Neighbourhood Watch: Crime Rates and School Safety in the West Side of Vancouver in 2015

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Abstract

The aim of our final project was to determine the relative safest neighbourhoods in the West Side of Vancouver for students to attend school. We used data compiled by the City of Vancouver for 2015 to analyze the amount of crime that occurred nearby to schools during daytime/school hours. The analysis consists of comparing crime rates around schools to overall crime within individual neighbourhoods, as well as to our entire targeted project area. Our map products show overall daytime crime, the safest neighbourhoods for students compared against the entire project area, the relative safety of each individual neighbourhood, and real crime rates based upon the number of schools per neighbourhood. For the analysis, it is possible conclude that the safest neighbourhood to attend school in the West of Vancouver is in Dunbar-Southlands and the least safe neighbourhood is the West End.

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Description of Project, Study Area, and Data

Our project sought to determine how much crime was occurring around Vancouver schools and, based on that information, determine which neighbourhoods were safest for students. We selected a radius of 250 meters around schools to show how much crime was occurring nearby. We also filtered only for crime that occurred during school hours or hours that students would be going to and from school, which we determined as between 0700 and 1800 hours. We selected out the evening and overnight hours as students are likely safe at home and unlikely to be affected by criminal activity during those times. Originally we had aimed to focus on the entirety of Vancouver, but later decided on a smaller sample area to focus on: the 12 neighbourhoods that make up the West of Vancouver: Arbutus Ridge, Downtown, Dunbar-Southlands, Fairview, Kerrisdale, Kitsilano, Marpole, Shaughnessy, South Cambie, Oakridge, West End, and West Point Grey. We also chose to focus only on public schools, as information on them is more readily accessible through reliable, government portals. The reason for the smaller sampling was primarily due to a change of course for our final project, constraining our timetable for analysis, as well as the fact that the crime report data consumed a large amount of data. The data we used was pulled from the City of Vancouver's website, with the exception of the Vancouver Mask layer that we loaded from one of the class labs. The other layers initially used were the crime shapefile, selected for 2015; the Local Area Boundary shapefile, showing neighbourhood delineations, and the Public Spaces shapefile.

Methodology of Analysis

Data was collected from the City of Vancouver's Online Data Catalogue as well as from the UBC shapefiles made available to the class. The layers collected included: Crimes 2015, Schools, Local Area Boundary for Vancouver, and the base layer Vancouver Mask. The first 3 layers were downloaded as zip files, and then extracted into a new file onto the computer. The last layer was extracted for the UBC database. The second step was to organise the workspace by setting up a GeoDatabase and connecting the folders, which contained our layers, via ArcCatalog before going on into mining the data and focussing our analysis in ArcMap 10.3.1. The 4 different layers were added to the ESRI software ArcMap and the coordinate systems of each layer was verified to be NAD_1983_UTM_10N. Nevertheless, before going further into analysing crime around schools and its spread around Vancouver, it was necessary to manipulate and filter the data in order to keep only that of interest.

To focus the analysis on the West Side of Vancouver, the West Side Neighbourhoods were selected by Attributes for the Local Area Boundary layer and then the selection used to create a new layer. Online resources were used in order to select which Neighbourhoods were on the West Side of the city (Faith Wilson Group, Web). The West Side Local Area Layer was Clipped to the Vancouver Mask layer using ArcToolBox, since the neighbourhoods areas extended to areas beyond the land. This resulted a final layer of **West_Side_Neighbourhoods**. The Crimes_2015 layer as well as the School layer were clipped to the final Neighbourhood layer. In addition, Crimes was also intersected with Neighbourhoods in order to assign the crimes to the neighbourhood in which they occurred and to know the total amount of daytime in a neighbourhood (Something important for further steps in the analysis).

The next step was to filter the crime data. When opening the layer's attribute table it was possible to observe that crimes were assigned a time/day/month of occurrence. Consequently, in order

to focus the analysis to crimes happening during the day around schools, it was necessary to select by attribute hours from 0700 to 1800 and to create a new layer from selection: Daytime_Crimes.

Afterwards, using ArcToolBox, a Buffer of 250 metre was created around Schools in the West Side of Vancouver, and then intersected with the Daytime_Crimes of West Side Vancouver. The resulting layer, Crimes_Day_SchoolBuffer_WS, thus provided the targeted information which was asked for: An attribute table with the crimes happening in the School Buffer, and with a field indicating in which neighbourhood the crime happened; the total amount of daytime crime around Schools was 1077.

