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HEALTH IMPACT ASSESSMENT

City of Vancouver Georgia and Dunsmuir Viaduct Replacement Desktop Health Impact Assessment

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REPORT

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1.0 INTRODUCTION

The Georgia and Dunsmuir Viaducts (the Viaducts) within the City of Vancouver (the City) currently occupy two full city blocks with support infrastructure and on and off-ramps. This infrastructure makes the city owned land between and beneath the Viaducts largely inaccessible and underused. The City is considering deconstructing the Viaducts and replacing them with a new, two-way Georgia Street extension to Pacific Boulevard that would be realigned and consolidated with Expo Boulevard north of the Sky Train guideway. This Proposed Project (the Project) would also involve construction of a new two-way connection to Prior Street and Quebec Street, including traffic calming measures to return Prior Street to a neighbourhood street. Traffic would be re-routed through upgraded road infrastructure south of Prior Street. Upgrades to bike and pedestrian infrastructure would be completed to improve and replace infrastructure currently in place on the Viaducts. Public consultation and design considerations are ongoing as the City prepares to decide whether to move forward with the Project.

The Project itself is part of a larger group of projects, including the Malkin Overpass Project (includes new arterial road, pedestrian and cycling infrastructure, and overpass over rail line), and neighbourhood and park planning in North East False Creek (NEFC). In addition, adjacent land owners including Concord Pacific, Aquilini Group, and the Province of BC are moving forward with planning processes at their own sites. The City has the opportunity to make desired changes in street structure before developments move forward and the flexibility for change is limited by other infrastructure.

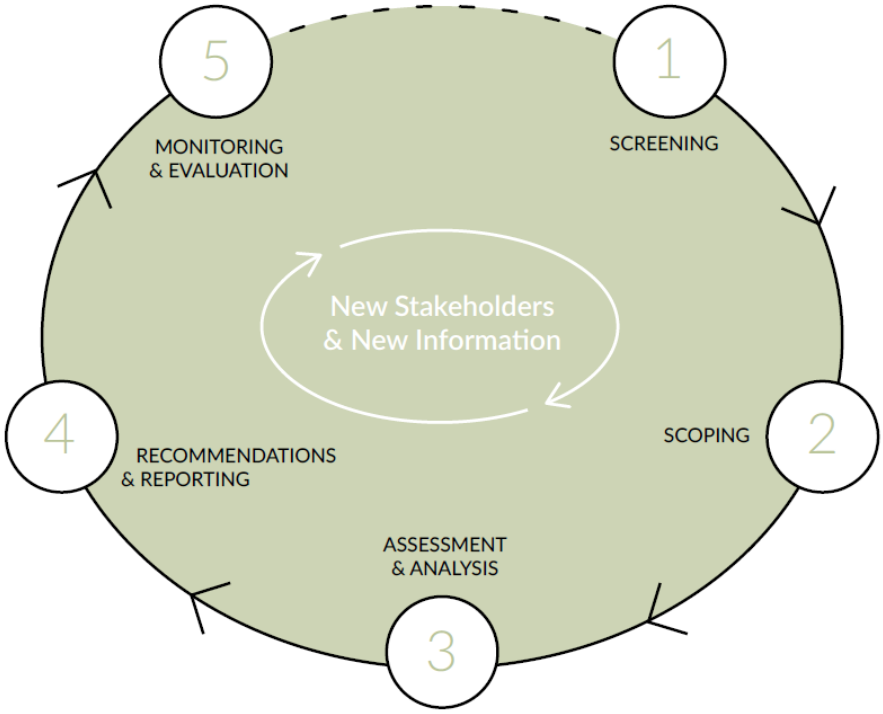
The City commissioned Golder Associates Ltd. (Golder) to prepare a desktop Health Impact Assessment (HIA), applying the HIA methodology from Metro Vancouver's "Health Impact Assessment of Transportation and Land Use Planning Activities Toolkit" (the Toolkit). Reflecting the World Health Organizations (WHO) definition of health, this assessment generally considers social, economic and environmental factors that influence health status, how health is experienced by potentially affected communities and stakeholders, and how changes to social, economic and environmental conditions as a result of the Project could potentially affect human health.[1] This report presents the methodology used and results of the Desktop HIA, and is organized according to the key elements of a desktop HIA as defined within the Toolkit.

[1] The World Health Organization (WHO) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948) and health impacts as "the overall effects, direct or indirect, of a policy, strategy, programme or project on the health of a population" (WHO, 1999)

2.0 METHODOLOGY

2.1 Overview of Metro Vancouver's Health Impact Assessment Process

Metro Vancouver defines health impact assessment within its Toolkit as "a process that provides a more structured approach for planners and policy-makers to objectively evaluate the potential health-related outcomes of an activity before it is built or implemented" (Metro Vancouver, n.d.a, p. 3). The Toolkit is based on a five step methodology to identify, assess, and report health effects and monitor and evaluate health outcomes resulting from a Project (Figure 1). The assessment process is based on identifying and analysing interactions between the Project and key determinants of health, which can be defined as "the personal, social, cultural, economic and environmental factors that influence the health status of individuals or populations" (WHO, 1999).



Source: (Metro Vancouver, n.d.a, p. 3)

Figure 1: Heath Impact Assessment Toolkit Process

As indicated in Figure 1, Step one (**screening**) is carried out to determine whether a HIA is appropriate, required, and feasible for the Project.

Step 2 (**scoping)** involves identifying the level of HIA that should be carried out. The Toolkit identifies three levels including:

- The **Desktop HIA** is a rapid, desk based exercise that is based on information available through existing secondary sources. It is the least detailed approach, does not include primary interviews or targeted consultation, but can help identify areas for further research should an intermediate or comprehensive HIA be required.
- The **Intermediate HIA** is a medium term project completed with input from a small group of stakeholders. It is also primarily based on secondary data, but includes information provided by specific people with knowledge about the Project or community.
- A **Comprehensive HIA** is a more in-depth project that requires literature review and Project specific primary data collection. The timeframe for completion is longer and requires a higher level of detail and analysis.

Given the early stage of Project design and current limitations in Project design and construction details, a desktop HIA was identified by the City and Golder as being appropriate and feasible for the Project at this time. The scoping stage also identifies what determinants of health and indicators should be assessed for the Project and the rationale for the assessment of Project effects on these health determinants via the desktop HIA, versus an intermediate or comprehensive HIA. For this assessment, scoping reflected an understanding of the Project to date, meetings with City representatives, and professional judgement. The selected scoped health determinants and indicators and the rationale for their consideration is outlined in Section 3.0 of this assessment.

Step 3 **(assessment and analysis)** describes the baseline conditions associated with identified health indicators and assessment of the potential health related outcomes associated with the Project. Section 4.0 provides a summary of the socio-economic context in the Study Area communities as well as indicators of the identified health determinants. Section 5.0 provides high level assessment of potential health concerns and impacts associated with the removal of the Viaduct infrastructure and ongoing use of completed Project. Both positive and negative effects are identified and assessed in this section.

Step 4 **(recommendations)** provides:

- the results of the assessment;
- proposed mitigation concepts to address adverse project effects on health and support health benefits,
- recommendations for further research to address gaps in baseline conditions and support further assessment of potential Project effects on the identified determinants of health; and
- follow-up consultation and communication tools.

Recommendations are provided in Section 6.0 of this report.

Intermediate and Comprehensive HIAs include **monitoring and evaluation** processes to monitor and track health outcomes as recommendations are put into action and Project effects are experienced within the community. As monitoring and evaluation techniques are not part of the Toolkit requirements for a Desktop HIA, monitoring and evaluation techniques are not proposed in this report.

In summary, applying the Toolkit steps, the assessment identifies Project interactions with key determinants of health, presents existing conditions with respect to relevant indicators for the key determinants, discusses potential health effects as a result of the Project based on preliminary Project design, existing conditions information, and other available studies completed for the Project. Where potential Project effects are identified but baseline data is insufficient to fully understand the extent of potential effects, available baseline information is provided but a Project effect assessment is not completed. In these instances, areas for further analysis through an intermediate or comprehensive HIA is recommended should the City move forward with the Project.

2.2 Data Sources and Data Limitations

As per guidance by the City, this study was scoped as a desktop assessment and relied upon publically available secondary information as well as Project specific reporting provided by the City. The Study Area for this assessment (defined below) is based on existing census boundaries from the 2011 Canadian Census and National Household Survey. It is acknowledged that there are smaller groups within each community that might experience the Project differently. For example, the people living directly on Prior Street could potentially have different views and experiences of the Project than those living a few blocks north or south. In the case of Prior Street, effects analysis considers the effect on Prior Street where changes would be most directly felt, compared to other areas of the neighbourhood located farther away. In addition, vulnerable populations in and around the Project would have different experiences compared to their more affluent neighbours and their experiences may not be captured in the data collected at the neighbourhood level. This is an aspect of the HIA that could be explored through primary interviews in a more comprehensive HIA, should the Project be approved.

Information from other studies commissioned by the City regarding the Viaduct replacement and NEFC developments were important data sources for this assessment. Studies referenced in this report include:

- Air Quality Assessment of the Georgia and Dunsmuir Viaduct Area, City of Vancouver, BC (Golder Associates Ltd., 2015b);
- Noise Assessment of the Georgia and Dunsmuir Viaduct Area, City of Vancouver, BC (Golder Associates Ltd., 2015b); and
- North East False Creek Transportation Study, Phase 2 Transportation Multi-Modal Assessment (Parsons, 2015).

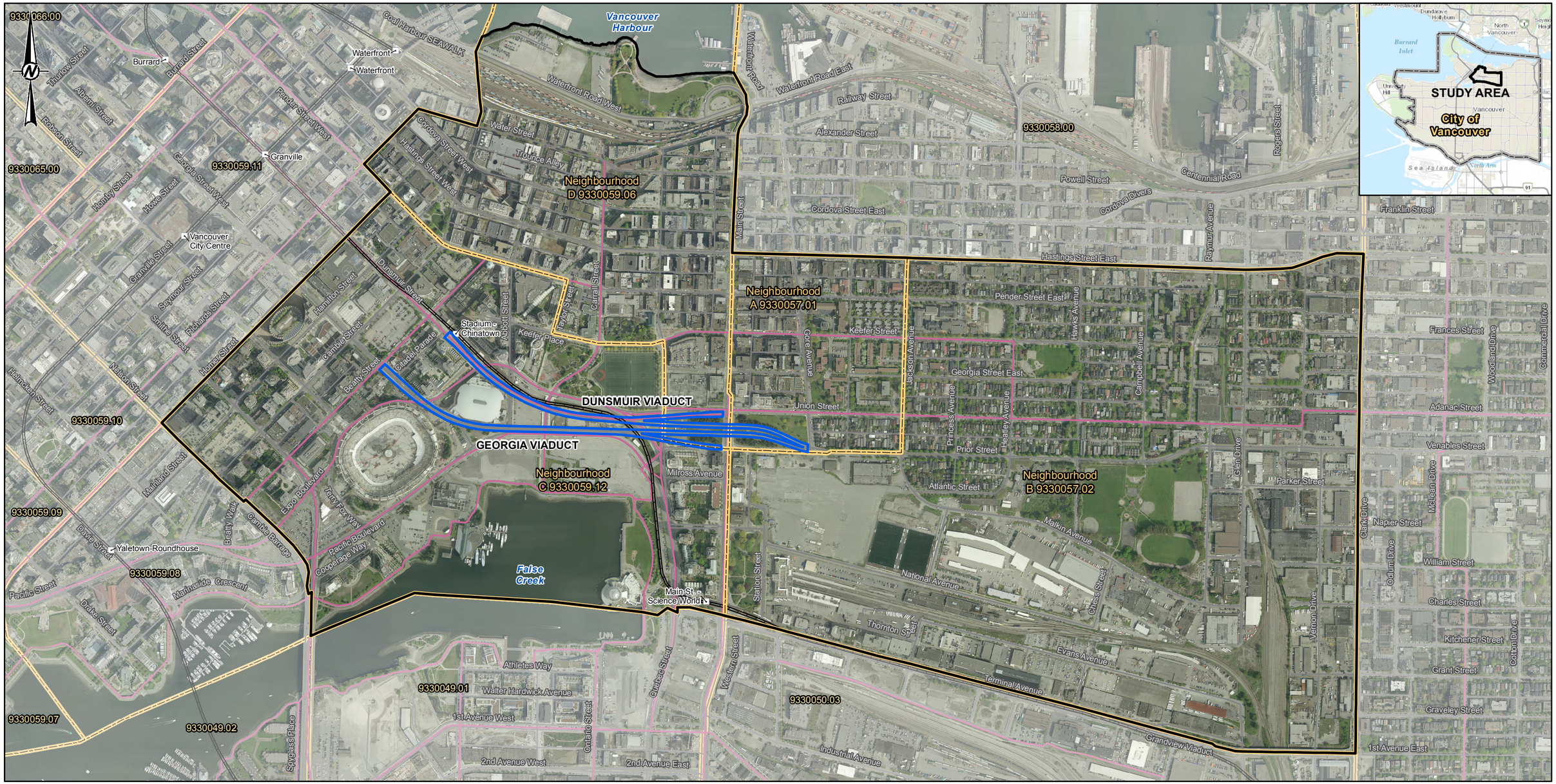
It is anticipated that there would be construction impacts on local residents, businesses and the general public with respect to road vehicle, bike and pedestrian access and mobility, as well as other health, safety and nuisance effects. Information on Project construction, including the length of time to complete the Project, size of the potential workforce, and how traffic would be re-routed during construction was not included as part of the scope of the HIA. Without this information, assessment of certain construction related effects was not possible including potential changes in traffic patterns associated with the deconstruction of the Viaducts and construction of the new road infrastructure. Recommendations for further assessment of potential construction related effects are included in Section 6.0.

Stakeholder engagement has been ongoing for this Project since 2012, including comprehensive engagement with key stakeholders and the public through the summer and fall of 2015. The City provided Golder with summaries of the consultation completed to date, including key issues tracking tables. Based on the information provided, key concerns regarding health were identified and taken into consideration in this assessment.

2.3 Study Area

The Study Area for the Project was identified based on the physical footprint of the Project and the neighbourhoods in which the Viaducts are located. The Viaducts straddle several different communities within the City's eastern core. To capture the diversity between these neighbourhoods, community profiles based on publically available data highlight the social and economic contexts within these neighbourhoods. The Study Areas comprises four Census Tract boundaries as shown on Figure 2. These include:

- **Census Tract 9330057.01** which represents the area from Main Street to Jackson Street (east/west) and Hastings Street to Prior Street (north/south). This tract includes the off-ramps to the east. Moving forward, this tract is referred to as **Neighbourhood A.**
- **Census Tract 933057.02** which represents the area from Jackson Street east to Clark Drive and Hastings Street south to Terminal Avenue. This area includes Prior Street and Malkin Avenue. Moving forward, this tract is referred to as **Neighbourhood B**.
- **Census Tract 9930059.12** which includes Northeast False Creek as well as the area to the northwest to Homer Street. This tract includes the western on and off ramps to both Viaducts. Moving forward, this tract is referred to as **Neighbourhood C**.
- **Census Tract 9330059.06** which includes the area from the Waterfront to the Viaducts west of Main Street. Moving forward, this tract is referred to as **Neighbourhood D**.



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- SKYTRAIN LINE
- ROAD
- BIKEWAY

0 200 400

1:10,000 METRES

REFERENCE(S)

1. ROADS OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CENSUS TRACTS OBTAINED FROM STATISTICS CANADA.
3. ORTHOPHOTO (2011), CITY BOUNDARY, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
STUDY AREA BY NEIGHBOURHOOD

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	**2**

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The Air Quality and Noise assessments have specific study areas that reflect the areas in which potential effects associated with the air quality and noise may be experienced. These study areas are similar, but slightly different from the study area delineated for the HIA. The Air Quality Assessment models potential Project effects by comparing the existing traffic volumes on the Viaducts to projected future traffic volumes associated with the Project. The noise study area includes the affected roads and nearest affected receptors to the Project. Thirteen residential receptors were identified representing the ground floor and first residential floor of the condo buildings in the noise study area. As it is assumed that the study areas delineated in these studies reflect the area in which air quality and noise effects could be experienced, the assessment of effects determinants of health due to air quality and noise are confined to these study areas.

3.0 DETERMINANTS OF HEALTH AND INDICATORS

The Toolkit categorizes determinants of health according to the following five themes:

- **Natural Environment Factors** include air quality, noise, and water quality;
- **Built Environment Factors** include active transportation, access to green space, change in traffic flow through neighbourhoods, construction hazards, access to existing community services, and increased mixed use developments;
- **Livelihood Factors** include education, employment and income;
- **Social and Community Factors** include sense of community belonging, gentrification and exclusion, affordable housing, safety and security, culture, and healthy child development; and
- **Lifestyle Factors** include diet and exercise and substance abuse and risky behaviour.

