



NORTH SHORE CONNECTS PROJECT WORKING GROUP

BURRARD INLET RAPID TRANSIT

BENEFITS ASSESSMENT



Tsleil-Waututh Nation
PEOPLE OF THE INLET



Skwxwú7mesh
Úxwumixw
Squamish Nation



August 2021



BURRARD INLET RAPID TRANSIT BENEFITS ASSESSMENT

NORTH SHORE CONNECTS PROJECT
WORKING GROUP

FINAL REPORT

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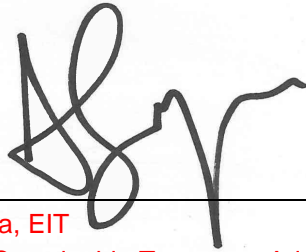
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EXECUTIVE SUMMARY

INTRODUCTION TO THE BENEFITS ASSESSMENT

With its transit-oriented community structure, diverse population and range of employment opportunities, Metro Vancouver has proven to be a globally renowned and desirable destination to live, work, and play. The North Shore is a prominent player in the region, with a concentration of important industry sectors such as tourism, professional services, ports and marine, arts and film, and healthcare. It is a key partner in Canada's supply chain providing critical ties to provincial and national goods movement, and playing a pivotal role as a gateway between Metro Vancouver and other growing regions and economic drivers of the province: The Sea-To Sky Corridor, Sunshine Coast and Vancouver Island. However, existing conditions on the North Shore such as land use, limited east-west road network connectivity and capacity, lack of transit travel time competitiveness (compared to auto mode), and robust employment growth with limited affordable housing opportunities have in turn created economic impacts locally, regionally, provincially, and nationally. These transportation and land use challenges have been studied extensively through the Integrated North Shore Transportation Planning Project (INSTPP) which has identified a suite of complementary measures needed for addressing chronic congestion.

Economic competitiveness and benefits to the region can be achieved through an investment in high-capacity rapid transit linking the North Shore, such as the proposed Burrard Inlet Rapid Transit (BIRT) project. This Benefits Assessment was conducted to analyse the benefits that can be expected to be generated by an investment in BIRT, with particular focus on the impacts to the local, regional, provincial, and national economies. The assessment investigated the expected impacts of BIRT in five categories: Transportation, Economic Development, Equity & Affordability, Health & Safety, and Climate & Environment.

OVERVIEW OF BIRT



Figure ES-1: BIRT Benefits Assessment Assessed Alignments

Two BIRT alignments were analysed and compared to a business-as-usual (BAU) case where transit service provided reflects investments committed to through the Mayors' Council Investment Plan. The modelled BIRT

alignments were based on those proposed in the *Burrard Inlet Rapid Transit Study: Stage 2 Engineering Review*² with minor updates to ensure a comparable analysis. The Gold and Purple alignments (shown in Figure ES-1 above) were chosen for this study to showcase a range in expected benefits, however they do not indicate recommended or approved alignments. These alignments were chosen as:

- It was noted in initial recommendations that an alignment over the Second Narrows is more likely to provide service better capturing key destinations and population centres across the North Shore; and
- Alignments across the Second Narrows provide better regional connection to municipalities across the south and east of Metro Vancouver either directly or via the Expo or Millennium Lines.

OVERVIEW OF THE BENEFITS ASSESSMENT

This Benefits Assessment analyzes impact categories in a typical Economic Impact Assessment through monetized, quantitative and qualitative analysis. This assessment analyzes solely project benefits, as opposed to a traditional Benefit-Cost Analysis that compares project benefits to project costs, as sufficient study has not yet been conducted to select a preferred alignment or technology and determine associated costs. As such, a study of the benefits is appropriate to establish the potential opportunities in investing in a project like BIRT.

The three methods of analysis were employed to capture project benefits as best as possible during this project stage:

- **Monetized analysis** – for accounts that are quantifiable, and where a dollar value can be attributed to the impact.
- **Quantitative analysis** – for accounts that are quantifiable, but where a dollar value cannot be easily attributed to the impact due to the preliminary stage of the project or other factors.
- **Qualitative analysis** – for accounts that cannot be easily quantified or monetized but are still expected to result in significant benefits as a result of BIRT.

STUDY FINDINGS

Table ES-1 provides a summary of the monetized, quantitative, and qualitative analysis; outcomes are provided as a range of the Gold and Purple Alignments as compared to the BAU Case. Individual outcomes based on alignment can be found throughout the subsequent report. The below subsections summarize the outcomes of the stakeholder engagement and analysed accounts.

Any monetized and quantified results are reflective of the expected impact in 2050. These are only reflective of one year of results, specifically 2050, and cannot be taken to be representative of an annual savings as results are dependant on variables that would change annually throughout the project life span (e.g., VKT, ridership etc.). The monetized results are shown in undiscounted 2020 dollars, that is monetized results have not been adjusted to account for the time value of money.

STAKEHOLDER ENGAGEMENT

Stakeholder³ perceptions anticipated that a **rapid transit connection to the North Shore would result in positive impacts** to congestion, travel time reliability, regional access and connectivity, local and regional tourism, labour mobility, industry-specific economic impacts, sustainable land development, and access to post-secondary institutions.

TRANSPORTATION IMPACTS

BIRT results in a number of transportation user benefits including travel time savings, reliability savings, and vehicle operating cost savings. **A benefit of \$571M - \$646M was calculated for all modes of transport** (i.e., auto, transit, light trucks, and heavy trucks), the majority of the benefits (\$498 - \$552M) arising as a result of projected travel time savings for transportation network users. This has an impact on both individual users and on local and regional businesses.

² Burrard Inlet Rapid Transit Study: Stage 2 Engineering Review (2020)

³ Stakeholders consultations included representation from North Shore businesses (from Tourism, Food & Beverage, Professional Services, Commercial Development, Post Secondary, Film, Ports & Terminals industries and business sectors) and representatives from First Nations communities.

ECONOMIC DEVELOPMENT IMPACTS

BIRT will necessitate the expenditure of capital, operational, and maintenance funds for construction and operations; the economic impacts of these expenditures were analysed using Statistics Canada's Input/Output model and were calculated per billion dollars spent in each expenditure category (Urban Transit Systems, Transportation Engineering Construction, and Architectural, Engineering and Related Services). BIRT was found to **contribute \$4.2 billion to Canada's GDP, and generate 43,000 full-time employment positions (FTE), \$114 million in unincorporated sector labour income, \$2.7 billion in wages and salaries, \$428 million in tax revenue creation, and \$7.6 billion in output per billion dollars spent in each capital and operating expense category**. In addition to these economic benefits, an **agglomeration benefit of \$84M - \$107M** is realized due to increased efficiencies from increased proximity among the Region's business clusters.

EQUITY AND AFFORDABILITY IMPACTS

Metro Vancouver has consistently been reported to be one of the most expensive places to live in Canada. A significant factor to Metro Vancouver's unaffordability is the comparatively lower average household incomes against the cost of living, and in particular, the cost of housing and transport. BIRT has the potential to improve equity and affordability in Metro Vancouver in two ways: by providing greater access to jobs and housing in the region, and by providing additional affordable housing units through development contributions. BIRT will **increase access to jobs accessible within a 60-minute transit ride** and will provide **1,300 – 2,600 additional affordable dwelling units** as compared to the BAU by the 2050 horizon date.

HEALTH AND SAFETY IMPACTS

Through a decrease in number of vehicular trips, and therefore a decrease in vehicle kilometres travelled (VKT), BIRT is expected to result in reduced roadway collisions compared to the BAU case. In the BIRT case, approximately **1,100 total prevented collisions** (fatalities, injuries, and property-damage only) are expected **in 2050, with a total reduced collision impact of \$89 million**. Collision reduction and associated monetary benefit would be realized each year BIRT is in operation, although the precise value would be dependant on the annual decrease in VKT before and after the horizon year of 2050.

BIRT is also expected to have increased societal benefits associated with improved health as a result of mode shift from auto to transit. Living a sedentary lifestyle has a significant impact on our physical health and wellbeing, and in turn an impact on local healthcare systems. Transit trips are most often paired with another form of active transportation (walking, cycling, rolling), and the addition of these trips reduces the negative health impacts associated with sedentary lifestyles and financial burden to society.

CLIMATE AND ENVIRONMENT IMPACTS

A reduction in auto travel across the region, and associated reduction in VKT, results in decreased pollutants - CO₂, SO_x, NO_x, and GHG emissions. The **reduced auto emissions impact for the year 2050 results in a benefit of \$1.4 million** for both BIRT alignments when compared to the BAU. The auto emissions reduction is highly dependant on electric vehicle (EV) adoption. It was assumed that an 80 percent EV adoption rate would occur in 2050, meaning that 80 percent of the VKT in 2050 is produced by EVs (which would have no tailpipe emissions). The implementation of BIRT prior to 80 percent EV adoption would impact the emissions reduction and associated monetary benefit.

A reduction in VKT will result in a reduction of particulate run-off and a corresponding reduction in stormwater run-off pollution associated with local transportation networks. As a result, BIRT can be expected to have a positive impact on the restoration of the local waterbodies through a reduction in stormwater run-off pollution.

FIRST NATION IMPACTS

BIRT is unique in its benefits for First Nations communities. A rapid transit connection to the North Shore will serve to fill gaps in regional access as it connects Capilano IR No. 5, Mission IR No. 1, Seymour Creek IR No. 2 and Burrard Inlet IR No. 3 for Squamish and Tsleil-Waututh First Nations. An investment in BIRT will establish improved connections for these communities to jobs and affordable housing in the region and generate socio-economic benefits through increased access to job opportunities. BIRT can be expected to establish a platform for sustainable economic growth through land development and partnership opportunities for First Nations on the North Shore, as well as tourism expansion opportunities.

Table ES-1: BIRT Benefits Assessment Summary (Undiscounted 2020\$)

| Topic | Outcome | Notes |
|---|-------------------------------|---|
| Transportation Impacts | | |
| Travel Time Savings Impact (2050) | \$498 - \$552M | Travel time savings impact is relatively high in comparison to other transportation business cases in the region. |
| Reliability Impact (2050) | \$55 - \$75M | Reliability impact is strong compared to other transportation business cases in the region. |
| Vehicle Operating Cost Savings (2050) | \$18 - \$19M | The annual auto VKT savings in 2050 is equivalent to removing 7,800 vehicles from the network. |
| Economic Development Impacts | | |
| GDP Contribution | \$4.2 billion | Benefits were calculated using Statistic Canada's Input/Output model. All numbers presented reflect the cumulative direct, indirect, and induced economic effects per a \$1 billion spent basis in the industries related to direct project spending (i.e., capital and operating expenses). |
| Employment Creation (in Job-Year FTE) | 43,000 jobs | |
| Labour Income of Unincorporated Sector Generation | \$114 million | |
| Wages & Salaries Generation | \$2.7 billion | |
| Tax Revenue Creation | \$428 million | |
| Output | \$7.6 billion | |
| Agglomeration Impacts | \$84 - \$107M | Benefits emerge from connecting industries on the North Shore to business clusters across the region. |
| Development Potential | <i>Qualitatively Assessed</i> | A rapid transit investment with upzoning (i.e., zoning changes to increase density) can create a land value gain between 20 - 40%. Land value capture can secure new sources of revenue for regional transportation initiatives, support transit-oriented affordable housing, and increase transit and active modes. Development opportunities exist for First Nations on the North Shore which will result in economic benefits and increasing affordable housing supply. |
| Capital Deferral | <i>Qualitatively Assessed</i> | An investment in BIRT introduces the potential for deferral of other major transportation capital-intensive projects in the region (i.e., highway expansions, bridge expansions, bridge replacements, goods movement infrastructure, etc.) Additional opportunities exist for the completion of other project scopes alongside BIRT; this may warrant further study to determine additional economic benefits that can be expected. |
| Equity and Affordability Impacts | | |
| Regional Access to Jobs and Housing | <i>Qualitatively Assessed</i> | In the BAU Case, North Shore jobs are only accessible by transit in 45 minutes to people living in Vancouver's downtown core and to those who live on the North Shore. BIRT opens access into Greater Vancouver, Burnaby, New Westminster, and Coquitlam, positively impacting North Shore businesses by increasing labour pool and mobility. BIRT provides improved access for areas in the region with a greater supply of affordable housing to access the North Shore. |
| Affordable Housing Supply | <i>Qualitatively Assessed</i> | A rapid transit investment will result in increased development and population residing along its corridor. Through a high-level assessment an estimated 1,300 – 2,600 incremental affordable housing units can be expected as a result of BIRT. This is highly dependant on local zoning bylaws and affordable housing policies. |
| Health and Safety Impacts | | |
| Reduced Collision Impact (2050) | \$88 - \$89M | A reduction in vehicle travel as a result of BIRT is expected to result in a total reduction of 0.5 fatalities, 232 - 233 injuries, and 881 - 887 property damage only incidents for the year 2050. |
| Health Impacts due to Mode Shift | <i>Qualitatively Assessed</i> | The impact of physical inactivity costs the provincial health care system more than \$570 million annual ⁴ . Mode shift from auto to transit introduces physical activity for daily trips and is generally paired with active modes (e.g., walking or rolling) to access transit stops, additional physical activity worked into our daily lives |
| Climate and Environment Impacts | | |
| Reduced Auto Emissions (2050) | \$1.4M | A reduction in regional travel by auto mode results in a reduction in auto emissions such as CO ₂ , NO _x , SO _x , etc. |
| Restoration of the Burrard Inlet | <i>Qualitatively Assessed</i> | Stormwater pollution is a large contributor to local waterbody contamination. Through reduction of motor vehicle use and reduced auto emissions, less toxic road run-off will make its way into the Burrard Inlet. |

⁴ Includes Direct Costs (hospital, physician, drug, institutional, etc.) and Indirect Costs (productivity losses due to premature death and disability) - <https://health.gov.bc.ca/library/publications/year/2004/inactivity.pdf>

REALIZING THE BENEFITS

BIRT offers unique benefits to the North Shore and Metro Vancouver region. In providing fast and reliable regional connectivity, transportation network users of all modes can be expected to benefit from travel time savings and reliability improvements. Furthermore, it is projected that BIRT will generate economic benefits to local and regional businesses, economic productivity known as agglomeration, and improved access to regional jobs and housing. These benefits impact the North Shore, Metro Vancouver, and also extend to the Lower Mainland and nationally through impacts to the tourism industry and national goods movement. Additional societal benefits include an increase in regional affordable housing supply, reduced collisions, health and economic benefits related to increased physical activity, and improved climate resilience and environmental outcomes as a result of reduced auto emissions and stormwater pollution. This catalog of strong benefits outlines the importance and significance of BIRT for the Metro Vancouver region.

There are a number of strategic rationales for an investment in BIRT:

FIRST NATIONS ECONOMIC DEVELOPMENT AND IMPROVED CONNECTIVITY – BIRT has a unique opportunity as the only proposed alignment running adjacent to four First Nations reserves belonging to the Squamish and Tsleil-Waututh Nations. There is potential for economic development for these communities through an investment in BIRT which would improve physical and cultural connectivity across the region providing access to jobs, housing, and traditional territories for decades to come.

TACKLING AFFORDABILITY AND ACCESSIBILITY – Living and, to a certain extent, working on the North Shore is inaccessible to many people in the region as a result of increasing housing prices, limited housing supply, extended commute times, and limited transportation choices. A strong economy exists on the North Shore, but it is being significantly impacted due to a lack of competitive transit connections. As a result, local businesses are struggling with employee attraction and retention. An investment in BIRT will provide greater and more affordable transportation choices connecting people within the region to jobs on the North Shore. Furthermore, a rapid transit corridor increases transit-oriented development, creating more opportunities to provide affordable housing units.

IMPROVED TRAVEL TIME AND RELIABILITY – The North Shore is constrained due to its geography and access being limited to two bridges crossing the Burrard Inlet, causing considerable congestion. BIRT has extremely strong benefits to travel time savings and reliability, up to \$552M and \$75M respectively in 2050. This has a significant impact on moving people across the region, as well as improving goods movement from port and marine operations located on the North Shore across the country.

ENABLING CONDITIONS FOR TRAVEL BETWEEN METRO VANCOUVER AND BEYOND – Communities and businesses up the Sea to Sky, on the Sunshine Coast, and on Vancouver Island connect through the North Shore to reach Metro Vancouver via the road network and Horseshoe Bay Ferry Terminal. These communities will continue to grow in population and visitation, and the road network will only continue to become more congested. An investment in BIRT allows for additional reliable transit connections beyond the region benefiting users and generating wider economic benefits.

BIRT has the advantage of a collaborative partnership between local governments, organizations, and First Nations who are in alignment on project planning and supporting investment in rapid transit across the Burrard Inlet to the North Shore as shown through their participation in previous and current work on INSTPP. This is an important advantage in creating efficiencies in the business case lifecycle process and along with its strong benefits, establishes BIRT as an important investment.

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1 PURPOSE OF THIS REPORT

The purpose of the Burrard Inlet Rapid Transit (BIRT) Benefits Assessment is to highlight the economic, environmental, and social benefits of investing in a rapid transit line across the Burrard Inlet, connecting the North Shore to the remainder of Metro Vancouver. The North Shore is a prominent player in the region, with a concentration of important industry sectors such as tourism, professional services, ports and marine, arts and film, and healthcare. It is a key partner in Canada's supply chain providing critical ties to provincial and national goods movement, and plays a pivotal role as a vital gateway between Metro Vancouver and other key growing regions and economic drivers of the province: The Sea-To Sky Corridor, Sunshine Coast and Vancouver Island. However, existing conditions on the North Shore such as land use, road network design, lack of transit travel time competitiveness (compared to auto mode), and road network capacity and management create challenges which in turn has economic impacts locally, regionally, provincially, and nationally.

Economic competitiveness and benefits to the region can be achieved through an investment in high-capacity rapid transit linking the North Shore, such as the proposed BIRT project. This Benefits Assessment was conducted to analyse the benefits expected to be generated by an investment in BIRT, with a particular focus on the impacts to the local, regional, provincial, and national economies. The assessment investigated the expected impacts of BIRT in five categories: Transportation, Economic Development, Equity and Affordability, Health & Safety, and Climate & Environment.

This is a study of the project benefits, as opposed to a traditional Benefit-Cost Analysis. Project planning to date has been conducted through the collaboration of municipalities, community organizations, and First Nations communities on the North Shore and sufficient study has not yet been conducted to select a preferred alignment, technology, or develop associated costs. As such, a study of the benefits is appropriate to establish the potential opportunities in investing in a project like BIRT.

