable (Zamon, 2013).

In order to determine which areas of Vancouver contain greenspaces within a 5-minute walking distance and which areas are lacking, map 2 was produced containing all the available public community gardens, parks and greenways in Vancouver buffered by a distance of 400m. Analysis of the data obtained revealed that about 92.4% of Vancouver's area comprises of greenspace within a 5-minute walking distance in 2009. Although the majority of Vancouver's greenspace areas are accessible within a 400m walking distance, there are still several areas that lack these greenspace areas. It was calculated that 7.6% of Vancouver's total area is not within a 5-minute walking distance of a greenspace (Refer Table 1) Of this area, 57.73% consists of areas assessed as high priority (residential areas), 31.22% consists of areas of medium priority (resource, industrial, government and institutional areas), and 11.14% consists of area of low priority (open and commercial areas). When considering why some spaces are as of yet not located within walking distance of a greenspace, it should be noted that in the Greenest City 2020 Action Plan, industrial areas that make up 5% of the city's land-base are not included in the goals for all areas being within 5 minutes walking distance of a greenspace (Greenest City: 2020 Action Plan, 2014).

As can be seen from the data analysis, the majority of the areas that lack accessible greenspace in Vancouver are residential areas followed by resource, government and institutional areas (Refer to Map 1). The lack of accessible greenspace in these areas appears to be due to a limited amount of available space as a result of the large amount of buildings located in these areas. Because there may not be sufficient area in these location to create large public parks, one way accessible greenspace could be incorporated into these areas of high priority could be to create pop-up parks (also known as mini-

parks or pocket parks), which are small parks that do not require large scale development and are relatively more easily be made near residential properties of on small vacant lots (The Grind, 2013). Pop-up parks are being made in cities of high density and architecture such as Athens and New York City, where space is also highly limited (The Grind, 2013). Even though they are discrete in size, pop-up parks will still add greenery to the city of Vancouver, allow for the establishment of wildlife, and will also help in increasing access to nature in Vancouver which, as previously mentioned, is one of the goals of the 2020 Greenest City Action Plan. The city of Vancouver has already made plans that involve the development of pop-up parks. For instance, a pop-up park is currently under development at 5th and Pine in Kitsilano that is to provide an outdoor seating areas for the neighbourhood and will contain trees and a wildflower meadow to attract wildlife such as pollinators. Besides pop-up parks, Shannon Mews Parks and Smithe and Richard Parks are two new parks that are under development in Vancouver that will alleviate some of the need for accessible greenspace in these areas (Creating New Parks, 2016).

In addition to the development of parks in high priority and medium priority areas, the creation of new community gardens, along with the expansion of canopy cover via the planting of trees, will also increase the amount of accessible greenspace to the Vancouver community. Although community gardens are a good way to expand greenspace, promote locally grown food and bring the community closer together, lack of available space remains to hinder the development of new greeaces such as these. A better way of incorporating more accessible greenspace to these area is to plant trees, which is one of the aforementioned targets of the "access to nature" goal in the Greenest City Action Plan 2020.This method of incorporating accessible greenspaces to more areas of Vancouver is also suitable for areas assessed as low priority, such as commercial areas, since they constitute only a very small area of Vancouver's total area, approximately 1.11 km^2.

Overall, our analyses show that although Vancouver's 2020 goals of 100% accessibility to greenspaces has not yet been reached, Vancouver's total area of various greenspaces is very high, at almost 93%, and is expected to increase. By looking at the areas outside of accessible 400 meter or 5 minute walking distance from greenspaces, we found that the top priority for greenspace development was residential, followed by resource and industrial and government and institutional, and finally, open area and commercial with the lowest priority.