Indicators are the measurable parameters that influence or are associated with health determinants. Relevant baseline indicators were identified for selected health determinants to guide baseline data collection, provide context for the Project and the assessment, and a starting point for measuring change associated with the Project. Where possible based on available secondary data, baseline information was gathered for indicators to better understand the current conditions within the Study Area.

The following sections outline how the Project might interact with each determinant, the potential health affect generated by the Project, and the rationale for considering or not considering the determinant in the desktop HIA. For some determinants, an interaction was identified, however in-depth information from primary sources is required in order to fully understand and assess potential Project effects. In these cases, determinants and potential health interactions from the Project are identified and baseline data presented where available, however an assessment of potential Project effects was not completed in the desktop HIA.

For other indicators, primary information was identified as a requirement to understand both baseline and potential Project effects. In these cases, no baseline data or effects analysis is presented, but the health determinant is highlighted for further research should an intermediate or comprehensive HIA be completed for the Project.

Finally, some determinants are not expected to be directly affected by the Project, but are key indicators of overall health within potentially affected communities. For example, income is considered an important determinant of health (Office of the Provincial Health Officer, 2009). Income levels would not directly be affected by the Project, as removing the Viaducts would not increase or decrease the level of income of individuals or local communities. However, income levels could be indirectly affected as Project construction creates local employment opportunities and Project-associated mixed use developments creates new business opportunities. Income levels of the existing community provide context and insight into the socio-economic conditions of the potentially affected communities. Baseline information is included for education, employment and income, and culture as they provide context for the assessment and could be indirectly influenced by the Project.

3.1 Natural Environment

3.1.1 Air Quality

Exposure to airborne contaminants can cause numerous health effects including increased cardiovascular and respiratory disease (WHO, 2006). Motor vehicles, including cars and buses, are large sources of air pollution, including particulate matter, nitrogen dioxide and volatile organic carbons (Government of Canada, 2012). For some air pollutants associated with vehicle emissions (e.g., fine particulate matter) there is no identified health risk threshold however, the potential risk of a negative health outcomes increases with exposure (WHO, 2006). There are some populations that are more susceptible to the effects of air pollution including children, the elderly and those with pre-existing breathing and heart problems (Toronto Public Health, 2007).

Air quality in the vicinity of the Project could potentially be affected due to changes in traffic emissions. The Project would change road infrastructure design which is expected to have a small effect on travel times within the study area. The change in traffic flow and travel times could change the traffic emissions and therefore air quality within the Study Area. Air Quality is carried forward for further assessment in the desktop HIA, with the results from the Air Quality Assessment providing relevant data inputs.

Indicators include baseline and projected air quality estimates for fine particulate matter, nitrogen oxide, carbon monoxide, and benzene in the Study Area calculated for the Air Quality Assessment. Changes in these indicators are considered within respect to potential effects on health.

3.1.2 Noise

There have been a number of studies completed that have shown that certain levels of noise can result in health effects. Noise can be detrimental to human health and can disrupt sleep, provoke annoyance, cause cardiovascular effects and reduce overall performance of an individual (WHO, 2015). Among these symptoms, annoyance and sleep disturbance are the most reported effects from environmental noise (Sygna, Marit Aasvang, Aamodt, Oftedal, & Hjertager Krog, n.d.). It is suggested that the non-clinical effects may inhibit mental and physiological performance, thus affecting a person's quality of life; however, studies that specifically assess road traffic noise and quality of life have found mixed results (Roswall et al., 2015). Weak associations between increased psychological distress and an increase in traffic noise have been found in self-assessed poor sleepers suggesting that there may be groups that are more vulnerable to the effects of traffic noise (Sygna et al., n.d.).

The removal of the Viaducts and replacement with an at-grade road would result in changes to noise levels both during construction due to construction activities and after Project completion due to change in traffic flows. Based on this anticipated change, noise is carried forward for further assessment in this desktop HIA, with the results from the Noise Assessment providing relevant data inputs.

Indicators for noise include baseline and projected noise level estimates in the study area calculated for the Noise Assessment. Changes in noise levels are considered with respect to potential effects on health.

3.1.3 Water Quality

As drinking water in the City is provided by Metro Vancouver from the Capilano, Seymour and Coquitlam Watersheds (Metro Vancouver, n.d.b), it is unlikely that drinking water quality would be affected by the Project. This indicator is not brought forward for further assessment.

3.2 Built Environment

3.2.1 Active Transportation

Active transportation is defined as any kind of transportation that is powered by people including walking and cycling. Transportation systems are known to be a significant determinant of health, with potential benefits from walking and cycling being increasing physical activity, improved physical health and reduction of health risks such as cardiovascular disease and diabetes (Ogilvie et al., 2011). Additionally, active transportation can contribute to increased social interactions and reduce air pollution from vehicle use, both which contribute to better health outcomes (Public Health Agency of Canada, 2014).

The Project would replace and increase infrastructure for active transportation, which in turn could encourage residents to use active forms of transportation rather than more passive forms like person vehicles. Active transportation is carried forward for further assessment in the desktop HIA.

Selected indicators of active transportation are based on available secondary information and include existing transportation methods used by employed persons, walkability of the existing neighbourhoods (measured through walk scores) and bike counts at major intersections in the Study Area.

3.2.2 Access to Green Space

Parks are considered part of the built environment. Access to urban parks provides physical health benefits including increased physical activity, reduced obesity, particularly among children, and reduce stress (Konijnendik, Annerstedt, Nielsen, & Maruthaveeran, 2013). A relationship between proximity to green space and social relationships has also been identified, particularly for children, elderly, and people with lower economic status (Maas, van Dillen, Verheij, & Groenwegen, 2009).

The Project is expected to create additional green space within the Study Area, increasing opportunities for urban park use in the Study area. Access to green space is carried forward for further assessment in the desktop HIA. The applied indicator is the number of existing parks in the Study Area.

3.2.3 Change in Traffic Flow through Neighbourhoods

Change in traffic flow from a project can affect public health and safety through a number of pathways, including vehicle accidents, exhaust emissions (air quality), vehicle noise, commute times and can also change the way traffic is experienced, positively and negatively. Risk factors associated with road vehicle accidents include vehicle type, speed, road type, traffic mix, weather condition, time of day, and personal risk factors such as alcohol and substance abuse. The Project would likely not affect vehicle type or traffic mix and would not affect weather condition, time of day, or personal risk factors since these factors are independent of road design.

The Project would substantially change the traffic flow in the study area, including road structures north/south and east/west as well as rerouting traffic away from the Prior Street neighbourhood. Studies show that perceptions of neighbourhood safety increase when traffic moves more slowly, when there are more frequent street crossings and when there are many other people out in the streets (City of North Vancouver, n.d.). Change in traffic flow through neighbourhoods is carried forward for further assessment in the HIA, taking into consideration how changes in traffic patterns might affect public health and safety within the Study Area communities, including changes to road design and traffic routing. Project health effects from air emissions and vehicle noise are assessed under sections 5.1.1 and 5.1.2 respectively and considered within the natural environment health determinant category.

Baseline indicators for change in traffic flows through neighbourhoods include existing traffic volumes and number of traffic accidents in the Study Area.

3.2.4 Construction Hazards

The Project is located in a heavily populated area of Vancouver and construction of the Project could pose certain health and safety hazards, particularly in the case of accidents and other malfunctions and unplanned events. However, it is anticipated that potential construction hazards generated by the Project would be mitigated through the application of standard construction safety management practices, including use of barriers around the construction areas to prevent public access to potentially hazardous areas, and through meeting the requirements with respect to worker safety as defined under the Occupational Health and Safety Regulation (and implemented and monitored by WorkSafe BC). Based on the assumption of Project application and adherence to safety management practices, this determinant is not brought forward for further assessment.

3.2.5 Access to Community Services

Access to community services such as hospitals, community centres, community groups and seniors centres allow a community to function by providing a consistent level of service. The availability of, and access to community services helps attract and retain people in the community, influences personal health and satisfaction with a community and maintains a level of community well-being. Access to health services, particularly those aimed at maintaining health and preventing disease are identified by Health Canada as a key determinate of population health since health services provide a key role in disease prevention that aid in the maintenance of good health (Public Health Agency of Canada, 2013b).

The Project could change access to existing services for some community members, potentially making it easier for them to reach service providers through better active transportation networks and a more accessible road network. However, increased access could also overwhelm some service providers if they are not equipped to serve a larger subset of the population. The Project would also provide safe road access to the new site of St. Pauls' Hospital on Station Street.

Primary information would be required to understand a) whether removal of the Viaducts would increase accessibility of these services to the community; and b) the ability of services to meet this changed demand. In addition, change in population associated with the housing developments in the NEFC area and affordable housing developments on City lands could further increase demand on services through a cumulative effect of the different developments occurring at the same time. Given that primary data collection would be required to address both the baseline and potential Project effects on access to services, this determinate is not assessed in the desktop HIA, but is highlighted for further assessment should the City decide to complete an intermediate or comprehensive HIA.

Change in access to the new St. Paul's Hospital site is assessed in the desktop HIA. However, baseline data is limited and not presented since the timeline and detail pertaining to the hospital's relocation is not publically available.

3.2.6 Increased Mixed-Use Developments

Access to amenities such as schools, civic services, green spaces, retail, and employment opportunities within close proximity to home encourage use of active transportation and physical activity generally (Provincial Health Services Authority, 2014). Specifically, mixed use developments in walkable and transit oriented areas, offering diversity in services and amenities, show decreased vehicle trips, leading to less traffic and subsequent improvement in air quality (Ewing et al., 2011). Pedestrian traffic is found to increase in communities with denser housing and commercial activities, particularly grocery stores (Vernez Moudon, Hess, Snyder, & Stanilov, 1997).

As the Project is expected to facilitate development of land previously occupied by the Viaducts into future neighbourhoods (including mixed-use development) this determinant is carried forward for further assessment in the desktop HIA. Baseline indicators include existing City Bylaw zoning within the Study Area.

3.3 Livelihood Factors

3.3.1 Education

Education is considered one of the most important predictors of health (Office of the Provincial Health Officer, 2009). Research has shown that individuals who graduate from high school live, on average 9.2 years longer than those who do not, which is attributed to improvement in cognitive ability and decision making in addition to better occupations and higher income (Office of the Provincial Health Officer, 2009).

As the Project is unlikely to directly affect education levels in the Study Area, Project effects on education are not assessed in the desktop HIA. However, as education is a key determinant of health and provides important context to the socio-economic conditions of the communities within the Study Area, baseline education levels are presented. The identified baseline education indicator is educational attainment for population aged 15 years and older.

3.3.2 Employment and Income

Employment and income are linked to health and wellbeing. Health Canada notes that low income Canadians are more likely to experience more illness and die earlier than higher income earners, regardless of age, sex, ethnicity, and place of residence (Public Health Agency of Canada, 2013b). Distribution of income is also a key determinant of health, with gaps in income distribution within a community linked to social problems and poorer health across the population as a whole (Public Health Agency of Canada, 2013b).

Information on Project construction was not included as part of the scope of the HIA and the composition and scale of new developments that are built around the Project are not known at this juncture so potential Project effects on employment and income are not assessed in the desktop HIA. However, as employment and income are key indicators of health and provide important context to the socio-economic conditions of the communities within the Study Area, baseline employment, income, and income distribution information is presented. Baseline indicators include population with income, median and average income, and prevalence of low income in the Study Area. In general it can be presumed that construction activities associated with the Project would create

employment opportunities and income generation, including employment at businesses supplying materials, goods and services. Business disruption is a possibility during construction but can be minimized or avoided through planning of construction activities. When engineering feasibility estimates for the selected Project design and construction become further developed, then various economic effects of the Project's construction activities on Vancouver and the province can be assembled, Subsequent planning for lands in the vicinity of the Project would indicate the scale and types of new uses and redevelopments that are likely to get installed around the new transportation infrastructure and civic amenities and with this information, estimates of associated employment and business opportunities can be prepared.

3.4 Social and Community Factors

3.4.1 Sense of Community and Belonging

Sense community is defined as "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together" (McMillan & Chavis, 1986). An association between social relationships and health has been documented in scientific studies, indicating that people who are more socially isolated are less healthy both physiologically and physically (for example, House, Landis, & Umberson, 1988). Large studies have found that people with social connections within their community experience lower mortality and morbidity rates compared with people without these connections (Berkman & Syme, 1979).

While construction related activities such as road detours and closure could temporarily disrupt current community structures, removal of the Viaducts would eliminate a physical barrier that currently separates local communities, including parts of Prior Street from Strathcona. The elimination of this physical barrier could potentially contribute to long-term increased social interaction and social cohesion among the larger communities. Relevant secondary baseline information is not currently available on this determinant, and primary data collection through consultation, community based interviews and meetings would be required to confirm this interaction and understand existing levels of sense of community and belonging within the existing neighbourhood. Sense of community and belonging is not assessed in the desktop HIA, but is highlighted as an determinant for further assessment should the City decide to complete a more comprehensive HIA.

3.4.2 Gentrification and Displacement

Gentrification is the transformation of neighborhoods from low economic value to high value (CDC 2013). While gentrification is often perceived as an opportunity to revitalize and restore areas of a city that are older and generally lower income, it can also result in displacement of long-time residents and businesses as rent, mortgages, and property tax increase (CDC 2013). Displacement can lead to a number of health implications, including shorter life expectancy, higher cancer rates, more birth defects, greater infant mortality, and higher incidence of asthma, diabetes, and cardiovascular disease particularly for vulnerable groups, including the poor, women, children, the elderly, and members of minority groups (CDC 2013).

The Project would provide the opportunity for a number of new developments in the Study Area, including a future neighbourhood, urban park, mixed-use developments, entertainment district, and affordable housing in addition to upgrades to the transportation networks. As a result, the Project may change the neighbourhood character in the surrounding neighbourhoods and lead to gentrification and subsequent displacement of existing

vulnerable residents. However, public policy, particularly around social housing, can help manage gentrification (Lay & Dobson, 2008). Assessment of potential Project effects on gentrification requires stakeholder consultations and primary information collection, combined with review of City plans on management of social housing and other public policy in the Study Area. Gentrification and displacement is not carried forward for assessment in the desktop HIA, but is highlighted as a recommended determinant for further assessment should the City decide to complete an intermediate or comprehensive HIA.

3.4.3 Affordable Housing

Acceptable housing (including housing conditions, size and affordability) is key to overall health (Office of the Provincial Health Officer, 2009; Wellesley Institute, 2010). Acceptable housing creates a stable living environment and affordable housing allows low income households to spend more money on necessities such as food, medicine, utilities, transportation, and childcare that contribute to both physical health and quality of life (MacKay, Wellner, & OMA Health Promotion, 2013). Conversely, poor housing conditions are associated with a variety of health concerns, including respiratory infections, asthma, lead poisoning, injuries, and mental health (Krieger & Higgins, 2002). In addition, stress linked to unaffordable housing can result in adverse physical and mental health outcomes (Ontario Public Health Association, n.d.).

Project effects on affordable housing were assessed in the desktop HIA as the removal of the Viaducts is expected to facilitate neighbourhood developments in the Study Area, including proposed affordable housing opportunities. However, the desktop HIA did not assess potential Project effects on homelessness since primary information is required to characterize existing conditions to further understand where homeless residents are living and assess potential Project effects on homeless residents. As homelessness is a concern within the City, it is highlighted for further assessment should the City decide to complete an intermediate or comprehensive HIA. Baseline indicators include housing suitability measures, including suitable size, condition, and affordability.

3.4.4 Safety and Security

The perception of neighbourhood safety and security is tied to health, well-being and quality of life. For example, studies have shown that there is a relationship between fear and mental and physical health as it can act as a barrier to participation in health promoting activities such as walking outside of the home or office and social activity (Ross & Mirowsky, 2001; Stafford, Chandola, & Marmot, 2007). This relationship appears to be particularly important among vulnerable populations such as older adults and young children. Studies have shown that future functional decline in older adults is linked to safety perceptions (Sun, Cenzer, Kao, Ahalt, & Williams, 2011). In addition, children may not get adequate physical activity due to parents perception of safety in their neighbourhood (Weir, Etelson, & Brand, 2006). This lack of exercise can lead to obesity and other related health issues and is pronounced more in minority and poor children than in other children (Weir et al., 2006). As previously indicated, perceptions of neighbourhood safety increase when traffic moves more slowly, when there are more frequent street crossings and when there are many other people out in the streets (City of North Vancouver, n.d.).

Information available through desktop sources is not sufficient to make an informed assessment on the crime rate indicator. However, there is an expectation that the increased number of mixed use developments and improvements to active transportation infrastructure due to the Project would result in more community members using the streets, and an offshoot of the more abundant street level activity would be a perception of enhanced safety among residents of the affected areas. Safety and security associated with crime is not carried forward for further assessment in the desktop HIA, however, should the City complete an intermediate or comprehensive HIA, further clarity on the linkage between the Project and this determinant could be obtained through primary data sources.

