GEORGE MASSEY CROSSING PROJECT

DISCUSSION PAPER

Rapid Transit Review

December 2020

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

URBAN SYSTEMS

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EXECUTIVE SUMMARY

The reference 10-lane concept for the George Massey Bridge from 2016 included HOV / transit lanes over the entire 24km length of the Highway 99 corridor and transit stations in the centre of the highway – to allow for possible future LRT capability. In 2018, the *Independent Technical Review* (ITR) recognized and acknowledged that in-highway stops would reduce transit travel times relative to buses leaving and re-entering the highway. Although the ITR acknowledged the importance of transit to serving communities south of the Fraser River, the report highlighted the significant increase in complexity and cost of preserving for LRT with the highway and interchange design by requiring additional lanes in the median for stations and transit-only ramps at Highway 17A and Steveston Highway. At the time, the ITR was advised by TransLink that the 2045 RTS did not contemplate an extension of LRT to the south of the river along the Highway 99 corridor. In fact, the transportation modelling confirmed that it was unlikely that there would be sufficient population to justify the capital investment.

In December 2019, the Ministry received final reports for Technical Services for George Massey Crossing Project (GMCP). The initiative was designed to work with the Mayors' Task Force on a complete review of the Highway 99 crossing alternatives of the Fraser River based on further technical work in response to the 2018 ITR. The GMCP essentially identified and developed a shortlist of alternatives for the crossing that included an 8-lane bridge or Immersed Tube Tunnel (ITT) along with provisions for bus-only lanes on the crossing and transit priority treatments at nearby interchanges. The technical assessment of alternative forms of rapid transit on the Highway 99 corridor for the long-term were not specifically addressed in the assessment.

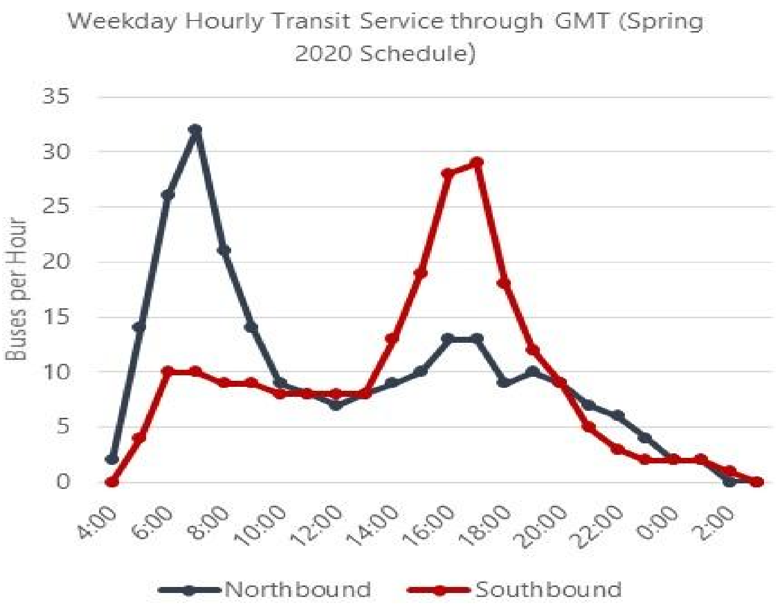
The purpose of this Discussion Paper was to examine the provisions for rapid transit on the Highway 99 corridor and George Massey Crossing providing connections between the Bridgeport Stations and the communities of Delta, Surrey, and Tsawwassen First Nation as well as to the Ferry Terminal. As part of the assessment, the potential long-term need for rail rapid transit to serve communities south of the Fraser River on the Highway 99 corridor was considered along with the physical implications on the crossing alternatives and nearby interchanges.

Starting from first principles, this Discussion Paper examined regional land use and transportation policies and strategies that shape the need for and approach to delivering rapid transit in Metro Vancouver. The regional vision includes creating and supporting land use patterns where scale, density, and mixture are conducive to sustainable transportation choices such as walking, cycling, and transit when provided. The dispersion of low-density land use patterns as well as the extensive greenspace in areas between the George Massey and communities to the south are generally considered a limitation to creating demands for strong, two-way transit ridership and service levels.

