

**ACCESSIBILITY OF THE HALIFAX POPULATION TO GROCERY STORES AND
FAST FOOD OUTLETS BASED ON SOCIO-ECONOMIC STATUS**

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ABSTRACT

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The purpose of this thesis was to determine accessibility to grocery stores and fast food outlets of the disadvantaged population of Halifax. Socio-economic data on dissemination areas was obtained from Statistics Canada and index scores were generated. The criteria used from Statistics Canada were that of age, household income, unemployment, and prevalence of lone parent households. The disadvantaged dissemination areas walking and driving accessibility was then compared to both chain grocery stores and chain fast food outlets in Halifax. The analysis found that just fewer than 50% of the disadvantaged dissemination areas did not have walking access to grocery stores. The analysis also found that of the areas that lacked walking access to grocery stores, 69.2% had 20 minute walking access to fast food outlets.

April 3, 2015

RÉSUMÉ

ACCESSIBILITY OF THE HALIFAX POPULATION TO GROCERY STORES AND FAST FOOD OUTLETS BASED ON SOCIO-ECONOMIC STATUS

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Le but de cette thèse était de déterminer l'accessibilité aux épiceries et sorties de la population défavorisée de Halifax de restauration rapide. Les données socio-économiques sur les aires de diffusion ont été obtenues de Statistique Canada et de l'indice marqué ont été générés. Les critères utilisés par Statistique Canada étaient celle de l'âge, le revenu des ménages, le chômage et la prévalence des ménages monoparentaux. Les aires de diffusion défavorisés marche et la conduite de l'accessibilité a été comparé à deux épiceries de la chaîne et la chaîne de restauration rapide à Halifax. L'analyse a révélé que peu moins de 50 % des aires de diffusion défavorisés n'a pas eu accès à pied à l'épicerie. L'analyse a également constaté que des zones qui ne avaient pas accès à pied à des épiceries, 69,2 % avaient accès à pied de 20 minutes aux points de vente de restauration rapide.

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Halifax, Nova Scotia
April 3, 2015

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Chapter 1

Introduction and Literature Review

Access to healthy food can be a deciding factor in the health of an individual. It has been found that the urban environment is intrinsically linked to access to food outlets. This thesis asks the question; how accessible are grocery stores and fast food outlets to the population of Halifax based on socio-economic status?

According to the Public Health Agency of Canada (2011) 1 in 4 Canadians are considered obese. Obesity can lead to increases in heart disease, diabetes, liver disease, and some forms of cancer (Public Health Agency of Canada, 2011). The urban environment is recognized to contribute to overall health of citizens both negatively and positively. However, Mikkonen and Raphael (2010) explain that poor quality housing, inadequate housing conditions, and limited access to healthy food options increase the risk of many health problems, including obesity and diabetes (p. 29). The number of overweight and obese individuals has surpassed the number of normal weight individuals within Canada (Navaneelan, and Janez, 2014). In the 2005 Canadian Community Health Survey, 38.9% individuals reported being normal weight (defined by a BMI ranging from 18.5 to 24.9) (Health Canada, 2014), while those overweight and obese (defined by a BMI ranging from 25.0 to 40+) was 51.4%. In 2008, the number of normal weight individuals declined to 36.1%, and the number of overweight and obese increased to 52.3%. However, since 2008 to 2012 these numbers remained stable. In 2012, the reported number of

people who were overweight or obese within Halifax metropolitan was 57.1%, which is above the national average of 52.3% according to Statistics Canada (2013). Obesity is becoming a serious problem within Canada, and Halifax is no different. With this in mind and the importance of accessibility to fresh food options, an analysis of supermarkets (grocery stores)¹ and fast food outlets will be conducted in this research project.

The 1960's witnessed an increase in suburbanization, accompanied by food retailers following people to the cheap land outside of the city (Bedore, 2013; Larsen, and Gilliard, 2008), and 'food deserts' began to emerge in the urban landscape. Food deserts are defined as "those areas of cities where cheap, nutritious food is virtually unobtainable. Car-less residents, unable to reach out-of-town supermarkets, depend on the corner shop where prices are high, products are processed and fresh fruit and vegetables are poor or non-existent" (Wrigley, 2002, p. 2032, as cited in Whitehead, 1998, p. 189). Without accessibility to grocery stores, which Huddleston *et al.* (2009) defines as "a traditional supermarket format offer[ing] a full line of groceries, meat, and produce, with some operations offering a mix of general merchandise items" (p. 63-64), a dependence on poorer quality food arises. Low income individuals are defined by the Hartfiel, *et al.* (2010) as individuals who spend 43% of their income on food, shelter, and clothing. The accessibility becomes an issue for low income individuals without access to a car causing a dependence on poorer quality food, including fast food, which is defined as "food sourced from an outlet without table service" (Burns and Inglis, 2007, as cited in Stewart *et al.*, 2004). Accessibility becomes the issue for disadvantaged individual. According to Litman (2011) accessibility is defined by "a person's ability to reach desired goods, services, activities, and

¹ The terms supermarket and grocery stores are used interchangeably to reflect the research literature.

destinations” (p.5). Accessibility to supermarkets became an issue for people who could not afford cars, or are not within walking distance to supermarkets.

The first reports of food deserts were from Britain in the 1990’s (Wrigley, 2002). With increasing suburbanization of grocery retailers, parts of urban landscapes became devoid of grocery stores, and people. As the problem of food deserts became more prevalent, and observable, a number of factors became evident: those being socio-economic factors. Research papers began to appear addressing the prevalence of food deserts. With evidence growing in many developed nations such as Great Britain, United States of America, Australia, and Canada, the issue came to the forefront (Wrigley, 2002). It becomes not just a question of physical accessibility, but also a question of what socio-economic conditions factor an individual’s accessibility to fresh food.

A number of studies have looked for food deserts in both Canada and United States of America. However, in a number of cases there were none to find. Within the literature there seems to be a trend within larger, and more densely populated cities, such as Montreal (Apparicio *et al.* 2007), Toronto (Kirkpatrick and Tarasuk, 2010), and in Edmonton (Smoyer-Tomic *et al.*, 2006), where all three studies found little evidence of food deserts. This may be the case of higher densities in neighbourhoods where grocery stores may see that they can be profitable within the markets. Also within the urban centres of British Columbia (Black *et al.*, 2011), there was little evidence of food deserts. However, British Columbia has had strong zoning by-laws since the mid 1990’s (Boyle *et al.*, 2004). Strong zoning may not allow for the great contrast of wealth, or allow retailers to move to the peripheral of urban areas. This may be the case as to why food deserts are not found in urban British Columbia.

A number of different methods were employed to distinguish if food deserts exist. For a number of articles like Apparicio *et al.* (2007) in Montreal, only large chain grocery stores were studied. Looking at only seven large chain grocery stores, those being IGA, Intermarché, Loblaws, Maxi, Métro, Provigo, and Super C, a study of food deserts was performed. It was found that in census tracts to the periphery of Montreal Island the higher income areas have good accessibility to supermarkets, however, to only one supermarket. This is contrasted by the areas of lower income in the central parts of the city where it was found they had good accessibility to multiply grocery stores. Overall it was found that lower income individuals had better access to grocery stores than the rest of the population. In the end there are few problem areas in relation to food deserts within Montreal according to Apparicio *et al.*

Similar to Apparicio *et al.* (2007), Eckerty and Shetty (2011) studied only large chain grocery stores in Toledo, Ohio in search of food deserts. The study excluded all small non-chain grocery stores, and small convenience stores as they were not considered as offering a full variety of food needs. Also prices tend to be inflated, and thus the customer would likely need to visit multiple stores. The need for multiple store visits and their separation is an important factor within the literature. If a person has to walk over a kilometer to one store, how likely are they to walk to another store, at which point they could be carrying bags already? Eckerty and Shetty (2011) used the following as indicators for neighbourhoods that would be indicated as a food desert: one mile distance cap for walking, the percent of the population below poverty line compared to the city average, the percent of households without vehicle access compared to the city average, the percentage of population receiving public assistance compared to the rest of the population, and the median household income of block group below the city average. When the distance was increased to two miles only one block group was highlighted. Overall the authors

do not feel that Toledo has a food desert problem; however, they did state that planners need to be active in their role in facilitating grocery stores movements to lower income areas to encourage better food choices (Eckerty and Shetty, 2011, p. 1223).

When studying food deserts, researchers often did not look at small independent stores; however, this is what Black *et al* (2011) did in their study. They also utilized descriptive statistical methods to conduct their research. The study was conducted on all metropolitan regions within British Columbia, which contained census tracts. The purpose of their research was to measure distance to food retailers including major grocery stores, small grocery stores, food markets, fruit and vegetables stores, independent seafood, meat, poultry, milk and cheese stores, where fresh ingredients are sold. When considering each variable separately, it was found that in 61% of census tracts, most residential locations had no large supermarket within a 1-kilometre buffer; the average median distance to the closest large supermarket was 1.5 kilometers. However, when considering smaller locally owned shops the median distance to the closest fresh food store was 793 metres. It was also found that a higher percentage of detached homes negatively affected the number of fresh food outlets and supermarkets. When considering all variables together it was found that areas with higher income had less accessibility to fresh food stores, and areas of greater distress (those of low income, recent visible minorities) had greater access to fresh food stores.

The following reviews are of articles that have found food deserts to exist within a geographic region, and a number of these articles also looked at the correlation to not just grocery store accessibility, but also accessibility to fast food outlets. A 2006 study conducted by Burns and Inglis (2007) analyzed the food accessibility in Casey, Australia, a suburb of Melbourne. Burns and Inglis (2007) conducted their study by measuring different ways

expressed in time for individuals to make a trip by car, bus, and by foot to the nearest supermarket or fast food outlet. Access to supermarkets was considered as a proxy for access to a healthy diet, whereas greater access to fast food was considered a proxy to poorer diet. The use of socio-economic data was used to determine which areas were disadvantaged. With the use of GIS they mapped in time which areas of Casey had greater accessibility to supermarkets and fast food outlets. Travel cost surfaces were created to show which had greater access versus lack of access to both supermarkets and fast food outlets. Results showed that 80% of residents had access by car to a supermarket or a fast food outlet, 50% by bus, and 4% by means of walking. However, with areas of less advantage there was greater access to fast food compared to areas of greater advantage. This research was the prime inspiration behind my project.