Error and Uncertainty

Though cause for errors and uncertainty were mitigated as best as possible in the making of the project's maps, there were specific areas of concern that should be made note of and addressed. Questions of error and uncertainty arose when evaluating the date of the release data. The data used in this analysis was said to be released in 2009 followed by weekly updates, however the date of the current updates is unknown. This begs the question of whether the maps produced from this data, can accurately and confidently predict areas within the city lacking greenspace. Unfortunately as no other recent data has been released in relation to Vancouver's greenspace, the maps in this analysis therefore can only provide an estimate of areas in need of greenspaces as there is uncertainty regarding the addition or removal of green spaces following 2009. Also of concern was the variation between polygon shapefile data versus the vector point data of parks. The dataset listing vector points had significantly more parks in areas where the polygon parks were not even shown as present. The discrepancy between these two data sets raises concerns about the quality and accuracy of both the park data sets, and questions whether the information represented in the map analysis portrays conclusive results. Similarly, some areas of well-known and accepted park space, such as Pacific Spirit Park, appeared as missing from the used data set, and thus raises questions about what is considered a "park" in the provided data. As such, multiple other areas that are considered parks by the public, may in fact, not be represented as parks. This discrepancy leads to our greenspace analysis having potentially missed or

misinterpreted areas lacking greenspace. Mitigation of this error was achieved by using multiple data sets of Vancouver parks to obtain an accurate understanding of where parks may or may not be present in the city. Another cause for error and uncertainty arises when defining a "walkability" parameter. The walkability measure was used to create a buffer around the current known green areas to provide an estimate of areas within the city that were not easily accessible. It was decided that a five-minute walking distance would be a suitable parameter as this is the distance that most people are willing to walk to access transit, shops, recreation centres and greenspaces instead of driving. As it happens, there are many suggestions as to what exactly a five-minute walking distance consists of. The School of Architecture and Landscape Architecture at the University of British Columbia suggest that a five-minute walking distance is approximately 400m. This is the parameter we decided to use for our analysis. However, other suggested walkability distances could span between 500m up to 800m. The variance and subjectiveness in walkability distance can thus cause uncertainty upon interpretation of the produced maps. While some causes of error and uncertainty were observed and subsequently mitigated in the evaluation and production of this analysis, readers should make note of the above discrepancies in data and keep them in mind when viewing and interpreting the report's maps.