The Benefits Assessment is structured as follows:

- **CHAPTER 2, BURRARD INLET RAPID TRANSIT OVERVIEW** – Introduces the history of BIRT, the project study area, modelling assumptions undertaken, and Benefits Assessment study limitations.
- **CHAPTER 3, PROJECT NEED** – Discusses the arguments and strategic case for investing in BIRT. Topics discussed were used as the basis for areas of further analysis as part of this Benefits Assessment.
- **CHAPTER 4, STAKEHOLDER ENGAGEMENT** – Summarizes key themes brought up by industry representatives and Nations regarding an investment in rapid transit to the North Shore.
- **CHAPTER 5, BENEFITS ASSESSMENT** – Provides an overview of the analysis conducted and expected benefits as a result of an investment in BIRT for impact categories including Transportation, Economic Development, Equity and Affordability, Health and Safety, and Climate and Environment.
- **CHAPTER 6, REALIZING THE BENEFITS** – Discusses the strategic arguments for investing in BIRT and next steps required in order to realize the discussed benefits.

This Benefits Assessment reflects a preliminary study prior to commencement of TransLink's official business case process, as such, quantifiers such as cost, Benefit-Cost Ratio (BCR), and Net-Present Value (NPV) were not derived at this stage. This Benefits Assessment reflects the benefits of BIRT as compared to a No-Build case, called the "business-as-usual" (BAU) case for the year 2050, and contextualizes these benefits.

2 BURRARD INLET RAPID TRANSIT OVERVIEW

2.1 BURRARD INLET RAPID TRANSIT STUDY HISTORY

Burrard Inlet Rapid Transit (BIRT) draws its origins from the Integrated North Shore Transportation Planning Project (INSTPP) completed in 2018. INSTPP outlines current and future transportation needs for better integrating transportation and land use, and overcoming chronic congestion issues impacting the North Shore and surrounding communities within the Metro Vancouver region in British Columbia. It also highlights opportunities for collaboration on short-term transportation improvements, and a collective long-term framework for solving transportation challenges across multiple agencies on the North Shore. One of the key near-term actions highlighted was to ‘Evaluate the conditions for rapid transit between the North Shore and Burrard Peninsula, connecting Lonsdale City Centre with Vancouver’s metropolitan core and the regional rapid transit network’. Figure 2-1 outlines the BIRT study area including locations of importance along the North Shore.

The Partner Working Group (PWG) was formed out of the INSTPP to guide the feasibility study and Benefits Assessment of BIRT. The PWG is comprised of senior staff from the City of North Vancouver, District of North Vancouver, District of West Vancouver, Tsleil-Waututh Nation, Squamish Nation, and the North Vancouver Chamber of Commerce. This partnership and dedication to taking an integrated approach to resolve issues is unique to this project and not previously seen in Metro Vancouver.



Figure 2-1: Metro Vancouver - BIRT Study Area

Following INSTPP, Stage 1 of the BIRT Study was completed by consultants Mott MacDonald at the end of March 2020 and included an assessment of various options to extend rapid transit across the Burrard Inlet. Technical work

included engineering feasibility studies as well as ridership potential and other factors that led to a Multiple Account Evaluation (MAE).



⁵ Source: Burrard Inlet Rapid Transit Study Stage 2 Engineering Review (2020)

2.2 BENEFITS ASSESSMENT ASSUMPTIONS



Figure 2-3: BIRT Benefits Assessment Assessed Alignments

Two BIRT alignments were analysed and compared in this Benefits Assessment against a Business as Usual (BAU) case where transit service provided reflects infrastructure investments committed to through the Mayors' Council Investment Plan. The modelled BIRT alignments were based on those proposed in the BIRT feasibility study with minor updates to ensure a comparable analysis. The Gold and Purple alignments shown in Figure 2-3 were chosen for this study. They do not indicate recommended or approved alignments, and were chosen as:

- It was noted in initial recommendations that an alignment over the Second Narrows is more likely to provide service reaching across the majority of the North Shore; and
- Alignments along the Second Narrows provide better regional connection to municipalities across Metro Vancouver including Burnaby, New Westminster, Surrey, Langley, Coquitlam, Port Coquitlam, and Port Moody either directly or through via the Expo or Millennium Lines.

Further alignment alternatives analysis will be undertaken during future regional planning work to determine the preferred BIRT alignment. Table 2-1 outlines the modelling assumptions for each alignment. The number of stations differs between the Gold and Purple alignments as current population and employment density is the general approach applied for determining number of stations at this preliminary stage. This difference in number of stations produces a range of results for the assessed accounts discussed and summarized in subsequent chapters.

Table 2-1: BIRT Modelling Assumptions

| Attribute | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|-------------------------------|---|-------------------------|
| Line Length | 18km | 20km |
| Start / End | Park Royal – Waterfront Station | Park Royal – Metrotown |
| Number of Stations | 11 | 10 |
| Technology | SkyTrain | |
| Frequency | Peak: 2.25min Off-peak: 5 min | |
| Transportation Network Impact | SeaBus included in the network; operational feasibility not assessed as part of scope | |

SkyTrain was chosen as benchmark due to the technology assumptions made in the Regional Transportation Model (RTM) and is appropriate for comparative purposes as it is the dominant rapid transit technology existing currently in the region. No decisions on appropriate technology for BIRT have been made at this time. The Gold alignment is envisioned to be an extension of the existing Expo Line with 2 out of every 3 trains continuing onto the North Shore, resulting in the above peak and off-peak frequency assumptions. The Purple alignment is not dependant on an existing line, but frequency assumptions were matched to the Gold alignment to ensure a level comparison between the two alignments.

2.3 BENEFITS ASSESSMENT LIMITATIONS

While the RTM has been a valuable tool for assessing the impact of major infrastructure and policy and has been used extensively on many business cases, it does have some limitations that impact end results. The following section highlights some of those limitations within the context of BIRT.

WEEKEND TRAVEL AND TOURISM

The RTM models travel demand for typical fall weekday conditions, and does not explicitly model weekend travel. The use of daily to annual expansion factors accounts for some of the benefits that accrue to weekend travellers. However, the weekend travel market is distinct as North Shore municipalities have noted with weekend traffic conditions. Furthermore, external and tourism travel is not well-represented in the RTM. Currently travel to and from external gates is based on outdated trip distribution patterns and is all assumed to be made by car. Given the North Shore's role as a tourist and recreational attraction, as well as being the region's Northern and Western gateway (to the Sea-to-Sky corridor and the Gulf Islands), the RTM likely under-estimates the overall benefits of BIRT.

CONNECTED AND AUTONOMOUS VEHICLES (CAVS), ELECTRIFICATION (EVS) AND NEW MOBILITY

The modelling undertaken for BIRT does not account for the impact of CAVs, EVs or new mobility such as Transportation Network Companies (TNCs), or micro-mobility. Recently, TransLink released a version of the RTM that accounts for some of the above, specifically CAVs and TNCs. The timing of this study preceded that release and therefore does not include consideration of new mobility. It is thought that automation will increase some car usage given potential improvement in traffic flow efficiency on freeways as well as the 'freeing up of time' used today for driving. However, most experts agree that rapid transit would still be more efficient way to move large numbers of people, especially in denser corridors. We recommend that BIRT forecasts are revisited at a later stage to account for some of those effects.

DEMOGRAPHIC ASSUMPTIONS

The RTM assumes demographic forecasts do not change with BIRT. In reality, densification around a new transit station would likely accelerate as local recent experience shows. Thus, the RTM likely under-estimates some of the BIRT benefits.

3 PROJECT NEED

BIRT is a critical piece of infrastructure for the Metro Vancouver region. A lack of reliable transportation connectivity across the Burrard Inlet has significant implications on growth opportunities, and economies at the local, regional, provincial, and national scale. There are compelling arguments for the local, regional, provincial, and national needs met through a BIRT investment; these are discussed below at a high-level and explored in further detail in the following chapters.

REGIONAL GROWTH

The Metro Vancouver Region continues to exceed growth projections and welcomes on average over 35,000 new residents on an annual basis. It is projected that by the year 2050, the region will house over 1 million new residents. The North Shore is expected to grow in line with the region and welcome 63,000 new residents between the municipalities of City of North Vancouver, District of North Vancouver, and District of West Vancouver, as well as Squamish and Tsleil-Waututh First Nations. Municipalities like Vancouver, Burnaby, and New Westminster are also expected to see significant growth and will welcome 280,000 new residents.⁶ Such significant growth warrants prioritization of rapid transit investments to help address current challenges relating to congestion, housing supply and labour mobility while also meeting the demands of expected growth. BIRT investment outcomes include increasing access across the region to jobs and housing, and increasing affordable housing supply. These impacts are discussed further in Sections 5.4.1 and 5.4.2.

DEMAND FOR TRANSIT

The North Shore has experienced many economic and social challenges relating to access and mobility as it is confined by topography and location across the Burrard Inlet. While it is connected to the rest of the Metro Vancouver by two bridges, the Lions Gate Bridge across the First Narrows and the Ironworkers Memorial Bridge across the Second Narrows, these ageing bridge structures do not have the capacity to keep pace with the fast pace of population, employment, goods movement and tourism growth. Demand for transit exceeds current service offerings and limited connections to the regional rapid transit network results in increased personal vehicle usage, putting a strain on the local transportation network and further exacerbating congestion on the North Shore.

A demand for rapid transit service connecting the North Shore to the rest of Metro Vancouver south of the Burrard Inlet exists. The recently implemented R2 Marine-Main RapidBus⁷ route connects the three municipalities and Squamish First Nation on the North Shore running from Phibbs Exchange to Park Royal but does not provide a regional connection across the Burrard Inlet. The neighbouring Sea to Sky, Sunshine Coast and Vancouver Island regions who link into the North Shore are also growing and demanding better transit-based travel choices to manage the commuters and tourists travelling to and through the North Shore. These communities are looking to realize their economic potential without creating additional gridlock around existing ferry terminals and roadways, and an investment in BIRT can open up capacity to achieve this.

REGIONAL AFFORDABILITY

Metro Vancouver is struggling with an affordable housing crisis and has become one of the least affordable regions in North America, as shown in Metro Vancouver's Housing and Transport Cost Burden study⁸. Extensive study has been undertaken on the topic of affordable housing to determine how best to tackle the challenge. The building of a rapid transit connection across the Burrard Inlet and along the North Shore will further encourage the development of residential housing supply, create land-value capture and density bonusing opportunities, and transit-oriented development. In combination with a robust affordable housing policy, BIRT will result in additional affordable housing supply. Transit itself is a solution in improving affordability as it allows for significant cost savings for

⁶ Based on Metro Vancouver Population Projections from 2016 to 2051

⁷ RapidBus is a frequent bus service with limited stops and transit priority operated by TransLink as part of their Fast and Frequent Transit Network

⁸ <http://www.metrovancouver.org/services/regional-planning/PlanningPublications/HousingAndTransportCostBurdenReport2015.pdf>

individuals and families as compared to the cost of owning and operating a vehicle; this is especially true with a rapid, reliable, transit connection.

ECONOMIC STIMULATION

BIRT will stimulate local, regional, provincial, and the national economies through knock-on effects resulting from enhanced regional connections, and improved travel times and transportation networks. While BIRT would benefit all sectors of the economy, two important sectors – tourism and industrial – are discussed in further detail below.

TOURISM SECTOR

The North Shore is a gateway for accessing regional tourism including areas such as the North Shore Mountains, Squamish, Whistler, and Horseshoe Bay BC Ferries Terminal (to access Bowen Island, the Sunshine Coast, and Vancouver Island). Tourism is a \$20.5 billion dollar industry in BC that is steadily growing with over 19,200 tourism related businesses.⁹ In 2006, BC Stats reported that the average community income dependence from tourism was 6 percent, while Squamish showed the highest dependence at 27 percent.¹⁰ Congestion on the North Shore can impede travel for these communities and have a significant economic impact on local and region tourism. Vehicle congestion on the North Shore, caused in part by limited access points and road network options, impacts downstream communities which rely on access through the North Shore.

INDUSTRIAL SECTOR

The North Shore is home to a number of major ports and terminals, and many industries that play a key role in provincial and national goods movement such as The Western Group, Neptune, Cargill, G3, Richardson, Seaspan Shipyards, and Fibrecore among others. The port industry on the North Shore contributes over 900 jobs and \$50 million dollars in wages to the local economy, and in 2014, port businesses generated \$60 million in GDP in the City of North Vancouver.¹¹ Important commodities to international trade such as grains, minerals, and steel from across Canada move through North Vancouver terminals. Furthermore, North Vancouver is a major hub for shipyards responsible for shipbuilding and repair as part of Canada's National Shipbuilding Strategy.

These industries experience significant business challenges with labour mobility issues (i.e., the ease with which laborers are able to move around within an economy) stemming from a lack of reliable public transportation access, and impacts to daily operations as a result of increased congestion on the North Shore and within the region. These seemingly 'local' impacts to North Shore port operations have national repercussions due to supply chain networks and regional dependencies of our national economy. Without access to employees and reliable daily operations, these industries, along with provincial and national economies, will suffer.

A rapid transit connection to the North Shore would alleviate congestion on the transportation network for tourism and goods movement traffic, and provide these industries with access to an extended regional labour pool through reliable transit.

GLOBAL CLIMATE CHANGE AND EMISSIONS

Metro Vancouver's Climate 2050 strategy outlines regional priorities to respond to changing climate and reduce GHG emissions to build a resilient region. Similarly, the Province of British Columbia and the Government of Canada have the *CleanBC Plan* and *A Healthy Environment and A Healthy Economy* climate plans which both include transportation goals for reducing GHG emissions. In Metro Vancouver, 4.7 million tonnes of GHGs are emitted by cars and trucks, while heavy duty vehicles, trains, ships, and airplanes emit 1.8 million tonnes.¹² The anticipated impacts of climate change include increased precipitation causing flooding and asset damage, and warmer temperatures increasing the occurrence of heat waves, forest fires, and rising sea levels. The opportunity exists to reduce GHG emissions through a shift to sustainable modes of transport, most notably through increasing transit mode share. BIRT will create a lower-emission travel alternative to personal vehicles and extend connections across the greater regional rapid transit network.

⁹ https://www.destinationbc.ca/content/uploads/2020/06/006_TIC2020_PowerOfTourism_Brochure-v7.pdf

¹⁰ https://www2.gov.bc.ca/assets/gov/data/statistics/economy/input-output-model/bc_local_area_economic_dependencies.pdf

¹¹ City of North Vancouver Economic Snapshot (2017)

¹² <http://www.metrovancouver.org/services/air-quality/climate-action/climate2050/regional-priorities/transportation/Pages/default.aspx>

4 STAKEHOLDER ENGAGEMENT

This section provides a summary of the perspectives and key messages gleaned from stakeholder engagement sessions conducted by KPMG during March 2021.

Engagement sessions were held in one-on-one meetings or via email questionnaire with key project stakeholders. The overarching goal of engagement was to gather perceived impacts on rapid transit connection to the North Shore and to understand the challenges for various sectors on the North Shore. Representatives from the following industries and Nations were engaged:

- Tourism (*including Tourism Association and Local & Regional Tourist Attractions*);
- North Shore Local Businesses (*including Food & Beverage, Professional Services, Commercial Developments*);
- Post-Secondary Institutions;
- Film Industry;
- Ports & Terminals; and
- Squamish Nation.

Engagement commentary ranged from descriptions of current conditions of respective organizations on the North Shore, to specific impacts and benefits they associate with a project such as BIRT. The meetings covered a broad range of topics that stakeholders identified as important for their organization.

Generally, stakeholders expressed similar views regarding a rapid transit connection across the Burrard Inlet. There was agreement that rapid transit to the North Shore from Metro Vancouver would help reduce congestion on the two bridges, and would improve reliability and connectivity for businesses, employees, and visitors on the North Shore. The consensus was that these outcomes would offer a significant benefit to their organization and the North Shore as a whole. Engaged stakeholders and communities are supportive of BIRT and identified the project as having positive economic impacts.

Stakeholder engagement undertaken comprised high-level discussions to gauge economic benefits and disbenefits of a rapid transit connection to the North Shore. The engagement sessions did not include an overview of BIRT alignments or technology selection as the project feasibility and engineering is in its early stages; this is to say that additional engagement will be required once the project continues to advance. It is also noted that while an in-depth interview was undertaken with Squamish Nation, the feedback collection does not constitute formal Indigenous Consultation¹³. Key messages from the stakeholder engagement sessions are summarized below, organized by topic area.

4.1 SUMMARY OF KEY THEMES FROM STAKEHOLDER ENGAGEMENT

4.1.1 LABOUR MOBILITY AND EMPLOYMENT

The lack of reliable transit and increasingly problematic congestion for commuters to the North Shore was cited by many parties as a major impact to their ability to both attract and retain staff who live across the rest of Metro Vancouver. Potential and existing employees cite a combination of a lack of affordable housing on the North Shore and increasingly congested commutes as reasons they elect to find employment elsewhere in Metro Vancouver.

¹³ <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations>

Businesses on the North Shore stated that they face a disadvantage compared to neighbouring communities where rapid transit is available. Integrated rapid transit was cited as necessary to compete for talent with non-North Shore municipalities. It is also cited as a reason why businesses choose to locate elsewhere and that an increasing number of businesses have opted to relocate closer to transit, which has had a negative impact on the rental values of commercial properties on the North Shore.

4.1.2 CONGESTION

All stakeholders recognised that BIRT would help alleviate vehicle traffic and congestion across the Burrard Inlet bridges by reducing the number of private vehicle trips. Many businesses on the North Shore require commercial vehicles or delivery trucks for their operations and anticipate seeing reduced congestion as a direct benefit to their business operations and growth potential. It was noted that some businesses currently face additional charges from their suppliers for time spent in traffic. Reduced congestion and travel time reliability would positively impact these businesses. Rapid transit to the North Shore was seen as a positive way to improve congestion and allow trucking and commercial vehicles to improve their reliability and shorten their travel times compared to existing conditions.

4.1.3 RELIABILITY

All stakeholders shared that by reducing congestion and providing an alternative mode of transport for commuters BIRT would improve the reliability of travel times for both commercial vehicles and personal trips. This would result in knock-on economic and social benefits for employers and employees through increased access across the region to jobs and improved business operations.

4.1.4 ACCESS AND CONNECTIVITY

Many stakeholders compared the lack of rapid transit on the North Shore against the connectivity and ease of access for Metro Vancouver via existing rapid transit options. It was a common sentiment that this was a disadvantage for the North Shore, and that transit connectivity was seen as a way to improve the North Shore's ability to compete for employees, business, and visitors.

4.1.5 LOCAL AND REGIONAL TOURISM

Congestion and unreliable travel times on the bridges over the Burrard Inlet were identified as a significant concern for tourism companies currently running bus tours. Visitors are often returning to Metro Vancouver for connecting trips, and the lack of reliability is a concern for the tourism businesses who must balance 'dead time' for their clients while avoiding disruptions en-route to their next destination. Increased congestion and unreliable travel times may deter tourists from visiting and staying on the North Shore and up the Sea to Sky corridor in Squamish and Whistler.

BIRT was seen as improving the bottleneck for visitors coming from Metro Vancouver, and if combined with other modes of transport to destinations such as Squamish, stakeholders involved in the tourism industry saw BIRT as an opportunity to increase the number of tourists who opt for overnight stays in the area. The arrival of BIRT is anticipated to encourage overnight stays at hotels on the North Shore, as visitors can find more affordable accommodation while being able to use transit to access downtown Vancouver. Investments in the North Shore as a destination for locals and tourists were cited as reasons for recent tourism growth.