With suburbanization occurring in Canada as in many other western nations, a study by Larsen and Gilliland (2008) in London, Ontario, analyzed food deserts and the spatial change from 1961 to 2005. The years 1961 and 2005 were utilized to find out whether the suburbanization of the 1960's and 1970's had an impact on accessibility to grocery stores. Larsen and Gilliland hypothesized that less advantaged individuals could not afford cars, and they would have to travel by low cost intra-urban transportation, those being busses and walking. A GIS analysis was conducted utilizing street networks and block level socio-economic data. A distance of 1000 metres for walking was utilized as a proxy for an acceptable walking distance. It was found that in 1961 45.2% of the population had access (1000m walk) to supermarkets, compared to 2005 where only 18.3% had access to supermarkets. It was also found that people within the core of the city in 1961 had greater accessibility to supermarkets compared 2005. This is thought to be a result of suburbanization of food retailing. There was also a correlation between socio-economic status and supermarket access. Similarly to Burns and Inglis (2007) in

Casey, Australia, the people of London, Ontario with lower socio-economic status had less access to supermarkets when walking. However, when considering public transit, there was no difference for people of lower or high socio-economic status and their accessibility to grocery stores in the case of Casey, Australia; however, within London, ON, people of lower socio-economic status had less access to grocery stores, underlining the food desert problem within London, Ont.

There have been some criticisms of how food deserts are studied within the academy. Some believe by taking a hard line around a study area, they are not incorporating the possibility of grocery stores occurring just outside of the study area, and thus people could have access to a store if the locations were incorporated. Sadler *et al.* (2011) studied Middlesex County in south western Ontario, measuring accessibility of rural residents to both grocery stores, and fast food restaurants, not just within their study area, but also up to 16 kilometers outside of the study area. The authors incorporated all grocery stores, fruit and vendor retailers, fast foods chains, and take-out pizza locations. A socioeconomic index was created by taking four variables: low educational attainment (proportion of adults aged 25 and over that have not graduated from high school), unemployment rate (proportion of unemployed adults who are eligible to work), lone parent families (proportion of all households with children that are headed by lone parents), and incidence of low income (proportion of households that fall below Statistics Canada's low-income cutoff for the region). Utilizing GIS and the socioeconomic distress index a measure of accessibility along the street network was conducted. However, because of the characteristics of this rural region, that being people with a higher incidence of distress tended to live in small towns within the county, it was found that people of higher incidence had the greatest accessibility to grocery stores. With the greater accessibility to grocery stores, came

accessibility to fast food restaurants as well. This study was conducted to look at food deserts within Middlesex County, however, it also tested an hypothesis that many studies missed out on vital data, because they utilized what is called a container method, not taking into account the stores just outside of the study area. Sadler et al. (2011) found that all residents were on average within 3,448 metres from a fast food location when considering the edge effect, and without the edge effect residents were 5,449 metres away from a fast food outlet.

The study conducted in Casey, Australia (Burns and Inglis, 2007) and the London, Ontario study (Larsen and Gilliland, 2008) found there to be food deserts. In London the authors did not look at the relationship between socio-economic groups and their accessibility to fast food outlets. However, within the Casey study, the people within those food deserts had greater accessibility to fast food over grocery stores. Within both studies each city had a presence of food deserts. A trend amongst both these situations is that both cities have populations below 500,000, and in the circumstances of the cities without food desert populations have over 750,000 (Statistics Canada, 2011). This excludes the British Columbian situation, because of outside controls like planning, and zoning.

It has been found that when individuals lack access to grocery stores, their chances of being overweight or obese is increased. A study conducted by Lee (2012) found that children that lacked access to grocery stores, and had greater access to fast food and convenient stores, had an upward shift in their Body Mass Index (BMI). This also corroborated by Caspi et al. (2012) explaining that “*availability* (emphasis original) refers to the adequacy of the supply of health food: examples in the food environment might include the presence of certain types of restaurants near people’s homes, or the number of places to buy produce” (p.1173). The accessibility of food options becomes important in dictating an individual’s health. Lichtenstein

et al. (2006) found that a diet rich in fruits and vegetables, whole grain and high fibre foods, regular consumption oily fish, and limited salt and sugar intake has been associated with decreasing the risk of cardiovascular diseases and diabetes. Lichtenstein et al. (2006) also found that it is also important to lead an active lifestyle, and that a lack of access to grocery stores was detrimental to an individuals health. According to Rundle et al. (2008) in New York City the built environment and the walkability of the environment has an effect of the level of obesity of the individuals in a neighbourhood. When lacking access obesity trends increase, while greater access decreases levels of obesity. According to Cannuscio et al. (2014) “the proximity to particular retail outlets is a major driver of consumers’ decisions regarding where to procure food, and that residents, especially low-income and disadvantaged urban residents, shop for food within their neighbourhood” (p. 14). Much of the literature presented has shown that the built environment and its walkability has a profound effect on the health of individuals. People are less likely to choose healthier food options if it is not within their neighbourhood, when they depend on walking to access food.

The study of food deserts is an important part of this research; however, accessibility to food outlets such as grocery stores is only one aspect of urban food options. With the issue of accessibility to food comes the question of if you cannot reach a grocery store what do you turn to instead? The purpose of this study is to compare accessibility of the Halifax population to grocery stores, and fast food outlets relative to socio-economic conditions of that population as distributed by dissemination area.

The remainder of the thesis is organized into chapters. Chapter 2 introduces the Halifax study area and discusses the city’s characteristics. Chapter three explains the methodology used, the data, and the explanation of socio-economic data. Chapter four discusses the results of the

methodology. Chapter five concludes the thesis, and draws comparisons to literature from the literature review.

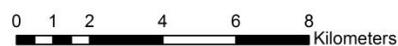
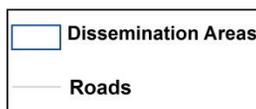
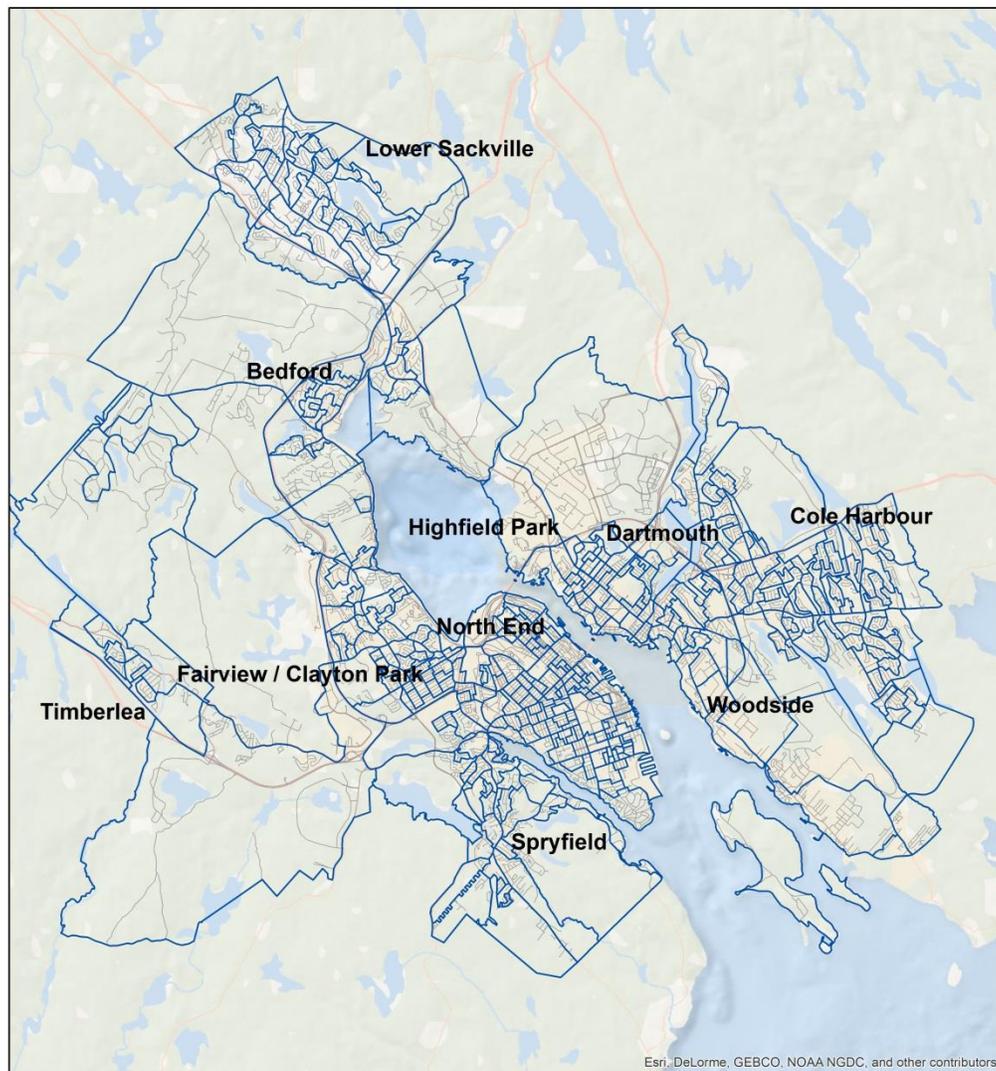
Chapter 2

Halifax

Halifax is the largest populated city east of Quebec City, with a population of 372,679 people in 2006 (Statistics Canada, 2007). However, this study is not concerned with the whole municipality. In 2006, the population for the study area was 301,486, with a population density of 1,106.5 km². Halifax is considered a medium sized city within the definition set out by Henderson (1997). That is a city that ranges from 100,000 to 500,000 people. Halifax has a mix of old urban areas, new and old suburban areas, as well as new exurban growth outside the urban areas (Halifax Municipality, 2014). The Halifax study area represents 32% of the population of Nova Scotia, making it the largest populated city in the province. The 2006 census was utilized for this study because the 2011 National House Hold survey became voluntary. With the survey becoming voluntary the participation rate was 68.6%. This becomes a problem because may not be representative of the whole population and could be considered bias. The median income was \$54,129, for all private households. The number of lone-parent households was 17,360, or 16% of household in Halifax. The unemployment rate for Halifax in 2006 was 4.3% of the population, and the average age of Halifax residents was 40 years old (Statistics Canada, 2007). These statistics are elaborated on because of their importance within the study. These statistics will be the variables in deciding socio-economic status, and which neighbourhoods are at the highest risk of not having accessibility to grocery stores.

The study area to be analysed consists of the most densely populated areas of Halifax municipality (Figure 1). Those areas within the study consist of the built up areas of Halifax, Dartmouth, Bedford, Timberlea, Spryfield, Lower Sackville, Woodside, Fairview, Clayton Park, Highfield Park and Cole Harbour.

Figure 1: Halifax Study Area



With this study it is not sufficient to just utilize raw statistical data from Statistics Canada, it is important to normalize the statistics to allow comparisons between the data. Chapter 3 outlines the methodology, and the data used to draw conclusions about accessibility within the Halifax study area.