Traffic calming measures put in place due to the Project would result in slower moving traffic, which could lead to higher perceptions of neighbourhood safety. Change in safety and security due to change in traffic patterns is addressed in the desktop HIA as outlined in Section 3.2.3.

3.4.5 Culture

Aspects of culture including shared language, beliefs and practices, and cultural resources (such as local institutions, cultural programs, events, and festivals) have important influences on health and well-being. According to the Public Health Agency of Canada, health risks are associated with cultural marginalization, stigmatization, loss or devaluation of language and culture and lack of access to culturally appropriate health care and services (Public Health Agency of Canada, 2013a).

As the Project is unlikely to directly affect access to cultural resources in the Study Area or the engagement in cultural beliefs and practices of local residents, culture is not assessed in the Desktop HIA. However, as culture is a key indicator of health and provides important context to the socio-economic conditions of the communities within the Study Area, baseline culture information is presented. Baseline indicators include number of cultural spaces, proportion of visible minorities, population speaking non-official languages, and Aboriginal identity within the Study Area.

3.4.6 Healthy Child Development

The quality of early childhood development is influence by the availability of economic and social resources to parents, and has important long-term implications for an individual's biological, psychological, and social health and wellbeing. For example, early childhood experiences have been shown to influence coping skills and resistance to health problems (Golder Associates Ltd., 2014; Mikkonen & Raphael, 2010).

As the Project is unlikely to directly affect childhood development in the Study Area, it is not assessed in the desktop HIA. However, as healthy childhood development is a key determinant of health and provide important context to the socio-economic conditions of the communities within the Study Area, baseline childhood development information is presented. Baseline childhood development indicators include the Early Child Development Instrument scores in the Study Area.

3.5 Lifestyle Factors

3.5.1 Diet and Exercise

Diet and exercise are primary factors associated with good health. The Canada Food Guide indicates that eating well and being active leads to better overall health, lower risk of disease, a healthy body weight, feeling and looking better, more energy, and stronger bones and muscles (Health Canada, 2007).

As the Project is unlikely to directly affect diet in the Study Area, diet is not assessed in the desktop HIA. The Project is likely, however, to increase opportunities for active transportation such as walking and biking which could lead to better health outcomes. Changes in active transportation are addressed in the desktop HIA as outlined in Section 5.2.1.

3.5.2 Personal Health Practices

Smoking, drug and alcohol abuse are considered personal health practices that influence overall health and wellbeing. Research shows that personal health practices are influenced by the socio-economic environments in which individuals live and work (Public Health Agency of Canada, 2013b). Smoking is a risk factor for a number of illnesses, including lung cancer, heart disease, stroke, chronic respiratory disease, and other conditions (Statistics Canada, 2013e). Heavy drinking can lead to serious health and social consequences, especially when combined with other behaviors, for example, driving while intoxicated (Statistics Canada, 2013e). Similarly, drug use becomes more hazardous when combined with activities such as alcohol, driving, and unsafe sex (Public Health Agency of Canada, 2013a).

The Project is unlikely to directly affect substance abuse or risky behaviour in the Study Area, however, information available through desktop sources will not be sufficient to make an informed assessment on this indicator. Substance abuse and risky behaviour is not carried forward for further assessment in the desktop HIA, however, should the City complete an intermediate or comprehensive HIA, the linkage between the Project and this determinant could be re-assessed through primary data sources.

Table 1 summarizes the health determinants and indicators scoped for the Desktop HIA.

Table 1: Health Determinants and Indicators

Health Determinant	Project Interaction	Addressed or Not Addressed in Desktop HIA	Potential Health Effect	Baseline Indicators
Natural Environment				
Air Quality	Change in traffic flow and travel times could change the traffic emissions and therefore air quality within the Study Area	Addressed	Traffic pollution can result in respiratory and cardiovascular health effects	■ Baseline Air Quality Estimates from Air Quality Assessment
Change in noise	Changes to noise levels due to construction activities and change in traffic flows during operations	Addressed	Increased stress and annoyance at specific residential receptor locations	■ Baseline noise estimates from Noise Assessment
Water Quality	No linkage	Not Addressed	n/a	n/a
Built Environment				
Active Transportation	The Project would replace and create additional active transportation infrastructure	Addressed	Increasing physical activity reduces the risk of cardiovascular disease, diabetes and overall health as well as contributes to increased social interaction and reduced air pollution due to lower vehicle volumes	■ Transportation Methods for Employed Persons ■ Walk Scores ■ Bike Counts
Access to green spaces	The Project includes the creation of the Creekside Park Extension	Addressed	Increased wellbeing, and social relationships, decreased stress	■ Number of parks in the Study Area
Change in traffic flow through neighbourhoods	Removal of the Viaducts and new road infrastructure would change traffic flow through neighbourhoods	Addressed	Traffic patterns influence public health and safety	■ Existing traffic volumes ■ Traffic accidents in the study area
Construction Hazards	No linkage	n/a	n/a	n/a
Change in access to community services	The Project could change access to existing services The Project would provide safe road access to the new site of St. Pauls' Hospital on Station Street	Change in access: Not addressed Access to St. Paul's Hospital: Addressed	Access to services at St. Paul's Hospital	n/a

Health Determinant	Project Interaction	Addressed or Not Addressed in Desktop HIA	Potential Health Effect	Baseline Indicators
Increased mixed use development	The Project would create opportunities for future economic development through new mixed use developments	Addressed	Studies have shown mixed use can enhance sense of community and health outcomes	■ Existing Zoning
Livelihood Factors				
Education	No direct linkage	Baseline information provided, no assessment	n/a	■ Educational attainment, population 15 years and older
Employment and Income	The Project would create beneficial employment and income opportunities during construction and operations, however, more information on Project design and engineering feasibility is required in order to quantitatively estimate potential employment and business effects.	Baseline information provided, no assessment	n/a	■ Population with Income ■ Median income and average ■ Prevalence of low income
Social and Community Factors				
Sense of community and sense of belonging	The physical barrier of the Viaduct can act as a dividing line between communities. The removal could either promote social cohesion among the larger communities or disrupt current community structures	Not Addressed – further research required	n/a	n/a
Gentrification and Displacement	The Project would provide the opportunity for a number of new developments in the Study Area which may lead to gentrification	Not Addressed – further research required	n/a	n/a
Affordable Housing	Project design includes potential for future affordable housing sites. However, current infrastructure may be used for shelter by vulnerable members of the community	Affordable housing: Addressed Homelessness: Not addressed – further research required	Poor housing conditions are associated with a variety of health concerns, including respiratory infections, asthma, lead poisoning, injuries, and mental health	■ CMHC Housing Suitability Measures
Safety and Security	Intermediate or comprehensive HIA may offer clarity on the linkage between the Project and safety and security	Not addressed – no linkage identified at the desktop level	n/a	n/a

Health Determinant	Project Interaction	Addressed or Not Addressed in Desktop HIA	Potential Health Effect	Baseline Indicators
Culture	No direct linkage	Baseline information provided, no assessment undertaken	n/a	■ Number of cultural spaces ■ Proportion of visible minorities ■ Population speaking non-official languages ■ Aboriginal Identity
Healthy Child Development	No direct linkage	Baseline information provided, no assessment undertaken	n/a	■ Early Child Development Instrument indicators
Lifestyle Factors				
Diet and Exercise	No direct linkage	Not addressed – no linkage identified at the desktop level	n/a	n/a
Personal Health Practices	No direct linkage	Not addressed – no linkage identified at the desktop level	n/a	n/a

n/a – Not applicable

4.0 BACKGROUND AND CONTEXT

This section presents baseline conditions on the following:

- General population and mobility profile of the study area, as supportive background information on nearby communities;
- Education, employment and income, and culture as they provide context for the assessment and could be indirectly influenced by the Project; and
- Key indicators associated with health determinants identified in Section 3.0 to be addressed in the desktop HIA.

4.1 Socio-economic Context

4.1.1 Population

In 2011 the Study Area population was 27,285 residents, representing approximately 4.5% of the total population in the City of Vancouver (Table 2). Population within the Study Area was centred in **Neighbourhood C**, with approximately 46.0% of the Study Area population, followed by **Neighbourhood D** at 23.8%, **Neighbourhood B** at 18.6% and Neighbourhood A at 11.7%.

The median ages in Neighbourhoods A, B, and D were all above the median age of the City of Vancouver in 2011. **Neighbourhood A** had the oldest median age in the Study Area, which was 4.0 years higher relative to the next oldest neighbourhood (D) and 8.9 years older than the City of Vancouver (Table 2). Reflecting this, residents aged 65 and over in Neighbourhood A represented over one quarter of the population or 12.6 percentage points higher compared to the City of Vancouver (Figure 3). However, Neighbourhood B had the largest number of residents aged 65 years and older, representing 19.8% of its population.

In 2011 **Neighbourhood C** had the largest number of residents aged 19 or under and a median age of 32.2 years, which is more than 11 years lower compared to the other neighbourhoods in the Study Area (Table 2). However, due to its larger overall population, this younger age demographic only represented 8.9% of the total population in **Neighbourhood C** (Figure 3). **Neighbourhoods A** and **B** had the highest proportion of younger residents, both with 10.3% of the population below the age of 15.

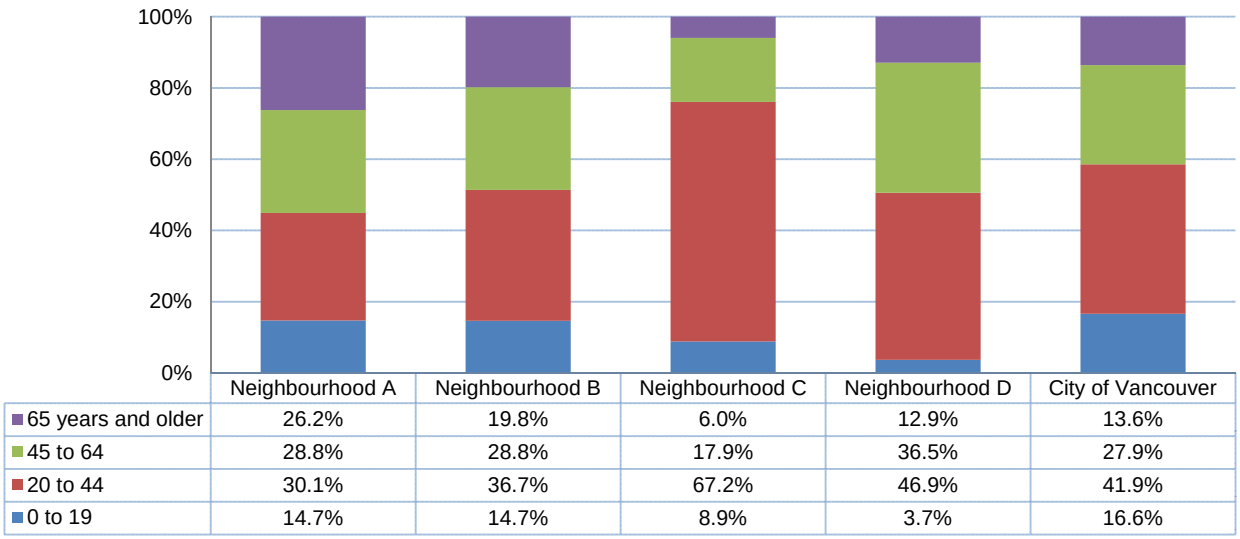
Both **Neighbourhoods C** and **D** had a higher concentration of residents between the ages of 20 and 64, at 85.1% and 83.4% respectively (Figure 3). The age demographic between 20 to 44 years was particularly high in **Neighbourhood C** at 67.2%, or approximately 25 percentage points above the City of Vancouver.

Between 2006 and 2011, population counts remained relatively similar in **Neighbourhoods A**, **B**, and **D**, however grew substantially in **Neighbourhood C**. **Neighbourhood C** nearly doubled in size, growing from 6,375 residents in 2006 to 12,513 in 2011 (Table 2).

Table 2: Population

	Neighbourhood A	Neighbourhood B	Neighbourhood C	Neighbourhood D	City of Vancouver
Total Population	3,190	5,085	12,515	6,495	603,500
0 to 19	470	745	1,110	240	100,440
20 to 44	960	1,865	8,405	3,045	252,955
45 to 64	920	1,465	2,245	2,370	168,165
65 years and older	835	1,005	745	840	81,930
Median Age (years)	48.6	44	32.2	44.6	39.7
15 years and over (%)	89.7	89.7	93.3	97.1	88.2
Percent change in population 2006-2011 (%)	6.1	0.0	96.3	4.7	4.4

Source: (Statistics Canada, 2012a, 2012b, 2012c, 2012d)



	Neighbourhood A	Neighbourhood B	Neighbourhood C	Neighbourhood D	City of Vancouver
65 years and older	26.2%	19.8%	6.0%	12.9%	13.6%
45 to 64	28.8%	28.8%	17.9%	36.5%	27.9%
20 to 44	30.1%	36.7%	67.2%	46.9%	41.9%
0 to 19	14.7%	14.7%	8.9%	3.7%	16.6%

Source: (Statistics Canada, 2012a, 2012b, 2012c, 2012d)

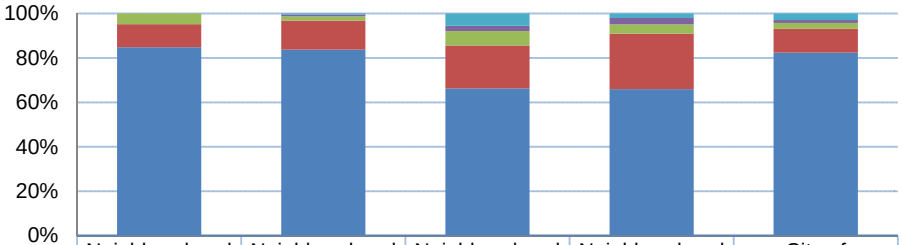
Figure 3: Age Demographics

4.1.2 Mobility

Over 80% of residents in the City of Vancouver in 2011 reported not moving within the last year, and over 50% reported not moving within the last five years (Figure 4 and Figure 5). A similar proportion of residents in **Neighbourhoods A** and **B** reported not moving relative to the city average, but within the last five years the responses diverge, with over 60% of residents in **Neighbourhood A** reporting they had not moved compared to 48.8% of residents in **Neighbourhood B**. Residents in **Neighbourhood C** and **Neighbourhood D** were substantially more likely to have moved within the last one or five years relative to other residents in the City of Vancouver. Within the last five years, only 21.0% reported not moving in **Neighbourhood C** (32.5 percentage points below the City of Vancouver) and 30.8% in **Neighbourhood D** (23 percentage points below). The relatively high proportion of residents moving into **Neighbourhoods C** and **D** likely reflects new condominium developments and associated increase in population.

Among residents that moved within the last year, each neighbourhood reported a majority moving within Vancouver (Figure 4). **Neighbourhood A** residents reported no moving from elsewhere in or outside of Canada, while less than 1.0% of residents in **Neighbourhood B** reported moving from these areas. Within the Study Area, **Neighbourhood C** had the largest proportion of residents moving from outside of Canada.

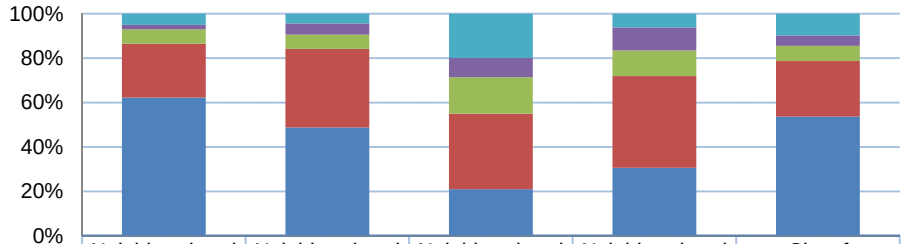
When Study Area residents reported moving within the last five years, the majority still reported moving from within Vancouver (Figure 5). Residents living in **Neighbourhood C** reported that close to 20.0% had moved from outside of Canada, over 10 percentage points higher than the Vancouver average.