BIRT also was identified as part of the solution for reducing the number of visitors arriving to regional tourist destinations in private vehicles, which require hotels and business owners to build parking lots in areas that could otherwise be used productively to generate revenue, employment, and housing.

Congestion was referenced as a reason that residents of Metro Vancouver hesitate to visit the North Shore for leisure, and the BIRT was seen as highly desirable to manage local tourism, reduce dependence on taxis to explore the area, and related congestion.

4.1.6 IMPACTS TO FILM INDUSTRY

The North Shore is considered a desirable location for the film industry, offering access to both downtown Vancouver and the wilderness, however congestion across the bridges is already negatively impacting the industry. Clients and partners find it challenging to access locations or take meetings that require a congested and unreliable commute time.

The film industry expressed that they will continue to require in-person talent, as a transition to virtual work is not a realistic option for all specialties in filming and productions. The film industry on the North Shore indicated they already must compete with communities who have reliable transit options for employees and clients. Rapid transit to the North Shore would support the labour force, which employs many people from various industries such as carpenters, technicians, stylists, etc. As the industry requires trucks and access to road networks, a reduction in congestion through BIRT would facilitate their operations and increase their attractiveness as a prime location for studios.

Increased density related to anticipated transit-oriented development was seen as an attractive proposition for the film industry, as productions spend significantly on goods and services from the areas with an emphasis on 'buy local'.

4.1.7 COMMERCIAL CONNECTIVITY – PORTS AND GOODS MOVEMENT

The North Shore is a vital gateway for Canadian exports and the Port of Vancouver (and its tenants) employ a significant number of people. Reliable rail and road network connectivity are an absolute necessity for terminal operators. Stakeholders cited congestion in the area has a significant impact on truckers, who are paid by the trip, and also on their employees who commute to work from outside of the North Shore.

4.1.8 AFFORDABLE HOUSING

In discussions about a rapid transit connection to the North Shore, stakeholders raised the concern of affordable housing in the North Shore communities. They recognised that many current or potential employees would like the option to live close to work but that affordable options are not available. Affordable housing was cited as a medium- and long-term need to develop and maintain skilled, mid-career professionals for the communities on the North Shore. BIRT will create development opportunities which, with collaboration and appropriate policy measures, could increase the supply of affordable housing units near affordable and reliable transit.

4.1.9 SUSTAINABLE LAND DEVELOPMENT

Sustainable solutions for land development on the North Shore and surrounding regions were mentioned as a priority by a First Nations community representative. BIRT was viewed as a project that could unlock economic opportunities in the region and one that would support sustainable land development on the North Shore.

4.1.10 ACCESS TO POST-SECONDARY EDUCATION

A significant share of students studying on the North Shore travel from other parts of Metro Vancouver and the majority of students rely upon public transit (71 percent of new students and 68 percent of returning students). In surveys by a local campus, half of students cite transit times longer than 45 minutes each way. Rapid and reliable transit connections are important for post-secondary students. Affordable transit is also important for students who commute to the North Shore.

5 BENEFITS ASSESSMENT

5.1 INTRODUCTION

This Benefits Assessment evaluates the economic advantages of an investment alternative. Typically, the disadvantages (i.e., costs) are also assessed in a greater evaluation framework to determine whether the expected benefits of a project justify the cost from a regional, provincial, and national perspective; this type of analysis is called a Benefit-Cost Analysis (BCA). As BIRT is in a pre-business case stage, there is not sufficient information to accurately determine project capital and operating costs and conduct a BCA. As such, a Benefits Assessment was conducted to provide insight and evidence on expected benefits relating to an investment in BIRT.

Similar to a BCA, a number of traditional user benefits were assessed as part of the Benefits Assessment. The three methods of analysis were employed to capture project benefits as best as possible during this project stage; an explanation of the three methods is provided below:

- **Monetized analysis** – for accounts that are easily quantifiable, and where a dollar value can be easily attributed to the impact.
- **Quantitative analysis** – for accounts that are easily quantifiable, but where a dollar value cannot be easily attributed to the impact due to the preliminary stage of the project or other factors.
- **Qualitative analysis** – for accounts that cannot be easily quantified or monetized at this stage but are still expected to result in significant benefits as a result of BIRT.

Table 5-1 below summarizes the impact categories analysed, as well the analysis method undertaken.

Table 5-1: BIRT Benefits Assessment Impact Categories

| Section | Impact Category | Description | Impact Type |
|---------|--|--|-------------|
| 5.2.1 | Travel Time Savings - Existing Auto Users | Rapid Transit connection will reduce road congestion resulting in vehicle travel time savings | Monetized |
| | Travel Time Savings - New Auto & Transit Users | Rapid Transit connection will reduce road congestion resulting in travel time savings | Monetized |
| | Travel Time Savings - Existing Transit Users | Rapid Transit connection provides a quicker transit connection for existing transit users | Monetized |
| | Travel Time Savings - Goods Movement | Rapid Transit connection will reduce road congestion resulting in travel time savings for freight | Monetized |
| 5.2.2 | Travel Time Reliability | Reduction in variability of trip travel time due to BIRT for transportation users | Monetized |
| | Travel Time Reliability - Goods Movement | Reduction in variability of trip travel time for Goods Movement due to reduced congestion | Monetized |
| 5.2.3 | Auto Operating Savings | Mode switch from auto to transit will reduce costs associated with operation of private vehicles. | Monetized |
| 5.5.1 | Reduced Collision Benefits | Reduced vehicle kilometres travelled (VKT) due to auto mode switch will reduce the number of collisions and associated injuries. | Monetized |
| 5.6.1 | Reduced Auto Emissions | Reduced VKTs due to auto mode switch will lead to reduced generation of emissions and improve air quality (CO ₂ , SO _x , NO _x , PM _{2.5} , PM ₁₀ , VOC) | Monetized |
| 5.3.3 | New Developments (Business and Housing) | Increased retail, office, and residential facilities along rapid transit corridor | Quantified |
| 5.4.2 | Housing Affordability | Increased development along rapid transit corridor will also increase the number of non-market units available | Qualitative |
| 5.3.3 | Land Value Uplift | Increased retail, office, and residential facilities, as well as improved transit service connectivity, will increase local property values. | Monetized |
| 5.3.1 | Wider Economic Impacts | BIRT produces agglomeration benefits in the form of improved productivity by bringing firms closer to one another through transportation improvements. | Quantified |
| 5.3.4 | Capital Deferral | Potential for deferral of road/highway upgrades or maintenance projects as a result of BIRT | Qualitative |
| 5.3.1 | Additional Investment | Creation of a Mobility Hub on the North Shore may result in increased investment (BC Ferries, Transit along Sea to Sky Highway, etc.) | Qualitative |
| 5.4.1 | Jobs and Housing Accessibility | Access to jobs and housing available within a 60-minute transit ride | Qualitative |

It is worth noting that quantified and monetized benefits were calculated for the year 2050 due to data availability within the RTM and the lack of information around operational horizon of BIRT. In reality, benefits – such as travel time savings, reduced collision benefits, etc. – would be observed over the entirety of a project’s life span but may differ as variables such as VKT and ridership change annually. The monetized results are shown in undiscounted 2020 dollars, that is monetized results have not been adjusted to account for the time value of money.

5.2 TRANSPORTATION IMPACTS

For large transportation infrastructure projects, travel time and cost savings for regular trip-makers usually account for the biggest share of the total benefits of a project. While travel time savings are self-explanatory, travel cost savings or expenses can accrue due to:

- Change in vehicle operating cost (VOC) due to switching modes or change in distances travelled; and
- Change in transit fares paid.

This section summarizes travel time accrued regionally (i.e., Metro Vancouver). These include the following:

- Travel time savings by mode: auto, transit, and trucks (goods movement);
- Travel time reliability; and
- Auto operating cost savings.

Travel time savings were estimated using the Regional Transportation Model (RTM3). The RTM is the region’s official travel demand model. The RTM models a typical fall weekday and has been used extensively to conduct BCAs for several large transit infrastructure projects in the region such as the Surrey-Langley SkyTrain, Broadway Subway Project, and the Canada Line. Assumptions within this benefits assessment are generally in-line with these other significant regional transit project assumptions.

The results presented here are based on a 2050 horizon year. Land-use inputs into the RTM are based on Metro Vancouver’s official Regional Growth Strategy (RGS) regional growth projections. All monetized values are in **undiscounted**¹⁴ 2020 dollars, that is monetized results have not been adjusted to account for the time value of money.

5.2.1 TRAVEL TIME SAVINGS

BIRT will generate travel time savings benefits in the range of \$498M - \$552M dollars in 2050.

BIRT travel time savings in 2050 were calculated based on consumer surplus theory. In mainstream economics, consumer surplus is defined as the difference between the consumers' willingness to pay for a commodity and the actual price paid by them, or the equilibrium price. A new infrastructure project results in positive consumer surplus due to the following:

- Existing users who previously accepted longer travel times (willingness to pay) now experience shorter travel times resulting in a net benefit (purple area in Figure 5-1); and
- New users, who previously did not make a specific trip because its cost exceeded their willingness to pay now decide to

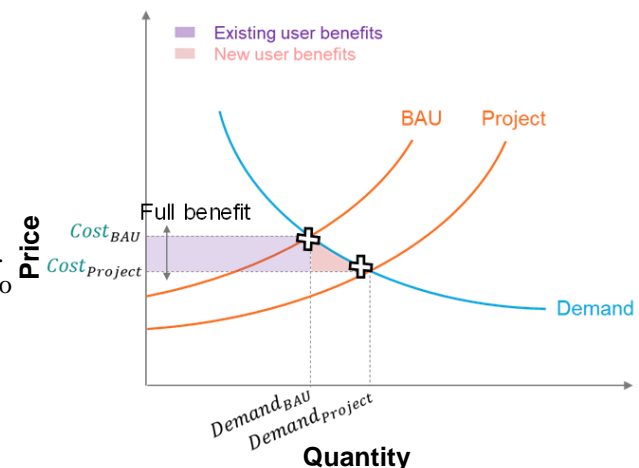


Figure 5-1: Economics Demand Curve

¹⁴ In benefit-cost assessment, monetary values are typically discounted. Discounting arises from the fact that a dollar today is worth more than a dollar in the future (e.g., ten years from now) even if there is no inflation because today's dollar can be used productively (i.e., invested) in the ensuing years, yielding a value greater than the initial dollar. The purpose of discounting is to put all present and future costs and benefits in a common metric, their present value.

make that trip due to improved travel time (pink area in Figure 5-1).

Figure 5-2 summarizes the travel time benefits by mode for the two BIRT alignment options, relative to the BAU scenario. For truck travel time savings, two categories are shown – one for light trucks, which represent smaller two-axle vehicles such as panel vans, and heavy trucks, which represents 3+ axle vehicles such as container trucks or long combination vehicles. The travel time savings in minutes were monetized using BC Ministry of Transportation and Infrastructures' guideline for default values of time¹⁵. Below are some key observations:

- Overall, both BIRT alignments provide a competitive and reliable alternative travel mode to access the North Shore. **The estimated travel time savings of BIRT are significant and of a similar magnitude to one another.**
- As expected, most of the travel time savings accrue to the transit market. In addition to typical time savings, BIRT users benefit from the improved reliability the service provides, discussed in Section 5.2.2. Furthermore, some benefits accrue to existing transit users as a result of the reduction in auto trips (approximately 2 percent) through minor travel time benefits to buses.
- On an absolute scale, BIRT generates significant auto benefits. Road travel times improve due to overall reduction in auto trips as previous car users switch to transit. Overall, BIRT generates between 50,000 – 60,000 new transit trips as shown in Figure 5-2. The majority of those, approximately 75 percent, were previously auto trips. The remainder switched to transit from active modes (walk and bike).
- Light and heavy truck travel time savings are largely derived from auto users switching to transit which leaves more roadway capacity for goods movement (particularly on Highway 1). These directly relate to regional and national economic benefits including the economic competitiveness of the Greater Vancouver Gateway.¹⁶

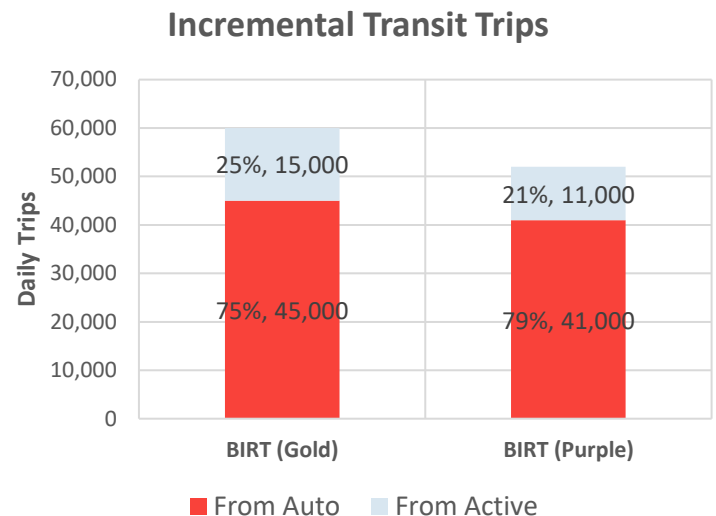


Figure 5-2: BRIT Incremental Transit Trips

Table 5-2: Summary of Travel Time Savings Impact (2050)

| Vehicle Type | | Travel Time Savings (2050) | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|----------------|---|----------------------------|-----------------------|-------------------------|
| Auto | Annual Travel Time Savings (person-minutes) | | 415.6 million | 330.7 million |
| | Annual Cost Savings (2020\$) | | \$132 M | \$105 M |
| Transit | Annual Travel Time Savings (person-minutes) | | 1.3 billion | 1.2 billion |
| | Annual Cost Savings (2020\$) | | \$413 M | \$386 M |
| Light Truck | Annual Travel Time Savings (veh-minutes) | | 5.8 million | 5.3 million |
| | Annual Cost Savings (2020\$) | | \$3.1 M | \$2.9 M |
| Heavy Truck | Annual Travel Time Savings (person-minutes) | | 6.9 million | 6.6 million |
| | Annual Cost Savings (2020\$) | | \$3.7 M | \$3.6 M |
| TOTAL (2020\$) | | | \$552 M | \$498 M |

¹⁵ https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/planning/tools/default_values-benefit_cost_analysis.pdf

¹⁶ The Greater Vancouver Gateway refers to the economic link that Greater Vancouver provides between Canada and Asia Pacific. The Gateway Transportation Collaboration Forum has been collaborating since 2014 to improve trade and transportation networks to meet anticipated economic growth by 2030.

5.2.2 TRAVEL TIME RELIABILITY

BIRT will generate travel time reliability benefits in the range of \$55M - \$75M dollars in 2050.

When a new transit infrastructure project is built, average times for travelers decrease. This improvement is already accounted for in the travel time savings impacts account as described in Section 5.2.1. Another benefit of a new transit project is (usually) an overall increase in travel reliability.

Figure 5-3 shows a hypothetical trip from City of North Vancouver Central Lonsdale to downtown Vancouver across the First Narrows Bridge. According to Google Maps, this trip takes between 18 and 45 minutes in the morning on a typical weekday.

This wide range represents the variable nature of travel times due to:

- Demand variability (i.e., traffic is usually busier on Tuesdays as compared to Mondays);
- Incidents including vehicle collisions and breakdowns; and
- Inclement weather, such as rain, snow or low visibility conditions.

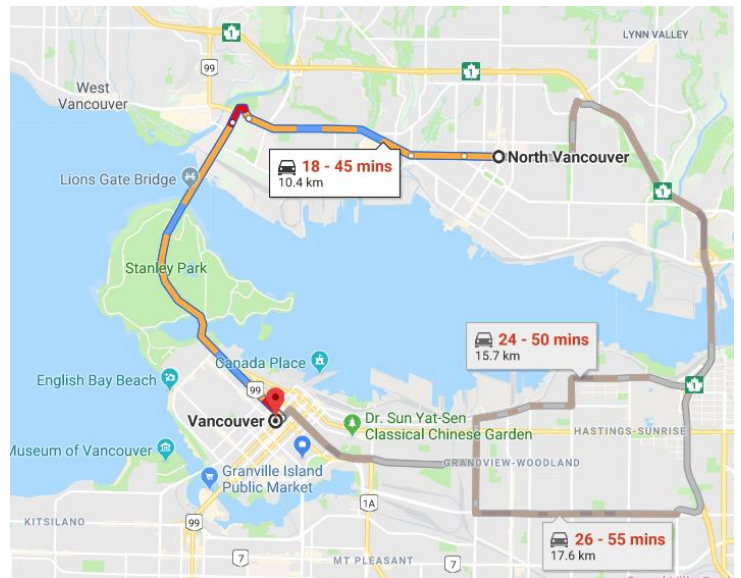


Figure 5-3: Travel Time Reliability Example – Trip from North Shore to Downtown

These factors can influence congestion levels significantly at capacity-constrained sections of the road network. Given the random nature of congestion, travelers include ‘buffer time’ in their schedule, especially for important trips such as a business meeting. In the example above, some people will leave their home 45 minutes earlier to guarantee reaching their destination on time, even if the trip takes 25 minutes on average. If travel to downtown was more reliable, a person could have used that extra buffer time to perform other activities. In short, travel reliability allows people to use their time more freely and valuably.

A transportation project that reduces congestion will improve travel times and increase reliability as shown by the decrease in ‘spread’ (i.e., standard deviation) of the travel time distribution curve shown in Figure 5-4.

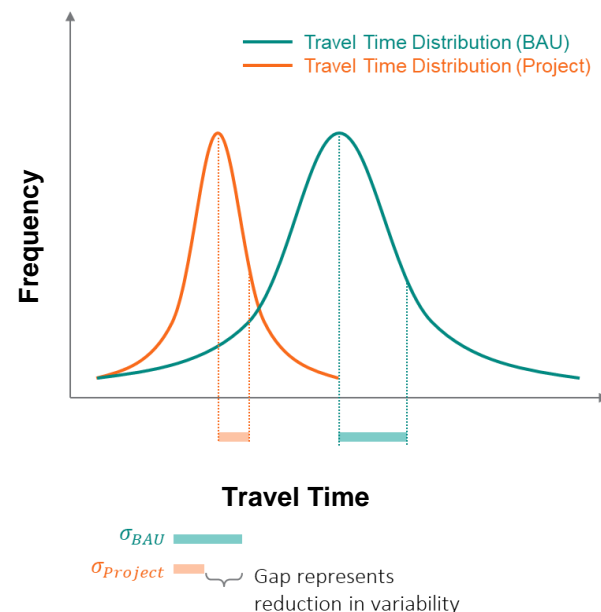


Figure 5-4: Hypothetical Travel Time Distribution

BIRT-related improvement in travel time reliability for autos and trucks was calculated using a tool¹⁷ developed by TransLink's transportation forecasting team, which estimates travel time standard deviation for each origin-destination¹⁸ pair in the RTM.