Chapter 3

Methodology

This study examines the relationship between socio-economic status and accessibility to supermarkets and fast food outlets. It investigates 183 locations of both grocery stores and fast food outlets throughout Halifax municipality's most densely populated neighbourhoods. This study utilizes 2006 census data because of the change to the census in 2011. The survey went from a mandatory to a volunteer survey. The census continued to ask questions pertaining to income, number of lone parent households, and unemployment. However, with it becoming voluntarily it had a 68.6% response rate, thus making any results possibly bias (Statistics Canada, 2013). For the purposes of this study dissemination geographic areas from 2006 census, and manually gathered GPS coordinates of chain grocery stores, and chain fast food outlets in 2014 will be utilized for the purpose of analysis.

Locations of grocery stores and fast food outlets were determined with reference to listings in the Yellow Pages, cross referenced with Internet searches, and confirmed with site visits. GPS coordinates of the stores and outlets, determined using a Garmin GPS, were entered into ESRI's Arc Map for mapping and analysis purposes.

In the study it is necessary to make assumptions of the city and its people. First, it is assumed that having access to supermarkets is an indicator for access to healthy nutritionally adequate food, as argued by Burns and Inglis (2007). Only Halifax supermarkets that operate

nationally with at least ten stores will be utilized for the study. It is necessary to do this to keep this project to a manageable size, and keep in line with the study conducted by Burns and Inglis (2007) who used grocery stores that were considered chains and accounted for a large proportion of food retailing within Australia. The assumed indicator for unhealthy choice in food is food sourced from fast food outlets. Similar to grocery stores, it is necessary to define the extent of fast foods outlets to be used within the study. Again, to keep the study to a manageable size the number of fast food outlets is limited to those which operate within Halifax region with at least ten franchises across Canada. It is also assumed that socio-economic status affects people's ability to access food. A study conducted by Giuliano and Dargay (2006) comparing Great Britain and United States travel patterns revealed that people of less economic means had lower car ownership when compared to higher income groups, and also depended on public transit more in the United States. This study will assume these conditions are similar here in Halifax and that people of lower socio-economic status have limited access to a motor vehicle, and rely on walking or transit to access supermarkets.

Data for dissemination areas were gathered from Canadian Census Analyser through the Saint Mary's University library website. The geographic dissemination shape files for 2006 were obtained from Statistics Canada, as well as the coastline shape file for Nova Scotia. The road network files were sourced from DMTI also through the Saint Mary's library website. It was necessary to truth the network to make sure all pedestrian crossings were included within the road network for the purposes of creating and running the Network Analyzer function in ArcMap.

A number of studies of food deserts used average distance measurements (Apparicio, et al. 2007; Eckert, and Shetty, 2011), generalized for whole neighbourhoods. However, the author

believes this gives a poor representation of distance involving neighbourhoods. One portion of the neighbourhood may be closer to the food outlet, than another portion of the neighbourhood. Sadler *et al.* (2011) utilized straight line distance as a measure of accessibility in Middlesex County; however, they measured from each geocoded addresses of rural residence, to not just the closest food outlet, but also to a secondary outlet, and also incorporated outlets outside of their study area to gain a greater understanding if there is an issue of accessibility to food retailers. It would be possible to create buffers using a straight radial distance around each grocery store and fast food outlet location; however, straight line distances do not utilize the road network nor do they take into account barriers to transport. Similar to the study conducted by Larsen and Gilliland (2007) in London Ontario, I will use the Network Analysis function of ArcGIS to determine areas furthest from grocery stores.

The road network is accessed through the Saint Mary's library website and is based on the network available by DMTI for Nova Scotia in 2013 which shows not only road location but also posted maximum speeds on the roads. It was necessary to add the speed for walking, though, of 3 kilometres an hour. The walking speed is consistent across the entire network, based on Burns and Inglis (2007) study in Casey, Australia. Buffer zones of 10 minutes and 20 minutes for each of walking and driving by car were created around each grocery store and fast food outlet. However, it was found that both 10 and 20 minute walking was redundant. The 10 minute interval was found to be showing the same patterns as the 20 minute interval thus not adding value to the analysis. The analysis found that 10 minutes of driving covered the entire Halifax study area, making the 20 minutes criteria redundant. So for the purpose of this project 20 minutes walking buffer was utilized, and a 10 minute driving buffer was used. The Network Analyst function utilizes the fields within the attribute table to determine the amount of time to

traverse the network based on the road speeds. The time is based on the length in speed on the road in kilometres multiplied by 1000 (metres in kilometers) divided by 60 (minutes in an hour). This is then all divided by the length of the segment in metres. This then gives a travel time for each segment. In the case of the car times this was already in the data from DMTI; however, it was necessary to calculate this for walking time, based on the 3 km/h. Unfortunately, car ownership by dissemination area is unavailable from Statistics Canada. This data could have added to the level of analysis and allowed the author to make correlations between of socio-economic disadvantage neighbourhoods and car ownership.

The polygon buffers created by the Network Analysis function gave a visible image of the degree of accessibility to each grocery store and fast food outlet. The areas with the least amount of accessibility were then analyzed with dissemination area data, to see how accessibility compared to the dissemination area socio-economic characteristics.

For the purposes of this study the author utilized four variables as indicators of socio-economic status: household income, age, lone parent household, and unemployment to create a socio-economic index for each dissemination area. These four variables came up a number of times throughout the literature (Apparicio *et al.*, 2007; Eckert and Shetty, 2011; Gilliland and Ross, 2005) as indicators of areal socio-economic status. There is a difficulty with obtaining 2011 census material as the indicators have not been published for the dissemination areas. This leaves the author with using the 2006 information. To justify using older data, the author has compared numbers from 2001 census to numbers in the 2006 census to see how stable the four indicators are over time. If the indicators are relatively stable between 2001 and 2006 it can be assumed that they were also stable between 2006 and 2011. Table 1 shows the values of the indicators in 2001 and 2006.

Table 1: Halifax Socio Economic indicators, 2001 vs. 2006 (Statistics Canada, 2007)

	2001	2006
Population (number and as a proportion of Nova Scotia's population)	359,111 (39.5 %)	372,679 (40.7%)
Median household income (\$)	22,989	27,198
Median Age (years)	36.6	39.0
Lone parent household (%)	16.0	16.5
Unemployment rate (%)	7.2	6.3

It was found that there was little change from 2001 to 2006 in the socio-economic variables isolated. As to be expected the overall population of Halifax has increased but as a proportion of the Nova Scotia population the change is small. The proportion of single parent households has stayed relatively the same as has the unemployment rate. The largest disparity between the years is the median age, in 2001 it was 36.6, and in 2006 it was 39 years old. The median total income for persons 15 years of age and over in 2001 was \$22,989, and in 2006 it was \$27,198, a change which can be partially accounted for by inflation. The inability to use 2011 census data is unfortunate; however, the results will still be useful because of the minimal change from 2001 to 2006, the assumption will be that there is little change from 2006 to 2011. The author feels that even though the 2006 data is getting close to being out of date, it is representative of the study area's socio-economic characteristics.

To show a composite measure of socio-economic status of the dissemination areas the approach of Gilliland and Ross (2005) was undertaken in which an index of socio-economic status is developed based on z scores. When using different unrelated numbers like age and

income it is important to create a normalized index. With the use of an unweighted mean, and standard deviation, z-scores were made for each of the socio-economic measures isolated, and summed together, with a range from -4 to +4. The z-scores were taken by the mean of the data, the standard deviation of the data, and then at which point the sample value is subtracted from the mean, and this is divided by the standard deviation. This is carried out for all 4 variables; however, the lone parent household, and unemployment rates gave a false positive. This is a problem because of the way the index rewards higher numbers, implying that higher is better. In the case of unemployment, and the proportion of lone parent households this implies that having a high number is positive. To counter this it was necessary to multiply the initial data by -1. With doing this the high numbers became negatives, and the low values became positives, thus allowing the index to show the proper reflection of positive and negative numbers. A number of the z-scores ranged from -3 to +8, and this becomes a problem because these numbers are not comparable. It was necessary to normalize the data so the statistics could be used for an index score. There are three groups of numbers created -1, 0, and +1. For z-scores that were less than -1 they became -1, z-scores that ranged -0.9 to +0.9 became a 0 index score, and z-scores greater than 1 became a 1 in the index score (see Table 2 for examples). This final numbers were summed together for an index score ranging from -4 to +4.

Table 2: Example of generated index scores (Statistics Canada, 2007)

Dissemination Areas	Household Income (\$)	Mean (\$)	Standard Deviation	Z-score	Index Score
12090140	27,250	68,695.20	28,233	-1.448	-1
12090106	101,256	68,695.20	28,233	1.15329	1
12090103	89,383	68,695.20	28,233	0.73275	0

The summed z scores gave a composite indicator of socio-economic status for each dissemination area. It is possible now to compare each dissemination area on an equal ground. Combined with the accessibility maps relationships between accessibility and socio-economic status of the dissemination areas can be assessed.

To measure distribution of the grocery stores, and fast food outlets, it was necessary to use nearest neighbour analysis. Nearest neighbour measures the distance from one point to another. With the distances from one point to the other, the mean of the distances between nearest neighbours, and the area of the study area, nearest neighbour analysis determines the amount of distribution, whether they are clustered, random, or regular. The end number will be able to determine whether the points lend towards clustering (nucleated) or regularity (uniform).

The following chapter is the discussion of the results from the methodology, and the geographic areas of Halifax that are affected by a lack of access to food service outlets.

Chapter 4

Discussion and Results

Grocery Stores

Throughout Halifax study area there are 30 chain grocery stores in total (Figure 2). This project looked specifically at stores that operated at least 10 locations nationally and sold a full line of groceries, that is fruits, vegetables, fresh meat, and bakery products. The stores that fell into this category were Atlantic Super Store, No Frills, Sobeys, Valu Foods, and Walmart. The number of grocery stores per person within the Halifax study area is 0.00009 or 1 store per 10,049 people. The nearest neighbour statistic shows a ratio of 0.713814 which exhibits a trend towards clustering amongst grocery stores. This is not surprising given the population distribution with concentrations on the Halifax peninsula, Dartmouth and Bedford, where there is a high number of grocery stores. There is also a close association between grocery stores and highway interchanges. On both the Halifax Peninsula and in Dartmouth competing grocery stores occur within a kilometer of each other. The grocery stores are located close to their customer base, or in area that have accessibility for car travel, along major thruways, and close to highway interchanges.