In support of land use patterns across Metro Vancouver, the Discussion Paper outlined the structure of services across the system that include rail, RapidBus, Frequent Transit Network (FTN) and local bus services. Today, Highway 99 is characterized as part of the FTN serving transit trips between Bridgeport Station and the King George Interchange, and supports connections to local transit services on Highway 17A that serve the Ladner and Tsawwassen areas. Beyond the highway, existing transit routing and service design provide coverage to areas of relatively low population and employment densities. This route design with continuous services between neighbourhoods and the Bridgeport Station also minimizes transfers required and in turn reduces overall transit travel times for customers to maximize ridership.

Transit services levels or frequencies have also been designed to suit the existing and potential ridership markets as they exist today. During the morning peak, the Tunnel supports approximately 32 buses per hour (every 2 minutes) in the morning peak direction and 10 buses per hour (every 6 minutes) in the off-peak direction and midday periods. Ridership is also peak-oriented with approximately 1,200 passengers in the peak direction (40% to/from Ladner & Tsawwassen and 60% to/from Surrey).

Figure E-1 Weekday Hourly Transit Service through GMT (Spring 2020 Schedule)



In support of the *Regional Growth Strategy*, Metro Vancouver is projected to grow by 1.2 million people and 470,000 jobs by 2050. Approximately 30% of that growth is planned for transit-oriented communities that include Metro and Regional Centres and the surrounding areas. Additionally, 40% of the overall growth is planned for communities south of the Fraser River, mostly accounted for by Surrey and Langley. In relative terms, growth plans for Ladner Town and Semiahmoo Town Centres that are connecting to Highway 99 transit services are modest in comparison to the other designated regional centres.

The Regional Transportation Model calibrated and utilized for the GMCP suggests that a 100% increase in bus service frequencies in the peak direction with dedicated lanes on the George Massey Crossing is likely to experience an increase in ridership of approximately 35% to 45% (or approximately 1,700 pphpd) with 30 years of population and employment growth. It was also found that ridership in the off-peak directions and during midday periods would remain relatively low even with supporting service increases. In support of the goal of reducing distance travelled by car however, the increase in employment south of the Fraser River means that peak directional traffic demands on the new crossing would increase by less than 15%.

Consistent with the comments raised through the ITR and their discussions with TransLink in 2018, the long-term transit ridership demands on Highway 99 between Bridgeport Station and communities south of the Fraser River are ideally suited to a bus-based service such as RapidBus.

Unlike regular services or the FTN, TransLink's RapidBus network is designed to provide a higher quality service and experience to customers. Stations are generally larger, more comfortable and provide real-time information to notify customers when the next bus is expected to arrive. Vehicles are designed to support higher capacity ridership, with additional amenities and information as well as all-door boarding to reduce dwell time and improve overall travel times. Further, RapidBus systems are supported by transit priority treatments that include dedicated bus-only lanes along the corridor and queue jumpers at intersections. All these and other features can be implemented over time to support and attract growing transit ridership. In this regard, RapidBus is scalable to meet demands and to deliver a similar customer experience as a rapid transit system.

A RapidBus system is ideally suited to the Highway 99 corridor for several reasons as highlighted below.

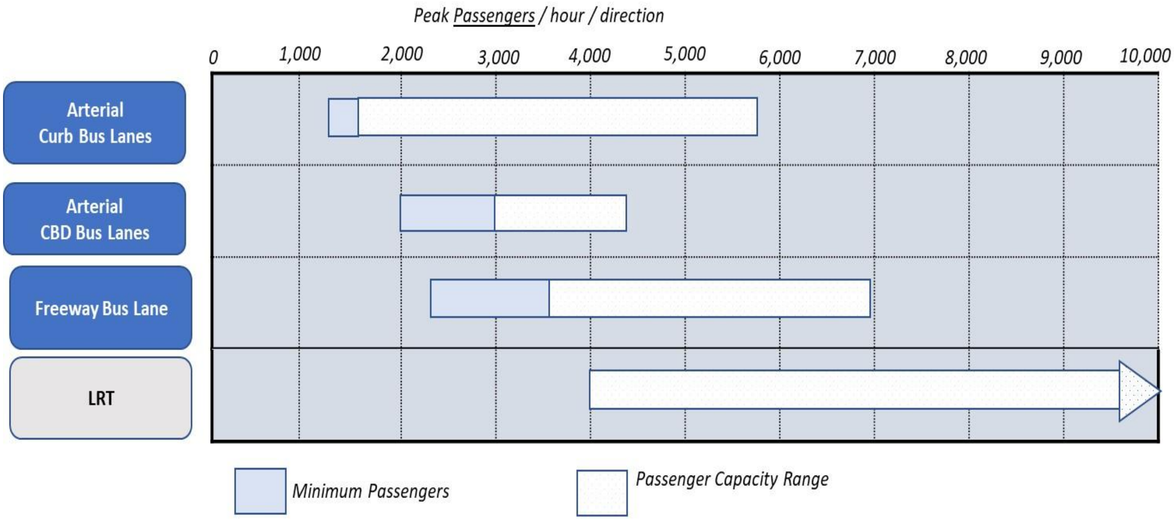
- The routing for RapidBus service can be designed for low-density areas of the region that are not expected to change dramatically. Services can be routed through communities to collect most customers and then provide a transferless trip on the Highway 99 and 17 corridors to / from the Bridgeport Station. Without significant changes to the scale, density, and mixture of land uses, the flexibility of RapidBus service design is ideally suited to these communities.