Further Research and Recommendations

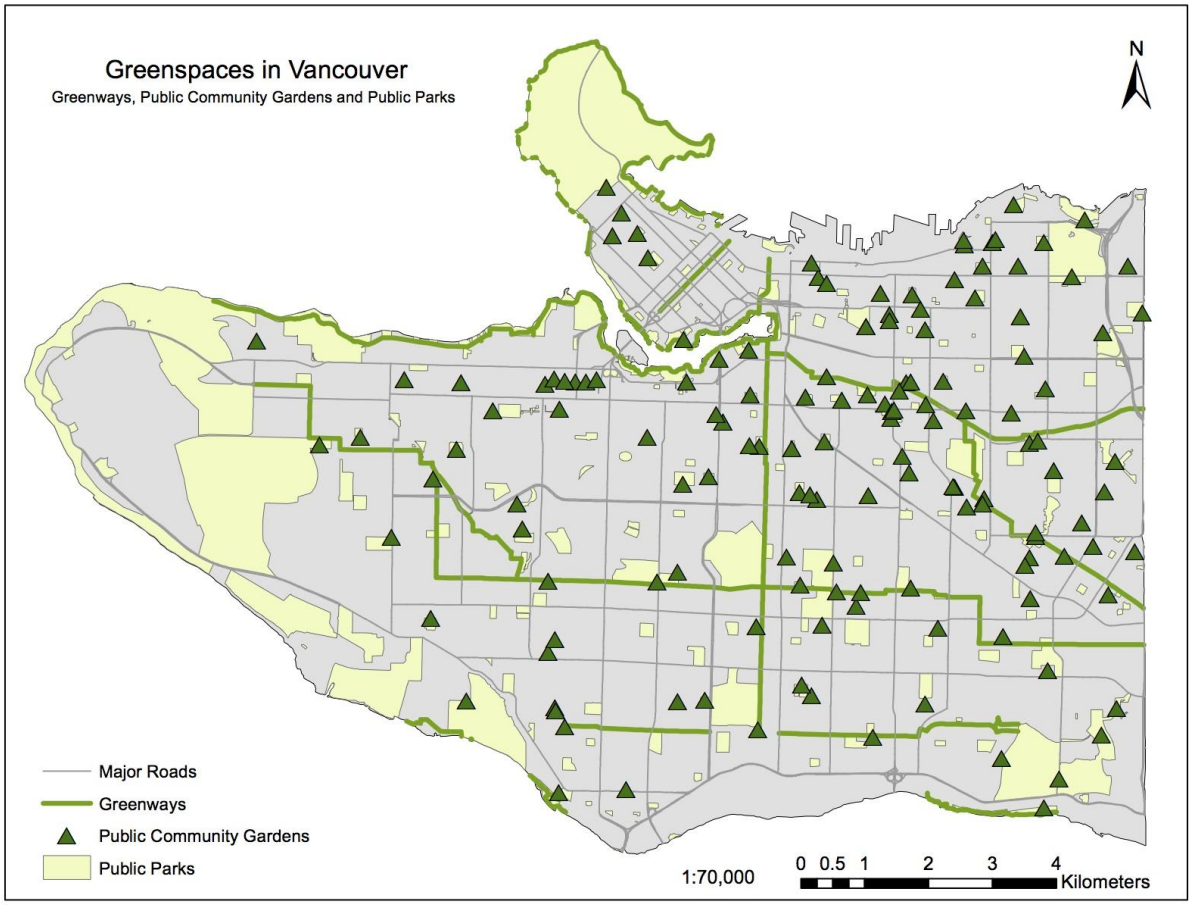
While the extent of this report's analysis covered multiple facets of greenspace related to Vancouver, there is significant room for further research on the matter, as well as multiple recommendations to take into account. The first area of further research involves expanding upon our research of areas lacking greenspace and the associated priority of these areas. Analysis could be done within the priority zones to determine the areas that would be most suitable to create new greenspaces. The connectivity of multiple greenspaces in Vancouver could also be examined, thus providing an analysis on green corridors and the best practice to manage, connect and create more green corridors within the city. Further research might also focus on the fastest growing cities in the lower mainland, such as Surrey. This would be an ideal opportunity to investigate where greenspace might be needed, and address the need while the implementation of new spaces is relatively feasible. Expanding the area of analysis to the entire lower mainland of British Columbia might also be a key future area of research. Analysis could be done on the surrounding cities and neighbourhoods to determine which have the most greenspace, and which cities are in need of more. Recommendations for future analysis include using more recent data to produce a current up-to-date analysis of greenspaces in Vancouver. Comparisons of greenspace over multiple years could thus take place, showing how the city's greenspaces are evolving and changing. Furthermore the re-evaluation greenspace areas in a couple years could make for a noteworthy analysis. As the City of Vancouver has an incentive to be the greenest city by 2020, analysing the greenspace areas before and after the target deadline in four years may bring insight into the realistic capabilities and limitations of transforming a city into one of the greenest in the world.