Four summary output tables were created. The first one summarised the total number of schools per neighbourhood. The second one summarised the different types of crime which occurred in the School Buffer per area per neighbourhood. The third table summarise the number of daytime Crimes in the respective neighbourhoods' total areas. The fourth summary table contained the number of crimes around school buffers in each respective neighbourhood. By using the *Join* option, the tables were added together to carry out the following calculations:

> **Calculation 1:** Number of crime in School Buffer within a neighbourhood/Total Crimes around School in West Side Vancouver(1077)*100
> **Calculation 2:** Number of crime in School Buffer within a neighbourhood/Number of Crimes in the total area of the Neighbourhood*100
> **Calculation 3:** Number of School Crimes in a neighbourhood/Number of schools in that neighbourhood.
> **Calculation 4**: Real crime percentage adjusted per number of school in each neighbourhood

Once the different categories of percentages have been calculated in the Summary Output Tables the next step is to join the table to the West_Side_Neighbourhoods (join and align to the Neighbourhood names). (If needed the Editor was used to correct for different spellings which prevented the join for some rows (Example: Arbutus-Ridge to Arbutus Ridge). Once the table has been joined, it was required to triplicate the data frame.

In the first data frame, the symbology of the Neighbourhoods was selected as such to represent (using Natural Breaks Classification), the calculated percentages of the total spread of crimes in the School Buffers in Westside Vancouver. The second data frame was symbolised to represent the percentages of crime within a Neighbourhood occurring within School Buffers. The last data frame was symbolised to represent the relative neighbourhood crime exposure adjusted for School Count within each neighbourhood.

The symbology representing the different percentages in each data frame enables the construction of different maps which enable a clear and precise analysis and comparison of the crimes around schools, their distribution around Vancouver, the percentages of crimes in a neighbourhood occurring around Schools, and the real percentages of crime rate according to the number of schools within a neighbourhood.

Discussion and Results

In our analysis we have included four maps. The first map depicts our area of study: mapping the public schools, the 250 metre radius created around them, and total day time crime for 2015 [Appendix 1]. The latter three maps will be discussed in detail in this section as they are the focus of our analysis. In the interest of brevity, unless otherwise specified, allow 'crime' to represent only crime within schools 250 metre radius during(7:00 AM- 6:00 PM.

Map 2 summarizes a neighbourhood's degree of risk based on the aggregated total of crime incidences around schools divided by the crime instances around a neighbourhood's schools. In other words this map compares neighbourhoods by the crime around their respective schools. The schools in the West End are perceived as the most dangerous, reflected by the colour red. In the West End we recorded three schools in the neighbourhood which accounted for 42.7% of crime. Kitsilano's schools were perceived as the second most dangerous accounting for 17.8% of crime. The number of schools between these neighbourhoods is a salient difference. Although the West End's crime rate more than doubles Kitsilano's, the West End has two less schools then Kits. The large concentration of crime around West End schools hints that some other factor may be at play. Allow me to expand more on that analysis after finalizing the neighbourhood results. Downtown is the third riskiest neighbourhood accounting for 6% of crime but note that Downtown area only has one school. The three schools in South Cambie saw marginally less crime than Downtown accounting for 5.8%. Shaughnessy's three schools are perceived to be slightly safer than South Cambie and account for 4.6% of crime. Oakridge, Marpole, and Fairview exhibited similar percentiles; respectively, 3.9%, 3.8%, 3.7% they have similar perceptions of risk with Fairview taking the cake for the safest of the lot given the lowest crime rate and two schools compared to the four in both Oakridge and Marpole. The West Point Grey neighbourhood hosts three schools and 3.4% of crime around them. Kerrisdale has four schools and 3.2% of crime. Arbutus has three schools and accounts for 3% of crime. Dunbar-Southland's has five schools and only accounts for 2%. For your convenience we have included a table depicting these results [See Table 1 in Appendix].

Analysis of this map identified some uncertainty because the number of schools within a neighbourhood was not considered as a function of total school crime in the neighbourhood. These issues will be addressed further in map 4.