- The design and implementation of RapidBus in terms of service levels, routing, stations, and vehicles can evolve over time to support and shape ridership along with transit accommodation along the Highway 99 corridor.

- RapidBus frequencies can be managed to better support the significant differences in peak versus off-peak directional demands as well as the lower midday ridership levels than rail rapid transit.

- With dedicated transit facilities – such as bus-on-shoulders, intersection queue jumpers, and other priority treatments at stations – and larger transit vehicles with uniquely designed stations, the capacity of RapidBus on the Highway 99 corridor can support three to four-times the projected 2050 ridership across the GMC as illustrated in **Figure E-2**. In contrast, a fixed rail link connection to the Bridgeport Stations would require transfers for customers from the South Surrey and would likely result in an increase in transit travel times.

Figure E-2 – Guidelines for Rapid Transit Ridership Technologies



Beyond the potential long-term demands and choices for rapid transit on Highway 99, the implications of incorporating provisions for rail rapid transit (either SkyTrain or LRT) on Highway 99 and the George Massey Crossing (GMC) Project are significant. Within a highway environment, rail would need to operate in exclusive areas with barrier protection or grade-separated from traffic for overall safety. For the crossing, this means either centre running system or side running with barrier supporting two-directions. This form of separated 'guideway' would offer the highest speed and reliability for transit, the greatest passenger capacity, and the lowest potential for conflicts between motor vehicles, pedestrians, and cyclists

The centre running bridge alternative would result in an increase to the total deck width of approximately 3m to accommodate rail rapid transit and barriers in the long-term (or a 7% wider structure). Further, the total width for ITT would need to be increased by approximately 6.0m to support future expansion with LRT (or a 13% increase). It is noted that a 13% increase to the width of the ITT affects the base design for the four lane cells currently included in the GMCP. At a minimum, the bridge and ITT costs would increase by the same proportions or more than the crossing widths.

North and south of the crossing, the stations areas for center running facilities within the highway corridor would need to be accommodated where changes are planned as part of the project. For centre running LRT, Steveston and Highway 17 Interchanges would need to be widened substantially. The highway below the interchanges would need to be much wider to support platforms for passenger boarding/alighting of three car train lengths (approximately 85m), buildings facilities with elevator/escalators, pedestrian walkways over Highway 99 and cross-over track areas on one side of the station. In total, the station area with tracks and barriers would be approximately 20m wide by 160m in length.

Although preserving for side running LRT would have similar impacts on the crossing alternatives in terms of additional width required, it would need to be separated from the highway and require overpass structures of the interchanges. This configuration would not influence planned changes at this time for the Steveston Interchange.