	Neighbourhood A	Neighbourhood B	Neighbourhood C	Neighbourhood D	City of Vancouver
Moved from outside of Canada (%)	0.0%	0.5%	5.5%	2.0%	2.9%
Moved from elsewhere within Canada (%)	0.0%	0.8%	2.4%	2.9%	1.3%
Move from elsewhere in BC (%)	4.8%	1.9%	6.5%	4.2%	2.7%
Moved within Vancouver (%)	10.3%	13.1%	19.3%	25.0%	10.7%
Did not move (%)	84.3%	83.9%	66.3%	66.1%	82.4%

Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

Figure 4: Mobility within One Year



	Neighbourhood A	Neighbourhood B	Neighbourhood C	Neighbourhood D	City of Vancouver
Moved from outside of Canada (%)	5.0%	4.4%	19.9%	6.2%	9.8%
Moved from elsewhere within Canada (%)	2.0%	5.0%	8.7%	10.4%	4.7%
Move from elsewhere in BC (%)	6.5%	6.4%	16.4%	11.6%	6.8%
Moved within Vancouver (%)	24.2%	35.3%	34.0%	41.4%	25.0%
Did not move (%)	62.3%	48.8%	21.0%	30.8%	53.8%

Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

Figure 5: Mobility within Five Years

4.2 Natural Environment

4.2.1 Air Quality

The assessment of background air quality focused on selected Criteria Air Contaminants and one speciated carcinogen that are expected to be emitted from the traffic associated with the Project, including:

- fine particulate matter, including particles less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$);
- nitrogen oxides (NOx) (expressed as nitrogen dioxide [NO_2]);
- carbon monoxide (CO); and
- benzene (as a representative of volatile organic compounds [VOC]).

Background concentrations were measured using available monitoring data from Robson Square, the North Vancouver Second Narrows and the Vancouver Kitslano air quality stations.

Particulate emissions occur due to anthropogenic activities, such as agricultural, industrial and transportation sources, as well as natural sources. Fine particulate matter ($PM_{2.5}$) is of primary concern as these particles are small enough to penetrate deep into the respiratory system and cause health impacts. Twenty-four hour Background concentrations of $PM_{2.5}$ measured at the North Vancouver Second Narrows station and the Vancouver Kitslano ranged from 12.7 to 12.8 µg/m^3, well below the Metro Vancouver Air Quality Objective criteria of 25 µg/m^3. Annual background concentrations were also well below the Metro Vancouver Air Quality Objective criteria of 8.0 µg/m^3 ranging from 5.0 to 5.2 µg/m^3 in the study area.

NO_X is emitted in two primary forms: nitric oxide (NO) and NO_2. NO reacts with ozone in the atmosphere to create NO_2. Emissions of NO_X result from the operation of stationary equipment such as incinerators, boilers,

and generators, as well as the operation of mobile sources such as vehicles, marine vessels, and other equipment. The presence of NO_2 in the atmosphere has known health effects (e.g., lung irritation) and environmental effects (e.g., acid precipitation, ground-level ozone formation) (MOECC, 2014). Background concentrations in the Air Quality study area were below the BC Ministry of Environment (BC MOE) Guidance on Application of Provincial Interim Air Quality Objectives for NO_2 and SO_2 1-hour criteria measure of 188 µg/m^3 at 82.0 µg/m^3. The annual levels were also below the Metro Vancouver annual Air Quality Objective criteria of 40 µg/m^3, measured at 36.7 µg/m^3.

CO is produced primarily through the incomplete combustion of hydrocarbons. It is a colourless, odourless, tasteless gas that can replace oxygen in the bloodstream, reducing the oxygen that is delivered to organs and tissues. The 1-hour and 8-hour BC MOE air quality criteria are 14,300 and 5,000 µg/m^3 respectively. Background concentrations are well below both criteria, with 1-hour averages measured at 691.6 µg/m^3 and 8-hour averages measured at 605.3 µg/m^3.

Benzene is emitted from motor vehicle exhaust, as well as any other type of fuel combustion. Short-term exposure to benzene may cause drowsiness, dizziness and headaches, as well as eye, skin and respiratory tract irritation. At high levels, benzene may cause unconsciousness. Long-term inhalation exposure has caused various blood disorders and adverse reproductive effects. The U.S. Environmental Protection Agency has classified benzene as a known human carcinogen for all routes of exposure. The annual background concentration for benzene in the Air Quality study area was 0.97 µg/m^3 which is well below Alberta Ambient Air Quality Objectives and Guidelines Summary[2] of 3.0 µg/m^3.

4.2.2 Noise

Current noise levels at 13 residences within the Noise Assessment study area were modelled as part of the Noise Assessment for the Project. In all cases, existing noise levels were within compliance of the City Noise Bylaw Limits for daytime and nighttime noise (Golder Associates Ltd., 2015b).

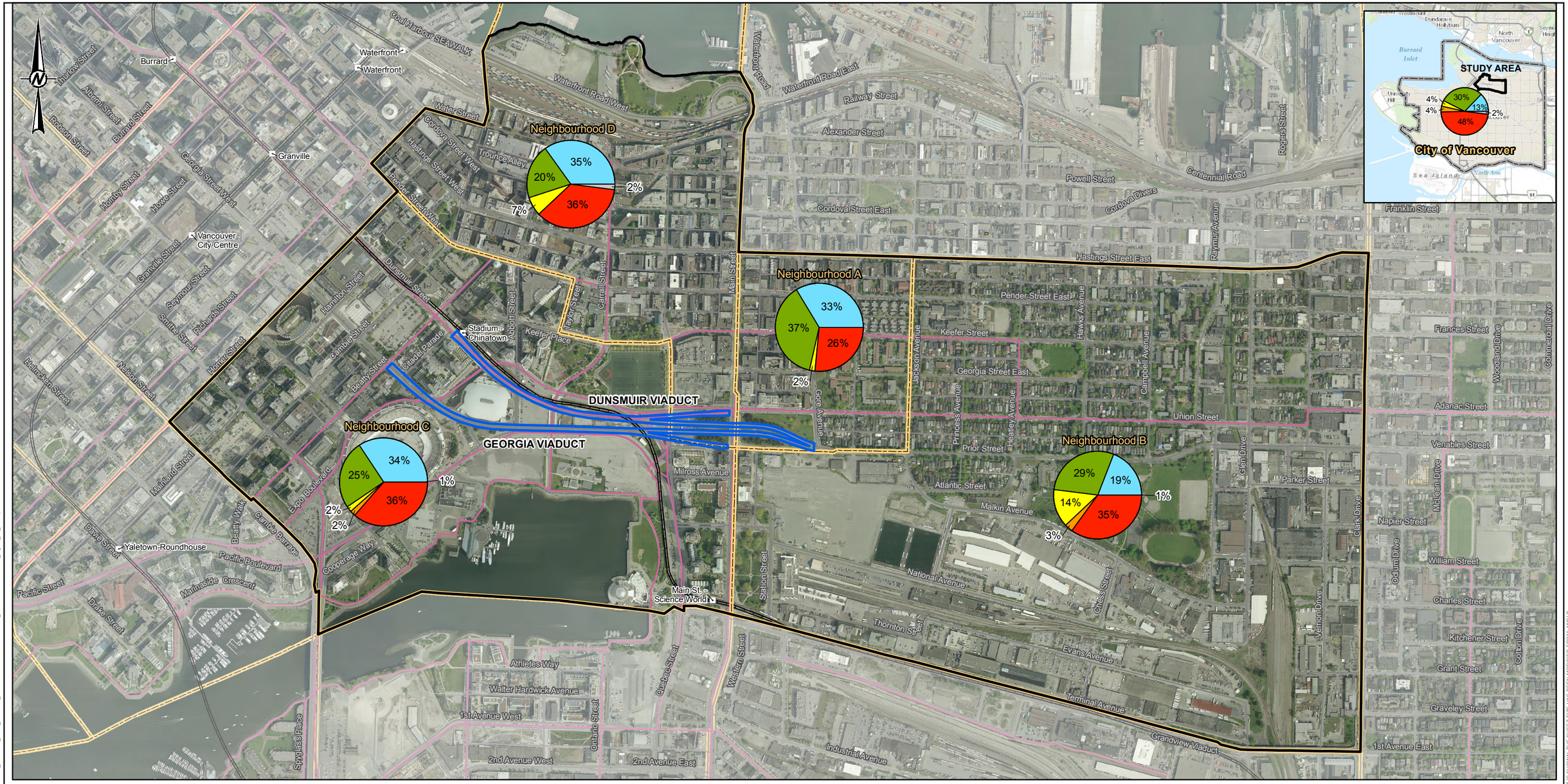
4.3 Built Environment

4.3.1 Active Transportation

Reflecting the Study Area's central location, use of personal vehicles for transportation in is relatively low (Figure 6). Although over a third of residents in **Neighbourhood B**, **Neighbourhood C**, and **Neighbourhood D** reported using car, truck or van, reported use of vehicles was much lower in **Neighbourhood A** at 26.0%.

Public transit, walking, and bicycling were used by over 60.0% of neighbourhood residents in 2011 compared to 47.0% in the City of Vancouver (Figure 6). Public transit and walking were generally the most popular forms of non-vehicle transportation, but transportation by bicycle was above the City of Vancouver average in **Neighbourhood B** (10.0 percentage points higher) and **Neighbourhood D** (3.0 percentage points higher).

[2] For benzene, as there is no ambient air quality criteria developed by Metro Vancouver, the Government of BC or the federal government, background concentrations are compared to the Alberta Ambient Air Quality Objectives and Guidelines Summary.



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- SKYTRAIN LINE
- ROAD
- BIKEWAY

TRANSPORTATION METHOD FOR EMPLOYED POPULATION AGED 15 YEARS OR OLDER

- WALKED
- PUBLIC TRANSIT
- BICYCLE
- CAR; TRUCK OR VAN - AS A PASSENGER
- CAR; TRUCK OR VAN - AS A DRIVER
- OTHER METHODS

0 200 400
1:10,000 METRES

REFERENCE(S)

1. ROADS OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CENSUS TRACTS OBTAINED FROM STATISTICS CANADA.
3. ORTHOPHOTO (2011), CITY BOUNDARY, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
TRANSPORTATION METHOD FOR EMPLOYED POPULATION AGED 15 YEARS OR OLDER

PROJECT NO.	PHASE	REV.	FIGURE
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The Study Area is already considered walkable. Walk Scores is a points-based system where scores out of 100 are calculated based on the walking distance to a number of different amenities. Amentias within a five minute walk are given maximum points, while amenities within distances greater than a 30 minute walk receive no points. The walk scores in the NEFC area is 86 out of 100, which is considered very walkable (Parsons, 2015). Walk scores for the other neighbourhoods in the Study Area range from 85 to 98, suggesting that most of the Study Area is currently very accessible by foot.

As of 2014, the peak of bike use on separated bike facilities was in July. In July 2014, the average weekday volume was observed on the designated bicycle lanes:

- Dunsmuir Viaduct: 2,600 bicycles
- Union Street at Hawkes: 4,000 bicycles
- Seawall at Science World (Terminal Avenue) 6,300 bicycles

4.3.2 Access to Greenspace

There are 14 City Park Board parks within the Study Area and two parks on elementary school grounds; however, many of them are not located within close proximity to the Project. Parks within close proximity to the Project include Andy Livingstone Park, the Dr. Sun Yet-Sen Park, Strathcona Park, Strathcona Linear Park, Trillium Park, and Creekside Park. The location of the parks in the Study Area is shown in Figure 7.

Andy Livingstone Park is located one block north of the Dunsmuir Viaduct between Union and Kiefer Streets. The park is 4.21 hectares and provides a wide range of recreation opportunities to the neighbourhood. The park provides scenic trails with greenery and a water feature as well as the following formal recreation amenities:

- Basketball court;
- Lighted fields;
- Field hockey pitches (2);
- Field house;
- Football field;
- Playgrounds (3);
- Skate park;
- Softball field;
- Tennis courts (2);
- Ultimate frisbee fields (2); and
- Washroom facilities (Vancouver Park Board, 2015).

The Dr. Sun Yet-Sen Park and the adjacent Dr. Sun Yet-Sen Garden is also located within close proximity to the Project. The Garden is an authentic representation of a Ming Dynasty traditional garden while the park is a public park built in a Chinese style (City of Vancouver, 2015b). While the park is free to the public, an admission fee is required to visit the garden.

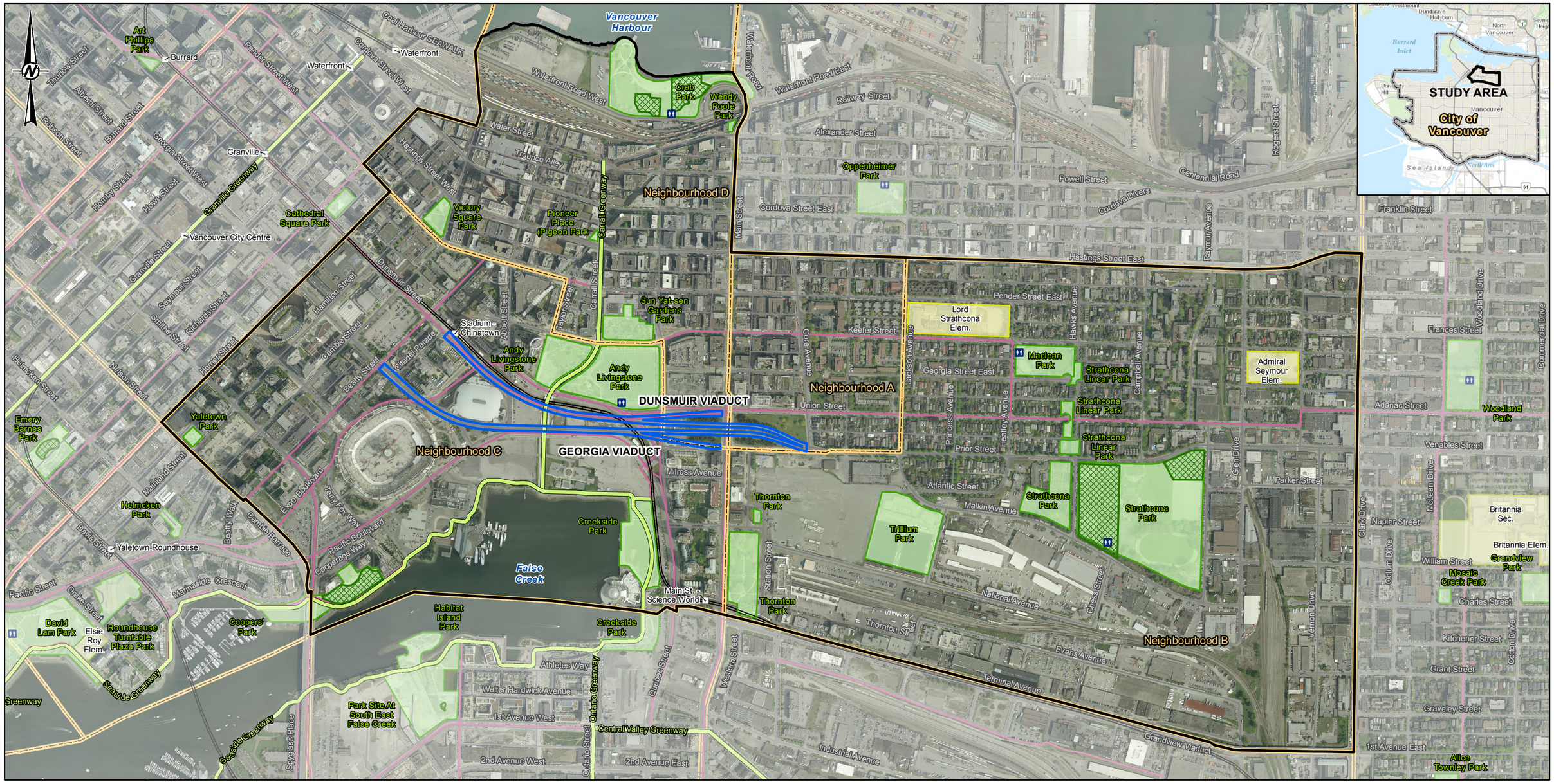
Strathcona Park is located between Prior Street and Malkin Ave, east of the Viaducts. The 10.07 hectare park is home to community gardens as well as a number of recreational amenities including the following:

- Baseball diamond;
- Basketball court;
- Off-leash dog area;
- Field house;
- Playground;
- Running track;
- Skateboard park;
- Soccer field;
- Softball field (2);
- Tennis court (4); and
- Washroom facilities.

Strathcona Linear Park is a network of parks linking Strathcona Park with MacLean Park to the north. The park includes pathways, green spaces, and a playground (Vancouver Park Board, n.d.).

Trillium Park is located south of the Project on National Avenue. The park has two synthetic turf fields, a perimeter walking path, playground, amphitheatre, lawn area, gardens, community plaza and park shelter.

The Study Area is also adjacent to Creekside Park. Further expansion of Creekside Park is anticipated with development on the shoreline of NEFC. The Project would increase the size of the expanded Creekside Park by 13% (City of Vancouver, 2015e).