Discussion of Map 3 [Appendix 3]:

In Map 3 we sought to create a relation between crime exhibited around schools within a neighbourhood and the total crime incidences in each neighbourhood and then compared these percentages to other neighbourhoods. Essentially we are looking at proportion of neighbourhood crime that happens around its schools. The downfall of this analysis is that it does not account for the discrepancies identified in number of schools per neighbourhood or the variance of crime rates by neighbourhood. Notice in map 3 that Downtown is perceived to have much lower risk of crime exposure then its representation in map two. This switch occurs because in this map total crime in the Downtown area is the highest recorded and there is only one school meaning that the location of the single Downtown school is very safe relative to its neighbourhood but still more dangerous than most schools. That said this map could be a good resource for families bound to the downtown area trying to provide themselves assurance of their child's safety. For this map to be more applicable to a general audience an additional step to normalize crime rates must be conducted, allowing simple comparison.

Discussion of Map 4 [Appendix 4]:

Map 4 assumes equal crime occurrences around each school within a neighbourhood, which gives each neighbourhood and average crime occurrence around its schools. By calculating this average,

we are able to look at neighbourhood school crime rates as if every neighbourhood only had one school, in other words normalizing school values to allow for an applicable comparison. In Appendix C, it is possible to find the complete table of the values that map 4 depicts; however the neighbourhoods in descending order from greatest crime exposure are: West End, West Point Grey, Downtown, Kitilano, South Cambie, Fairview, Shaughnessy, Arbutus, Oakridge, Marpole, Kerrisdale, and Dunbar- Southlands.

Social Implications of Study

The results of our project have important social implications for Vancouver, particularly for parents who may be trying to decide where to send their children to school. It could also influence where a family moving in from out of town may decide to settle. Obviously, parents want their children to have a safe environment in which to study. Our maps and analysis illustrate those areas clearly for the West Side of Vancouver, much of which is residential. Overall, the maps reflected a trend we expected to see, namely that the more dense areas of the city experienced more crime, meaning more crime was likely to happen within our set range of a school. This is most apparent in our second map, "Neighbourhood Distribution of Crimes Around School, West Side Vancouver, 2015". Specifically the West End, Downtown, and Kitsilano show a higher percentage of crime overall.

What was surprising during our analysis, however, was that Downtown and Fairview schools are much less likely to have crime occur around them when only considering the crime that occurs within the boundaries of the neighbourhoods in which they reside. When comparing the data to the first map, which shows all crimes committed, it becomes clear why this is the case. These schools are located away from the arterial roads and sit on the edge of their neighbourhoods. In Downtown, the highest concentration of crime occurs near Hastings Street and along other main arteries that run into and out of the city. The same is true in Fairview; most of the crime occurs near W. 4th Ave, or radiating out a few blocks in either direction. The schools in these areas occupy beneficial geographic terrain. They are far enough away from the central hubs of their respective neighbourhoods that they do not experience much crime nearby, despite being in neighbourhoods where more crime occurs overall.

On a related note, although not directly analyzed for this project, it is surprising that in some of the more crime dense neighbourhoods of the city, there are fewer schools. This is shown on the map "Percentage of Crimes Happening Around Schools in Respective Neighbourhoods". A parent deciding on where they want their child to attend school might consider several factors when parsing this data. First, there is wider selection of safe schools to choose from to the south and west of Vancouver. Second, despite the relative safety of the schools close to Downtown, a child would likely still need to cross through areas of the city that have higher rates of crime, thus possibly negating the benefits of attending a safe school.

Our final map, "relative neighbourhood crime exposure: adjusted for school count" gives the clearest picture of the safety of Vancouver schools and their neighbourhoods. This map adjusts the data to show the real crime percentage that occurred around schools. Effectively, this shows how likely or unlikely a student is to be nearby a school when a crime occurs. Given the results of our analysis, the safest neighbourhoods overall in the West Side of Vancouver are in Dunbar-Southlands, West Point Grey, Arbutus Ridge, and Kerrisdale. In contrast, the least safe neighbourhoods for students are in the West End, Downtown, Kitsilano, Shaughnessy, and South Cambie.

Error and Uncertainty

Unlike writing a paper or conducting an experiment uncertainty and error take on a different light in map making using ArcMap. There is little uncertainty regarding the validity of sources as they are

primary sources garnered from Vancouver's public data catalogue. However, we must consider that each of our layers has been converted from the three dimensional space which we live in to two-dimensional form that is expressed through a datum and projection. Aggregating the layers needed for your map can challenge the uncertainty and error in a project. We ensured that our layers were consistent and valid for spatial analysis by choosing a default projection & datum: NAD 83, UTM 10N. With our default datum & projection established, we must clearly identify and maintain focus on the scope of our projects study.