1.0 INTRODUCTION

In 2016, the Ministry of Transportation and Infrastructure (MoTI) completed the reference 10-lane design for the George Massey Bridge. The design included HOV / transit lanes over the entire 24km length of the Highway 99 corridor and transit stations in the centre of the highway – to allow for possible future LRT capability. In 2018, the *Independent Technical Review* (ITR) recognized and acknowledged that in-highway stops would reduce transit travel times relative to buses leaving and re-entering the highway. Although the ITR acknowledged the importance of transit to serving communities south of the Fraser River, the report highlighted the significant increase in complexity and cost associated with preserving for LRT with the crossing and interchange design by requiring additional lanes in the median for stations and transit-only ramps at Highway 17A and Steveston Highway Interchanges. At the time, the ITR was advised by TransLink that the 2045 Regional Transportation Strategy (RTS) did not contemplate an extension of LRT south of the river along the Highway 99 corridor. In fact, the transportation modelling at the time confirmed that it was unlikely that there would be sufficient population to justify the capital investment for the planning horizon.

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The purpose of this Discussion Paper is to examine the provisions for rapid transit on the Highway 99 corridor and George Massey Crossing providing connections between the Bridgeport Stations and the communities of Delta, Surrey, and Tsawwassen First Nation as well as to the Ferry Terminal. As part of the assessment, the potential long-term need for rail rapid transit to serve communities south of the Fraser River on the Highway 99 corridor is considered along with the implications on the crossing alternatives and nearby interchanges.

The Discussion Paper is separated into four sections as follows:

Section 1 – Introduction describes the background context for the Discussion Paper in terms of the evolution of the George Massey reviews in relation to preserving for rail rapid transit and the approach to considering the types of rapid transit and the implications of preserving for rail on the GMCP.

Section 2 – Considering Rapid Transit Alternatives describes the policy and land use context for rapid transit in Metro Vancouver, and specifically examines the potential for and appropriate design of rapid transit services along the Highway 99 corridor between Bridgeport Station and communities south of the Fraser River. The forecast ridership demands are considered along with the capacity of alternative forms of rapid transit based on the findings from the GMCP as well as existing and planned land use patterns over the next 30 years and beyond.

Section 3 – Implications of Designing for Rail Rapid Transit highlights the design requirements for rail rapid transit within a highway environment based on experience in other communities in North America and identifies the implications on the crossing alternatives as well as at nearby interchanges on the Highway 99 corridor.

Section 4 – Summary highlights the primary observations in terms of the form of rapid transit that is best suited for communities served by the Highway 99 corridor and George Massey Crossing and the potential implications of preserving for rail.

2.0 CONSIDERING RAPID TRANSIT ALTERNATIVES

This section of the Discussion Paper describes some of the fundamental considerations for rapid transit on the Highway 99 corridor that include the regional context, land use characteristics and planned growth, the general structure and types of transit services in Metro Vancouver, existing and forecast ridership characteristics and service levels, and the overall capacity of rapid transit alternatives for the Highway 99 corridor and the George Massey Crossing (GMC).

2.1 TRANSIT SYSTEM VISION

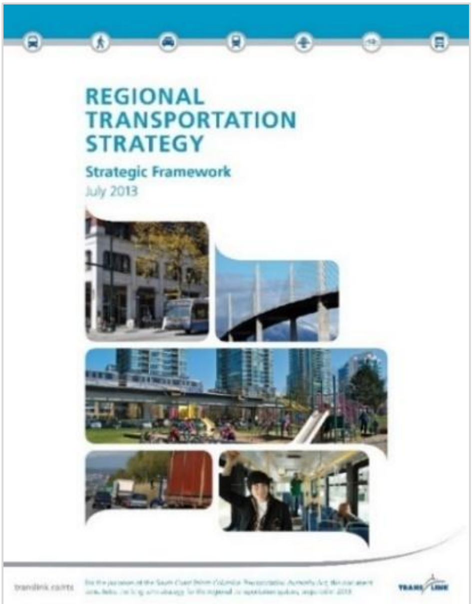
In 2008, the Mayors' Council prepared Transport 2040, which was designed to identify the strategies for Metro Vancouver's transportation future through rolling 10-year implementation plans. The Highway 99 corridor was identified in Transport 2040 as a proposed "rapid transit" corridor between Bridgeport Station and King George Boulevard (see Figure 2-1).

As a follow-up to Transport 2040, TransLink prepared a Strategic Framework for the Regional Transportation Strategy in 2013 to guide planning and development of transportation systems, with a goal of supporting the Regional Growth Strategy as well as regional economic and provincial objectives.