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- PARK PUBLIC WASHROOM
- SKYTRAIN LINE
- ROAD
- BIKEWAY
- GREENWAY
- OFF-LEASH DOG PARK
- PARK
- SCHOOL PROPERTY

0 200 400
1:10,000 METRES

REFERENCE(S)

1. ROADS OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CENSUS TRACTS OBTAINED FROM STATISTICS CANADA.
3. ORTHOPHOTO (2011), CITY BOUNDARY, PARKS, OFF-LEASH DOG PARK, GREENWAY, SCHOOL PROPERTIES, PARK PUBLIC WASHROOMS, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
PARKS AND GREENWAYS

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	**7**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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4.3.3 Change in Traffic Flows through Neighbourhoods

It is estimated that the Viaducts carry approximately 40,000 vehicles per day (City of Vancouver, 2015e). Half of this traffic comes from the eastern half of the City while 10% of vehicles are either entering or leaving downtown. However, traffic volume is currently less than half of the designed capacity during peak daytime hours, approximately 750 vehicles per lane compared to 1,800 vehicle design capacity (City of Vancouver, 2015e).

Prior Street from Gore to Jackson currently carries a vehicle volume of 29,196 two way trips in 24 hours, with a peak afternoon volume of 2,433 (Parsons, 2015). Two percent of traffic on Prior Street is estimated to be light trucks while another 2% are heavy trucks.

Between 2009 and 2013, ICBC reports list 670 accidents occurring within in the study area (calculated from Insurance Corporation of British Columbia, 2014). Nearly half of these accidents, 312, occurred on the viaduct on and off ramps on Main Street (calculated from Insurance Corporation of British Columbia, 2014).

4.3.4 Access to Community Amenities

Figure 8 shows the community amenities within the Study Area including community gardens, community centres, libraries and schools.

Located in **Neighbourhood B** on East Pender Street near Princess Avenue, Strathcona Community Centre offers licensed childcare, preschool classes programming for children, youth, adults and seniors, and breakfast and food security programs for children. Facilities include a fitness centre, games room, and a playground (City of Vancouver, 2015d). Located within the community centre, the Strathcona Branch library offers books, DVDs, CDs and magazines for children and adults, including an Aboriginal collection and a small collection of children's books in French. The library was closed in August, but offered Library in the Park at nearby MacLean Park every Wednesday and Saturday from 10:00 am to 2:30 pm for the month (Vancouver Public Library, 2015c).

Also located in **Neighbourhood B** on East Hastings Street near Clark Drive, Ray-Cam Co-operative Centre is a neighbourhood facility and provides support services for individuals and families, and out-of-school, preschool, and daycare programs for children. Other facilities include a fitness gym, drop-in lounge and games room, media lab, and multipurpose rooms (City of Vancouver, 2015c).

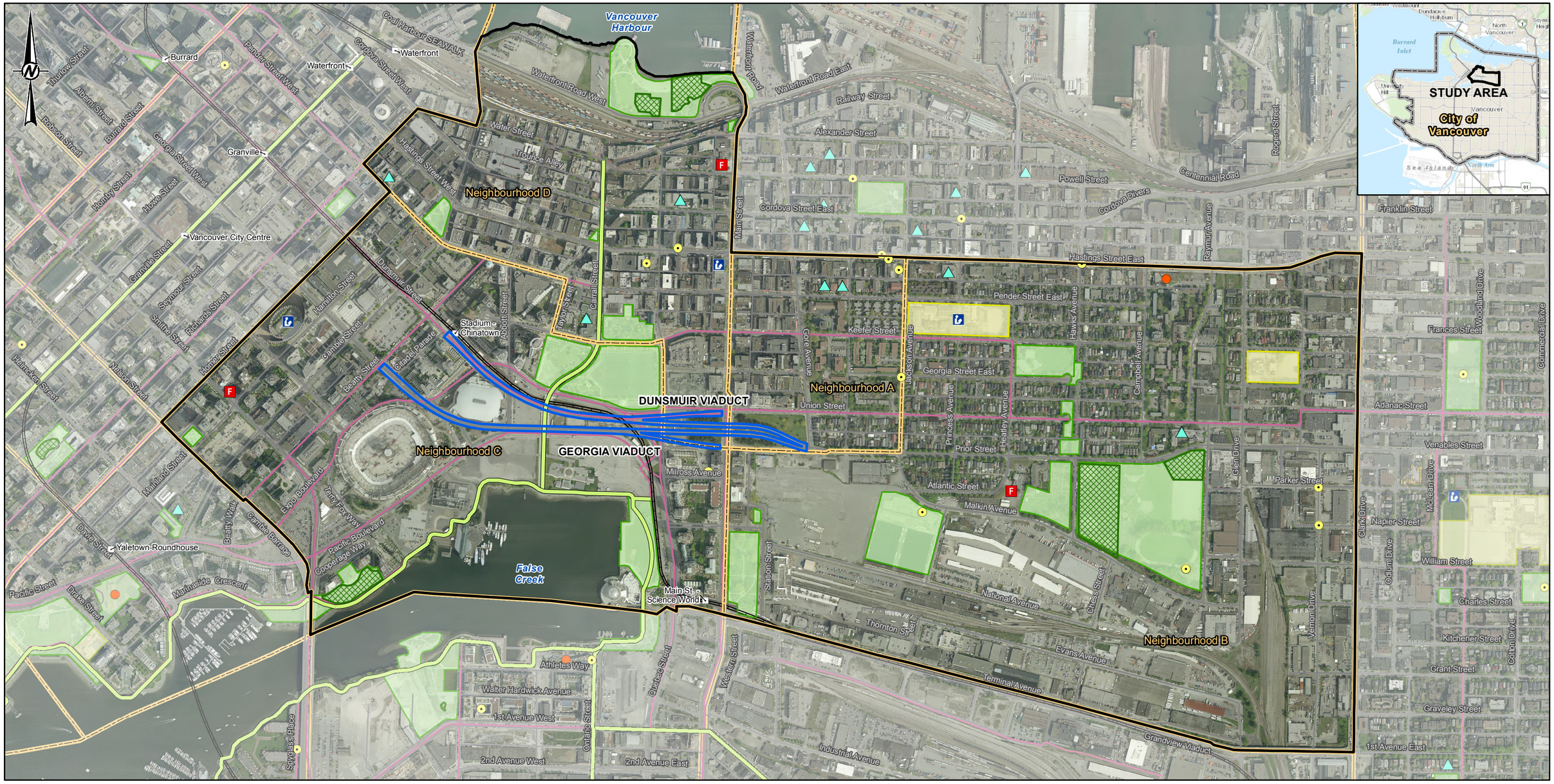
Two elementary schools were identified in the Study Area, both of which are located in **Neighbourhood B**. On East Pender Street, the Lord Strathcona Community School is Vancouver's oldest elementary school and has a population of over 500 students. The school offers K -4 French Immersion and an Intermediate Special Remedial Class for students requiring a smaller supported class setting to support behaviour (Lord Strathcona Elementary, n.d.). Admiral Seymour Elementary School, located on Keefer Street, had approximately 115 students and offers a District Band Program for students in Grades 5-7, hot breakfast and lunch programs, and "Buddy Programs" with St. George's, Crofton, and Sentinel schools. The school also houses a Strong Start Centre providing support for preschoolers and their parents/caregivers (Vancouver School Board, 2014). A new elementary school is currently planned in **Neighbourhood C** adjacent to Andy Livingstone Park and International village. The school will provide 60 kindergarten and 450 grade 1 to 7 spaces (Vancouver School Board, 2015). As part of the Project, the Vancouver School Board and the City will work to incorporate community accessible spaces within the school (Vancouver School Board, 2015). While there is no secondary school within the Study Area,

Lord Strathcona Community School and Admiral Seymour Elementary School are within the catchment area for Britannia Secondary School (Vancouver School Board, n.d.).

Located in **Neighbourhood C** on West Georgia Street, the Vancouver Central Library has a total seating capacity of 1,200 and includes an extensive collection of materials. Occupying seven floors, the Central library offers public computers on each floor, as well as meeting rooms and public lockers (Vancouver Public Library, 2015b, n.d.).

Located in **Neighbourhood D** on Main Street, the Carnegie Community Centre provides social, educational, cultural and recreational activities, including sports, music, arts and crafts, on-site, at nearby Oppenheimer Park, and through an outreach team. The programs serve low income adults with the goal of nurturing mind, body, and spirit in a safe and welcoming environment (City of Vancouver, 2015a). The Carnegie Community Centre is also home to the Carnegie Reading Room, which offers approximately 11,000 books on the shelves at any given time, including a collection of Aboriginal, Chinese language, and literacy materials (Vancouver Public Library, 2015a).

Other community amenities in the Study Area include three fire halls, five licenced and registered care facilities, and several community gardens/food trees.



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- LIBRARY
- COMMUNITY CENTRE
- COMMUNITY GARDEN/FOOD TREE
- LICENSED AND REGISTERED CARE FACILITY
- FIRE HALL
- SKYTRAIN LINE
- ROAD
- BIKEWAY
- GREENWAY
- OFF-LEASH DOG PARK
- PARK
- SCHOOL PROPERTY

0 200 400
1:10,000 METRES

REFERENCE(S)

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2. CENSUS TRACTS OBTAINED FROM STATISTICS CANADA.
3. ORTHOPHOTO (2011), CITY BOUNDARY, PARKS, OFF-LEASH DOG PARK, GREENWAY, SCHOOL PROPERTIES, LIBRARIES, FIRE HALLS, COMMUNITY CENTRES, COMMUNITY GARDENS/FOOD TREES, LICENSED AND REGISTERED CARE FACILITIES, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
COMMUNITY AMMENITIES

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	**8**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

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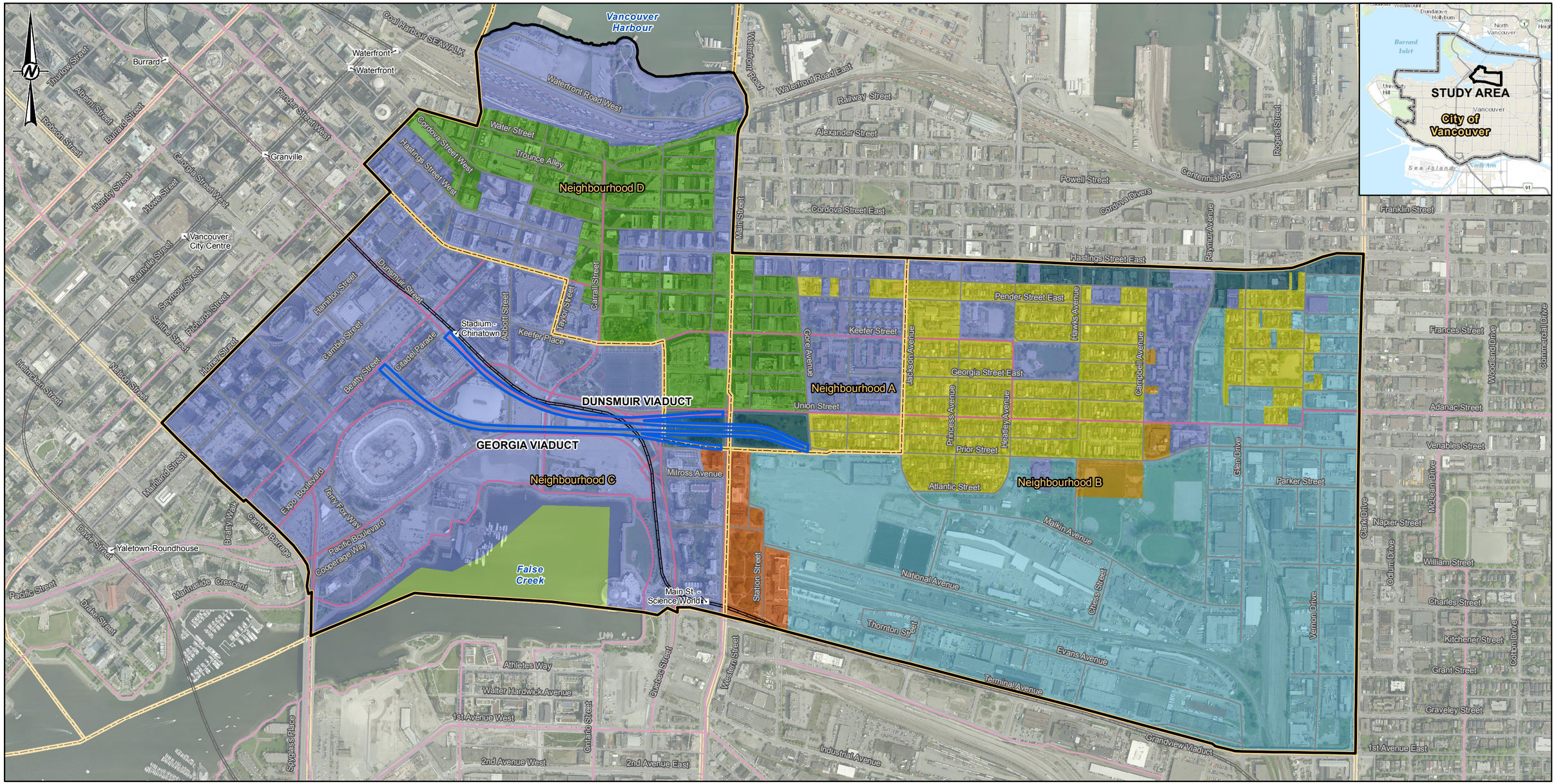
4.3.5 Increase in Mixed Use Developments: Existing Zoning

Figure 9 shows the zoning designations within the Study Area. All of **Neighbourhood C** and portions of **Neighbourhoods A**, **B** and **D** are zoned as "Comprehensive Development", which allows uses outlined in the Development District planning documents rather than the city-wide zoning schedules. While the Comprehensive Developments zoning boundaries each have specific permitted uses, most generally include residential, industrial, commercial, parks and open spaces, and cultural and recreational uses.

Other zoning designations within the Study Area include:

- Industrial (Neighbourhoods A, B, D);
- Light Industrial (Neighbourhood B);
- Commercial (Main Street, Neighbourhoods B and C);
- Historic Area (Chinatown, Neighbourhoods A and D);
- Two family dwellings (Neighbourhood A and B); and
- Multiple family dwellings (Neighbourhood B).

The Project site overlaps with the Comprehensive Development and Industrial zones.



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- SKYTRAIN LINE
- ROAD
- BIKEWAY

ZONING

- ONE FAMILY DWELLING
- TWO FAMILY DWELLING
- MULTIPLE FAMILY DWELLING
- COMMERCIAL
- INDUSTRIAL
- LIGHT INDUSTRIAL
- HISTORIC AREA
- COMPREHENSIVE DEVELOPMENT;

0 200 400

1:10,000 METRES

REFERENCE(S)

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3. ORTHOPHOTO (2011), CITY BOUNDARY, ZONING, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

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CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
ZONING BOUNDARIES

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	**9**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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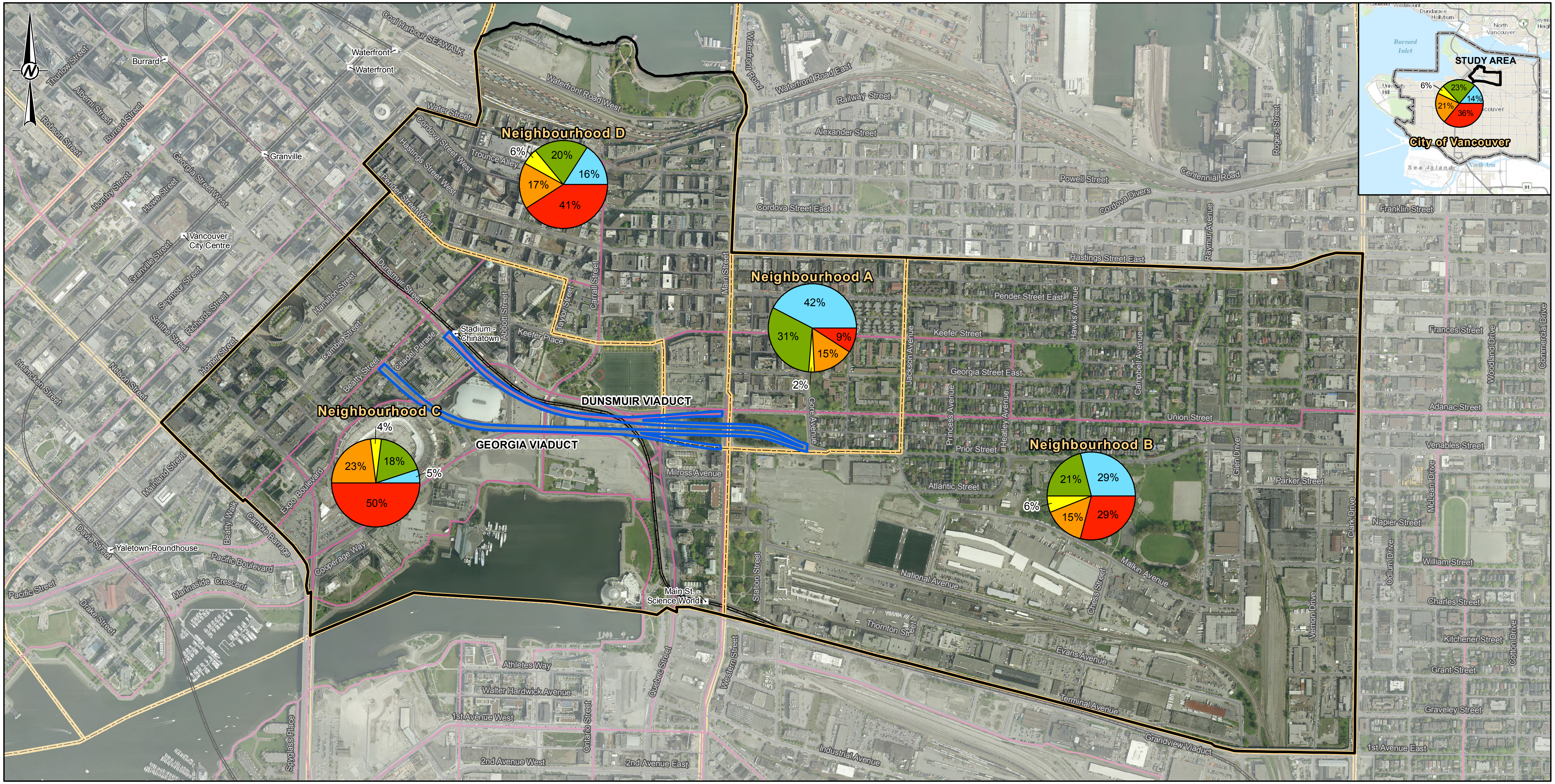
4.4 Livelihood Factors

4.4.1 Education

In 2011, educational attainment in **Neighbourhood A** and **B** was low (Figure 10). Relative to the City of Vancouver, the proportion of residents without a certificate, diploma, or degree was 28.0 percentage points higher in **Neighbourhood A** and 15.0 percentage points higher in **Neighbourhood B**. The proportion of residents with no more than a high school diploma or equivalent was 73.0% in Neighbourhood A and 50.0% in **Neighbourhood B. Neighbourhood A** also had the smallest proportion of residents in the Study Area with a university certificate, diploma or degree, 27 percentage points below the City of Vancouver.