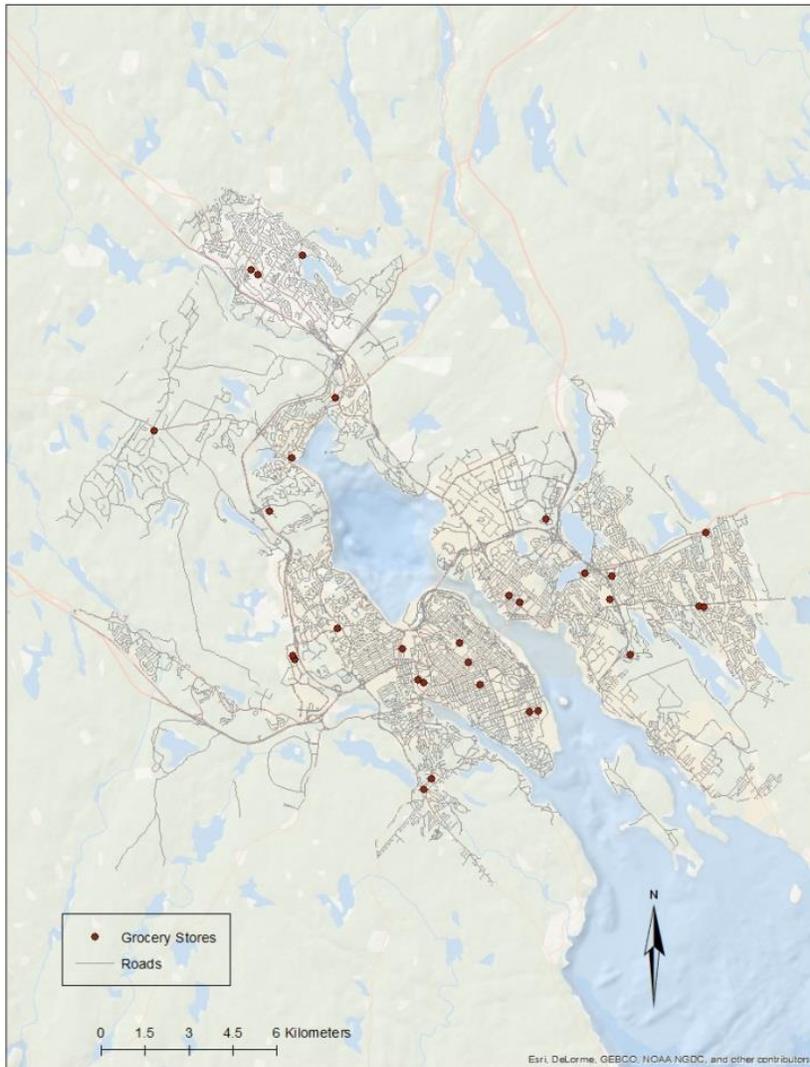


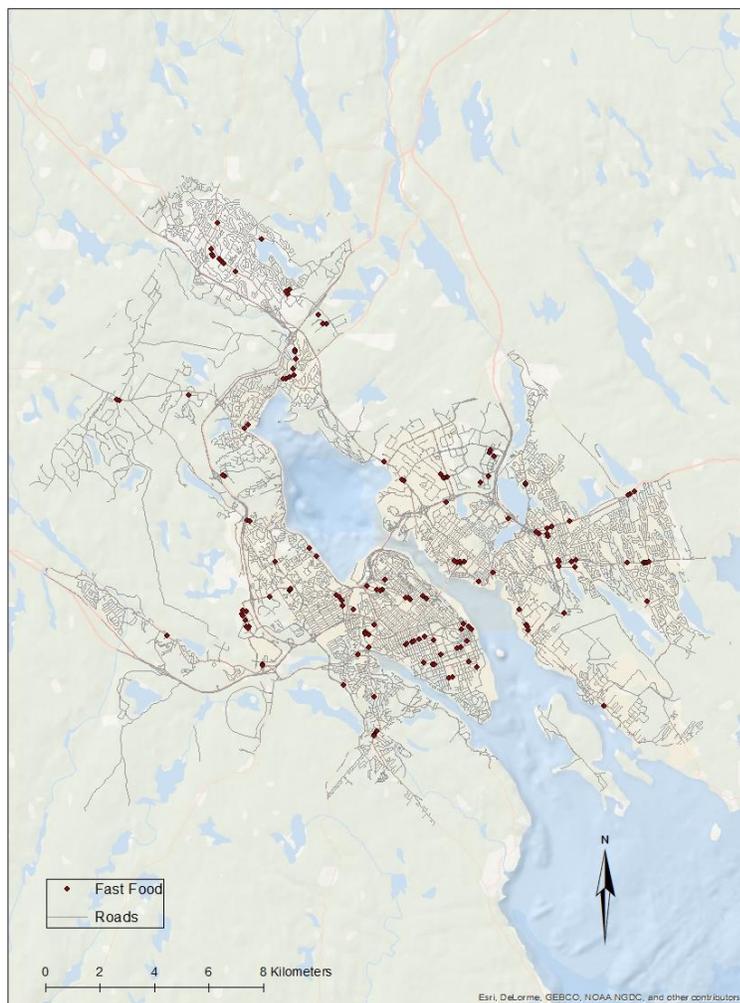
Figure 2: Spatial distribution of grocery stores across Halifax Study Area

Fast Food Outlets

Throughout the Halifax study area there are 153 chain fast food outlets in total (Figure 3). This project looked specifically at outlets that operated at least 10 locations nationally, and did not offer table service. The fast food outlets that resulted from these requirements were A&W, Arby's, Burger King, Dairy Queen, Extreme Pita, Harvey, KFC, McDonalds, Quiznos, Subway,

Taco Bell, Tim Hortons, and Wendy's. The number of fast food outlets per person in the study area of Halifax is 0.0005 or 1 store per 1,908 people. The nearest neighbour statistic shows a ratio of 0.400972, which exhibits a trend towards clustering amongst fast food outlets. As the nearest neighbour statistic approaches 0 the more clustering is represented by the data. In this case the data show that fast food outlets have a higher tendency to be clustered than grocery stores.

The spatial distribution of fast food outlets is similar to that of grocery stores, being located in high density population centres, eg. Halifax peninsula, and close to highway interchanges. However, amongst the fast food outlets there is greater clustering along busier



thruways, such as that of Quinpool Road, Chain Lake Road, Dutch Village Road, and in the Burnside industrial park. This clustering is not surprising with the competition between similar venues; each store is attempting to attract customers to their store. The clustering along major thruways, this allows for the greatest exposure for the fast food outlet, with each outlet competing for exposure along busy through ways. Fast food outlets also tend to have smaller parking lots than

Figure 3: Spatial distribution of fast food outlets across Halifax

grocery stores, allowing for greater density within a smaller area.

When comparing fast food outlets to grocery stores the spatial distribution is similar in that they locate on major streets and tend to locate close to each other. However, grocery stores are larger and serve greater populations than fast food outlets on a per store basis. Grocery stores also have much larger parking lots compared to fast food outlets. The larger parking lots are likely to cater to their customers who use cars for shopping. Fast food outlets tend to locate within other buildings, such as in malls, or where little to no parking is available. As long as the population density, or the daytime working population is high enough, such as found in downtown Halifax or Burnside, fast food outlets can locate in areas where fewer people live.

Dissemination areas, and socio-economic status and Areas of Disadvantage

The purpose of this study is to compare accessibility of the Halifax population to grocery stores and fast food outlets relative to socio-economic of that population as distributed by dissemination area. Particularly the focus is on the expectation of isolating socio-economically disadvantaged areas with limited accessibility to both, or either, grocery and fast food outlets. Dissemination areas are the smallest geographical statistical areas available to the public from Statistics Canada. Each dissemination area has socio-economic data showing the characteristics of the people who live there. For this study four characteristics were considered, those being: age, income, proportion of lone parent households, and unemployment. These four characteristics translated into index scores with each dissemination area receiving an index score based on its socio economic factors. The scores ranged from -4 to +4, -4 indicating areas at a lower socio-economic status, and +4 being the highest socio economic status. The lower socio-economic areas, referred to as disadvantaged areas from heron, are shown in Figure 4. This study

was particularly interested in the areas that ranked from -2 to -4. These are the areas that are considered to be the areas of greatest disadvantage. Negative two was chosen as a threshold index to filter out dissemination areas that are not likely to be severely disadvantaged. When a dissemination area receives a score of 0 it is considered to be the norm, or the average. However, because of the nature of the index score, areas may have a neutral score (0) in areas like unemployment, lone parent, and income but have a low score (-1) in age. With these circumstances the area would then be scored a -1, but these areas may not be at a great disadvantage. This study is concerned with areas that have a lower rank in more than one category, that when combined would hinder an individual's accessibility and perhaps ability to afford a car.

When analysing the map and the dissemination areas that are highlighted as disadvantaged, there is a noticeable trend towards the North End of Halifax, Fairview/ Clayton Park, the Highfield Park area, and Spryfield (Figure 4). There are a total of 39,358 of 301,486 people considered to be disadvantaged, or 13.1% of the study area population.