Appendices

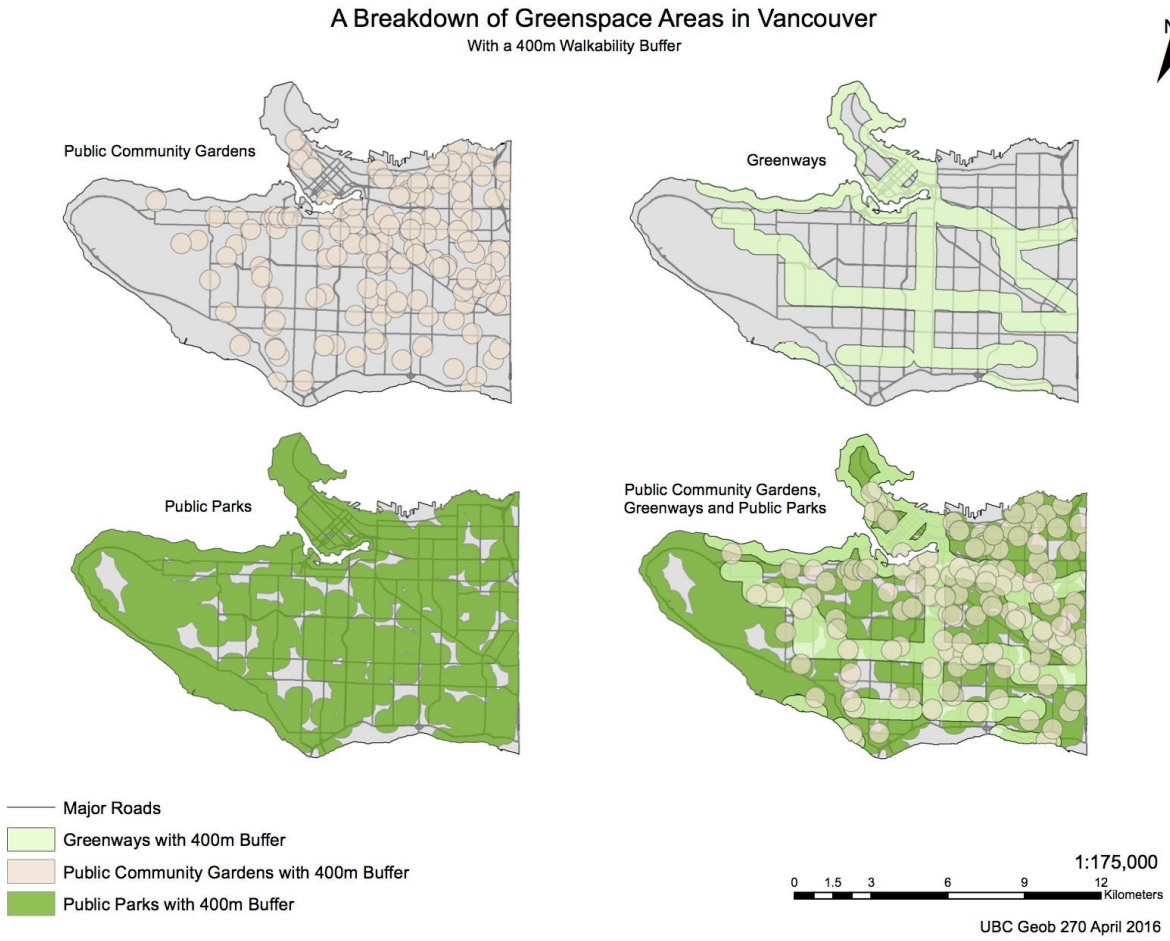
Maps and Tables

Table 1. Various calculations of areas of greenspace and areas lacking greenspace.