Table 5-3 summarizes the reliability benefits for BIRT. Below are some key takeaways:

- Transport reliability benefits are significant, about 55 – 60 percent of conventional auto benefits (See Table 5-3). This is largely due to highly variable travel times across the First Narrows and Second Narrows bridges. The improvement in reliability is due a reduction in auto volumes and resulting reductions in travel time improvement and incidents such as accidents and breakdowns.
- Reliability savings accrue also to the goods movement sector which potentially have positive knock-on effects that are not captured in the RTM. Reliability improvements reduce economic inefficiency in the supply chain which sometimes arise from trucks not making their deliveries within their assigned time slot, resulting in additional receiver costs and potential penalties to the delivery businesses. For example, a truck may have a half hour window to deliver goods to a warehouse where staff have been scheduled to help unload the goods. If the truck is late, then these staff sit idle, and possibly have to accrue overtime hours to unload the truck at a later time incurring additional business costs that reduce company competitiveness.

It is important to note that transit time reliability improvements were not calculated explicitly for this study. Transit reliability is one of the most important factors that influence an individual's decision to take transit, especially in the case of rail (SkyTrain) which is perceived as being highly reliable. The reliability component is included in the transit time savings estimate shown in Table 5-2. Given the RTM mode choice model structure, it is difficult to extract the transit reliability benefits component from the overall transit travel time savings estimates, but it is presented as part of this Benefits Assessment to provide an understanding of impact.

Table 5-3: Summary of Reliability Benefits (2050)

| Vehicle Type | Travel Time Reliability (2050) | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|-----------------------|---------------------------------|-----------------------|-------------------------|
| Auto | Annual Savings (person-minutes) | 280 million | 204 million |
| | Annual Savings (2020\$) | \$71.2 M | \$52.0 M |
| Light Truck | Annual Savings (veh-minutes) | 3.9 million | 3.3 million |
| | Annual Savings (2020\$) | \$1.7 M | \$1.4 M |
| Heavy Truck | Annual Savings (person-minutes) | 4.7 million | 4.1 million |
| | Annual Savings (2020\$) | \$2.0 M | \$1.8 M |
| TOTAL (2020\$) | | \$75 M | \$55 M |

Source: WSP Analysis. Note: Sums may not align due to rounding

¹⁷ The tool was developed as part of the Mobility Pricing Independent Commission (MPIC) Study

¹⁸ Origin-destination is a term that refers to trip flows from one traffic analysis zone (TAZ) origin to a TAZ destination. TAZs are the RTM's basic unit of geographic analysis. Conceptually, TAZs are similar to zip codes, albeit smaller in size.

5.2.3 VEHICLE OPERATING COST (VOC) SAVINGS

BIRT will generate vehicle operating costs savings in the range of \$18M - \$19M dollars in 2050.

As shown in Figure 5-3 BIRT eliminates approximately 40,000 to 45,000 daily auto trips. This results in substantial auto operating cost savings stemming from reduced fuel and maintenance costs. Table 5-4 summarizes BIRT VOC savings¹⁹. Below are some key observations:

- Assuming average annual distance driven is 13,000 kilometres per vehicle²⁰ the VKT savings shown in Table 5-4 are equivalent to removing approximately 7,800 vehicles from the network.
- Vehicle operating cost savings are relatively small when compared to monetized travel time savings.
- The small (and relatively insignificant) increase in truck VKT is due to the slight increase in road capacity as a result of auto users shifting to transit. As such, some trucks travel slightly longer on the faster highway network (Highway 1) as opposed to using the arterial network. This generally is a desirable outcome as fewer trucks travel on the municipal road network adjacent to residential communities. Increased truck volumes can also be associated with increased economic prosperity.
- VKT savings shown in Table 5-4, are used in subsequent calculations of green-house gas (GHG) emissions and auto collision reductions.

Table 5-4: Summary of Vehicle Operating Cost Savings (2050)

| Vehicle Type | Vehicle Operating Cost Savings (2050) | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|----------------|---------------------------------------|-----------------------|-------------------------|
| Auto | Annual Savings (VKT) | 101,836,584 | 101,394,196 |
| | Annual Savings (2020\$) | \$18.9 M | \$18.8 M |
| Light Truck | Annual Savings (VKT) | (661,179) | (861,891) |
| | Annual Savings (2020\$) | (\$0.2 M) | (\$0.2 M) |
| Heavy Truck | Annual Savings (VKT) | (197,957) | (271,064) |
| | Annual Savings (2020\$) | (\$0.1 M) | (\$0.2 M) |
| TOTAL (2020\$) | | \$19 M | \$18 M |

Source: WSP Analysis. Note: Sums may not align due to rounding

¹⁹ The monetized estimates use RTM assumptions for VOCs which ignore electric vehicles. As such, the VOC savings presented in this study can be considered an upside estimate.

²⁰ Average VKT per vehicle: <https://www.thinkinsure.ca/insurance-help-centre/average-km-per-year-canada.html>

5.3 ECONOMIC DEVELOPMENT IMPACTS

BIRT will contribute \$4.2 billion to Canada's GDP, and generate 43,000 full-time employment positions (FTE), \$114 million in unincorporated sector labour income, \$2.7 billion in wages and salaries, \$428 million in tax revenue creation, and \$7.6 billion in output per billion dollars spent in each capital and operating expense category.

The introduction of a rapid transit connection to the North Shore is expected to present positive travel and mobility impacts as well as create opportunities for new, incremental economic activity. This section explores the economic impacts associated with the implementation and operation of BIRT at a regional, provincial, and national level.

The construction and operation of BIRT will necessitate the expenditure of capital, operational and maintenance funds. The economic impacts of these expenditures, and any induced economic stimulation, are analysed in this section.

5.3.1 MACROECONOMIC IMPACTS

For the purposes of this analysis, economic impacts within British Columbia as well as the subsequent impact to other Canadian provinces, are reported in terms of Gross Domestic Product (GDP) at Market Prices, Employment, Labour Income of Unincorporated Sector, Taxes on Production and Products, Wages & Salaries, and Output. A description of each term is provided below from Statistics Canada's User Guide:

- **GDP at Market Prices** refers to the difference between an industry's total output and the cost of its intermediate inputs. It measures the total 'value-added' amount that producers contribute to generate their output. Essentially, it equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported). GDP is measured in dollars.
- **Employment** measures the total employment impact created from industry incremental spending. The number of jobs created is measured in job-year Full-Time Equivalent (FTE); an FTE is defined as being equivalent to one full-time position that is held for a year. For example, one job lasting 12 months is equivalent to two jobs lasting six months each.
- **Labour Income of Unincorporated Sector** refers to compensation paid to employees outside of corporate entities. The unincorporated sector is comprised of self-employed owners of unincorporated businesses or professional practices and are typically small in size, often hire workers, and usually have relatively low start-up costs compared to larger businesses. Unincorporated sector compensation would include wages, salaries, social contributions, bonuses, and performance among potential others. It is a component of the GDP impact and is measured in dollars.
- **Taxes on Products & Production** measures government tax revenue collected from production processes and products. *Taxes from production* refers to taxes collected from producers in a way that is not directly linked to product sales. These are taxes that must be paid regardless of whether the business enterprise is profitable or not. *Taxes on products* refer to taxes collected from producers or importers as a percentage of the price of the product when traded, or as a specific dollar amount per physical unit of the product traded. Typically, these taxes are collected on behalf of a government and remitted to the government by the producer when the product is sold. Taxes on Products and Production are measures in dollars and are a component of GDP.
- **Wages and Salaries** refer to the paycheques and all other forms of direction compensation employees receive. Wages and salaries provide employees with income that can be spent on goods and services, transferred to other institutional units or saved at their discretion. They are defined on an accrual basis, rather than a cash basis, and typically they must be partially or entirely imputed. Wages and salaries are measured in dollars.
- **Output** represents the value of industry production within an economy. It is essentially the total value of goods and services produced during the accounting period and includes intermediate purchases by

industries within the supply chain. As such, Output will therefore exceed the GDP impact described above. Output is measured in dollars.

Economic multiplier effects are used to measure the cumulative provincial and national economic impacts of a project's incremental spending. These effects are expressed as either direct, indirect, or induced, and described as follows:

- **Direct effects** refer to the initial economic activity resulting from direct expenditures of that industry. These effects capture the impacts on identified industries associated with incremental spending spurred by the capital and operational costs associated with BIRT.
- **Indirect effects** refer to the impact of local industries buying goods and services from other local industries. The cycle of spending works its way backwards through the supply chain until all money leaks from the local economy, either through imports or by payments to GDP.
- **Induced effects** refer to the effects by an economy to an initial change (i.e., direct and indirect impacts) that result from re-spending of income received by a component of value added. Essentially, these effects result from subsequent upstream employee spending within an industry and its upstream supplier base where money is recirculated through household spending patterns causing further economic activity.²¹

5.3.1.1 ECONOMIC SNAPSHOT

The following section provides an economic snapshot of current economic conditions on the North Shore and within the region. This is used as the basis and shows economic development and growth as a result of an investment in rapid transit connecting the North Shore.

LABOUR FORCE STATISTICS

Unemployment statistics in the Lower Mainland are currently higher than those presented in Table 5-5 due to the COVID-19 pandemic; across the region Metro Vancouver reported quarterly unemployment rates between 5.4 percent and 13.0 percent during 2020.²²

Based on Table 5-5, Capilano IR No. 5, Mission IR No. 1, and Burrard Inlet IR No. 3 have a higher unemployment rate than other communities on the North Shore. Access to jobs within the region will be transformative for these communities in realizing economic and social benefits. Furthermore, BIRT will be an important regional link for as it connects communities within Metro Vancouver with higher unemployment as the region deals with the post-pandemic economic recovery.

Table 5-5: Regional Unemployment Statistics (2016)

| Region | Unemployment Rate |
|--------------------------------------|-------------------|
| City of North Vancouver | 5.0% |
| District of North Vancouver | 5.1% |
| District of West Vancouver | 5.5% |
| Capilano IR No. 5 | 12.9% |
| Mission IR No. 1 | 16.1% |
| Seymour Creek IR No. 2 ²³ | 0.0% |
| Burrard Inlet IR No. 3 | 7.3% |

Source: Statistics Canada 2016 Census

²¹ It is important to note that economic impacts resulting from induced effects should be interpreted with some consideration as they are affected by a number of variables including a household's propensity to save. For example, in times of high unemployment such as those experienced during a market crash, household saving rates typically tend to increase and therefore economic impacts resulting from induced effects will decrease. When analyzing induced effects, it is important to consider the local, regional, and national market conditions.

²² <https://www.dtvancouver.ca/covid-19-snapshot/>

²³ Numbers provided by Statistic Canada may indicate an error in labour force statistics for Seymour Creek IR No.2

5.3.1.2 REGIONAL ECONOMIC IMPACTS

In 2019, there were approximately 11,243 businesses (1 or more employees) on the North Shore; the majority are small- and medium-sized businesses²⁴. Of these businesses, DNV has the highest share at 37 percent while CNV and DWV have similar shares at 22.2 percent and 21.2 percent respectively. Table 5-6 below summarizes employers by size and region.

Many of the employees on the North Shore commute from across the Lower Mainland and up the Sea-To-Sky corridor to access employment. A heat map of employee origins for select North Shore businesses is shown in Appendix A, and shows regional dependence between the North Shore, Metro Vancouver, and beyond (the Sea-to-Sky corridor, Sunshine Coast, and Vancouver Island). An investment in BIRT would improve these commutes and extend benefits within the region.

Table 5-6: Number of Businesses on the North Shore by Size and Location (2019)

| REGION / BUSINESS EMPLOYEE SIZE | CITY OF NORTH VANCOUVER | DISTRICT OF NORTH VANCOUVER | DISTRICT OF WEST VANCOUVER | SQUAMISH | WHISTLER | LIONS BAY | BURRARD INLET IR NO. 3 | MISSION IR NO. 1 | CAPILANO IR NO. 5 | SEYMOUR CREEK IR NO. 2 |
|---------------------------------------|-------------------------------|-----------------------------------|----------------------------------|------------|------------|--------------|------------------------------|---------------------|----------------------|------------------------------|
| No Employees* | 12,223 | 19,755 | 12,272 | 4,896 | 6,149 | 379 | 387 | 8 | 246 | 50 |
| 1-4 | 1,535 | 2,754 | 1,789 | 559 | 340 | 38 | 40 | 2 | 67 | 11 |
| 5-9 | 444 | 640 | 310 | 202 | 182 | 5 | 1 | 2 | 47 | 4 |
| 10-19 | 255 | 459 | 149 | 129 | 144 | 2 | 3 | 0 | 47 | 1 |
| 20-49 | 169 | 220 | 104 | 70 | 115 | 2 | 1 | 1 | 32 | 6 |
| 50-99 | 61 | 79 | 24 | 25 | 31 | 1 | 0 | 1 | 13 | 0 |
| 100-199 | 14 | 22 | 9 | 4 | 15 | 0 | 1 | 0 | 4 | 0 |
| 200-499 | 12 | 12 | 5 | 5 | 3 | 0 | 0 | 0 | 3 | 1 |
| 500-999 | 2 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 1,000-1,499 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,500-2,499 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2,500-4,999 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 5,000+ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Businesses | 2,494 | 4,192 | 2,393 | 995 | 832 | 48 | 46 | 6 | 214 | 23 |

Source: Government of British Columbia (BC Stats)

* The locations in the "no employees" category do not maintain an employee payroll, but may have a workforce which consists of contracted workers, family members or business owners.

Within these businesses are a diverse employment base. Employment concentration by industry are shown in Figure 5-5 through Figure 5-7 for the City of Vancouver, District of North Vancouver, and District of West Vancouver. From these pie charts, it is evident that the industry makeup on the North Shore is quite similar between the three municipalities; professional services, construction, and health care related industries constitute a large portion of the employer base. It is also worth noting that while aggregated and categorized as 'Other' in the below figures, transportation and warehousing, and wholesale trade are also significant industries with four major ports located on the North Shore; these industries have significant regional and national value as they are part of the national goods movement network and shipbuilding industry.

²⁴ The Government of Canada defines a small business as having 1 to 99 paid employees and a medium-sized business as having 100 to 499 paid employees (https://www.ic.gc.ca/eic/site/061.nsf/eng/h_03126.html)

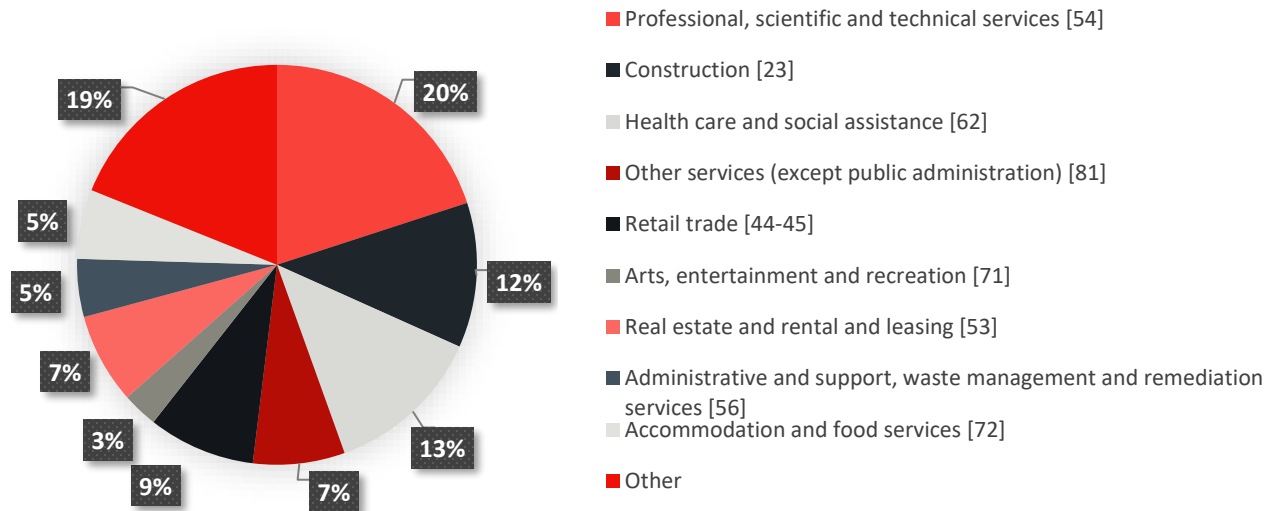


Figure 5-5: Business Breakdown by Industry - City of North Vancouver

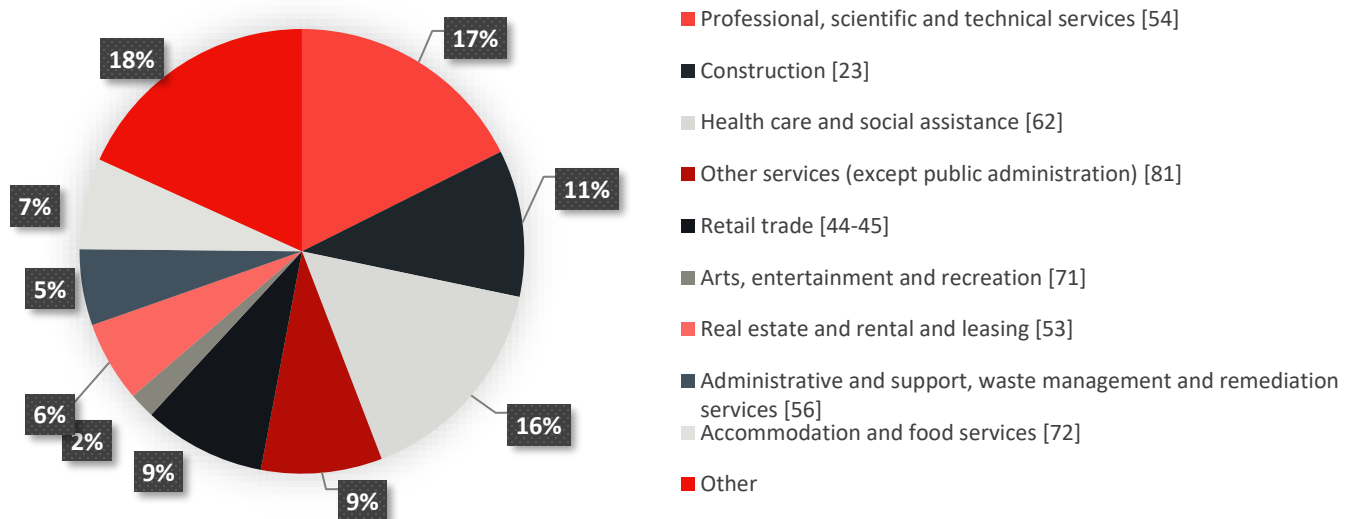


Figure 5-6: Business Breakdown by Industry - District of North Vancouver

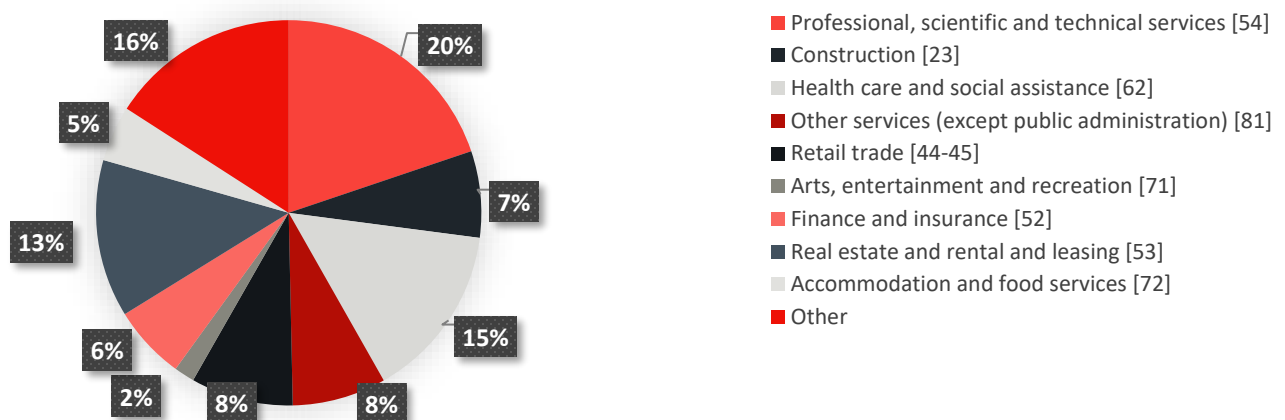


Figure 5-7: Business Breakdown by Industry - District of West Vancouver

In the long-term, an investment like BIRT presents a unique opportunity for the retail, services, tourism, and development industries. By providing an improved transit option, distribution of local and visitor spending is likely to expand regionally, increasing the footprint of industry impacts past what is accessible with current transit offerings. That is, rapid transit alignments with reliable connections are likely to create greater hubs around station locations and expand past the major commercial developments on the North Shore at Park Royal, Lonsdale Quay, and Park & Tilford Gardens to positively impact new and existing businesses along the North Shore. A similar phenomenon will occur along the corridor alignment into Metro Vancouver. With a limited number of large businesses and corporations along the study corridor, local communities and small business owners are expected to reap the potential economic benefits spurred by rapid transit investment, resulting in direct community economic contributions. In addition, an investment such as BIRT has the potential to reduce higher unemployment rates observed in some First Nation communities in the long run, through new employment opportunities, labour mobility options, and increased employee retention rates.