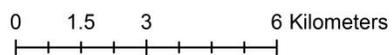
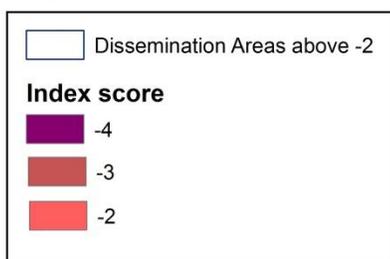
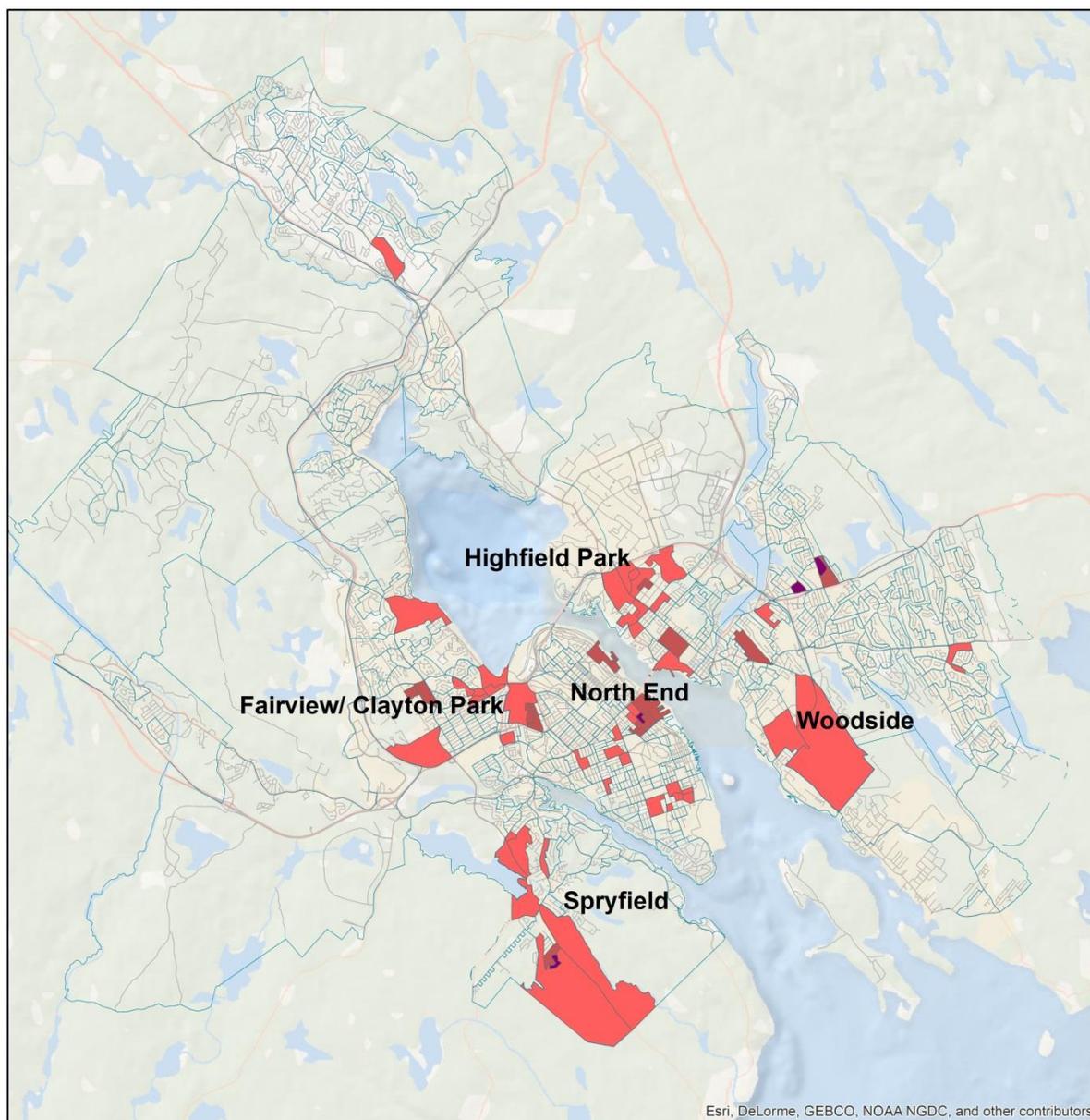


Figure 4: Dissemination areas with an index score of -2 to -4

To better understand the characteristics of the disadvantaged areas it is important to identify any similar characteristics found in each other. Four dissemination areas scored an index of -4. These are the areas that received a negative on all 4 of the socio-economic characteristics. This means their median age of the dissemination area is below the average age of Halifax, their income for the dissemination area is below the average within Halifax, their unemployment is higher than the average unemployment in Halifax, and their proportion of lone parent households is above the average within Halifax. The 4 dissemination areas receiving a score of -4 are located in the parts of Halifax traditionally considered the most disadvantaged: in Spryfield, the area in Halifax north of downtown and south of the Macdonald Bridge, and two areas in the Main Street area of Dartmouth east of the Circumferential Highway.

The next lowest score possible is -3, and 13 of the dissemination areas within Halifax that were analysed received a score of -3. Of these 13 areas that received an index score of -3, all had a -1 in income, and all but 2 received a -1 in lone parent households. Age and unemployment were not as strong indicators of disadvantage compared to lone parent households and income. The spatial pattern of the dissemination areas ranking -3 are similar to the -4's; however, there is a greater number of them, and the areas of the north end of Dartmouth, the west end of Halifax near Bayers Road and a portion of Clayton Park by Willet Street are now identified as socio-economically disadvantaged.

The dissemination areas that received a rank of -2 are more plentiful and more spatially separated. But no one characteristic is a greater contributor to the negative score than another. There are areas of Halifax Municipality that continue to be identified as disadvantaged such as north end Dartmouth, and Spryfield; however, there is also the area around Woodside, and larger portions of Fairview close to Dutch Village Road, and Lacewood Drive that can be so described.

There is a noticeable pattern of socio-economic disadvantage across the Halifax Municipality. The early suburbs of Spryfield, North End Halifax, and Dartmouth are shown to be some of the most disadvantaged areas in this analysis.

Grocery Store and Fast Food Outlet Service Areas and Accessibility

With this project it is not just important to determine the areas of Halifax Municipality that are considered disadvantaged, but also the areas that lack accessibility to grocery stores and fast food outlets, and comparing the lack of accessibility to the two types of food outlets. Service areas of both grocery stores and fast food outlets were determined with Esri's ArcMap Network Analyst function, and DMTI road network, along with coordinates manually taken of each grocery store and fast food outlet. Accessibility to both food outlet types was considered for walking of 20 minutes, and driving of 10 minutes. Service polygons centred on each grocery store and fast food outlets were created for these two accessibility conditions.

In the case of grocery stores there are large areas of the Halifax study area that are not covered by a 20 minute walking service area (Figure 5). In particular, areas in Sackville, Highfield Park, Timberlea, Dartmouth Cove, and Clayton Park are poorly covered. A total of 87,324 or 30% people in the study area are within a 20 minute walk to grocery stores leaving 70% unserved. This is contrasted by the 10 minute driving service area where the entire study area is served (Figure 6).

For fast food outlets the 20 minute walking polygon encompasses a greater area and population served than that of grocery stores (Figure 7). This is not surprising given that there are five times more fast food outlets in the city than grocery stores. The Halifax Peninsula in

particular is well covered by fast food outlets. For the entire study area a total of 229,853 people or 76.2% of the study area population have 20 minute walking access to fast food outlets. There are, however, some areas not served; particularly in West Bedford, Timberlea, and the Highfield Park area. Similar to grocery stores, the accessibility of fast food outlets within 10 minutes of driving by car is extensive, and covers all streets and areas of Halifax study area (Figure 8).

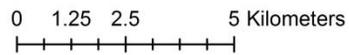
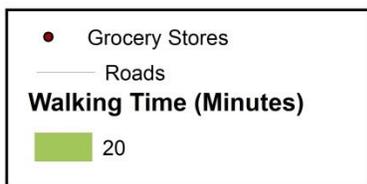
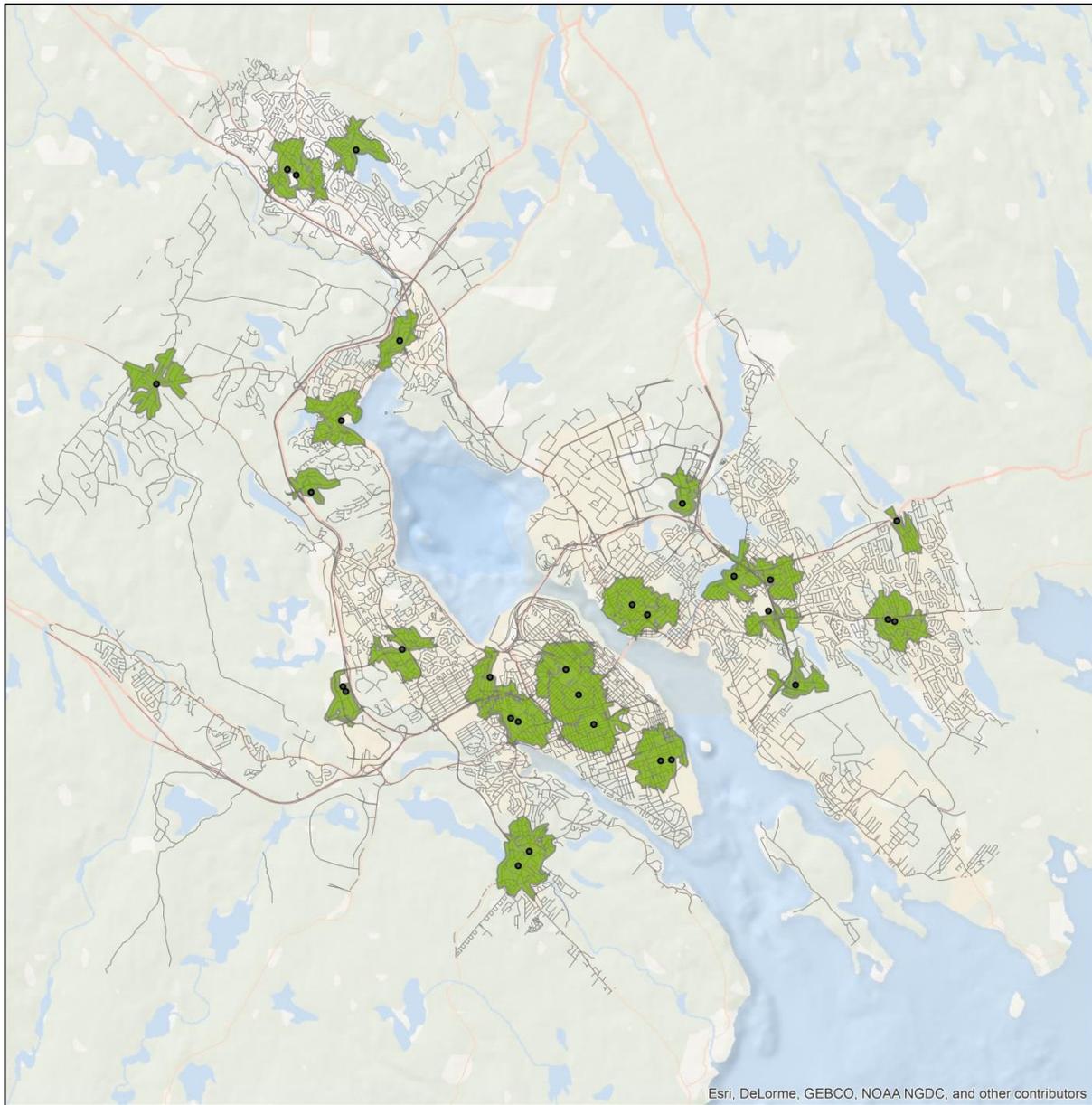