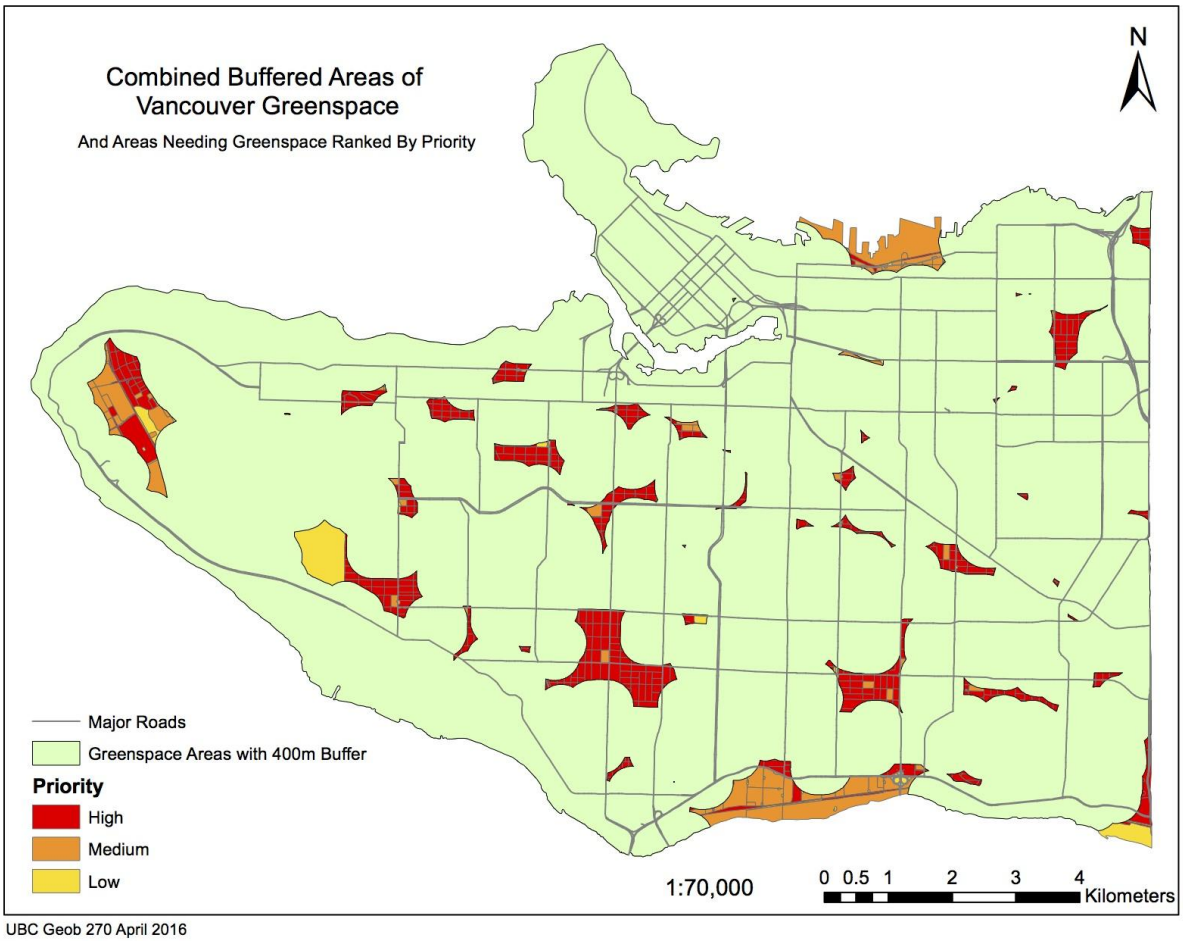
Total length of greenways	75.05 km
Total number of public community gardens	147
Total area of public parks	25.1 km^2
Total area of Vancouver	131.0 km^2
Total area not within walkable distance to green spaces (400m)	9.96 km^2
Area of spaces with high priority for green space development (residential)	5.74 km^2
Area of spaces with medium priority for green space development (resource and industrial, government and institutional)	3.11 km^2
Area of spaces with low priority for green space development (open area, commercial)	1.11 km^2
Total area in Vancouver within a walkable distance to green spaces, as a percentage.	92.4%
Total area in Vancouver not within walkable distance to green spaces, as a percentage.	7.6%
Total area of public parks in Vancouver, as a percentage.	19.2%



Map 1. Greenspaces in Vancouver: greenways, public community gardens and public parks.