Tourism on the North Shore and along the Sea to Sky Highway (connecting to Squamish, Whistler, and Horseshoe Bay) will also benefit from BIRT. Although there are current limitations with what can be analysed regionally with the RTM, some conclusions can be drawn on the anticipated regional economic benefits. Ongoing growth for access to communities along the Sea to Sky Corridor, and to the Sunshine Coast and Vancouver Island (via Horseshoe Bay) is anticipated to continue growing. These communities are seeing significant growth as shown in Table 5-7, and will continue to experience further growth. As most of these regional trips are undertaken by driving, congestion will continue to worsen and result in peak spreading²⁵ and congestion outside of traditional peak hours (e.g., weekends). A rapid transit connection to the North Shore will ease congestion bottlenecks formed between the Lower Mainland and the North Shore and free up space on the road network for regional travellers²⁶. A rapid transit connection to the North Shore is also likely to encourage the establishment of a regional mobility hub to encourage transit mode share for accessing tourist destinations on and beyond the North Shore and regional commuters. A regional hub would connect local and international tourists to destinations along the Sea to Sky corridor with a stopover on the North Shore; this would likely result in economic benefits for businesses on the North Shore from incremental spending and extended visits. Commuters would also benefit from a regional hub with greater connections to the regional rapid transit network, this would further incentivize transit mode competitiveness.

Table 5-7: Regional Population and Projected Growth

| | Population, 2011 ²⁷ | Population, 2016 ²⁷ | Population Change (2011 to 2016) ²⁷ | Population Projection, 2041 ²⁸ |
|-----------------------------------|--------------------------------|--------------------------------|--|---|
| Sunshine Coast | 28,619 | 29,970 | 4.7% | 34,894 |
| Vancouver Island and Coast | 759,366 | 799,400 | 5.3% | 1,030,621 |
| Squamish | 17,158 | 19,512 | 13.7% | 30,592 |
| Whistler | 9,824 | 11,854 | 20.7% | 18,229 |

Increased tourism and visitation introduces economic opportunities for North Shore First Nations communities. Beyond economic opportunities, improved connectivity through a rapid transit connection is important for First Nation communities to access reserves and traditional territories across the Lower Mainland. This connection is

²⁵ Peak spreading refers to the phenomena of travellers changing their journey times as travel conditions deteriorate. This results in changes to the peak-period profiles which indicate an increase in number of travellers and an increase in congestion (i.e., instead of PM peak occurring from 5-6PM it will spread and occur from 4:30-6PM).

²⁶ It is worth noting that sufficient study has not been conducted to accurately conclude impact to external generators such a Horseshoe Bay Ferry Terminal, communities up the Sea-to-Sky corridor, Sunshine Coast, and Vancouver Island. Some of these trips have unique recreational purposes (i.e., kayaking, mountain biking, access to remote locations) that specifically warrant travel by vehicle. An investment in rapid transit would still provide a reliable transportation alternative that will not be impacted by anticipated increases in congestion.

²⁷ Data from Statistics Canada 2016 Census

²⁸ Data from BCStats P.E.O.P.L.E 2020 Population Projections

especially important for members of the Squamish Nation as members reside across the North Shore and up the Sea to Sky corridor. A rapid transit connection facilitating easier and more efficient travel between these locations is important for social and cultural wellbeing.

5.3.1.3 PROVINCIAL AND NATIONAL ECONOMIC IMPACTS

This section quantifies the provincial and national economic impacts of BIRT. Assessed measures discussed in this section include BIRT's GDP contribution, employment generation, labour income of unincorporated section generation, tax revenue creation, wages and salaries, and project output. Economic impacts within the Province of British Columbia and across the rest of Canada are presented and discussed.

The basis of economic impact and benefits assessments is the principle that an input in one sector of the economy has effects on the economy as a whole; that is a product is both an output to satisfy the final demand of that sector as well as a factor of production (i.e., an input) used in the creation of other goods.

These economic impacts are analysed through an Input/Output (I/O) model. An I/O model can be used to explain how one sector or industry within an economy can affect others in the same region, province, and nation. The I/O model is a matrix of industries and commodities that maps the relationship between production and industries, and identifies primary and intermediate commodities that are used in the production of goods and services for consumption or export. The model also aggregates expenditures on goods and services throughout their supply chains. When the two model processes are combined, an I/O model can simulate the economic impact of an expenditure on a given basket of goods and services. Essentially, an I/O model allows for the calculation of relationships between various aspects of a given economy, including production, consumption, and inter-industry relationships. Economic impact estimates generated by I/O models are typically broken down by direct, indirect, and induced impacts.

Statistics Canada produces Canada's most authoritative and comprehensive I/O model, widely recognized as the benchmark for conducting economic impact modelling. This study uses Statistics Canada's I/O model as the base for assessing provincial and national economic impacts resulting from the Project. The I/O model used in the formulation of this analysis is the most recent version published by Statistics Canada for input-output multipliers at the provincial and territorial detailed level for the year 2017. Statistics Canada last revised this model in 2020 to account for updates on international travel expenditures among other industry activities. Therefore, this study assumes that the proportional effect of investment of one industry on the remainder of the economy is based on 2017 Statistics Canada multipliers, remains constant across years, and is applicable to an investment in BIRT and its impacts. It is important to note that Statistics Canada's I/O model is independent of WSP.

Statistics Canada's I/O model categorizes industries in Canada using the North American Industry Classification System (NAICS). Incremental spending, such as additional Project Capital and Operations and Maintenance (O&M) expenditure in the economy as a result of BIRT, results in commodity and investment outputs. Table 5-8 details the respective industry sectors employed for capturing incremental project spending impacts. As costing for this project has not yet been undertaken, the table represents economic impacts per \$1 billion spent to indicate the relative benefits associated with an investment in BIRT.

Table 5-8: Summary of Economic Impacts of the Burrard Inlet Rapid Transit Project Per Year Per \$1B spent (Millions of undiscounted 2020\$)

| | BRITISH COLUMBIA | | | ALL PROVINCES | | |
|---|-----------------------|---|---|-----------------------|---|---|
| | Urban Transit Systems | Transportation Engineering Construction | Architectural, Engineering Related Services | Urban Transit Systems | Transportation Engineering Construction | Architectural, Engineering Related Services |
| GDP at Market Prices | \$1,273 | \$964 | \$1,197 | \$1,619 | \$1,207 | \$1,368 |
| Employment (in Job-Year FTE)* | 19,507 | 7,950 | 9,518 | 22,204 | 9,728 | 10,940 |
| Labour Income of Unincorporated Sector | \$22 | \$32 | \$42 | \$30 | \$37 | \$47 |
| Tax Revenue | \$202 | \$84 | \$79 | \$231 | \$103 | \$94 |
| Wages & Salaries | \$1,230 | \$477 | \$631 | \$1,372 | \$578 | \$706 |
| Output | \$2,400 | \$1,921 | \$1,807 | \$3,077 | \$2,396 | \$2,128 |

Source: WSP Analysis

Note 1: This table summarizes cumulative direct, indirect, and induced economic effects for NAICS codes impacted by capital and operating expenditure

Note 2: Sums may not align due to rounding

*Job effects per billion dollars of output

The above economic impacts are a result of the direct project spending related to capital and operating expenditures. Additionally, increased incremental spending will impact industries on the North Shore and within the region. Benefitting industries would be reflective of current and future spending profiles of visitors to the North Shore; further analysis of incremental tourism spend and resulting economic impact needs to be undertaken to better understand potential benefit at a regional scale.

5.3.2 AGGLOMERATION

BIRT will generate agglomeration benefits in the range of \$84M - \$107M dollars in 2050.

Agglomeration is the increase in GDP for different economic sectors resulting from increased proximity among a region's business clusters. In Metrolinx's (the Regional Transportation Authority for the Greater Toronto and Hamilton Area) Business Case Guidelines, agglomeration can be defined as follows²⁹:

"Agglomeration refers to the tendency for firms and workers to benefit from proximity. Transport investments reduce the cost/time to travel between locations, which in turn improves the 'effective' or perceived density of a region. As proximity over time and space increases, there is an allowance for improved choice of inputs in production; greater exchange of information between workers and firms, and faster learning from increased face-to-face contact. These factors in turn can lead to more productive firms. One part of a region has a high number of high-tech jobs. A second part of the region is known for its financial sector. Currently the travel time between these two locations is an impediment to economic development. The rail line between the locations is improved, reducing the travel time substantially. As a result, these two industries have greater collaboration potential and agglomeration benefits are realized."

²⁹ <http://www.metrolinx.com/en/regionalplanning/projectevaluation/benefitscases/Metrolinx-Business-Case-Guidance-Volume-2.pdf>

The benefits of Economic Agglomeration are well-documented in literature. The C.D. Howe Institute³⁰ makes a strong case for the inclusion of economic agglomeration in transport economic studies and provides a comprehensive summary on the evidence of agglomeration impacts in Canada and around the world. Furthermore, agglomeration has been included as a monetized benefit on recent business cases in the region, including the Surrey Langley SkyTrain, Rail to UBC, and the George Massey Tunnel Replacement business cases, following a BC MOTI review of the calculation methodology.

Only 'static' agglomeration (i.e., productivity increase resulting from proximity among businesses) is included in the BIRT Benefits Assessment study. 'Dynamic' agglomeration (i.e., people moving from outside the region to live and work in Metro Vancouver) is not included since the region's demographics and land use assumptions are held constant between the BAU and BIRT scenarios³¹.

Agglomeration impacts were calculated based on the UK Department of Transport's Transport Analysis Guidance (WebTAG) methodology³². The WebTAG calculation estimates increase in GDP per worker by sector due to improved proximity resulting from a transportation intervention. Total GDP increase is then calculated by multiplying the estimated per-worker GDP increase by total employment for each sector. This calculation is implemented in the RTM, which is used to estimate proximity improvements.

Table 5-9 presents the GDP per worker by industry sector in Metro Vancouver, which was calculated by dividing each sector's estimated GDP³³ by its corresponding total number of workers³⁴.

Table 5-9: Gross Domestic Product per Worker (\$2020)

| Employment Category based on NAICS | Percent of GDP | GDP (\$2007 Billion) | GDP (\$2020 Billion) | Employment | GDP per worker (\$2020) |
|--|----------------|----------------------|----------------------|------------|-------------------------|
| Construction and Manufacturing | 17% | 23 | 28 | 200,173 | 141,000 |
| Finance Insurance and Real Estate | 31% | 42 | 52 | 106,653 | 484,000 |
| Transportation, Communication, Utilities and Wholesale | 13% | 18 | 22 | 143,006 | 151,000 |
| Retail | 6% | 8 | 10 | 153,002 | 65,000 |
| Business and Other Services | 10% | 14 | 17 | 261,124 | 64,000 |
| Accommodation, Food, Information and Cultural | 8% | 11 | 13 | 192,852 | 69,000 |
| Health, Education and Public Administration | 15% | 20 | 25 | 298,806 | 84,000 |

³⁰ "Cars, Congestion and Costs: A New Approach to Evaluating Government Infrastructure Investment". Website: https://www.cdhowe.org/sites/default/files/attachments/research_papers/mixed/Commentary_385_0.pdf

³¹ There is only one set of RGS demographic inputs provided with the RTM

³² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/554790/webtag-productivity-impacts-tag-unit-a24.pdf

³³ Conference Board of Canada. Website: <https://vancouver.ca/files/cov/1-5-economic-structure-gdp-of-metro-vancouver.pdf>

³⁴ Employment obtained from the RTM's land-use inputs which are provided by Metro Vancouver

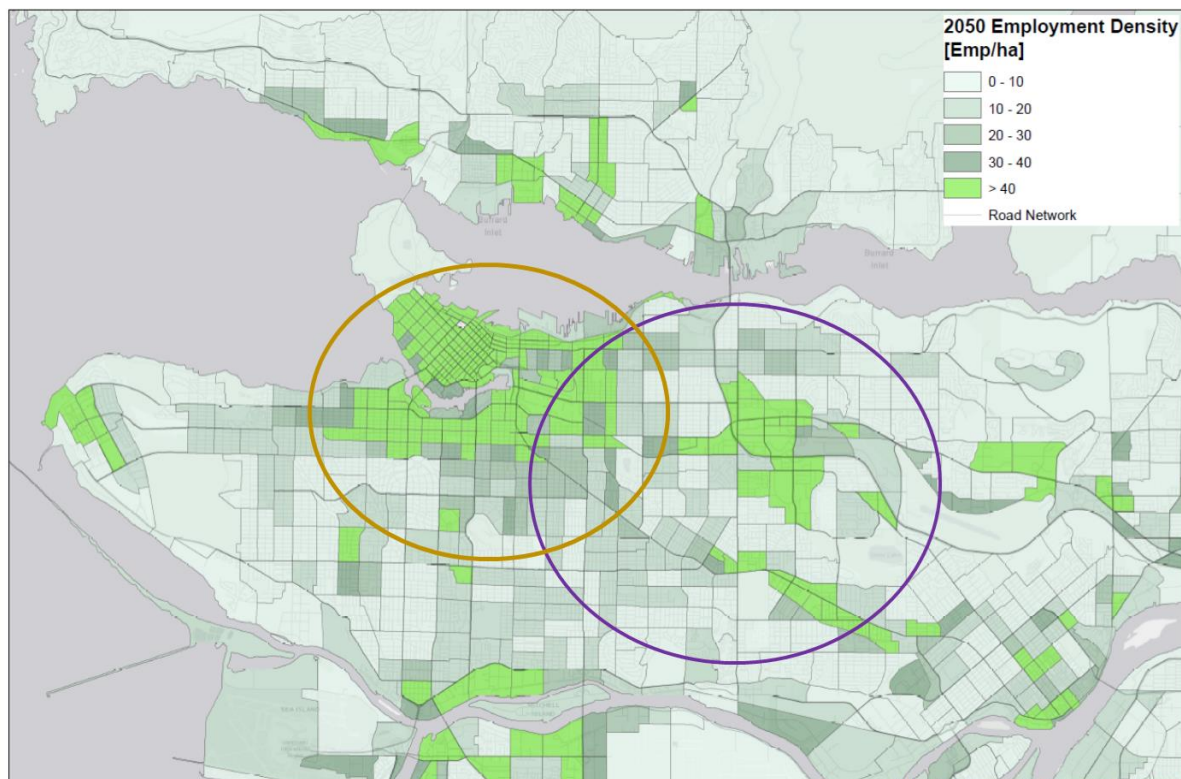


Figure 5-8: Metro Vancouver Employment Density (2050)

Overall, BIRT generates significant agglomeration benefits as shown Table 5-10. The BIRT options improve North Shores businesses’ overall access to distinct industry clusters south of the inlet as shown in Figure 5-8. The Gold alignment particularly improves connectivity to finance and service sectors concentrated downtown whereas the Purple alignment provides direct access to business parks, post-secondary institutions (BCIT) and town centres (Brentwood and Metrotown).

Table 5-10: Summary of Agglomeration Benefit (2050)

| Agglomeration Impact (2050) | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|---|-----------------------|-------------------------|
| Annual GDP Increase due to Clustering Effect (2020\$) | \$106.7M | \$84.3M |

5.3.3 DEVELOPMENT POTENTIAL AND LAND VALUE UPLIFT

BIRT will create between 20 – 40% gain in land value. This can be leveraged in support of affordable housing goals.

The construction of a rapid transit connection and new stations along a corridor has the potential to affect surrounding land values; this phenomenon is commonly referred to as ‘land value uplift’. Land value uplift is the increase in a station catchment area’s assessed land value as a result of BIRT. A study conducted by Coriolis for TransLink³⁵ summarizes a number of case studies of land value uplift following a transit investment and concluded the following:

³⁵ Evaluation of Land Value Capture and Urban Development as Sources of Revenue for TransLink (Coriolis Consulting, 2020)

- Factors that determine land value include geography and context, local zoning and infrastructure, and individual site characteristics;
- Land value gain varies across the region and with type of transit technology (land value gain for RapidBus exists but it less than SkyTrain);
- A rapid transit investment (with upzoning³⁶) can create 20% or more of the gain in land value, with some areas with existing lower land values reaching up to 40%; and
- Land value capture can support transit-oriented affordable rental housing.