The Strategic Framework also established a regional mode share target, outlining that half of all trips are to be made by walking, cycling and transit by 2040 (up from 27% in 2011 and 29% in 2016). The Strategic Framework outlined the need for integrated land use and transportation decision-making and coordinated commitments to invest, manage, and partner concurrently with other agencies.

Based on Transport 2040 and further work on regional priorities, TransLink put forward a 30-year concept for transit that outlines the regional transit network of the future. On top of the existing rapid transit corridors, expansion priorities are identified for Fraser Highway and King George Boulevard corridors providing connections between Surrey, Langley, and South Surrey/White Rock.

Building from Transport 2040, the Mayors' Council prepared a plan entitled *Regional Transportation Investments: A Vision for Metro Vancouver* in 2014. This plan advanced the commitment to invest, manage, and partner in transit across Metro Vancouver over the next 10 years. As illustrated in Figure 2-2, the rapid transit investment priorities included rail rapid transit in Surrey and the Langleys as well as the Millennium Broadway Line extension.



South of the Fraser River, priority was given to expanding B-Line (now RapidBus) services along King George Boulevard, 120th Street, and 200th Street. Bus service upgrades are noted for the Highway 99 corridor. The George Massey crossing was described as a provincial project and not addressed as part of the 10-year investments.

Figure 2-1 Transport 2040 & Mayors' Council Vision (Source: RTS Strategic Framework, 2013)

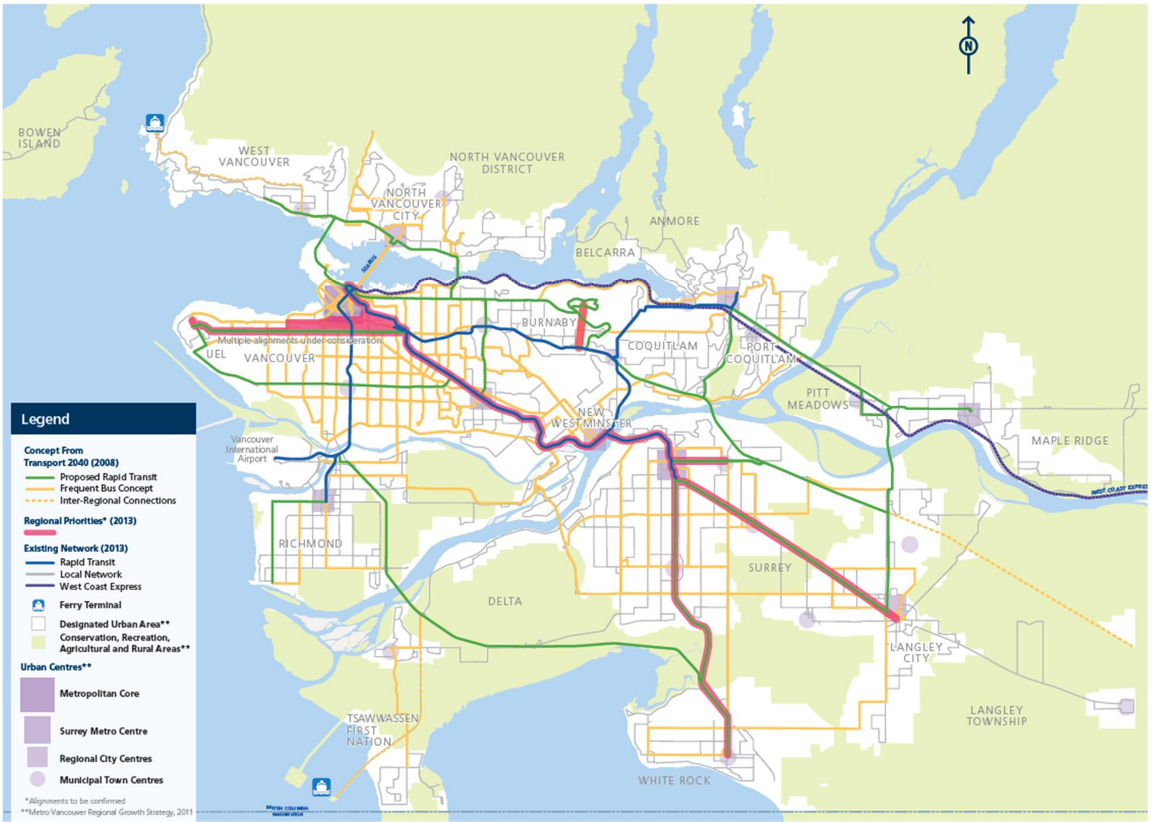
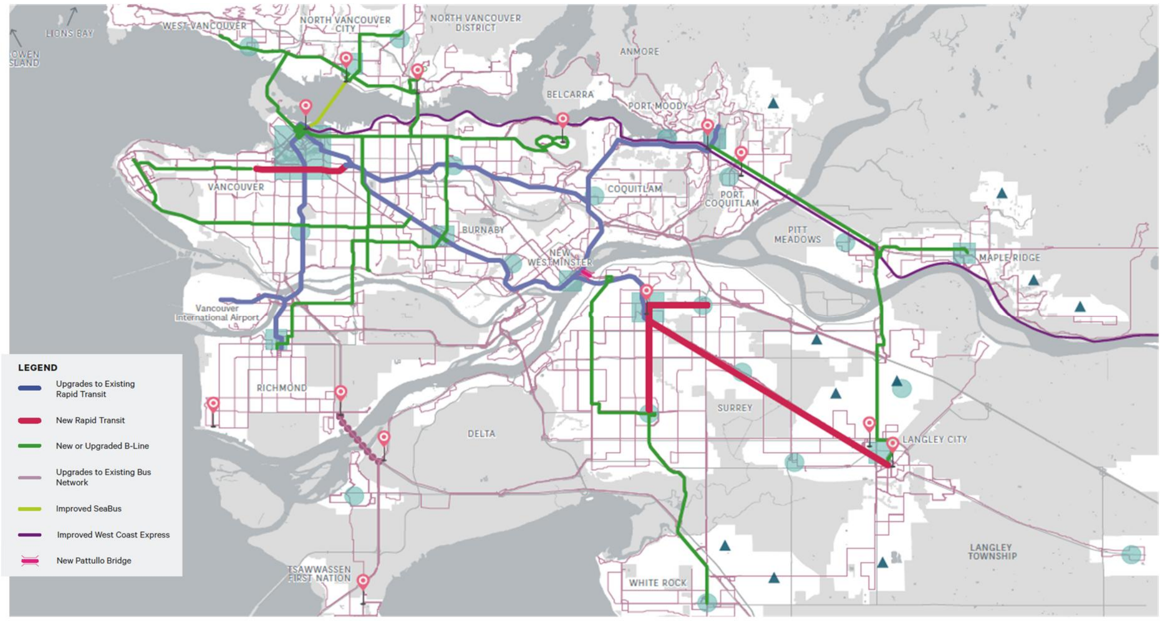