However, educational attainment in the Study Area varies substantially, with over a 40 percentage point different in the proportion of residents with a university certificate, diploma or degree between **Neighbourhoods A** and **C**. Educational attainment in **Neighbourhoods C** and **D** was also high relative to the City of Vancouver; the proportion of residents with a university certificate, diploma or degree was 14.0 percentage points above the City of Vancouver average in **Neighbourhood C** and 5.0 percentage points higher in **Neighbourhood D**.



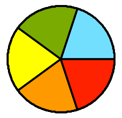
LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- SKYTRAIN LINE
- ROAD
- BIKEWAY

EDUCATION PROFILE OF POPULATION 15 YEARS OR OLDER



- LESS THAN HIGH SCHOOL
- HIGH SCHOOL DIPLOMA OR EQUIVALENT
- APPRENTICESHIP OR TRADES CERTIFICATE OR DIPLOMA
- COLLEGE CERTIFICATE OR DIPLOMA
- UNIVERSITY CERTIFICATE, DIPLOMA OR DEGREE

0 200 400
1:10,000 METRES

REFERENCE(S)

1. ROADS OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
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3. ORTHOPHOTO (2011), CITY BOUNDARY, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
EDUCATION PROFILE OF POPULATION AGED 15 YEARS OR OLDER

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

4.4.2 Employment and Income

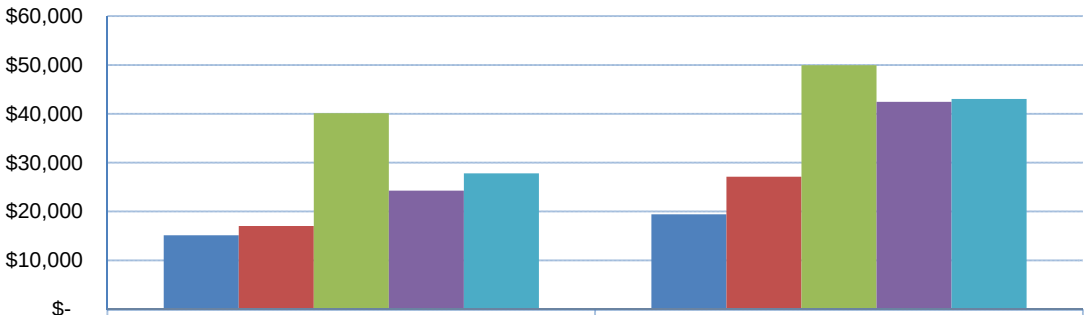
Within the Study Area, **Neighbourhood C** had the highest number of residents without income in 2010, but proportionately **Neighbourhood A** was the only neighbourhood to have more residents without income (6.4%) relative to the City of Vancouver (Table 3).

Table 3: Income Profile, 2010

Income	Neighbourhood A	Neighbourhood B	Neighbourhood C	Neighbourhood D	City of Vancouver
Population aged 15 years and over (2010)	2,435	4,010	11,665	4,140	518,975
Without income	155	110	380	65	24,580
With income	2,275	3,895	11,285	4,070	494,395

Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

While **Neighbourhoods A, B,** and **D** all reported median and average incomes below the City of Vancouver, **Neighbourhood C** had comparatively high income in 2010 (Figure 11). Income disparity across the Study Area neighbourhoods was substantial, with **Neighbourhood C** reporting median and average incomes that were $25,010 and $30,531 higher compared to **Neighbourhood A.**



	Median income ($)	Average income ($)
Neighbourhood A	$15,134	$19,411
Neighbourhood B	$17,023	$27,137
Neighbourhood C	$40,144	$49,942
Neighbourhood D	$24,261	$42,455
City of Vancouver	$27,815	$43,058

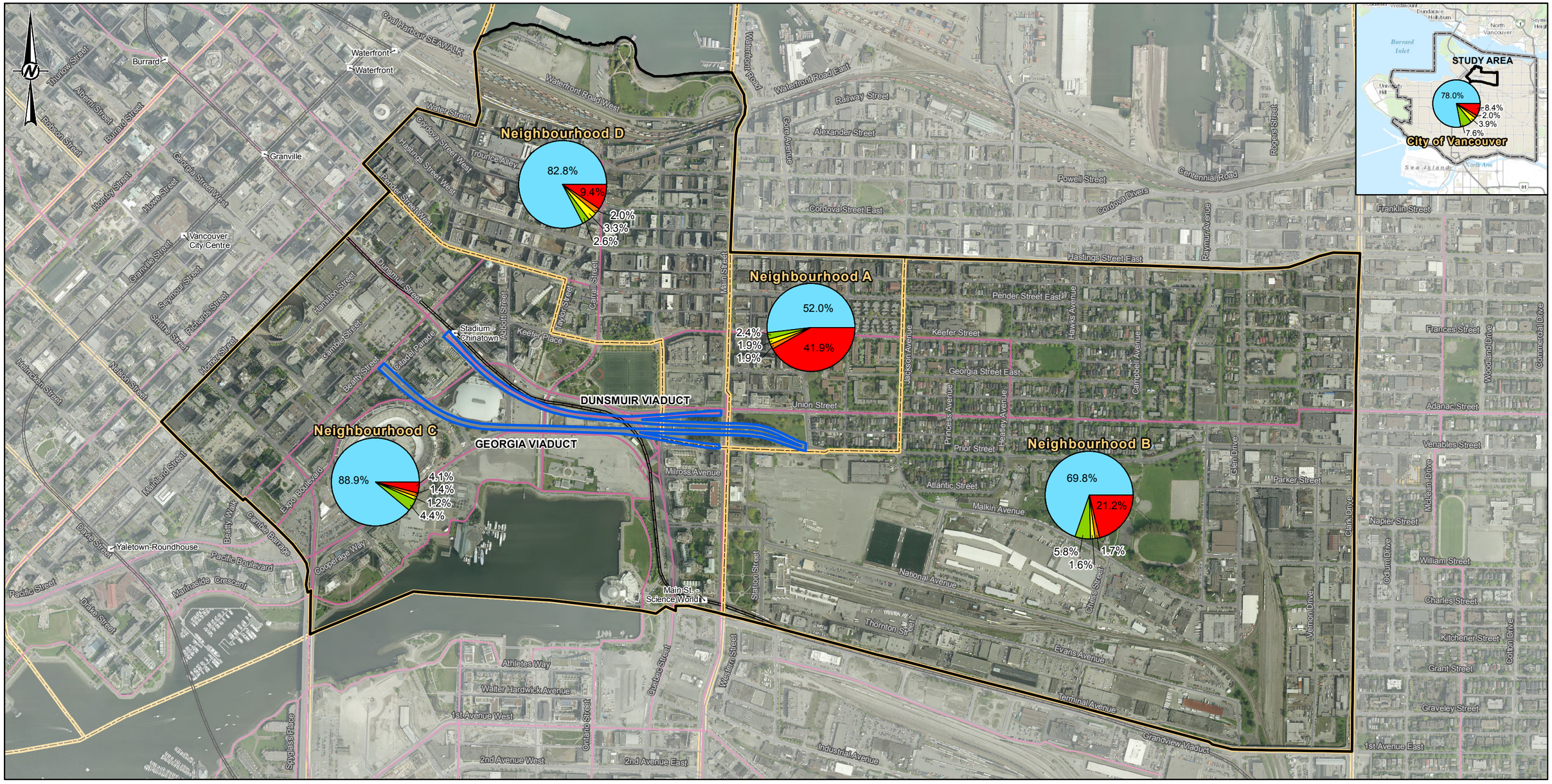
Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

Figure 11: Median and Average Income

Reflecting the high proportion of residents without income and the lower median and average incomes reported employment income in Neighbourhood A represented 52.0% of total income in 2010. Government transfer payments represented 41.9% of total income in Neighbourhood A, which is 33.5 percentage points higher than the City of Vancouver. The composition of total income in Neighbourhood B was also similarly distributed, with employment income representing 69.8% of total income and government transfer payments representing 21.2%.

Employment income in **Neighbourhood C** and **Neighbourhood D** both represented over 80% of total income and was above the City of Vancouver average in 2010. **Neighbourhood C** had a lower proportion of income coming from government transfer payments, 4.3 percentage points below the City of Vancouver, while **Neighbourhood D** was above the City of Vancouver average by 1.0 percentage point.

The proportion of total income from investments, retirement pensions, superannuation and annuities, and other money income was equal to or lower relative to the City of Vancouver for all the Study Area neighbourhoods.



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- SKYTRAIN LINE
- ROAD
- BIKEWAY

COMPOSITION OF TOTAL INCOME IN 2010 OF POPULATION 15 YEARS AND OVER

- EMPLOYMENT INCOME
- INVESTMENT INCOME
- RETIREMENT PENSIONS; SUPERANNUATION AND ANNUITIES (%)
- OTHER MONEY INCOME
- GOVERNMENT TRANSFER PAYMENTS

0 200 400
1:10,000 METRES

REFERENCE(S)

1. ROADS OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. CENSUS TRACTS OBTAINED FROM STATISTICS CANADA.
3. ORTHOPHOTO (2011), CITY BOUNDARY, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-29
DESIGNED	AT
PREPARED	JP
REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
COMPOSITION OF TOTAL INCOME IN 2010 OF POPULATION 15 YEARS AND OVER

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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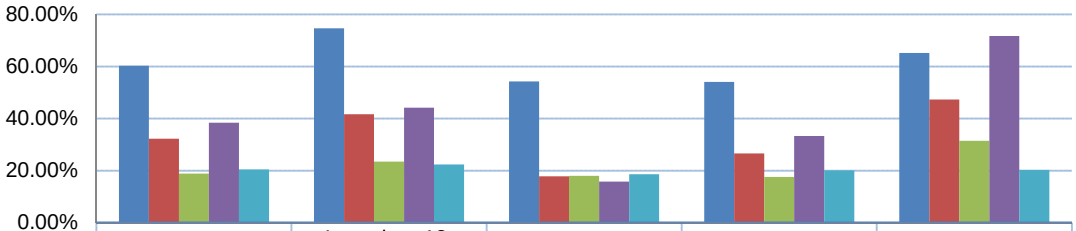
With the exception of **Neighbourhood C**, the prevalence of low income in 2010 was higher in the Study Area relatively to the City of Vancouver (Figure 13). **Neighbourhood A** had the highest prevalence of low income at 60.3% of residents (39.8 percentage points above the City of Vancouver), followed by **Neighbourhood D** (17.9 percentage points above) and **Neighbourhood B** (11.8 percentage points above). Residents aged less than 18 years and 65 years and over in the Study Area generally experienced higher rates of low income relative to the City of Vancouver. Specific neighbourhood age-groups with particularly high (above 60%) prevalence of low income include residents aged less than 18 years in **Neighbourhood A** and residents aged 65 years and over in **Neighbourhoods A** and **D**.



	Overall	Less than 18 years	Less than 6 years	18 to 64 years	65 years and over
Neighbourhood A	60.30%	74.70%	54.30%	54.10%	65.20%
Neighbourhood B	32.30%	41.70%	17.80%	26.60%	47.30%
Neighbourhood C	18.90%	23.50%	18%	17.60%	31.50%
Neighbourhood D	38.40%	44.20%	15.80%	33.30%	71.70%
City of Vancouver	20.50%	22.40%	18.60%	20.10%	20.30%

Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

Figure 13: Prevalence of low income in 2010 based on after-tax low-income measure

4.5 Social and Community Factors

4.5.1 Affordable Housing

The proportion of residents with unsuitable housing was highest in **Neighbourhood B** and **Neighbourhood A**, both of which are at approximately 15.0% and between 4.2 and 4.8 percentage points above the city of Vancouver (Table 4) In terms of housing condition, **Neighbourhood A** and **Neighbourhood B** also had a higher proportion of housing in need of major repairs compared to the City of Vancouver average. For **Neighbourhood A** the proportion of housing in need of major repair was twice as high as in the City of Vancouver, but **Neighbourhood B** was less than a percentage point higher in comparison. In Neighbourhood C, the proportion of housing in need of major repairs was exceptionally low at less than 1.0%.

Compared to the City of Vancouver, the proportion of residents in the Study Area spending more than 30% of their household total income on shelter was high (Table 4). Among residents living in **Neighbourhood A** and **Neighbourhood D**, over 50% of residents reported spending over 30% of their household total income on shelter, while over 40% of residents in **Neighbourhood B** and **Neighbourhood C** reported the same.