While land value increases can be problematic for housing affordability, revenue from land value capture can support investments into transit-oriented affordable housing development, and transit and active transportation amenities. Development limitations due to local geography indicates that a high likelihood of significant land value uplift exists for the North Shore which may be an opportunity for North Shore municipalities, TransLink, and Metro Vancouver to proactively discuss opportunities for capturing land value uplift and redirecting these benefits towards affordable housing.

A high-level analysis was conducted to estimate the incremental new supply in affordable housing units as a result of BIRT, this is discussed in Section 5.4.2.

5.3.4 MAJOR INFRASTRUCTURE INVESTMENT DEFERRAL

BIRT may result in deferral of investment in capital projects and/or major maintenance programs.

Investment in transit has the potential for deferral of investments in other major infrastructure projects within the road network and major maintenance programs. Mode shift from personal vehicle use to transit will reduce the usage of roads and bridges compared to the BAU case resulting in extended infrastructure life and deferring capital investments further into the future. Capital deferral is dependent on BIRT's implementation horizon and may be an opportunity to maximize benefit to municipalities, regional agencies, and the provincial government.

Opportunities may exist for the completion of multiple project elements as part of one project scope (i.e., road improvements, bridge widening, bridge reinforcement, heavy rail track, etc. to occur as part of the construction of BIRT). These options may warrant further study as BIRT progresses through project feasibility and preliminary engineering and may also create opportunity for additional economic benefits regionally, provincially, and nationally.

5.4 EQUITY AND AFFORDABILITY

In recent decades, Metro Vancouver has consistently been one of the most expensive places to live in Canada. A significant factor to Metro Vancouver's affordability is the comparatively lower average household incomes when compared to the cost of living, and in particular, the cost of housing and transport. Regional transit systems with frequent service can reduce the cost burden by providing increased affordable housing opportunities, reducing auto ownership and its high associated costs, and by inducing travel by active modes. The estimated total annual driving cost for a compact vehicle in British Columbia is over \$9,000 dollars a year; major costs items include fuel costs at over \$2,000 dollars, depreciation costs at \$2,900 dollars, maintenance costs at \$1,200 dollars, and insurance costs of \$2,400 dollars.³⁷ In comparison, a 2-Zone monthly pass for TransLink costs \$134.00 dollars and would cost just over \$1,600 dollars annually.³⁸ Reducing car ownership can result in significant cost savings for individuals and families but it is important to recognize that providing high quality options (such as BIRT) are necessary to maintain reliable and comfortable ways to travel around the region.

³⁶ Upzoning is defined as the changes to zoning policy undertaken to increase density

³⁷ <https://carcosts.caa.ca/>

³⁸ <https://www.translink.ca/transit-fares/pricing-and-fare-zones>

Transport equity refers to providing equal opportunities for access and travel regardless of mode of transport. Incentivizing travel by private vehicle creates marginal benefits for some users while negatively impacting many users through increased congestion on the transportation network, whereas an investment in rapid transit creates greater benefits to society through improved travel times and providing affordable transportation choices. BIRT has the potential to impact equity and affordability in Metro Vancouver in two manners: by providing greater access to jobs and housing in the region, and through spurring additional affordable housing development. The impacts to jobs and housing, and affordable housing development as a result of an investment in BIRT were analysed at a high-level and are discussed in the below subsections.

5.4.1 REGIONAL ACCESS TO JOBS AND HOUSING

BIRT will result in increased access to jobs and housing on the North Shore and within the region.

Accessibility refers to a measure of the ease of reaching (and interacting with) destinations or activities distributed in space. It is usually quantified by calculating the number of opportunities (e.g., jobs) that a person can reach from a starting point (i.e., origin), within a reasonable amount of time. According to the 2016 Census Journey to Work, the average transit commute in the Vancouver Census Metropolitan Area (CMA) is approximately 44 minutes³⁹. Based on the distribution of transit commuting durations shown in Figure 5-9, a reasonable transit commuting time is approximately 45 to 60 minutes or less. Within the region commute times are increasing and will continue to as a result of increased congestion, thereby decreasing the physical access to jobs available to individuals. Investing in rapid transit can help maintain reliable access to employment areas.

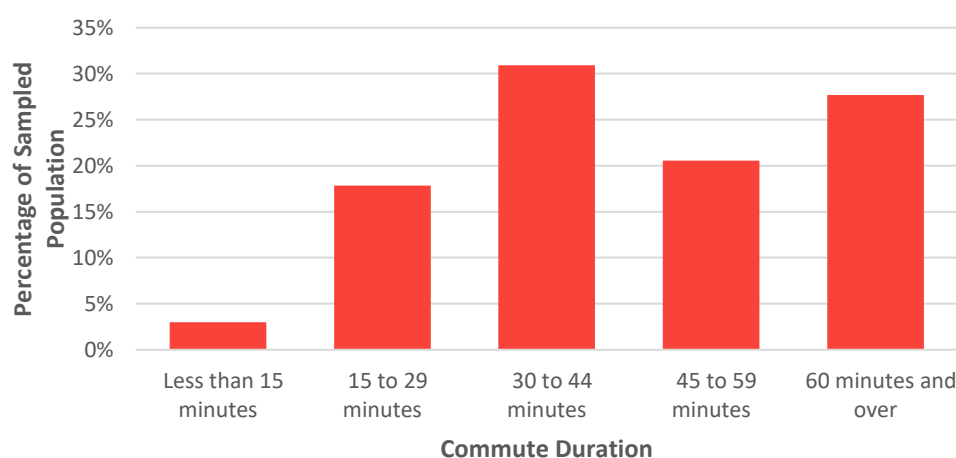


Figure 5-9: Vancouver CMA Commuter Duration (Transit Mode) Distribution⁴⁰

Physical accessibility⁴¹ is a simple yet powerful transportation performance metric. Accessibility mapping is used to gauge the geographic impact of transportation policy and projects and identify areas poorly served by transit. BIRT is a large transit infrastructure project that can unlock the economic and housing potential of the North Shore as well as areas south of the Burrard Inlet, along Hastings Street in Vancouver (Gold alignment) and Willingdon Avenue in Burnaby (Purple alignment). BIRT is expected to improve accessibility to jobs as well as discretionary activity generators such as shopping, dining, and tourism, across both sides of the Burrard Inlet. Further, BIRT will provide access to a larger pool of workers who will benefit from improved access to jobs and housing options including affordable housing units on the North Shore and elsewhere in the region.

³⁹ <https://globalnews.ca/news/3888976/vancouver-commute-times/>

⁴⁰ 2016 Census – Statistics Canada

⁴¹ As opposed to social or financial accessibility. These items are also important and impact transportation performance, but are not considered in this analysis.

Given the regional scale of both BIRT alignments, and their connectivity to other rapid transit lines, access to jobs within and outside the North Shore increases as shown in Table 5-11.

As expected, the largest accessibility improvement accrues to North Shore residents, especially in the case of the Gold alignment, which connects the North Shore directly with downtown. The Purple alignment increases accessibility substantially for residents of Burnaby.

Table 5-11: Regional Job Accessibility by a 60-minute transit trip

| Area | Jobs Accessible within a 60-minute transit ride (weighted by households) | | |
|----------------------------------|---|-----------|-------------|
| | BAU | BIRT Gold | BIRT Purple |
| North Shore | 200,000 | 369,000 | 382,000 |
| Vancouver + UEL | 728,000 | 750,000 | 759,000 |
| Burnaby + New Westminster | 725,000 | 795,000 | 744,000 |

Figure 5-10 through Figure 5-13 show the improvement in transit accessibility to Regional and North Shore jobs geographically with the introduction of BIRT, assuming a 60-minute commuting catchment. Below are some observations:

- BIRT significantly improves access to North Shore jobs from South of Burrard Inlet.
- The Gold alignment increases access to North Shore opportunities for residential areas east-west along and parallel to Hastings Street, Downtown, East Vancouver and Brentwood Town Centre.
- The Purple alignment market shed is generally north-south, providing access to North Shore jobs for residential areas along and parallel to Willingdon Avenue, Metrotown and Brentwood Town Centre. The direct connection to the Millennium Line provides access for areas further east, specifically Lougheed, Burnquitlam and other parts of the Northeast Sector.

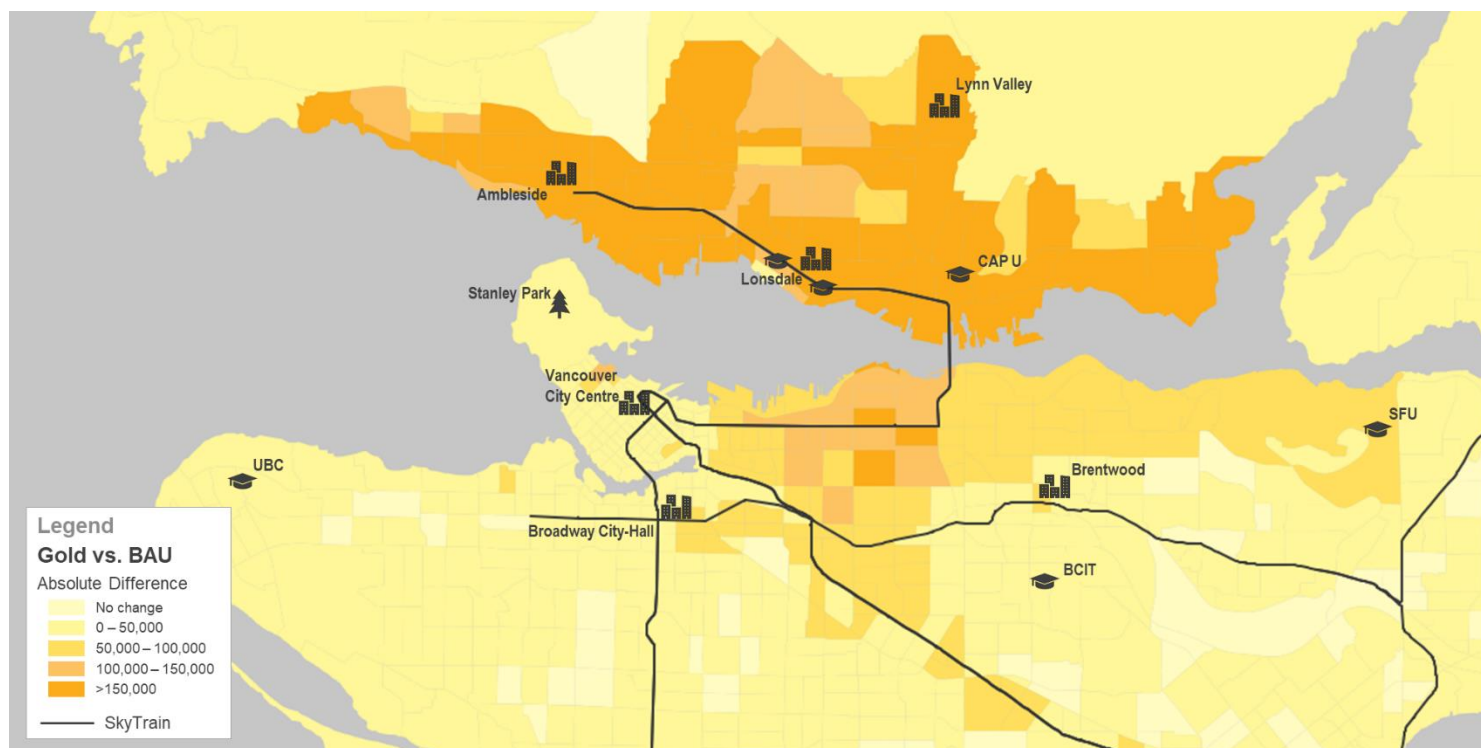


Figure 5-10: Transit Accessibility in 60 minutes to Regional Jobs - BIRT Gold Alignment vs BAU

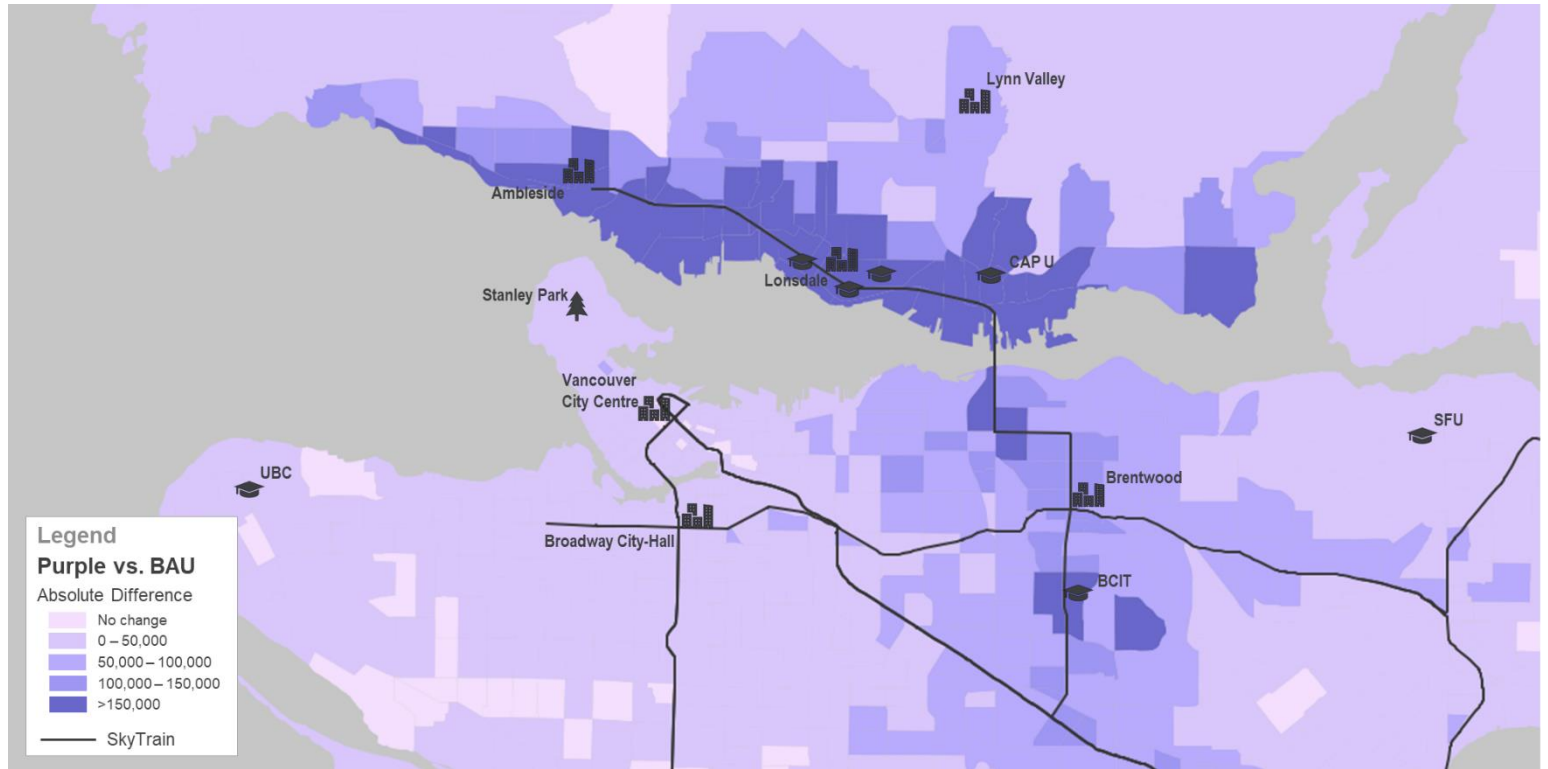


Figure 5-11: Transit Accessibility in 60 minutes to Regional Jobs – BIRT Purple Alignment vs BAU

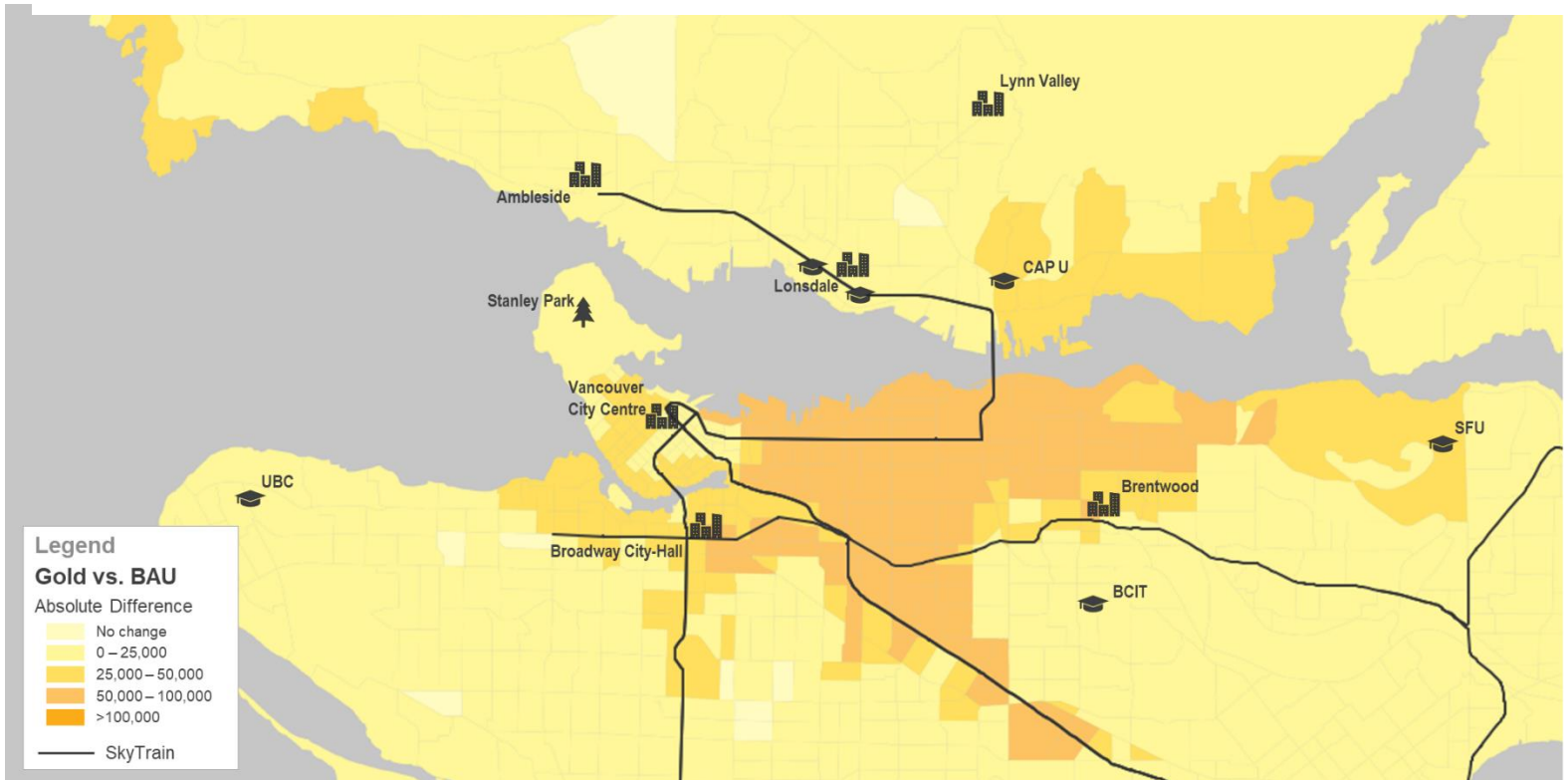


Figure 5-12: Transit Accessibility in 60 minutes to North Shore Jobs - BIRT Gold Alignment vs BAU