In this project we focused on identifying a student's likelihood of being subjected to a crime in a 250-metre radius around Vancouver's West-side schools. Although similar, there are many definitions available for the Westside. For the purpose of this project, the Westside of Vancouver extends East to West from Cambie St. to Blanca St. and North to South from the Northside perimeter of the downtown core to the Fraser river. This area excludes Stanley Park and UBC. The 40 public schools identified within this boundary are classified within Vancouver's School Boards (VSB) district 39. It is important to clarify that we are not looking at all of the schools in district 39, just the ones on the Westside. Included in our sample are a variety of public annex, elementary, and secondary schools; there are private schools within our spatial scope that have been omitted from analysis. The neighbourhood boundaries represent long-standing local planning areas that tend to follow street centre lines and were also obtained from the Vancouver's public data catalogue.

We chose a school buffer radius of 250 meters because it is close enough to the school to seem likely that a student could cross paths with crime in this radius as they are leaving the school to get home. This number could be larger but would only muddy the data as you get further away from the school and area of focus. Additionally the radius has been kept small to increase certainty that the majority of the school's population will have to walk through the area. In order to keep our analysis relevant, we have only displayed crimes between 7:00 AM - 6:00 PM a slightly extended school day. Our sample covers Monday - Sunday January 1, 2015 to December 31, 2015. Our analysis could be perceived as more accurate if we chose to exclude summer months and weekend days but we chose to include them because it has become more commonplace for schools to host weekend events and offer summer camps and programs. The public crime data we obtained counts the instances of: commercial break and entry, residential break and entry, mischief, theft from a vehicle, theft of a vehicle, and other theft.

Further Research/recommendations

Time constraints have forced us to neglect certain aspects we believe salient to this analysis. Below you will find three suggestions for further research:

1) Further research in this field could be supplemented with further data that seeks to explain the origins of the crime. For example is it a concentration of population that leads to higher crime rates around select schools, or a lower education level, or some nearby facility that attracts a unsavoury crowd.

2) There is certainly more work to be done to provide a complete look at risk within 250 m of a school. Some crimes were neglected from the report, such as sexual assault, further research should seek to include these neglected crimes. Another risk that has been overlooked is travel risks. Traffic accidents around schools could prove useful in classifying associated risk and opportunity cost of choosing one school over another.

3) Additionally through our research it was discovered that the VSB has identified school families that a student would naturally progress through as their education advances, for example elementary schools are paired with secondary schools. An interesting analysis that we didn't have time to complete would be to compare the relative safety of school families.

Bibliography

Group, Faith Wilson. "Vancouver Neighbourhood Information Map | Faith Wilson Group." Vancouver
  Neighbourhood Information Map | Faith Wilson Group. Web. Nov. 2016.
  <http://faithwilsongroup.com/vancouver-neighbourhoods/>.

"Open Data Catalogue." City of Vancouver Open Data Catalogue. Web. Nov. 2016.
  <http://data.vancouver.ca/datacatalogue/>.