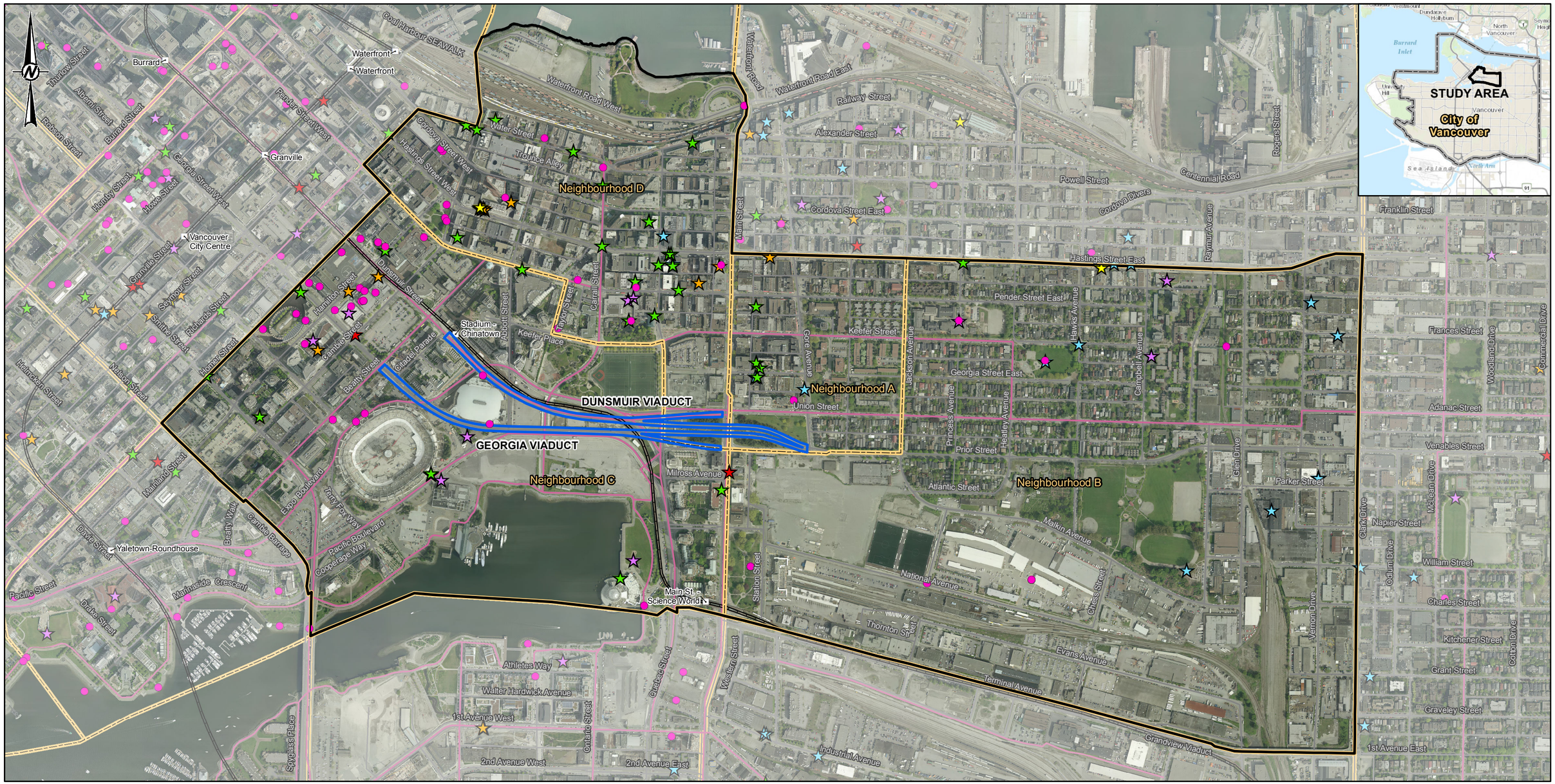
Table 4: Canadian Mortgage and Housing Corporation Housing Suitability Measures

		Neighbourhood A	Neighbourhood B	Neighbourhood C	Neighbourhood D	City of Vancouver
Suitable Size	Suitable (%)	84.7	84.7	88.2	93.2	89.2
	Not Suitable (%)	15.0	15.6	11.7	6.8	10.8
Condition	Only regular maintenance or minor repairs needed (%)	84.0	91.2	99.1	93.7	91.9
	Major repairs needed (%)	16.0	8.6	0.8	6.3	8.1
Affordability	Spending less than 30% of household total income on shelter costs (%)	49.3	59.2	53.8	48.4	62.3
	Spending 30% or more of household total income on shelter costs (%)	50.7	40.5	46.2	51.6	37.7

Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

4.5.2 Culture

Approximately 355 cultural spaces have been identified in the City of Vancouver, including museums, galleries, theatres, studio and rehearsal spaces, art and performance schools, cafés, restaurant and bars. A total of 67 cultural spaces were identified in the Study Area, most of which are located away from the Project site (Figure 14). A number of significant amenities, such as Science World, Plaza of Nations, BC Place Stadium, Rogers Arena, and Queen Elizabeth Theatre, are centred in **Neighbourhood C** and mostly to the west of the Project. **Neighbourhood D** has a concentration of privately run art gallery spaces, particularly located on East Hastings Street. Smaller cultural spaces in the Study Area include the Playwrights Theatre Centre, Vancouver Access Artist Run Centre, Centre for Contemporary Asian Art, and the Rickshaw Theatre in **Neighbourhood A**, the Strathcona Park and Maclean Field Houses, Russian Hall, and the City of Vancouver Artist Studio in **Neighbourhood B**, and the Djavad Mowafaghian Cinema, Fortune Sound Club, and Chinese Cultural Centre in **Neighbourhood D**. Further information on cultural spaces including parks and community amenities is available in Sections 4.3.2 and 4.3.4 respectively.



LEGEND

- STUDY AREA
- GEORGIA/DUNSMUIR VIADUCT
- CITY OF VANCOUVER MUNICIPAL BOUNDARY
- CENSUS TRACT (2011)

BASE DATA

- SKYTRAIN STATION
- SKYTRAIN LINE
- ROAD
- BIKEWAY

CULTURAL SPACE TYPE

- EDUCATIONAL
- MUSEUM/GALLERY
- THEATRE/PERFORMANCE
- STUDIO/REHEARSAL
- COMMUNITY SPACE
- CAFE/RESTAURANT/BAR
- PUBLIC ART LOCATION

0 200 400
1:10,000 METRES

REFERENCE(S)

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2. CENSUS TRACTS OBTAINED FROM STATISTICS CANADA.
3. ORTHOPHOTO (2011), CITY BOUNDARY, CULTURAL SPACES, BIKEWAY AND SKYTRAIN FEATURES OBTAINED FROM THE CITY OF VANCOUVER.
4. INSET BASE SOURCES: ESRI, NRCAN, GEOBASE, AND THE GIS USER COMMUNITY.

DATUM: NAD83 PROJECTION: UTM ZONE 10

CLIENT
CITY OF VANCOUVER

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YYYY-MM-DD	2015-09-29
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REVIEWED	AT
APPROVED	RS

PROJECT
VIADUCTS DATA CONSOLIDATION PROJECT
NORTH-EAST FALSE CREEK, VANCOUVER, B.C.

TITLE
CULTURAL SPACES

PROJECT NO.	PHASE	REV.	FIGURE
1405994	3000	0	**14**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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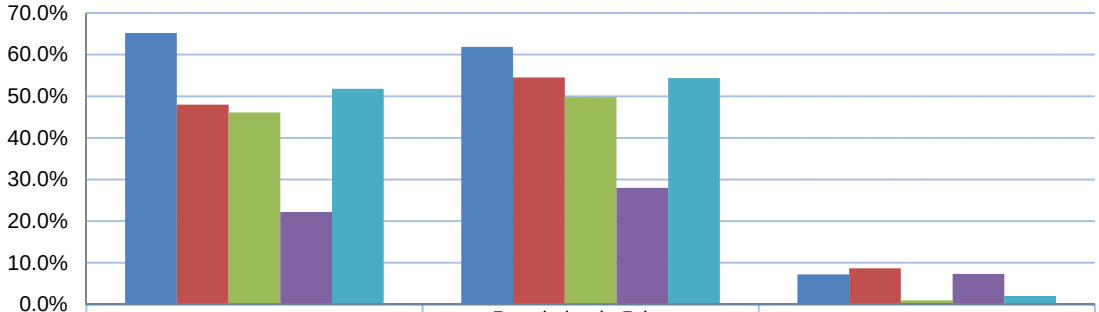
As shown in Figure 15, only **Neighbourhood A** has a higher proportion of visible minorities[3] in 2011 compared to the City of Vancouver, with a difference of 13.4 percentage points. While the proportion of visible minorities in **Neighbourhoods B** and **C** were relatively close to the City of Vancouver average, **Neighbourhood D** was 29.6 percentage points lower compared to the City of Vancouver average. Similarly, **Neighbourhood A** was also 7.5 percentage points above the City of Vancouver average with respect to the proportion of the population speaking non-official languages, while **Neighbourhood D** was 26.4 percentage points below.

In 2011, approximately 2.0% of the City of Vancouver population identified as Aboriginal (Figure 15). The proportion of the population identifying as Aboriginal was higher in the Study Area relative to the City of Vancouver average, with the exception of **Neighbourhood C**, which was 1.1 percentage points below.



	Visible Minority Population	Population in Private Households by Non-Official Languages Spoken	Aboriginal Identiy
Neighbourhood A	65.2%	61.9%	7.2%
Neighbourhood B	48.0%	54.5%	8.7%
Neighbourhood C	46.1%	49.8%	1.0%
Neighbourhood D	22.2%	28.0%	7.3%
City of Vancouver	51.8%	54.4%	2.0%

Source: (Statistics Canada, 2013a, 2013b, 2013c, 2013d)

Figure 15: Cultural Characteristics

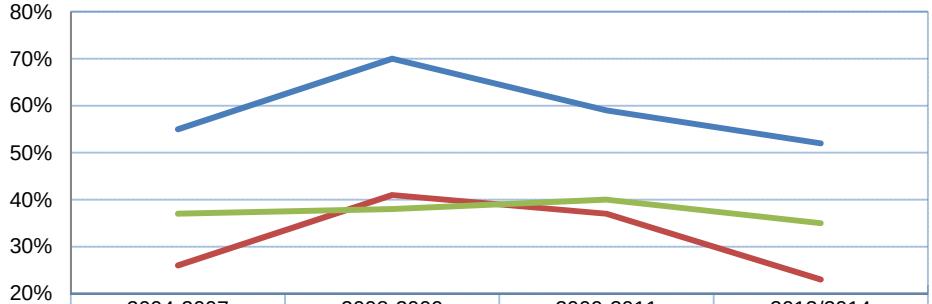
4.5.3 Healthy Child Development

The Early Development Instrument (EDI) is a tool created to assess key areas of early child development and vulnerability. The EDI measures five core areas of early child development that are known to be good predictors of adult health, education and social outcomes: physical, social, emotional, language, and communication. The EDI questionnaire has over 100 questions and is completed by kindergarten teachers from across BC for all children in their classes. Results are collected in "waves," containing data from numerous consecutive school years. This report uses EDI data from Wave 2 to Wave 5, covering the 2004/05 to 2012/13 academic years (UBC, n.d.).

[3] Persons other than Aboriginal peoples who are non-Caucasian in race or non-white in colour.

Vulnerability is defined as “the portion of the population which, without additional support and care, may experience future challenges in school and society”. EDI vulnerability measurements are understood to be strong forecasters of social, health and education outcomes in adulthood (UBC, n.d.).

Between 2004 and 2014, vulnerability in one or more domains for kindergarteners declined by two percentage points in the Vancouver School District[4] to 35.0%. Both the Strathcona and Downtown Vancouver neighbourhoods[5] also saw improvement over the same time period, with Strathcona dropping three percentage points and Downtown Vancouver dropping by two percentage points. However, both Strathcona and Downtown Vancouver saw their weakest performance between 2007/08 and 2008/09, with 70.0% of kindergarteners in Strathcona and 41.0% of kindergarteners in Downtown Vancouver identified as having vulnerability in one or more domains. With the exception of between 2007/08 and 2008/09, Downtown Vancouver has had proportionately fewer kindergarteners identified as having vulnerability in one or more domains compared to the Vancouver School District. Between 2011/12 and 2012/13, Downtown Vancouver was 22.0 percentage points below the Vancouver School District average. In contrast, Strathcona has remained above the Vancouver School District average, and was 29.0 percentage points above between 2011/12 and 2012/13 (UBC, 2013).



	2004-2007	2008-2009	2009-2011	2013/2014
Strathcona	55%	70%	59%	52%
Downtown Vancouver	26%	41%	37%	23%
Vancouver School District	37%	38%	40%	35%

Source: (UBC, 2013)

Figure 16 Early Development Instrument Overall Vulnerability (2004-2013)

[4] Vancouver School District 39 covers the City of Vancouver and the University of British Columbia.

[5] Refer to http://earlylearning.ubc.ca/maps/edi/nh/sd39/ for a figure of neighbourhood boundaries.

5.0 PRELIMINARY EFFECTS ASSESSMENT AND ANALYSIS

5.1 Natural Environment

5.1.1 Air Quality

Golder Associates assessed current and predicted air quality associated with the Project operation (Golder Associates Ltd., 2015a). Air emissions associated with the Project were modelled based on vehicular traffic associated with the Project. It is anticipated that during the earlier part of the day (A.M. period), traffic in the study area would decrease by approximately 2% with the implementation of the Project. During the latter part of the day (P.M. period), traffic is anticipated to decrease by approximately 6% (Golder Associates Ltd., 2015a).

Using the emission factors and the total vehicle kilometres travelled on the current Viaducts and the Project, high-level estimates of current and future daily contaminant emissions were calculated for comparison. Future emissions of all four compounds after the construction of the two-way Georgia Street extension to Pacific Boulevard are predicted to be 1.2% lower than current A.M. period emissions and 5.4% lower than current P.M. period emissions. This corresponds with the predicted decrease in traffic associated with the Project.

Overall, the Project itself is anticipated to be a relatively minor source of the indicator compounds when compared to other larger sources within the area and is predicted to decrease traffic in the Study Area compared to the existing Viaducts. The decrease in vehicle traffic would result in a subsequent decrease in the emission of air pollutants from exhaust. In addition, as the Project is intended to improve active transportation networks and promote use of public transportation, it is predicted that the Project will have a net long-term beneficial effect on local and regional air quality (Golder Associates Ltd., 2015a). Given these finding, health related effects associated with air quality are anticipated to be neutral.

5.1.2 Noise

Golder Associates assessed current and predicted noise levels associated with the Project construction and operation at various receptor locations (Golder Associates Ltd., 2015b). The assessment of noise from Project construction considered the following activities:

- Construction of the intersection at Georgia St. and Pacific Boulevard and the south portion of the Georgia Ramp;
- Completion of all necessary works at Abbott St. and Pacific Boulevard; and
- Removal of the Main Street off-ramp and construction of Quebec St. between Prior St. and Main Street.

Construction is anticipated to be completed primarily during daytime hours, with night-time activities requiring permission from the City. The Noise Assessment indicated that the predicted construction noise levels at all selected receptor locations were below the US Federal Transit Administration Transit Noise and Vibration Impact Assessment criteria for construction noise (FTA construction noise criteria) utilized by the Noise Assessment. However, it is recommended that standard construction noise mitigation measures identified in the FTA construction noise criteria be used to reduce the impact on noise-sensitive individuals. Understanding that noise

can impact sleep quality and therefore over quality of life, it is also recommended that construction at night be avoided as much as possible.

The assessment of future traffic noise levels after Project construction is completed was based on a design of the future road network and projected traffic volumes provided by the City. The assessment characterized noise contributions from the Project traffic using a computer noise model and compared to both the Ministry of Transportation and Infrastructure (MoTI) Noise Policy City Noise Bylaw Limits. Without mitigation, noise modelling predicted an exceedance of the City Noise Bylaw Limits during the maximum hour at the ground floor for one residential receptor location. This receptor also had a moderate impact rating according to the MoTI Noise Policy along with several other receptors in the same area which are all located near the intersection of Pacific Boulevard and Quebec Street just south of the existing viaducts. The moderate MoTI rating indicates that mitigation should be considered to lessen the noise effect. The predicted noise levels at the south side of the south tower at 800 Griffiths Way were below the City Noise Bylaw Limits, but the change in noise level was rated severe under the Ministry of Transportation and Infrastructure Noise Policy. The severe MoTI rating indicates that more comprehensive noise mitigation should be considered. Noise levels at all other receptor locations are predicted to either remain the same or improve (i.e. decrease) after Project construction is completed.

Proposed mitigation measures for the moderate MoTI sites include three earth berms. Noise modelling (which included the proposed mitigation measures) predicted the impact rating for the Project would be either a ‘no impact’ or ‘positive impact’ rating. Recommended mitigation measures for the site with the severe MoTI rating includes low-noise pavement options and upgrading sound insulation (i.e. windows and doors) of the receptor building façade to reduce traffic noise by 5 to 20 dBA (Golder Associates Ltd., 2015b). Given this finding, Project-induced changes in noise levels are anticipated to have no effect on health (i.e. the effect is neutral).

5.2 Built Environment

5.2.1 Active Transportation

Active transportation networks in the Study Area already exist, including part of the False Creek Seawall recreational pathway, protected and paved on-street bikeways, and sidewalks (shown on Figure 2).

As indicated in Section 4.3.1, the study area is already very accessible by foot. Estimates developed for the Transportation Assessment completed for the Project indicate that 51% of trip made by people living or working in the new NEFC development blocks are anticipated to be walking, resulting in a peak hourly volume of over 5,400 walking trips associated with the new developments (Parsons, 2015). Design considerations such as pedestrian crossings, grade of the road, clear and unobstructed sidewalls, standing/loading areas, and boulevard separators are identified as key criteria for creating a high quality walking environment in the Study Area with both the Project and the other NEFC developments (Parsons, 2015).

As indicated in Section 4.3.1, the average weekday bike volume was observed on the designated bicycle lanes in the Study Area are as follows:

- Dunsmuir Viaduct: 2,600 bicycles;
- Union Street at Hawkes: 4,000 bicycles; and
- Seawall at Science World (Terminal Avenue) 6,300 bicycles.

The Transportation Assessment completed for the Project predicts that bike volumes on Dunsmuir Street would more than triple from current use levels. Table 5 shows the forecasted daily cycling counts on the major street segments in the Study Area.

Table 5: Forecasted Daily Cycling Counts

Segment	Directional Orientation	Two-Way Daily Bike Traffic
Dunsmuir Street	At Beatty Street	8,800
Carrall Street	North of Expo/Pacific Boulevard	5,800
Carrall Street	South of Expo/Pacific Boulevard	6,200
Union Street	East of Carrall Street	7,400

Source: (Parsons, 2015)

Separated bike lanes are required when the vehicle volumes exceed 5,000 vehicles per day and the operating speed is 50km/h or higher. As the projected two-way bike traffic is expected to exceed 5,000 bikes per day, separated bike lanes would likely be required. The removal of the Viaduct would also remove the existing separated bike lane which is currently located on the Dunsmuir Viaduct which would be replaced by infrastructure on the at-grade roadways. Design considerations are underway to determine the best option for to meet the projected bicycle volumes by providing safe cycling infrastructure, including new separated bike lanes.