Figure 5: Service Areas by way of walking for grocery stores

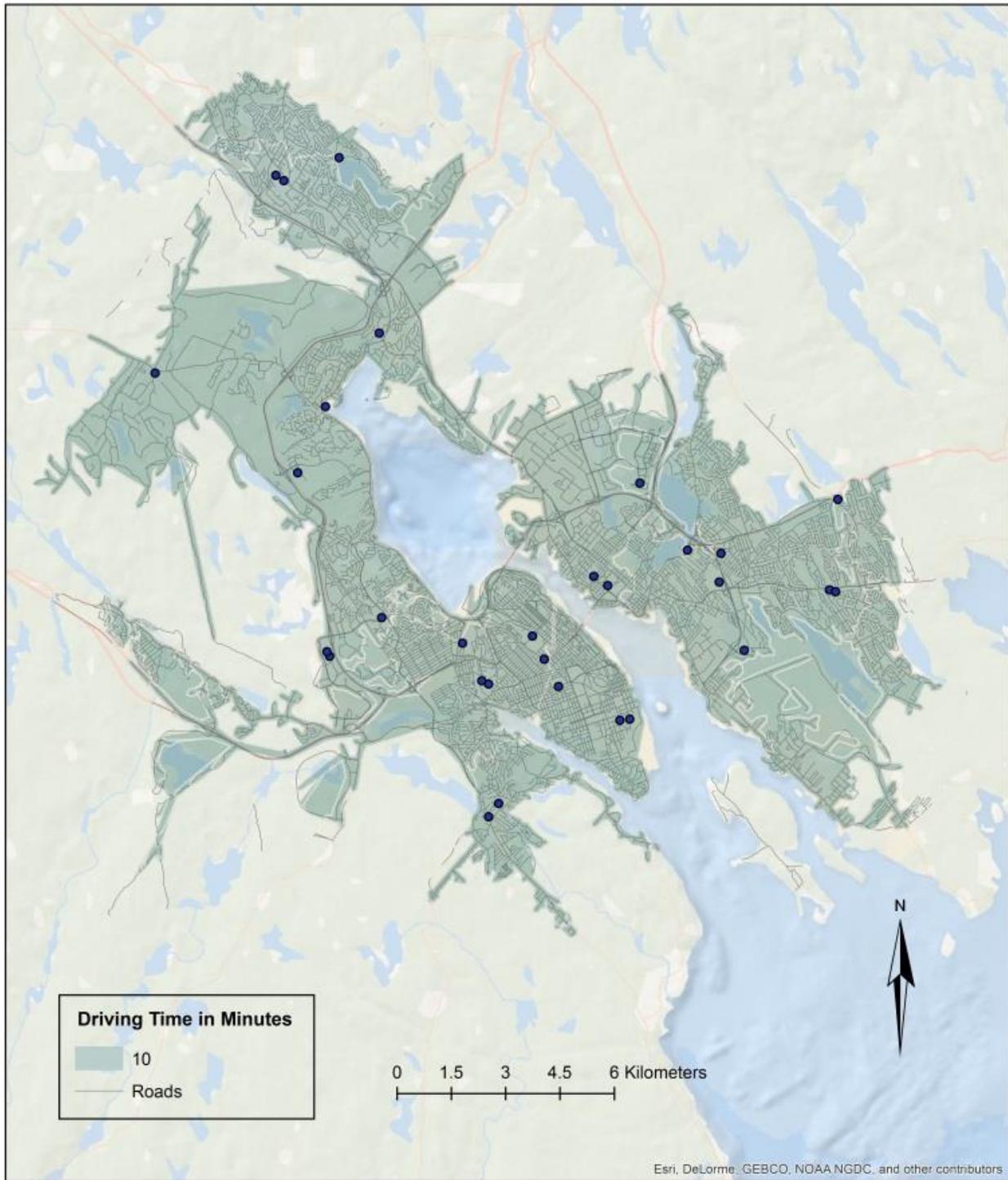
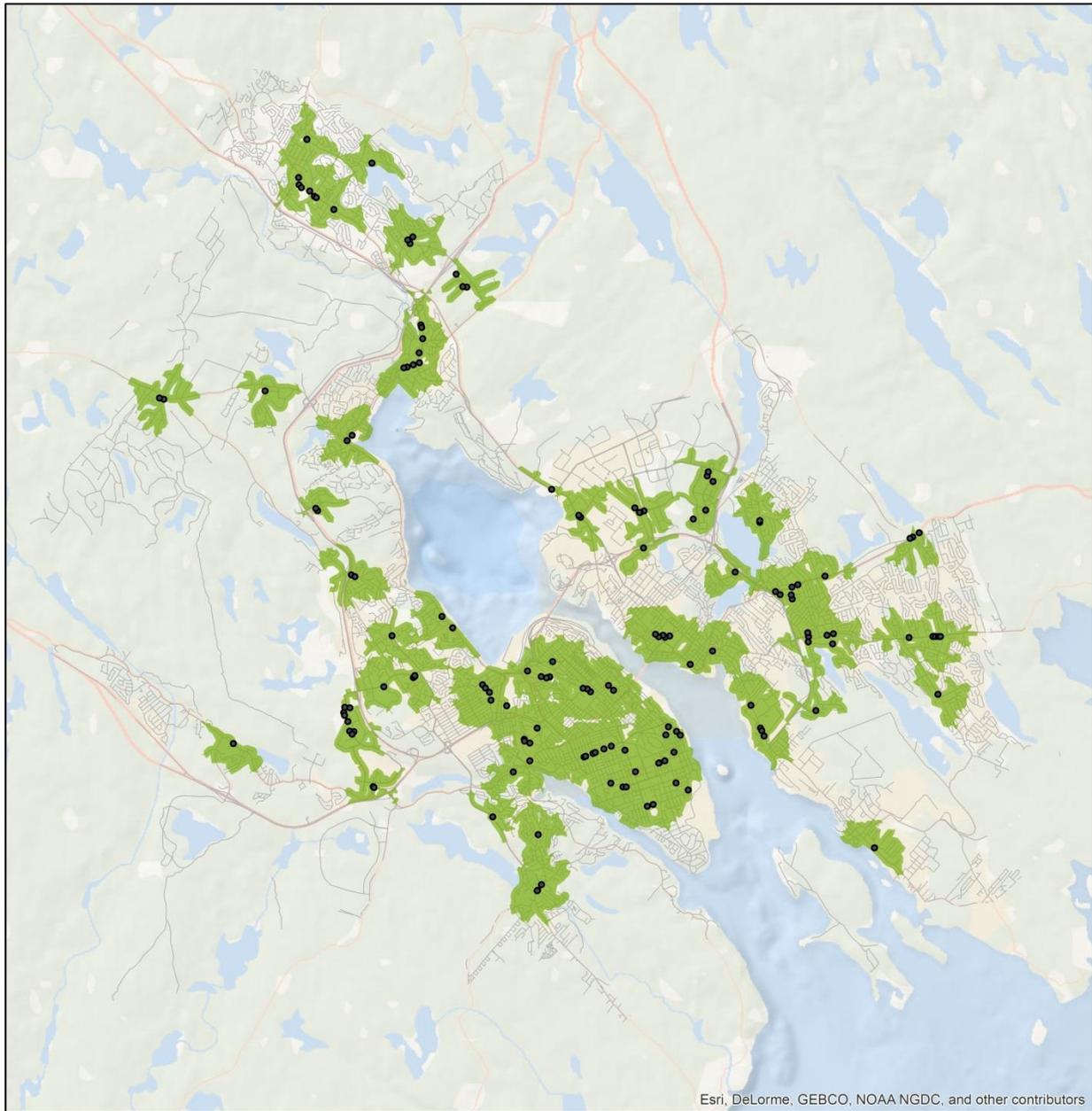