Appendix 1 – Map 1

Daytime Crime and School Buffers, West Side Vancouver, 2015
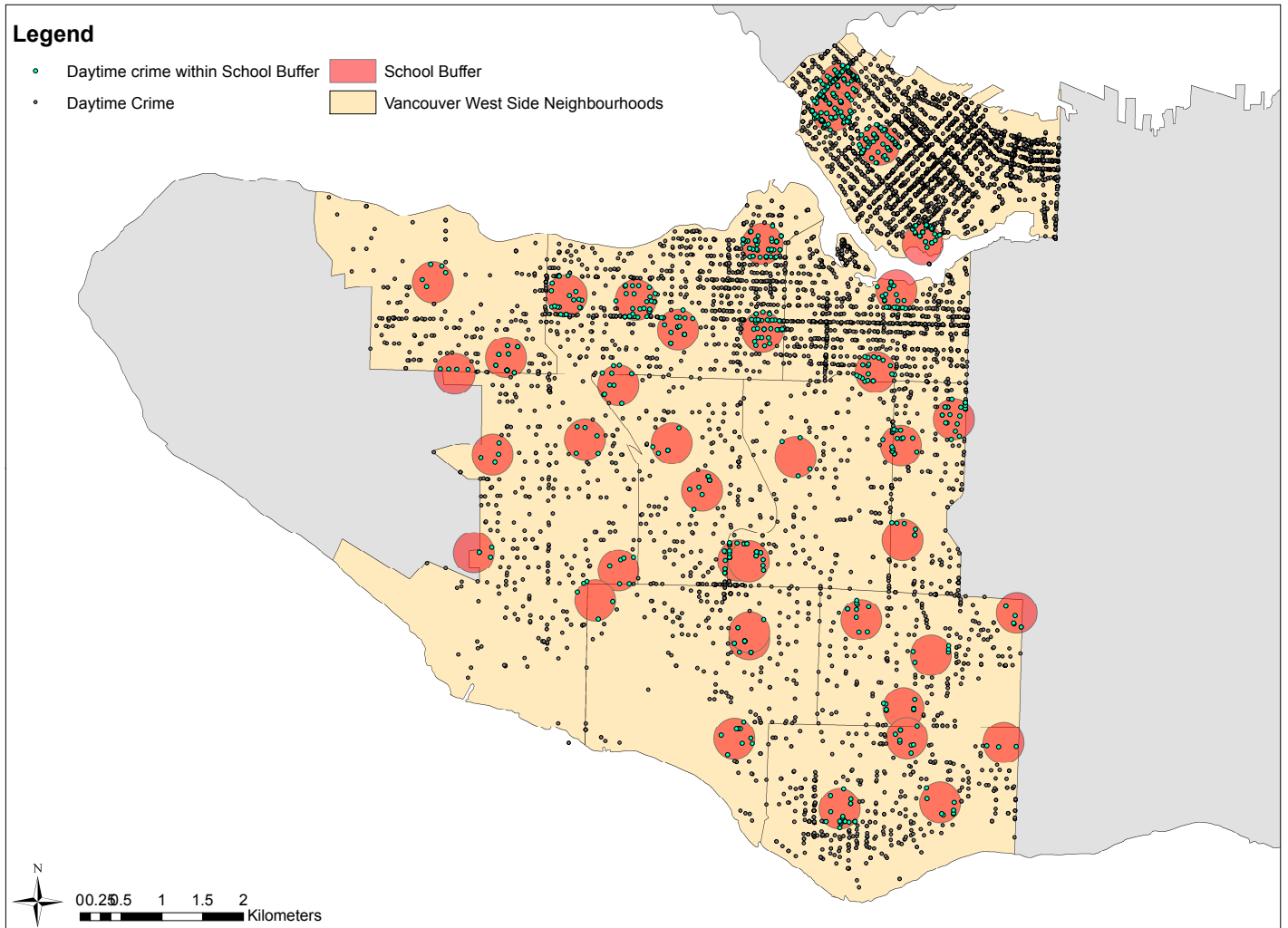
Appendix 2 – Map 2 and Table of Calculations