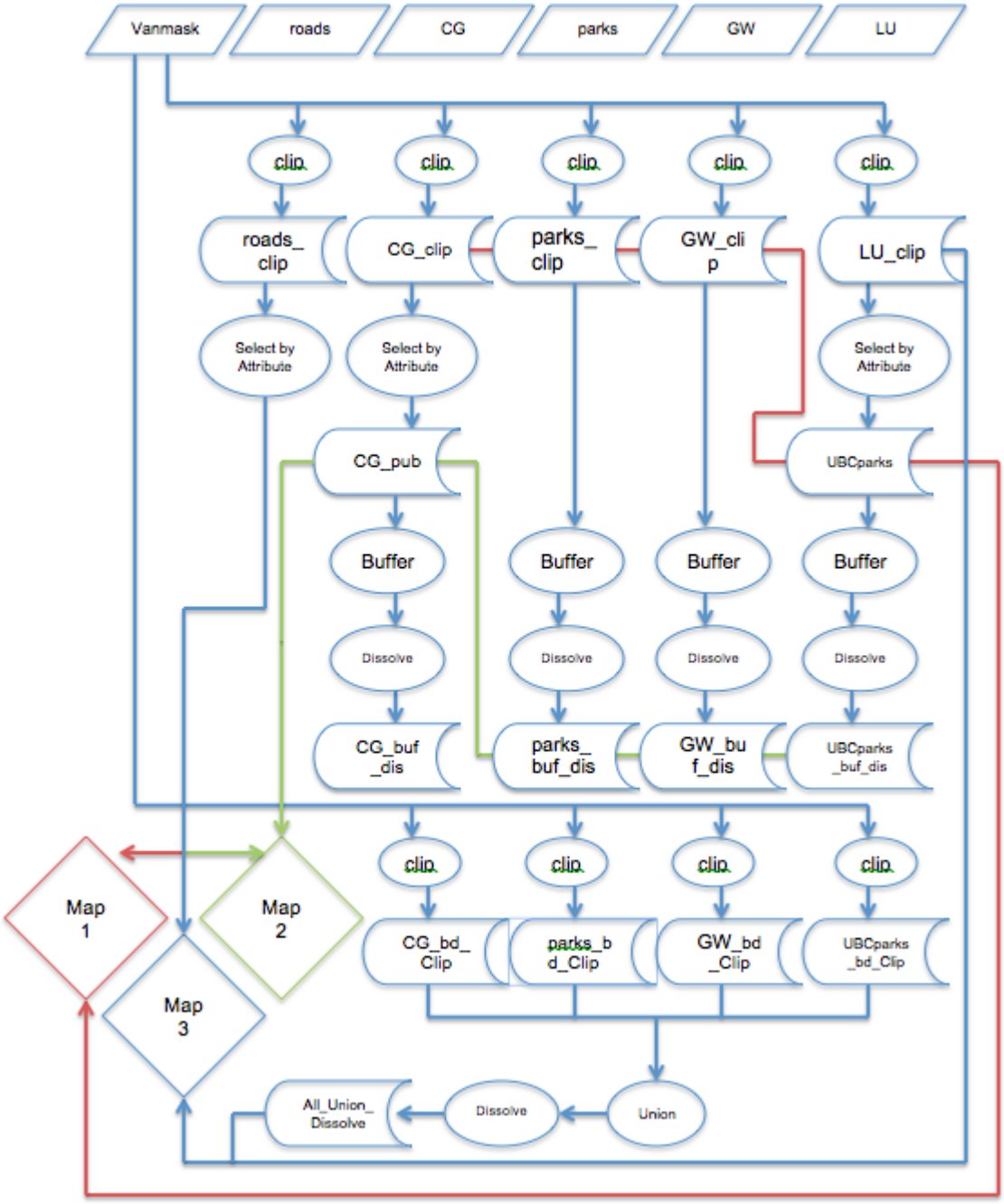


Map 2. A breakdown of greenspace areas in Vancouver with a 400 m walkability buffer.



Map 3. Combined buffered areas of Vancouver greenspace and areas needing greenspace ranked by priority.

Flowchart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