Increased opportunities for safe, active transport including access to bicycle lanes or separate pathways, has been shown to potentially increase the number of people walking and cycling (Dill, 2009). Given this finding, it is likely that the improved walking and bike infrastructure associated with the Project would lead to increased use of active transportation within the Study Area supporting positive health and safety environment for residents within the Study Area.

5.2.2 Access to Green Space

As indicated in Section 4.3.2 and shown in Figure 7, currently, all, or part of 14 City Park Board parks are located within the Study Area representing more than 29 hectares of park land. These parks provide community access to a number of different recreational opportunities to the community.

The current Project design includes the opportunity to further expand Creekside Park (located in Neighbourhood C) by 13% by including parts of City owned land currently utilized by Viaduct infrastructure into park design (City of Vancouver, 2015e). As access to urban parks provides both physical and community health benefits, increased urban park space at Creekside Park would provide greater opportunity for local residents to experience the related positive health benefits of urban parks.

5.2.3 Change in Traffic Flow through Neighbourhoods

Project-related infrastructure development that would affect traffic patterns include removal of the raised, separated roadways, including the on and off ramps, a new at grade road structure to replace the north/south and east/west viaduct infrastructure, and calming of neighbourhoods along Prior Street.

As indicated in Section 4.3.3 from 2009 to 2013, nearly half[6] of accidents occurring in the Study Area occurred on the Viaduct on and off ramps on Main Street (calculated from Insurance Corporation of British Columbia, 2014). The on and off ramps represent an area where the local neighbourhood traffic interacts with the highway style infrastructure. The on and off ramps on Main Street would be removed as part of the Project enabling traffic to remain on at-grade roads that match the character of the neighbourhood and the rest of the City.

The current speed limit on the Viaducts is 50km/h. While the posted speed limit would likely remain similar to the current limit, the proposed new road network would have more controlled intersections (i.e. traffic lights) that interrupt vehicle travel. With this change, travel time associated with the Project is expected to increase by one to three minutes depending on the route used.

The Project would also re-route traffic from Prior Street to a new road adjacent to the industrial developments south of Prior Street on Malkin Avenue. Prior Street would then be calmed to a neighbourhood street, reconnecting it to the larger Strathcona community, including Strathcona Park, on the other side of the street. As indicated in Section 3.2.3, traffic volumes and speed are known to be linked to safety perceptions. Traffic patterns have been found to influence sociability of neighbourhoods by either encouraging or discouraging residents ability to develop social networks and develop sense of belonging and security and, in turn, resident satisfaction. The proposed change in street design on Prior Street, including traffic calming initiatives could create the conditions associated with a sociable neighbourhood, which can lead to a safer, quieter, and healthier environment.

The Project would replace viaduct structures with at-grade roads and intersections which are predicted to reduce traffic speeds through the network. Additionally, certain streets such as Prior and Venables would become residential streets and experience a large reduction in traffic through the neighbourhood. Any reduction in traffic volumes and traffic speed as a result of the Project would serve to increase feelings of safety in the network neighbourhoods. Based on this, overall, it is expected that change in traffic flows through neighbourhoods due to this Project would be positively experienced within the Study Area, particularly on Prior Street.

5.2.4 Access to Community Services

The Project would facilitate safe road access to the new site of St. Pauls' Hospital on Station Street. As the current Viaduct infrastructure is not expected to withstand a moderate earthquake, the new roadway would maintain access to the hospital in the event of such an emergency. Safe access road access to St. Paul's Hospital in the event of a natural disaster like an earthquake is considered a health benefit to the Study Area and region as a whole.

[6] Between 2009 and 2013, ICBC reports list 670 accidents occurring within in the study area, of which 312 happened on the Viaduct Main Street On-ramp at Union Street or off-ramp at Prior Street.

5.2.5 Increased Mixed-Use Developments

The Project is expected to substantially change the type and intensity of land use in and around the Project site due to the removal of the Viaducts, specifically in the NEFC area. Potential changes to land uses for the new lands and associated developments in NEFC include mixed residential, office, commercial and recreational amenities (Parsons, 2015). It is estimated that approximately 5.4 million (M) square feet of residential and 2.3 M square feet of non-residential developments could be enabled due to the Project (Parsons, 2015).

As indicated in Section 3.2.6, there is a positive relationship between pedestrian volumes and dense housing and commercial activity. In turn, walking and biking can increase as distance between services and amenities and residences decreases, which in turn could positively influence health. Anticipated neighbourhood design suggests that travel between nearby residences, offices, and retail and recreational facilities would be easily made on foot (Parsons, 2015). Based on this analysis, health related effects associated with increased mixed developments are anticipated to be positive.

5.3 Social and Community Factors

5.3.1 Affordable Housing

The deconstruction of the Georgia and Dunsmuir Viaducts would remove infrastructure currently located on City owned lands and allow for further development within the region. Current Project design includes the opportunity for new affordable housing on city owned lands (City of Vancouver, 2015e). Affordable housing units would likely have a positive effect on the health of those who are housed, should these residential units be constructed under policy outlined in the City's Affordable Housing Strategy.

In addition, the Transportation Assessment for the Project identified 11 distinct area blocks with potential for up to 5.4 million square feet of residential space and 2.3 million square feet of non-residential development. While these estimates do not reflect council approved projects or density, they provide context for the potential for new housing developments in and around the Project. The Project would facilitate new development of housing stock, but their affordability would depend on market conditions, city policies, and planning for the region. Given the uncertainty as to the type of housing units, their price, and number of units, the potential health effect associated with these developments cannot be assessed at this time, but could be assessed at a future date through further data collection linked to the NEFC developments.

The findings of the Preliminary Effects Assessment are summarized in Table 6.

Table 6: Summary of Predicted Health Effects

Health Determinant	Predicted Health Effect	Rationale
Natural Environment		
Air Quality	Neutral (no effect)	The Project itself is anticipated to be a relatively minor source of the indicator compounds when compared to other larger sources within the area.
Change in noise	Neutral (no effect)	Noise modelling for the Project suggests no impact to noise with mitigation measures in place. Therefore, no health effects associated with increased noise are anticipated.
Built Environment		
Active Transportation	Positive	Improved walking and cycling infrastructure associated with the Project would lead to increased use of active transportation within the Study Area supporting positive health and safety environment for users.
Access to green spaces	Positive	Project design includes the opportunity to further expand Creekside Park by an additional 13%. As access greater park space provides greater opportunity for local residents to experience the related positive health benefits of urban parks.
Change in traffic flow through neighbourhoods	Positive	The Project would reduce traffic volume and speed along Prior Street, increasing feeling of safety and sociability of the neighbourhood.
Change in access to community services: Access to St. Paul's Hospital	Positive	New road infrastructure would provide safe road access to the new St. Paul's Hospital site as the current Viaducts are not predicted to withstand a moderate sized earthquake.
Increased mixed use development	Positive	Project design includes increased mixed use developments in the Study Area. Mixed use developments facilitate greater use of active transportation which positively influences physical health.
Social and Community Factors		
Affordable Housing	Positive	Lands currently housing Viaduct support structures are designated for affordable housing which would likely have a positive influence on the health of those who are housed.

6.0 RECOMMENDATIONS

The high level recommendations of this assessment fall into two key categories - proposed mitigation and benefit enhancement measures to address Project effects, and areas for further research.

6.1 Mitigation and Benefit Enhancement Measures

Many of the potential health effects are a result of changes to the biophysical or structural environment from the Project, which if controlled or mitigated, would result in no anticipated health effect. For noise and transportation related health effects, the noise and transportation assessments have identified a number of mitigation measures. The HIA assumes that the mitigation measures recommended in these other studies will be implemented and are as effective as predicted. This assumption is applied when considering the effectiveness of these mitigations in addressing health effects.

Mitigation measures identified in the Noise Assessment include construction of three earth berms modelled to decrease traffic noise at receptor locations R10, R11, R12, and R13 and consideration using low noise pavement options or increasing sound insulation of the R01 building façade. Implementing these mitigation measures would result in little to no anticipated noise effect to residents living in and around the existing viaducts, thus limiting the potential health pathway between the Project and annoyance from noise. For more detailed information about the noise assessment modelling and technical rationale informing the mitigation measures, please see the Noise Assessment of the Georgia and Dunsmuir Viaduct Area, City of Vancouver, BC (Golder Associates Ltd., 2015b). In addition, it is recommended that construction at night be avoided to prevent health effects associated with loss of sleep. As per best practice, a noise monitoring program may be required to monitor noise levels at potentially affected receptors, and any potential noise nuisance effects experienced by receptors. Monitoring results would be reported to the City, and stakeholders in accordance with any Project-related construction communications plan.

The Northeast False Creek Transportation Study: Phase 2 Transportation Multi-Modal Assessment identifies design considerations for developing high quality walking and cycling environments that are accessible to all ages and abilities once the Project is completed (i.e., the Transportation Assessment did not assess project construction effects or propose construction mitigations). Implementation of these design considerations are directly linked to the positive health considerations identified in this assessment. Design considerations to support a quality walking environment that promotes public safety once the Project is completed include the following:

- Assumed walking speed of 1.0m/s for time signaled crosswalks;
- Property line offset from back of sidewalk by 0.35 to 0.5m to allow for maintenance and offset from buildings;
- Desirable grade of 4%, up to 5% with no landings and 8% with landings to reduce walking effort and impacts to mobility impaired individuals;
- Clear, unobstructed sidewalks to accommodate comfortable walking space for forecasted pedestrian volumes;

- Total sidewalk width of 5.5m (including utility boulevard);
- Standing and loading areas to accommodate transit, taxi, and school pick-up and drop-off zones; and
- Boulevard separators to provide suitable maintenance areas for landscaping.

Design criteria identified for cycling infrastructure includes the following:

- Desirable design speed of 30km/h on main routes and 20km/h on other routes;
- 3.0 to 4.5m two-way cycle tracks for sufficient operation and passing space;
- One way track with of 2.0 m for up to 150 bicycles per hour and 3.0m for 750 bicycles per hour;
- On road cycling lane width of 1.5 to 2.0 m;
- Additional clearance to lateral obstructions;
- Suitable maneuvering distance from turns or roundabouts, minimum 5.0 m, up to 20 m for main routes and 10m for connections;
- Stopping distance from 20m to 35m to allow for perception reaction time and braking action on level but wet surfaces;
- Vertical clearance of 2.5 to 3.6m;
- Underpass sideslopes of 1:1 for suitable openness to avoid claustrophobic quality;
- Grade from 0.5 to 5% for drainage and acceptable climbing effort; and
- Grade for short height distance from 7% for 1m and medium wind and 8% for 2.5m and low wind.

Technical specifications of the above mitigation measures are included in the Northeast False Creek Transportation Study: Phase 2 Transportation Multi-Modal Assessment (Parsons, 2015). It is assumed that through consultation, the Project will obtain feedback from stakeholders on effectiveness of identified mitigation and mitigation preferences (including those identified above), and consider this input into final project design. Public consultation processes undertaken for the Project should be utilized to further identify measures to support positive effects from the Project as identified in Section 5.0. This consultation could focus on the following:

- Types of services and amenities needed or desired in the neighbourhood by local residences and amenity users. This information would inform types and location of businesses and amenities that would best support reduced vehicle usage and walkability within the neighbourhoods, design features of new greenspace, as well as overall project design considerations to support low-vehicle service and amenity access and use.
- Engagement with Prior Street residents as Project design progresses to further identify and confirm that proposed traffic calming measures are resulting in the anticipated traffic outcomes.

- As project design for the new St. Paul's Hospital progresses, targeted engagement with Providence Health and senior hospital staff to identify Project design features that would support and enhance access to the new St. Paul's Hospital site.
- Public preferences for types and location of new affordable housing on city owned lands affected by the Project taking into consideration how social and other forms of affordable housing are currently structured and provided within the Study Area and more broadly within the region.

Input from consultation into project design to enhance positive project benefits could be further considered through an intermediate or comprehensive HIA, based on the Project moving forward and development of more advanced design information. Predicted project effects (i.e. positive, adverse, neutral) on identified health determinants and associated mitigation and benefit enhancement measures are summarized in Table 7.

Table 7: Mitigation and Benefit Enhancement Measures for Assessed Health Determinants

Health Determinant	Predicted Effect on Health		Proposed Mitigation and Benefit Enhancement
	Construction	Operations	
Natural Environment			
Air Quality	Not addressed in desktop HIA	Positive	■ No mitigation proposed
Noise	Neutral	Neutral	■ Implement mitigation identified in the Noise Assessment ■ Avoid construction at night ■ Noise monitoring
Built Environment			
Active Transportation	Not addressed in desktop HIA	Positive	■ Implement design considerations identified in the Northeast False Creek Transportation Study: Phase 2 Transportation Multi-Modal Assessment
Access to Green Space	Not addressed in desktop HIA	Positive	■ Benefit enhancement measures identified through consultation
Change in Traffic Flow through Neighbourhoods	Not addressed in desktop HIA	Positive	■ Ongoing consultation with Prior Street residences
Access to Existing Community Services: Access to St. Paul's Hospital	Not addressed in desktop HIA	Positive	■ Ongoing dialogue with Providence Health to manage access to the new St. Paul's Hospital site.
Increased Mixed-Use Developments	Not addressed in desktop HIA	Positive	■ Benefit enhancement measures identified through consultation
Social and Community Factors			
Affordable Housing:	Not addressed in desktop HIA	Positive	■ Implement affordable housing as per City policy

6.2 Areas for Further Research

As indicated in Sections 3.0 and 5.0, a number of Project determinants potentially impacted by the Project were not assessed through the desktop HIA, as these areas of assessment generally require more detailed Project design information to understand Project interactions with the determinant and further baseline data from primary sources (i.e. interviews) to fully understand existing conditions.

As indicated in Section 3.0, determinants and indicators for further research and analysis, through an intermediate or comprehensive HIA include:

- Access to existing community services;
- Sense of community and belonging;
- Gentrification and exclusion;
- Affordable housing – homelessness; and
- Safety and security.

As the desktop HIA is based on review of secondary information only, there is a relatively high level of uncertainty with the preliminary effects assessment statements presented in Section 5.0. If the Project goes forward and an intermediate or comprehensive HIA is undertaken, primary data and information would also be required for all potentially affected determinants of health to:

- Confirm desktop information are accurate and up to date, and fill in information gaps not attainable through secondary data review;
- Further understand potential disaggregation of health related impacts spatially, and with respect to vulnerable versus general populations; and
- Capture community and other stakeholders' perspectives on:
  - Health values and objectives as they link to the Project;
  - Concerns and issues regarding potential Project effects on these values; and
  - Mitigation measures to address adverse effects from the Project and mechanisms to help enhance positive health effects.

One of the limits of this assessment is lack of firm detail associated with the construction phase of the Project, including how long it would take to construct, roads affected by construction activities, how traffic would be re-routed, and associated delays. The Viaducts are a major piece of road infrastructure within the City's eastern core. The physical removal of the infrastructure would influence traffic pattern as roads closures would likely be required to safely dismantle the Viaducts. As changes in traffic patterns could temporarily affect many of the health indicators (e.g., traffic patterns through neighbourhoods and active transportation) further investigation of

the potential short term effect of construction, mitigation, and management is recommended once Project planning is more advanced.

Table 8 summarizes potential further research requirements to address health impact assessment requires in accordance with the Project, should the Project proceed.

Table 8: Further Research

Health Determinant	Key Questions to Address through an Intermediate or Comprehensive HIA	Data Collection Methods or Sources
Access to Community Services	■ Will the Project increase access to services for residents in the Study Area? ■ Do existing service providers have the capacity to address a higher volume of clients if access is increased?	■ Primary interviews or focus groups with service providers
Sense of Community and Belonging	■ Are there concerns within the existing communities regarding potential effects, both positive and adverse to sense of community and belonging?	■ Primary interviews or focus groups with representatives of the existing neighbourhoods
Gentrification and Displacement	■ Are there concerns within the existing communities and the City Planning Department regarding gentrification for to the Project?	■ Stakeholder consultations ■ Primary interviews with City Planning Staff ■ Review of City plans on management of social housing and other public policy in the Study Area
Affordable Housing: Homelessness	■ Is the Study Area being used by Homeless residents in the City?	■ Primary interviews or focus groups with City Planning staff and homeless outreach service providers
Safety and Security	■ Will the Project influence crime, safety and security in the study area?	■ Primary interviews or focus groups with City Planning staff, Police, and other outreach service providers
All Health Determinants	■ How will construction activities affect the determinants of health?	■ Review of construction plan, including timing for construction, road closures, projected delays, and detours ■ Address construction related effects in primary interviews and focus groups

7.0 CLOSURE

We trust the above meets your present requirements. Should you have any questions concerning this assessment, please do not hesitate to contact us at 604-296-4200.

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