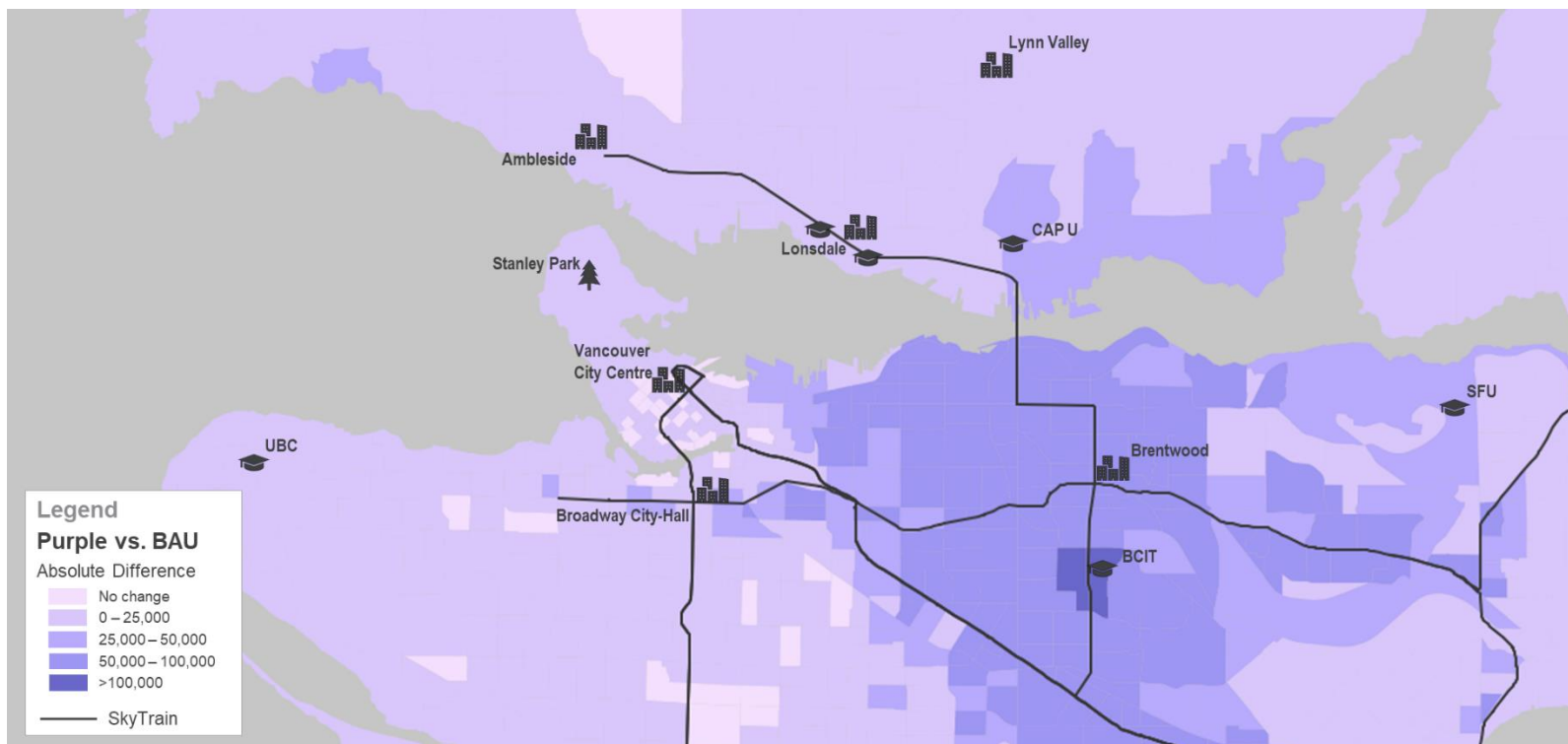


Figure 5-13: Transit Accessibility in 60 minutes to North Shore Jobs - BIRT Purple Alignment vs BAU

5.4.2 AFFORDABLE HOUSING SUPPLY

BIRT will result in incremental new affordable housing dwellings in the range of 1,300 – 2,600.

Affordable housing, and particularly affordable rental housing, is especially important to ensure the success of transit systems as those demographics are more likely to use transit and benefit from the reduced cost of living⁴². The supply of affordable housing is in part dependent on the amount of development occurring, and zoning bylaws and other local policies to which developers are required to adhere to. Investment in rapid transit attracts developers and incentivizes increased density as reliable and frequent transportation options is something that many residents seek to be close to⁴³. This phenomenon, in addition to policies allowing density bonusing and regional policies encouraging affordable housing, increases the supply of affordable housing.

With an investment like BIRT, the amount of development around station locations is likely to increase when compared to the BAU case. This incremental development will be subject to local zoning bylaws and regional affordable housing policy that encourages developers to provide affordable housing units as a development contribution. Additionally, municipalities on the North Shore and in the Metro Vancouver region identify the potential for density bonusing within zoning policy, that is the authorization of additional density beyond zoning constraints in exchange for affordable housing units or other amenity contributions with public benefit.

There is recent acknowledgement from senior levels of government that housing affordability should be considered through economic impact assessments and transportation business cases, however there are no agreed upon

⁴² <http://www.metrovancouver.org/services/regional-planning/PlanningPublications/HousingAndTransportCostBurdenReport2015.pdf>

⁴³ Evaluation of Land Value Capture and Urban Development as Sources of Revenue for TransLink (Coriolis Consulting, 2020)

methodologies at the time of writing this report. Therefore, two high-level approaches were undertaken to provide a range for anticipated incremental affordable housing supply given an investment like BIRT:

- **Corridor redevelopment-based approach** - an estimate of percent of land that could be redeveloped and assumptions for Floor to Area Ratio (FAR) for BAU and BIRT scenarios were used to estimate the incremental new dwellings expected. Regional policy of 15% affordable housing⁴⁴ in redevelopment and new housing development was used to estimate affordable housing stock.
- **Population-based approach** – Two development scenarios were created to reflect the BAU and BIRT with different assumptions for net future population of municipalities living in the corridor area. Number of incremental new dwellings were estimated using average household population; regional policy of 15% affordable housing in redevelopment and new housing development was used to estimate affordable housing stock.

CORRIDOR REDEVELOPMENT-BASED APPROACH

A conservative evaluation of land to be redeveloped along the corridor was estimated for the corridor redevelopment-based approach. Land within one kilometre of conceptual station locations were reviewed. A high-level redevelopment assessment was undertaken based on age of building, land use, existing FAR, among other variables to estimate the square footage for redevelopment. Multipliers were developed based on average FAR observed for a BAU case (existing transit service) and the BIRT case (with rapid transit). Buildable floor area percentage and average unit sizes was ultimately used to estimate total number of dwellings and number of affordable dwellings. This approach allowed for the estimation allowed for redevelopment on the North Shore portion of the alignments only and along the entire alignments.

Table 5-12 summarizes the results of the analysis conducted in the corridor redevelopment-based approach. The analysis compares estimated redevelopment on the North Shore only in the BAU case against the BIRT Cases, an incremental increase of 9,200 dwellings is expected, of which 1,400 are affordable dwellings.⁴⁵ The analysis yields the same results for comparison of the BIRT Purple and Gold Alignments to the BAU Case as the alignments are assumed to be the same along the North Shore.

In the analysis of entire alignments, an incremental increase between 11,000 and 17,500 total new dwellings is expected, of which between 1,600 and 2,600 are affordable dwellings.⁴⁵ The incremental new affordable dwellings is based on the assumption of 15% of new units are considered affordable dwellings as per Metro Vancouver's draft policy direction in Metro 2050. Metro Vancouver defines affordable units as accessible for households with 120% of median regional household income, which is approximately \$80,000 for Metro Vancouver.

Table 5-12: Summary of Corridor Redevelopment-based approach

| Analysis Scenarios | North Shore Only | | Entire Alignment Length | |
|---|---------------------|--------------------------|-------------------------|--------------------------|
| | New Total Dwellings | New Affordable Dwellings | New Total Dwellings | New Affordable Dwellings |
| BAU (Purple Alignment) | 13,500 | 2,000 | 26,500 | 4,000 |
| BAU (Gold Alignment) | | | 16,000 | 2,400 |
| BIRT (Purple Alignment) | 22,700 | 3,400 | 44,000 | 6,600 |
| BIRT (Gold Alignment) | 22,700 | 3,400 | 27,000 | 4,000 |
| Incremental Dwellings (BIRT Purple Alignment) | +9,200 | +1,400 | +17,500 | +2,600 |
| Incremental Dwellings (BIRT Gold Alignment) | | | +11,000 | +1,600 |

⁴⁴ Source: Metro Vancouver Regional Planning Committee May 7 P22 http://www.metrovancouver.org/boards/RegionalPlanning/RPL_2021-May-7_AGE.pdf

⁴⁵ 15% as per regional affordable housing policy in footnote 44

POPULATION-BASED APPROACH

A conservative evaluation increased new incremental population growth living along the rapid transit corridor was estimated to complete the population-based approach. This was done on a percentage basis due to BIRT being in a preliminary planning stage and items such as detailed alignment and station locations have not yet been confirmed. This approach created two scenarios based on whether BIRT occurs or does not occur, and how this would influence population distributions from a concentrated or dispersed perspective. Providing more development along a rapid transit corridor may allow for increased density that can be accommodated as more people will be able to travel by transit which has higher people-moving capacity than a scenario with dispersed development patterns, where transit is less accessible and more travel via vehicle is anticipated. Accordingly, more density adjacent to a rapid transit corridor could allow for increased amounts of affordable housing units through development contributions.

Table 5-13 summarizes the results of the analysis conducted in the population-based approach. The analysis compares estimated redevelopment along the entire length in the BAU case against the BIRT Cases, an incremental increase between 8,500 and 13,000 total new dwellings is expected, of which between 1,300 and 1,900 are affordable dwellings.⁴⁵ The incremental new affordable dwellings is based on the assumption of 15% of new units are considered affordable dwellings as per Metro Vancouver's draft policy direction in Metro 2050. Metro Vancouver defines affordable units as accessible for households with 120% of median regional household income, which is approximately \$80,000 for Metro Vancouver.

Table 5-13: Summary of Population-based approach

| Analysis Scenarios | Entire Alignment Length | |
|---|-------------------------|--------------------------|
| | New Total Dwellings | New Affordable Dwellings |
| BAU (Purple Alignment) | 17,000 | 2,500 |
| BAU (Gold Alignment) | 11,000 | 1,600 |
| BIRT (Purple Alignment) | 30,000 | 4,400 |
| BIRT (Gold Alignment) | 19,500 | 2,900 |
| Incremental Dwellings (BIRT Purple Alignment) | +13,000 | +1,900 |
| Incremental Dwellings (BIRT Gold Alignment) | +8,500 | +1,300 |

5.5 HEALTH AND SAFETY IMPACTS

Through a decrease in the number of trips on the road network, an investment in BIRT will reduce the probabilities of road collisions and introduce health benefits associated with mode shift, thereby saving society and communities the hefty costs associated with collisions and sedentary lifestyles. These benefits are discussed in greater detail in the following subsections.

5.5.1 REDUCED COLLISION BENEFITS

BIRT will result in reduced collision benefits in the range of \$88M - \$89M dollars in 2050.

By decreasing the number of trips on the road network compared to the BAU, BIRT will reduce the probability of vehicle collision incidents, thereby saving society and communities the hefty costs associated with them. The costs associated with collisions are both direct and indirect. Direct costs reflect the cost of goods and services consumed as a result of collisions including property-damage costs, emergency services, medical expenses, legal costs, travel delay costs, and lost time costs. Indirect costs include all changes and irretrievable losses experienced by people involved in collisions and by society as a whole and include items such as future net production lost by society and willing-to-pay costs.

The safety benefits assessed in this analysis include a reduction in fatalities, injuries, and property damage only (PDO) collision costs resulting directly from BIRT-related VKT reductions. To estimate safety benefits from

reduced VKT, crash data from the Insurance Corporation of British Columbia (ICBC) was analysed and collision rates per VKT were established. Table 5-14 below summarizes current collision rates by severity in the region.

Table 5-14: Historical Collision Severity Rates per Million VKT Within the Study Region

| Collision Severity Rate | 2017 |
|-------------------------|--------|
| Fatalities / 1 M VKT | 0.0046 |
| Injury / 1 M VKT | 2.32 |
| PDO / 1 M VKT | 8.79 |

To monetize collisions, values by collision outcomes are typically estimated using a Value of a Statistical Life (VSL), that is an estimate of how much society is willing to pay to reduce their risk of death or injury. Values for VSL were used from BC MoTI's Default Values for BCA⁴⁶ and account for the direct and indirect costs of collisions discussed above; values were inflated to 2020 dollars.

Table 5-15: Applied Collision Monetization Values (in CAD 2020\$)⁴⁶

| Collision Severity | Fatality | Injury | PDO |
|--------------------|-----------|---------|--------|
| Value (2020\$) | 8,339,142 | 314,064 | 13,939 |

Reductions in fatalities, injuries, and PDO were estimated by multiplying VKT savings outlined in Table 5-4 by historical collision rates in Table 5-14. Monetization values outlined in Table 5-16 were applied to determine the reduced collision benefit in 2050. All monetized values are in undiscounted 2020 dollars, that is monetized results have not been adjusted to account for the time value of money.

Table 5-16: Prevented Annual Collisions by Collision Severity (2050)

| Collision Severity | Reduced Collision Benefit (2050) | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|--------------------|--|-----------------------|-------------------------|
| Fatalities | Annual Prevented Accidents (# of collisions) | 0.5 | 0.5 |
| | Annual Savings (2020\$) | \$3.9 M | \$3.8M |
| Injury | Annual Prevented Accidents (# of collisions) | 233 | 232 |
| | Annual Savings (2020\$) | \$72.9 M | \$72.5 M |
| PDO | Annual Prevented Accidents (# of collisions) | 887 | 881 |
| | Annual Savings (2020\$) | \$12.4 M | \$12.3 M |
| TOTAL (2020\$) | | \$89.2 M | \$88.6 M |

The introduction of BIRT is expected to result in a total reduction of 0.5 fatalities, 232 - 233 injuries, and 881 - 887 PDO incidents from reduced road travel for the year 2050. Benefits would extend over the entire operational period as a result of reduced VKT compared to the BAU case due to consistent mode shift from auto to transit. These incident reductions translate directly to local and regional health and wellbeing benefits. **BIRT will result in safety incident reductions in the range of \$88 - \$89 million in undiscounted 2020 dollars for the 2050 analysis year.**

⁴⁶ See BC MoTI Default Values for Benefit Cost Analysis in British Columbia – 2018.

5.5.2 HEALTH BENEFITS ASSOCIATED WITH MODE SHIFT

While major metropolitan cities provide citizens with economic and social opportunities, there are significant health impacts resulting from a lack of active travel and physical activity (prolonged sedentary work, lack of time for physical activity, etc.), poor air quality, and noise. Sedentary activity and increased stress are also associated with urban dwellers and especially those who complete trips by driving. Studies have shown that physical inactivity and the ever prevalent sedentary lifestyle costs the BC provincial health care system more than \$570 million dollars a year.⁴⁷ Taking transit results in increased physical activity through walking, cycling, or rolling to and from transit stations to fill the 'first and last mile'. The increase in regular physical activity can have a significant benefit on individuals, communities, and the health care system.

While these impacts are not regularly quantified in North America, some agencies elsewhere in the world monetize the benefits associated with prevented deaths and reduced sickness absences associated with an increase in physical activity. Transport for London (TfL), the regional transport agency in London, England, uses two tools to monetize the health benefits associated with transport projects and programs, and estimate that a 10 percent reduction in risk of death in people who regularly cycle 100 minutes per week and a 11 percent reduction in risk of death in people who regularly walk for 168 minutes per week.⁴⁸ Similarly, in monetizing reduction in sickness absences, TfL methodology estimates that a 25 percent reduction in sickness absences results for each newly active person per year, and has significant productivity and economic benefits when taking into account the prevention of sick days.⁴⁸

The World Health Organization (WHO) lists air pollution as a major cause of disease and death with the decline of air quality resulting in increased risk of stroke, heart disease, lung cancer, and other diseases.⁴⁹ Air pollution is caused by the burning of fossil fuels which release pollutants causing human harm. Decreased vehicle travel can reduce illness and deaths associated with air pollution, along with societal costs. Vehicle emission reductions is discussed further in Section 5.6.1.

5.6 CLIMATE AND ENVIRONMENT IMPACTS

Through a decrease in the number of trips on the road network, an investment in BIRT will reduce GHG emissions, contributing to reduced air pollution and local waterbody pollution including the Burrard Inlet. These benefits are discussed in greater detail in the following subsections.

5.6.1 REDUCED AUTO EMISSIONS

BIRT will result in reduced auto emission benefits in the order of \$1.4M dollars in 2050.

From an environmental standpoint, fewer vehicle trips resulting from BIRT service introduction will lead to reduced Greenhouse Gas (GHG) and Criteria Air Contaminant (CAC) emissions (such as NO_x, particulate matter, etc.) compared to the BAU case. GHG emissions have a global impact that is realized over a longer time period, while CAC emissions exhibit more localized and short-term impacts by directly affecting the health of exposed individuals. Emission reduction benefits of the Project are summarized in Table 5-18 below.

Table 5-17 outlines the assumed emission factors for 2030 applied to determine the emissions reduction achieved by BIRT. These emission reduction factors may not represent those expected in 2050 but are a conservative estimate. Emissions factors cannot reliably be determined for 2050 as many factors contribute to technological improvements seen in emissions reductions.