Neighbourhood Distribution of Crimes Around School, West Side Vancouver, 2015
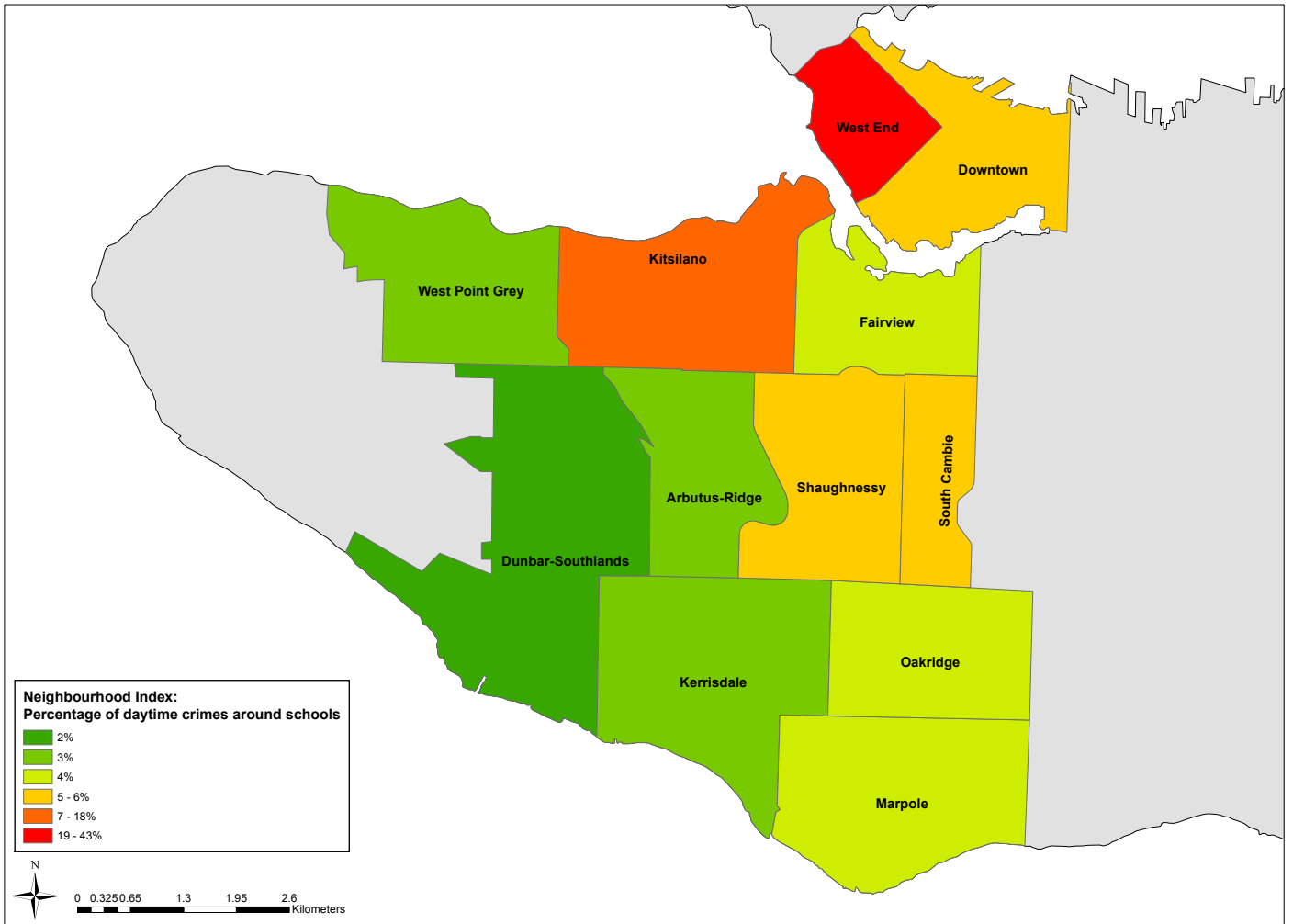
Neighbourhood	Number of schools	Total Neighbourhood Day-time Crime	Crime Within School Buffers
Arbutus	3	218	32
Downtown	1	5879	65
Dunbar-Southlands	5	302	22
Fairview	2	1412	40
Kerrisale	4	207	34
Kitsilano	5	972	192
Marpole	4	434	41
Okaridge	4	385	42
Shaughnessy	3	222	50
South Cambie	3	252	62
West End	3	1724	460
West Point Grey	3	226	37
Total	40	12233	1077