Figure 6: Service Areas by way of driving for grocery stores



● Fast Food
— Roads
Walking Time (Minutes)
■ 20

0 1.25 2.5 5 Kilometers



Figure 7: Service area by way of walking for fast food outlets

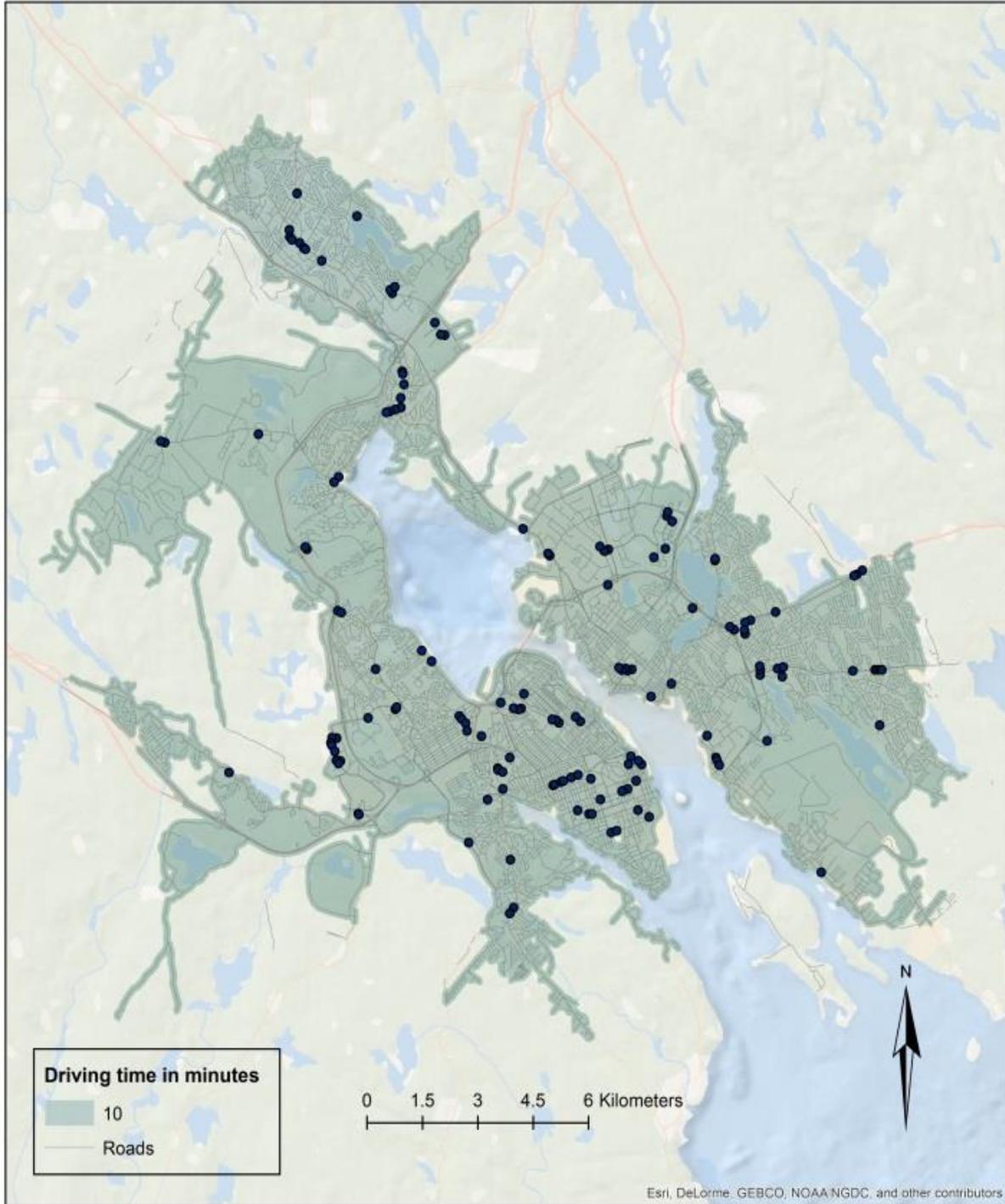
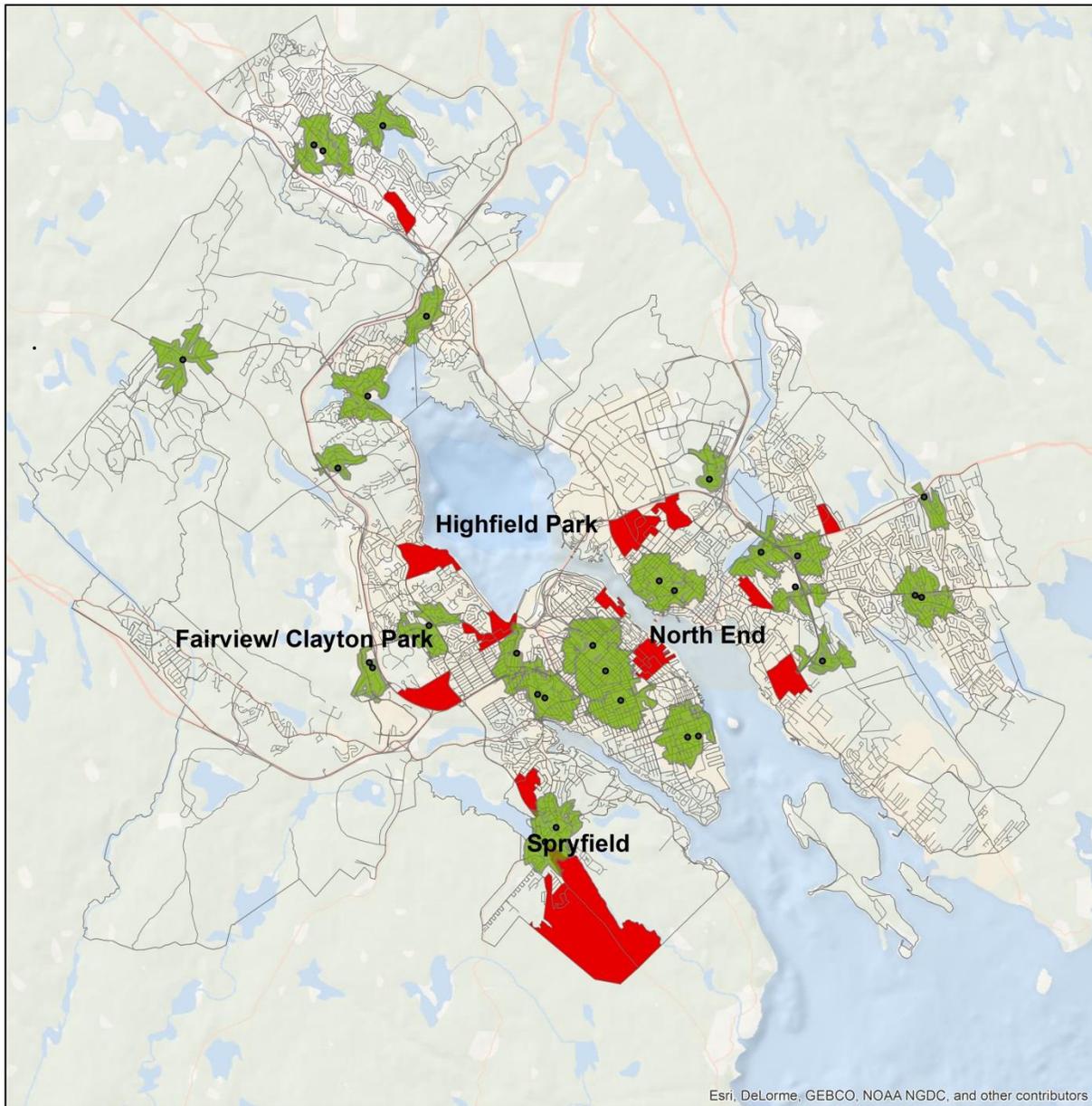


Figure 8: Service areas by way of driving for fast food outlets

Walking Accessibility and Disadvantaged Areas

The next consideration of this project is the relationship between accessibility to food outlets and disadvantaged socio-economic areas. For grocery stores there are a total of 30 disadvantaged dissemination areas that do not have 20 minute walking accessibility (Figure 9). There is a total of 19,915 people or 6.6% of the study area population considered disadvantaged and as well as living in areas that lack walking access to grocery stores. These areas are scattered throughout the study area. Of note, the 4 areas that rank as a -4, 3 of them lack access to grocery stores. These are the areas of Spryfield, North End Halifax, and the area on Main Street in Dartmouth.



- Grocery Stores
- Roads
- Walking Time (Minutes)**
- 20
- Disadvantaged Dissemination Areas**
-

0 2.25 4.5 9 Kilometers

A scale bar with markings at 0, 2.25, 4.5, and 9 kilometers. To the right is a north arrow pointing upwards, labeled with 'N'.

Figure 9: Disadvantaged dissemination areas and their accessibility to grocery stores

Fast Food Outlets and lack of Grocery Store Accessibility

Turning now to fast food outlets and walking accessibility it becomes apparent that some of the disadvantaged areas that lack access to grocery stores have greater access to fast food outlets. Of the disadvantaged dissemination areas that lacked access to grocery stores, 14,895 of those people have greater access to fast food outlets; that is 76.6% of the 19,443 people. Particularly, the North End of Halifax, Woodside, and the Main Street area of Dartmouth have greater access to fast food outlets rather than grocery stores (Figure 10).

As shown in Figure 11 there are some disadvantaged dissemination areas representing a small portion of dissemination areas that lack access to both grocery stores, and fast food outlets. There are 8 such areas representing 4,580 people, which is 1.5% of the population of Halifax study area. These areas lack access to both grocery stores, and fast food outlets, as well as being considered disadvantaged.

Of all the areas that are considered disadvantaged there is a total population of 39,358. Of those it is important to understand their access to grocery stores, as well as fast food outlets. When measuring the accessibility of walking and grocery stores it was found that 19,915 or 50.5% of the disadvantaged population have access to grocery stores. However, this is contrasted by fast food access, where it was found that 31,162 or 79.1% of the disadvantaged population have access to fast food outlets.

However, what is interesting is that of the overall study area 30% had walking access to grocery stores; this is contrasted by disadvantaged areas having greater access to grocery stores, with 50.5% walking access. This could be explained by greater population densities in areas considered disadvantaged.

Table 3 summarized the main statistical findings of the study area in terms accessibility to grocery stores and fast food outlets for both the overall study area and the disadvantaged neighbourhoods.

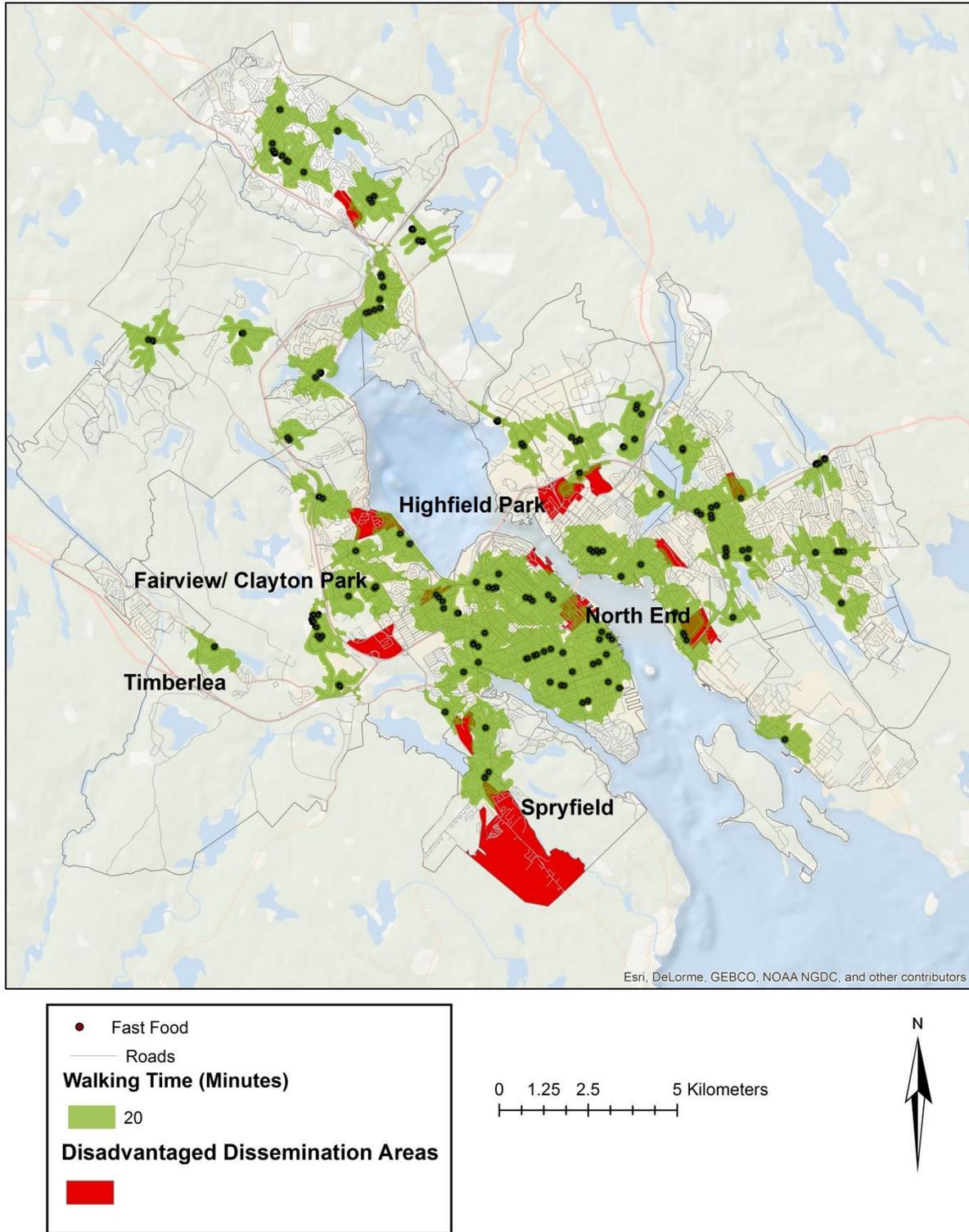


Figure 10: Disadvantaged Dissemination and their accessibility their to fast food outlets