⁴⁷ Includes Direct Costs (hospital, physician, drug, institutional, etc.) and Indirect Costs (productivity losses due to premature death and disability) - <https://health.gov.bc.ca/library/publications/year/2004/inactivity.pdf>

⁴⁸ <http://content.tfl.gov.uk/valuing-the-health-benefits-of-transport-schemes.pdf>

⁴⁹ <https://www.un.org/sustainabledevelopment/blog/2016/05/un-health-agency-warns-of-rise-in-urban-air-pollution-with-poorest-cities-most-at-risk/#:~:text=%E2%80%9CAir%20pollution%20is%20a%20major%20cause%20of%20disease%20and%20death.&text=As%20urban%20air%20quality%20declines,live%20in%20them%2C%20WHO%20stressed.>

Table 5-17: 2030 Vehicle Emission Factors (g/VKT)⁵⁰

| Pollutant | Auto | Truck |
|---|------|--------|
| Oxides of Nitrogen (NO _x) | 0.02 | 2.37 |
| Particulate Matter 2.5 (PM2.5) | N/A | N/A |
| Particulate Matter 10 (PM10) | 0 | 0.01 |
| Oxides of Sulfur (SO _x) | 0 | 0.01 |
| Volatile Organic Compounds (VOC) | 0.04 | 0.15 |
| Carbon Dioxide Equivalent (CO ₂ eq.) | 116 | 897.26 |

Based on the CleanBC strategy⁵¹ all new vehicle sales will be electric vehicles by 2040; the Government of Canada has also recently announced the acceleration of its previous target of 100 percent sales of new light-duty and passenger trucks to be zero-emission by 2040 to its new target of 2035⁵². Accounting for typical vehicle retirement age⁵³ and EV adoption rates from Norway⁵⁴, we estimate that approximately 80% of vehicle trips will be made by EVs in 2050. McElhanney is concurrently working with TransLink to develop an EV module for the RTM to better understand the impact of EV adoption. Table 5-18 outlines the auto emission reductions in 2050 as a result of BIRT, this was calculated based on the vehicle emission factors from Table 5-17 and the VKT savings in Table 5-4.

Table 5-18: Summary of Auto Emissions Reduction (2050)

| Pollutant | Average Annual Reduction (Tonnes) | |
|---|-----------------------------------|-------------------------|
| | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
| Oxides of Nitrogen (NO _x) | 48 | 48 |
| Particulate Matter 2.5 (PM2.5) | N/A | N/A |
| Particulate Matter 10 (PM10) | 0.2 | 0.2 |
| Oxides of Sulfur (SO _x) | 0.2 | 0.2 |
| Volatile Organic Compounds (VOC) | 4 | 4 |
| Carbon Dioxide Equivalent (CO ₂ eq.) | 20,463 | 20,318 |

The monetization values in Table 5-19 were applied to the auto emissions reduction by pollutant in Table 5-18 to determine the total auto emissions cost savings. This is summarized in Table 5-20.

Table 5-19: Applied Emissions Monetization Values (in CAD 2020\$)

| Pollutant | Monetized Value (\$ / tonne) |
|---|------------------------------|
| Oxides of Nitrogen (NO _x) | \$9,268 |
| Particulate Matter 2.5 (PM2.5) | \$397,200 |
| Particulate Matter 10 (PM10) | \$3,792 |
| Oxides of Sulfur (SO _x) | \$3,792 |
| Volatile Organic Compounds (VOC) | \$7,342 |
| Carbon Dioxide Equivalent (CO ₂ eq.) | \$2,046 |

⁵⁰ Metro Vancouver Mobility Pricing Study (2018) Table 2B-2

⁵¹ <https://news.gov.bc.ca/releases/2020EMPR0031-001416>

⁵² <https://www.canada.ca/en/transport-canada/news/2021/06/building-a-green-economy-government-of-canada-to-require-100-of-car-and-passenger-truck-sales-be-zero-emission-by-2035-in-canada.html>

⁵³ This is based on data from the Insurance Corporation of BC

⁵⁴ Norway was selected as an appropriate comparative EV adoption indicator as it has a similar population to BC and its early EV adoption rates are similar to those of BC

Table 5-20: 2050 Auto Emissions Cost Savings (Undiscounted 2020\$)

| Pollutant | BIRT (Gold Alignment) | BIRT (Purple Alignment) |
|---|-----------------------|-------------------------|
| Oxides of Nitrogen (NO _x) | \$447,341 | \$444,168 |
| Particulate Matter 2.5 (PM _{2.5}) | N/A | N/A |
| Particulate Matter 10 (PM ₁₀) | \$802 | \$796 |
| Oxides of Sulfur (SO _x) | \$802 | \$796 |
| Volatile Organic Compounds (VOC) | \$28,173 | \$27,973 |
| Carbon Dioxide Equivalent (CO ₂ eq.) | \$911,323 | \$904,859 |
| TOTAL | \$1.4M | \$1.4M |

5.6.2 RESTORATION OF LOCAL WATERBODIES

Transportation infrastructure is a significant source of stormwater runoff and contributes to local waterbody contamination. Toxic particles from the use of vehicles including heavy metals from tires, brakes and engine wear, hydrocarbons from lubricating fluids, and asbestos from brake linings are deposited on the road network and are collected as stormwater runoff.^{55 56} This stormwater runoff subsequently contaminates local waterbodies and contributes to toxin accumulation in local marine wildlife and is therefore referred to as stormwater pollution. Stormwater pollution requires a multi-faceted approach to tackle, though the most effective solution is limiting pollution through investment in sustainable transport initiatives. An investment like BIRT is slated to induce mode shift from auto to transit, and in doing so reduces significant VKT across the region. This reduction in vehicle and road usage results in a decrease in stormwater pollution entering local water bodies including Capilano River, Lynn Creek, and the Burrard Inlet.

PollutionTracker is a monitoring program tracking pollution and contaminant concerns by collecting and processing mussels and nearshore ocean sediment samples along the BC coastline. Ocean sediment samples from coastal BC locations were collected as part of the project and results indicate that samples collected from Burrard Inlet rank in some of the top contaminated sites from the study.⁵⁷ In the nearby Puget Sound, recent research shows that 40 – 90% of returning coho salmon are dying of toxic chemical poisoning from tire particulate run-off. While marine pollution is due to various sources, the transportation system is still a large contributor to stormwater pollution and initiatives such as BIRT will reduce the negative impact of transportation related pollution on local waterbodies.

5.7 SUMMARY OF BENEFITS

This Benefits Assessment analyzed the expected impacts of BIRT in five impact categories typically included in an Economic Impact Assessment through monetized, quantitative or qualitative analysis. The analysed categories included: Transportation, Economic Development, Equity and Affordability, Health & Safety, and Climate & Environment.

⁵⁵ <https://transportationchoices.org/project/transitstormwater/>

⁵⁶ <https://www.epa.gov/npdes/stormwater-discharges-transportation-sources>

⁵⁷ <https://pollutiontracker.org/#>

Table 5-21 and the following subsections summarize the expected benefits of BIRT.

Table 5-21: Summary of Benefits Assessment Findings

| Topic | Outcome |
|---|-------------------------------|
| Transportation Impacts | |
| Travel Time Savings Impact (2050) | \$498 - \$552M |
| Reliability Impact (2050) | \$55 - \$75M |
| Vehicle Operating Cost Savings (2050) | \$18 - \$19M |
| Economic Development Impacts | |
| GDP Contribution | \$4.2 billion |
| Employment Creation (in Job-Year FTE) | 43,000 jobs |
| Labour Income of Unincorporated Sector Generation | \$114 million |
| Wages & Salaries Generation | \$2.7 billion |
| Tax Revenue Creation | \$428 million |
| Output | \$7.6 billion |
| Agglomeration Impacts | \$84 - \$107M |
| Development Potential | <i>Qualitatively Assessed</i> |
| Capital Deferral | <i>Qualitatively Assessed</i> |
| Equity and Affordability Impacts | |
| Regional Access to Jobs and Housing | <i>Qualitatively Assessed</i> |
| Affordable Housing Supply | <i>Qualitatively Assessed</i> |
| Health and Safety Impacts | |
| Reduced Collision Impact (2050) | \$88 - \$89M |
| Health Impacts due to Mode Shift | <i>Qualitatively Assessed</i> |
| Climate and Environment Impacts | |
| Reduced Auto Emissions (2050) | \$1.4M |
| Restoration of the Burrard Inlet | <i>Qualitatively Assessed</i> |

STAKEHOLDER ENGAGEMENT

Stakeholder⁵⁸ perceptions anticipated that a **rapid transit connection to the North Shore would result in positive impacts** to congestion, travel time reliability, regional access and connectivity, local and regional tourism, labour mobility, industry-specific economic impacts, sustainable land development, and access to post-secondary institutions.

TRANSPORTATION IMPACTS

BIRT results in a number of transportation user benefits including travel time savings, reliability savings, and vehicle operating cost savings. **A benefit of \$571M - \$646M was calculated for all modes of transport** (i.e., auto, transit, light trucks, and heavy trucks), the majority of the benefits (\$498 - \$552M) arising as a result of projected travel time savings for transportation network users. This has an impact on both individual users as well on local and regional businesses.

ECONOMIC DEVELOPMENT IMPACTS

BIRT will necessitate the expenditure of capital, operational, and maintenance funds for construction and operations; the economic impacts of these expenditures were analysed using Statistics Canada's Input/Output model and were calculated per billion dollars spent in each expenditure category (Urban Transit Systems, Transportation Engineering Construction, and Architectural, Engineering and Related Services). BIRT was found to **contribute \$4.2 billion to Canada's GDP, and generate 43,000 full-time employment positions (FTE), \$114 million in unincorporated sector labour income, \$2.7 billion in wages and salaries, \$428 million in tax revenue creation, and \$7.6 billion in output per billion dollars spent in each capital and operating expense category**. In addition to these economic benefits, an **agglomeration benefit of \$84M - \$107M** is realized due to increased efficiencies from increased proximity among the Region's business clusters.

EQUITY AND AFFORDABILITY IMPACTS

Metro Vancouver has consistently been reported to be one of the most expensive places to live in Canada. A significant factor to Metro Vancouver's unaffordability is the comparatively lower average household incomes against the cost of living, and in particular, the cost of housing and transport. BIRT has the potential to improve equity and affordability in Metro Vancouver in two ways: by providing greater access to jobs and housing in the region, and by providing additional affordable housing units through development contributions. BIRT will **increase access to jobs accessible within a 60-minute transit ride** and will provide **1,300 – 2,600 incremental new affordable dwellings** as compared to the BAU.

HEALTH AND SAFETY IMPACTS

Through a decrease in number of vehicular trips, and therefore a decrease in vehicle kilometres travelled (VKT), BIRT is expected to result in reduced roadway collisions compared to the BAU case. In the BIRT case, approximately **1,100 total prevented collisions** (fatalities, injuries, and property-damage only) are expected in **2050, with a total reduced collision impact of \$89 million**. Collision reduction and associated monetary benefit would be realized each year BIRT is in operation, although the precise value would be dependant on the annual decrease in VKT before and after the horizon year of 2050.

BIRT is also expected to have increased societal benefits associated with improved health as a result of mode shift from auto to transit. Living a sedentary lifestyle has a significant impact on our physical health and wellbeing, and in turn an impact on local healthcare systems. Transit trips are most often paired with another form of active transportation (walking, cycling, rolling), and the addition of these trips reduces the negative health impacts associated with sedentary lifestyles and financial burden to society.

CLIMATE AND ENVIRONMENT IMPACTS

A reduction in auto travel across the region, and associated reduction in VKT, results in decreased pollutants - CO₂, SO_x, NO_x, and GHG emissions. The **reduced auto emissions impact for the year 2050 results in a benefit of**

⁵⁸ Stakeholders consultations included representation from North Shore businesses (from Tourism, Food & Beverage, Professional Services, Commercial Development, Post Secondary, Film, Ports & Terminals industries and business sectors) and representatives from First Nations communities.

\$1.4 million for both BIRT alignments when compared to the BAU. The auto emissions reduction is highly dependant on electric vehicle (EV) adoption. It was assumed that an 80 percent EV adoption rate would occur in 2050, meaning that 80 percent of the VKT in 2050 is produced by EVs (which would have no tailpipe emissions). The implementation of BIRT prior to 80 percent EV adoption would greatly impact the emissions reduction and associated monetary benefit.

A reduction in VKT will result in a reduction in tire particulate run-off and a corresponding reduction in stormwater runoff pollution associated with local transportation networks. As a result, BIRT can be expected to have a positive impact on the restoration of the local waterbodies through a reduction in stormwater runoff pollution.

FIRST NATION IMPACTS

BIRT is unique in its benefits for First Nations communities. A rapid transit connection to the North Shore will serve to fill gaps in regional access as it connects Capilano IR No. 5, Mission IR No. 1, Seymour Creek IR No. 2 and Burrard Inlet IR No. 3 for Squamish and Tsleil-Waututh First Nations. An investment in BIRT will establish improved connections for these communities to jobs and affordable housing in the region and generate socio-economic benefits through increased access to job opportunities. BIRT can be expected to establish a platform for sustainable economic growth through land development and partnership opportunities for First Nations on the North Shore, as well as tourism expansion opportunities.

6 REALIZING THE BENEFITS

BIRT offers unique benefits to the North Shore and Metro Vancouver region. In providing fast and reliable *regional connectivity*, transportation network users of all modes can be expected to benefit from travel time savings and reliability improvements. Furthermore, it is projected that BIRT will generate *economic benefits* to local and regional businesses, economic productivity known as agglomeration, and improved access to regional jobs and housing. These benefits impact the North Shore, Metro Vancouver, and also extend to the Lower Mainland and nationally through impacts to the tourism industry and national goods movement. Additional *societal benefits* include an increase in regional affordable housing supply, reduced collisions, health and economic benefits related to increased physical activity, and improved *climate resilience and environmental* outcomes as a result of reduced auto emissions and stormwater pollution. This catalog of strong benefits outlines the importance and significance of BIRT for the Metro Vancouver region.

A number of compelling rationales exist for an investment in BIRT:

1. Investment in First Nation economic development and improved connectivity
2. Tackle affordability and accessibility issues in Metro Vancouver
3. Significant improvements in travel time and reliability for general purpose traffic and goods movement
4. Enabling conditions for travel between Metro Vancouver and beyond (Sea-to-Sky, Sunshine Coast, and Vancouver Island)

BIRT has the advantage of a collaborative partnership between local governments and First Nations who are in alignment and support investment in transit. These partners are committed to implementing sustainable demand management initiatives and transit priority measures to improve local and regional travel as proven through their participation in the INSTPP and NXSTPP. This is an important advantage in creating efficiencies in the business case lifecycle process and along with its strong benefits, establishes BIRT as an important investment.

Rapid transit alignments connecting the North Shore with Downtown Vancouver and Burnaby (alignment-dependent) are presented in TransLink's Transport 2050 Phase 2 engagement indicating the regional significance of connecting the North Shore to the region.

In reference to the TransLink Business Case Lifecycle, BIRT is in the project exploratory phase in advance of the formal business case lifecycle process. As BIRT advances towards confirmation within Transport 2050 and the Mayor's Council Investment Plan, it has not officially entered the stage-gating process outlined in Figure 6-1. BIRT has set itself up for success through significant pre-planning work previously undertaken.⁵⁹ Once formally accepted into the business case lifecycle process, project partners will have significant information and project history to expedite the process and efficiently make informed decisions and land on a preferred BIRT alternative to further develop. In advance of determining the best solution for technology and alignment, it is recommended that the PWG proceed liaising with regional partners and senior levels of government to further progress BIRT project planning.

⁵⁹ INSTPP, Stage 1 and Stage 2 BIRT Preliminary Feasibility Studies

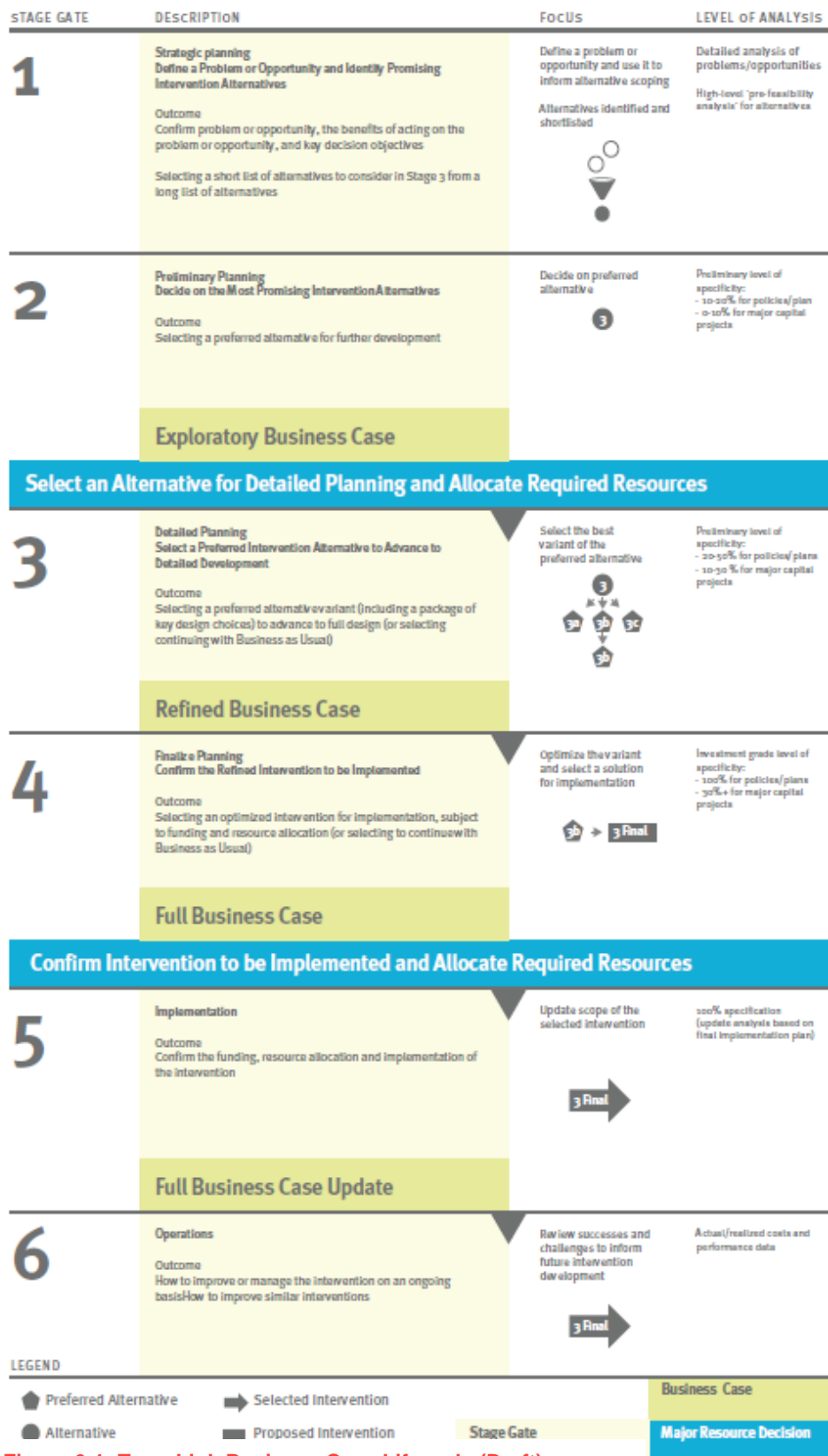


Figure 6-1: TransLink Business Case Lifecycle (Draft)

APPENDIX

A NORTH SHORE EMPLOYEE HEAT MAP

Where do they commute from? - Employee origin for select North Vancouver businesses, 2018

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