Appendix 3 - Map 3 and Table of Calculations

Percentage of Crimes happening around Schools in respective Neighbourhoods, West Side, Vancouver 2015
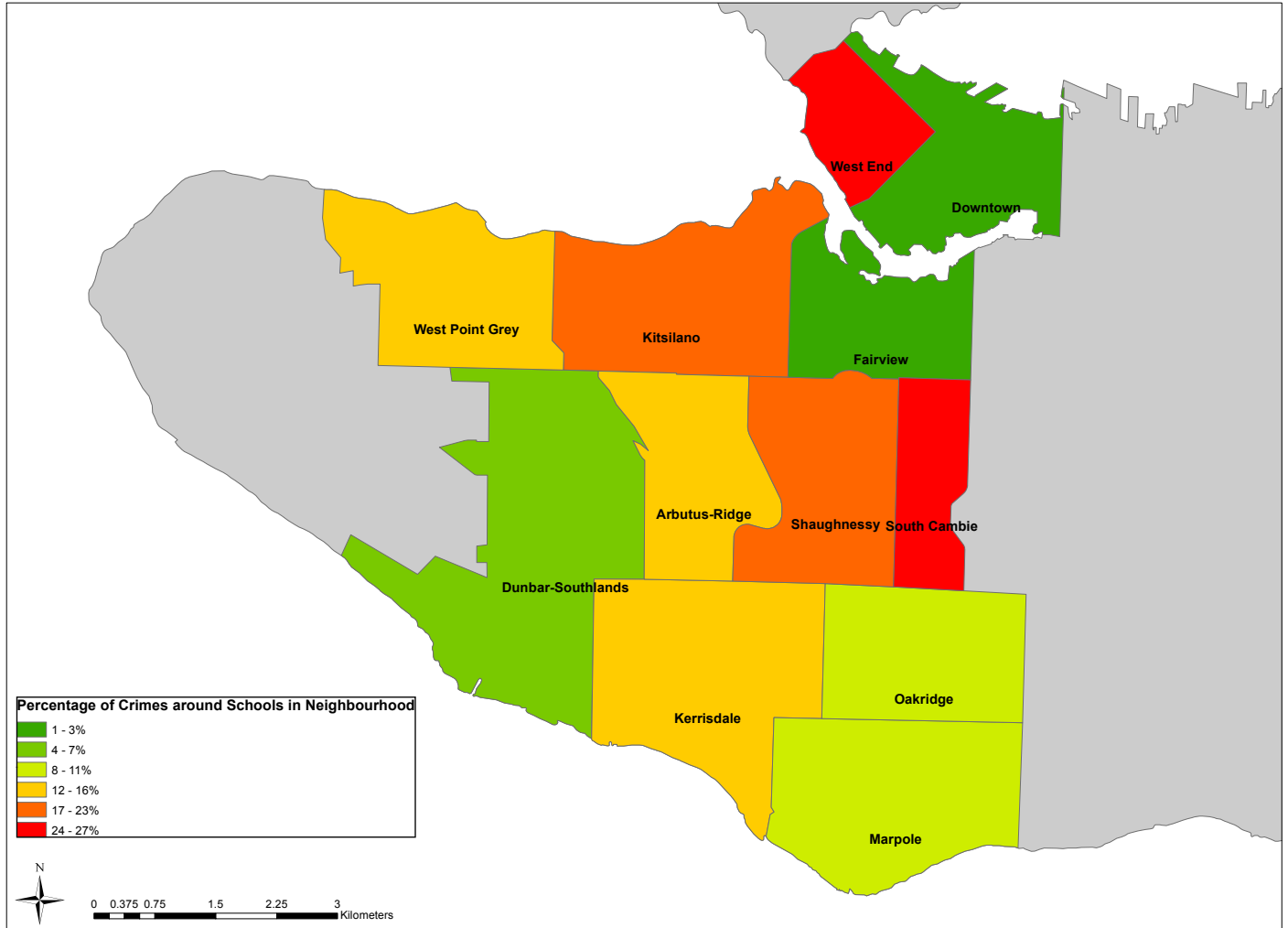
Neighbourhood	Percent of Crime around Schools Relative to Total Neighbourhood Crime (%)	Total Neighbourhood Day-time Crime	Crime Within School Buffers
Arbutus	14,68	218	32
Downtown	1,11	5879	65
Dunbar-Southlands	7,28	302	22
Fairview	2,83	1412	40
Kerrisale	16,43	207	34
Kitsilano	19,75	972	192
Marpole	9,45	434	41
Okaridge	10,91	385	42
Shaughnessy	22,52	222	50
South Cambie	24,60	252	62
West End	26,68	1724	460
West Point Grey	16,37	226	37
Total		12233	1077