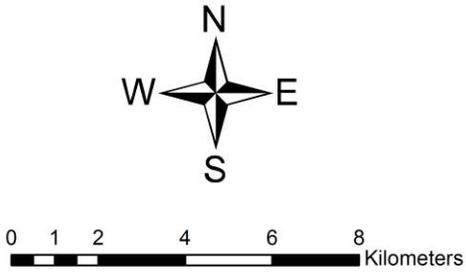
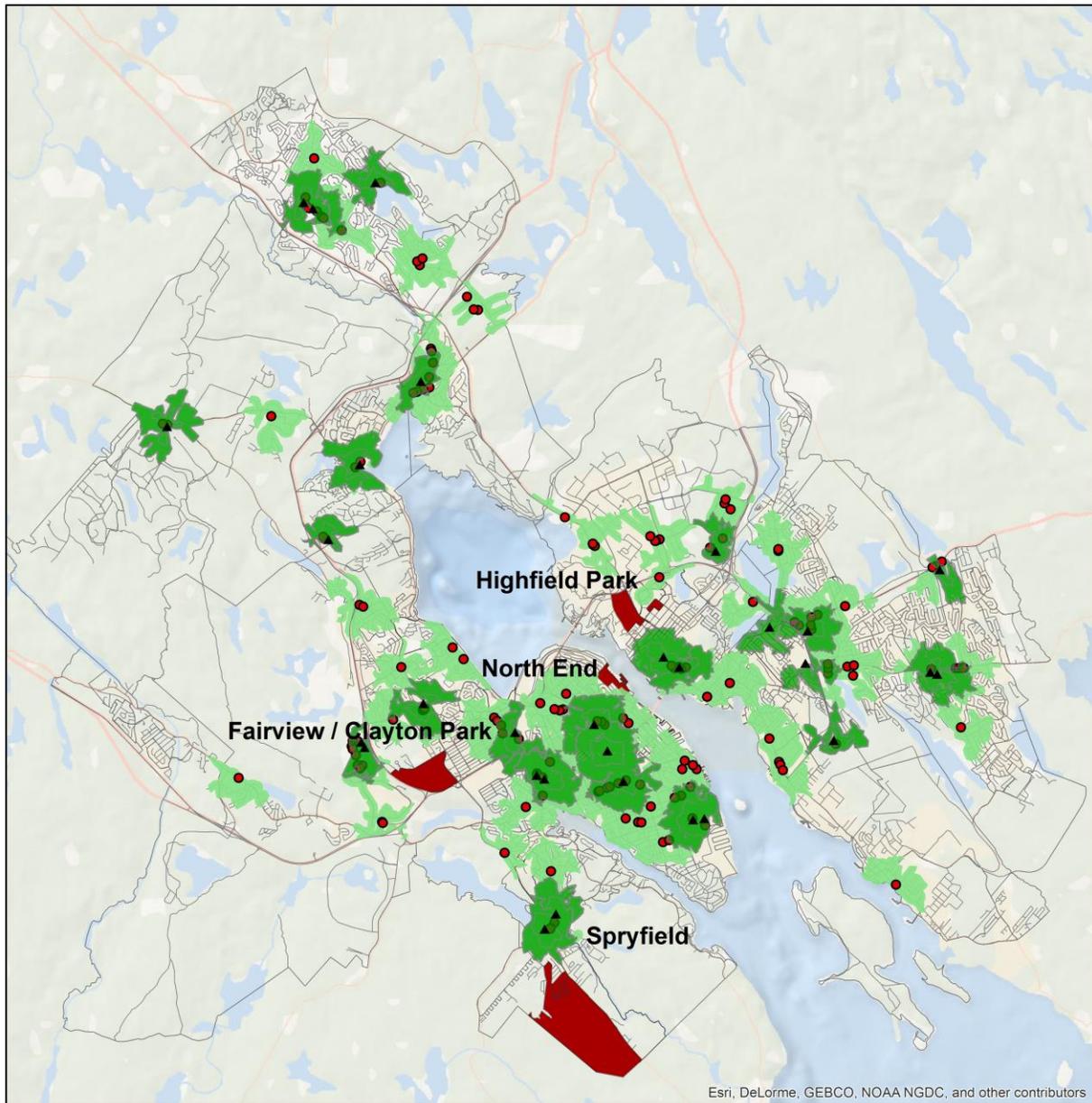


Figure 11: Lack of access to both grocery stores and fast food outlets

Table 3: Summary of Statistical Results

	Overall Study Area, including disadvantaged neighbourhoods		Disadvantaged Neighbourhoods	
	#	%	#	%
Population	301,486		39,358	
20 minute walking access to grocery stores	87,324 (30%)	30	19,915	50.5
10 minute driving access to grocery stores	301,486	100	39,358	100
20 minute walking access to fast food outlets	229,853	76.2	31,162	75.1
10 minute driving access to fast food outlets	301,486	100	39,358	100
Not serviced by 20 minute walking access to both grocery stores and fast food outlets	57,529	19	4,580	11.6
Not serviced by 10 minutes driving to both grocery stores and fast food outlets	0	0	0	0

The following chapter is the conclusion. This sums up the results of the discussion, and draws comparisons to literature from previous studies spoken about in the literature review.

Chapter 5

Conclusion

The purpose of this study is to compare accessibility to grocery stores and fast food outlets relative to socio-economic status of Halifax's population as distributed by dissemination area. Particularly the focus is on the expectation of isolating socio-economically disadvantaged areas with limited accessibility to both, or either, grocery and fast food outlets. With the use of GIS analysis it was possible to determine the socio-economically disadvantaged areas, as well as their access to both grocery stores, and fast food outlets.

The two methods of movement utilized were: a 10 minute drive and 20 minute walk. The 10 minute drive to both fast food outlets and grocery stores covered the entirety of the study area. Because of the access to all grocery store and fast food outlets by driving, this study was more concerned with the people and areas that do not have access to a car and depend on walking to purchase their food.

This study analyzed the dissemination areas considered socio-economically disadvantaged with a generated index value from z-scores, as previously discussed in Chapter 2. It was found that there were 62 dissemination areas considered disadvantaged, representing 13.1% of the study areas population. The analysis found that just fewer than 50% of the disadvantaged dissemination areas did not have walking access to grocery stores. The analysis

also found that of the areas that lacked walking access to grocery stores, 69.2% of the population had 20 minute walking access to fast food outlets.

When walking it was found that all dissemination areas in the Halifax study area had greater access to fast food outlets, compared to grocery stores. However, there were some socio-economic disadvantaged areas that lacked walking access to both grocery stores, and fast food outlets. There are a total of 4,580 people or 1.5% of the Halifax study area population that are considered disadvantaged that lack access to both grocery store and fast food outlets when walking.

This project relied on a paper from Casey, Australia by Burns and Inglis (2007) in which they measured accessibility to fast food outlets, and grocery stores by driving, bus, and walking. It was found in the case of Casey, only 4% had walking access to grocery stores, this is contrasted by this study of Halifax that found 30% had walking access to grocery stores. Also in Casey it was also found that socio-economic advantaged areas had greater access to grocery stores; this is contrasted by this study where it was found that the greater access to grocery stores was for the socio-economic disadvantaged areas. This could be attributed to how the methodology was carried out. Burns and Inglis (2007) used cost surface analysis rather than network analyst, this could have led to different results. The difference could also be attributed to how disadvantaged neighbourhood were defined.

In the Halifax study area there were a number of areas that lacked walking access to grocery stores. However, it is a fairly low portion of the disadvantaged population (13.1%). There have been other studies conducted in Canada and internationally where it was found that disadvantaged socio-economic areas had limited access to grocery stores, similarly to Halifax. A

number of studies that found there to be less walking access to grocery stores by the way the methodology for these studies was framed, the cities included: Toledo, Ohio by Eckerty and Shetty (2011) with a population of 282,313 (United States Census, 2015), and in London, Ontario by Larsen and Gilliland (2008) with a population of 352,395 (Statistics Canada, 2012). Both cities would be considered medium sized cities, with a population less than 500,000 people. Halifax a city similar to these cities with a population of 390,096, and a population density of 71.1 people, the results are not surprising (Statistics Canada, 2012). Cities like Montreal (Apparicio *et al.*, 2007), Toronto (Kirkpatrick and Tarasuk, 2010), and Edmonton (Smoyer-Tomic *et al.*, 2006), had complete access to grocery stores, and lacked ‘food deserts’. All three cities have a population over a million people (Statistics Canada, 2012). It is unknown to the author of studies conducted in cities that range from 400,000 to 1,000,000 people and what access to grocery stores would be like. However, there appears to be a trend amongst larger cities with greater population (over a million people) and the absence of ‘food deserts’. There appears to be greater walking access to grocery stores than in medium sized cities like Halifax.

Food desert literature was heavily utilized for much of the research for this project. However, studying food deserts was only one part of the overall project goal, though it is important to readdress the possible presence of food deserts within Halifax. From the analysis it was found that food deserts do exist in the Halifax study area. These are the areas in and around, Spryfield, North End Halifax, and the Highfield Park area of Dartmouth.

Recognizing different methodology Halifax is arguably not the worst when it comes to walking access to grocery stores for disadvantaged socio-economic areas, nor is it the best. However, there is always room for improvement. There has been a growing trend in Canada to create more walkable communities, and to integrate mixed land uses into one area. Within

Halifax these same ideals are being encouraged by the city (Halifax Municipality, 2014, p.45). By creating more compact walkable communities the problem of inaccessibility of grocery store may be addressed.

This study is a measure of accessibility of socio-economically disadvantaged people of the Halifax area to food outlets. The author has had an interest in urban design and its effects on community health. Part of what can make a community healthier is the walkability of the urban environment. This study is not a direct study of walkability; however, the results from this study could argue that Halifax needs to make itself more walking friendly, and encourage grocery stores to open in areas previously not serviced. A high proportion of the Halifax study area population does not have walking access to grocery stores (70%). This study could be considered part of the increasingly popular study of health geography. A number of studies looking at the health of communities and access to grocery stores have risen in the last few years. This study will add to the growing number of studies and hopefully help communities and cities in the future.

This study did not take into account of locally operated grocery store outlets, farmers markets, or local co-op's. These represent healthy food options in many parts of the city; however, for the sake of time and manageability this omission was necessary. The data presented in this paper may be altered by the presence of these outlets, and access to grocery stores may be greater than presented. Conversely, locally owned fast food outlets and all types of pizza outlets were not considered either. It may become the case that areas may have even greater access to poorer food choices when considering these locations as well.

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