Appendix 4 – Map 4 and Table of Calculations

Relative Neighbourhood Crime Exposure: Adjusted for School Count
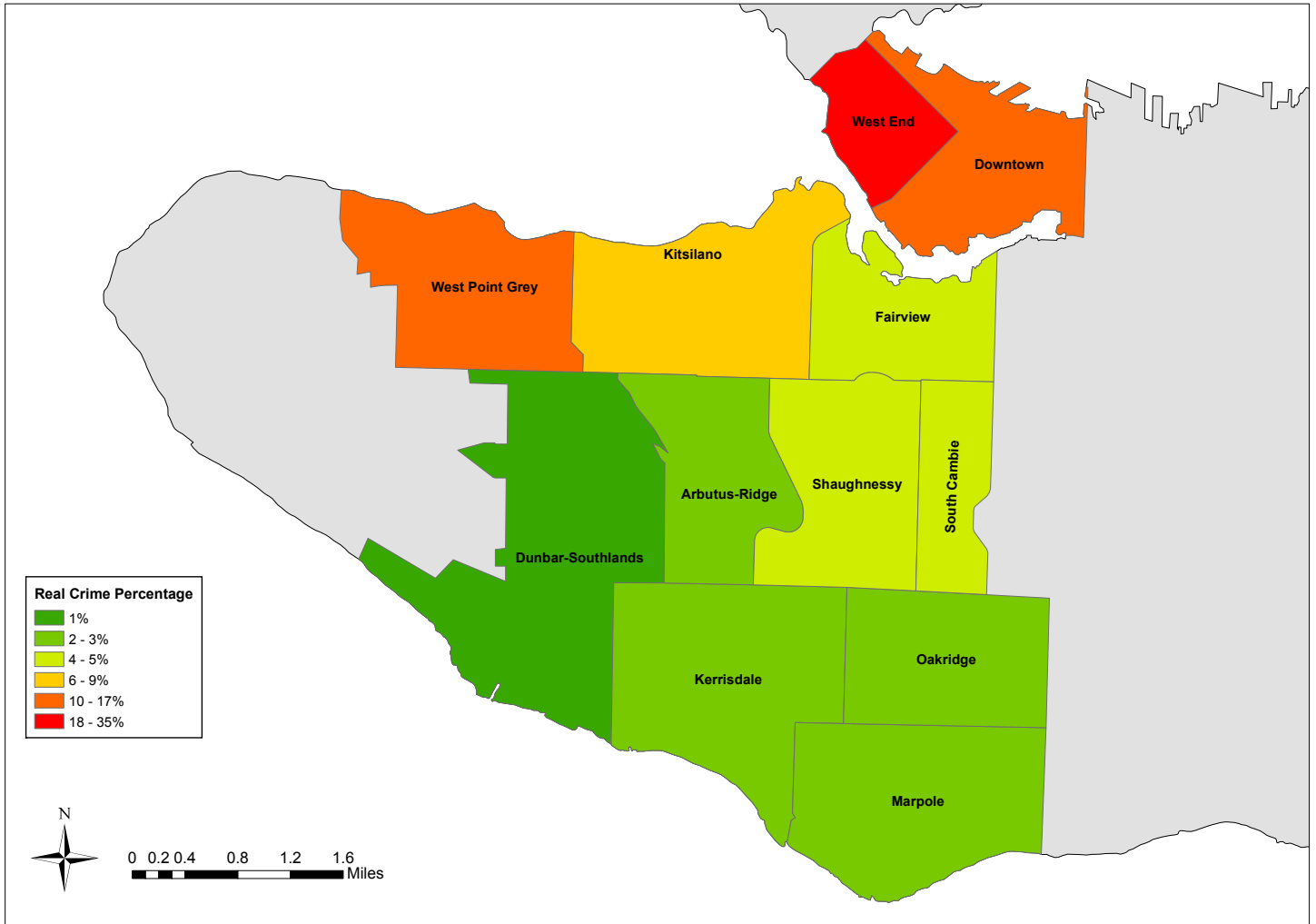
Neighbourhood	Real Crime Rate: School Crime ÷ Number of Schools Per Neighbourhood	Real Crime Percentage (%)
Arbutus	10,67	2,46
Downtown	65,00	14,99
Dunbar-Southlands	4,40	1,01
Fairview	20,00	4,61
Kerrisale	8,50	1,96
Kitsilano	38,40	8,85
Marpole	10,25	2,36
Okaridge	10,50	2,42
Shaughnessy	16,67	3,84
South Cambie	20,67	4,77
West End	153,33	35,35
West Point Grey	75,33	17,37
Total	433,72	100,00

Flowchart

BASE LAYERS | Crime_shp_2015 | Vancouver_Mask | Local Area Boundary | Schools

Clip all initial layers to Vancouver Mask

Local Area Boundary

Public Places

Select by Attribute for Western Vancouver neighbourhoods

Categorize and select for schools to create new layer

New Layer: local_area_westvancouver

New Layer: Schools

Intersect lawv and crime layers

Intersect lawv and schools layers

New Layer: crime_wv

New Layer: schools_wv

Intersect crime_wv and schools_wv

Select by attributes for time of day of crime 0700-1800

Buffer 250m around schools

New Layer: crime_wv_intersect_schools

New Layer: crime_wv_daytime

Clip crime_wv_intersect_schools to crime_wv_daytime

New Layer: crime_daytime_school_intersect

Output: Map 1

Reclassify, Manual Break for risk. All crimes near schools during the day, across entire field of study, % by neighborhood.

Reclassify, Manual Break for risk. Crimes near schools during the day, % by individual neighborhood.

Reclassify, Manual Break for Real Crime %, relative to crime by neighborhood, and school count.

Output: Map 2

Output: Map 3

Output: Map 4