Figure 2-2 10-Year Investments (Source: Mayors' Council Vision, 2014)



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2.2 SOUTH OF FRASER COMMUNITIES

Transit services in Metro Vancouver are generally designed to support and attract the travel markets, much of which are influenced by land use patterns. In basic terms, the relative scale, density, and mixture of population and employment influence how much, where, and when people travel. The availability of transportation alternatives such as transit to reasonably serve those travel needs affects mode choice. For transit in particular, the continuity of higher density, mixed-use areas along corridors within and between communities is critical to create the two-way travel demands needed to support frequent, all-day transit services.

The Regional Growth Strategy (RGS) – *Metro Vancouver 2040* – provides a vision for a sustainable future to guide regionally important decisions. The RGS recognizes the regional land use designations and overlays that are required to achieve the goals set out in the strategy. These designations recognize the following major areas:

- The Urban Containment Boundary that identifies the long-term, regionally defined areas for urban development.
- Rural, agricultural, conservation and recreational lands where the character of these areas are protected from development.
- Urban Centres (Metropolitan Core, Surrey Metro Centre, Regional Centres and Municipal Town Centres) and Frequent Transit Development Areas are designated priority locations for employment and services, higher density housing, commercial, cultural, entertainment and institutional uses.

Figure 2-3 illustrates the land use designations contained in the RGS that are used to guide and plan growth across Metro Vancouver. It is noted that Ladner and Semiahmoo Centres are designated as Municipal Town Centres with significant areas of rural, agricultural, conservation and recreation between the urban containment boundaries for south Delta and South Surrey areas.

Figure 2-3 Regional Land Use Designations

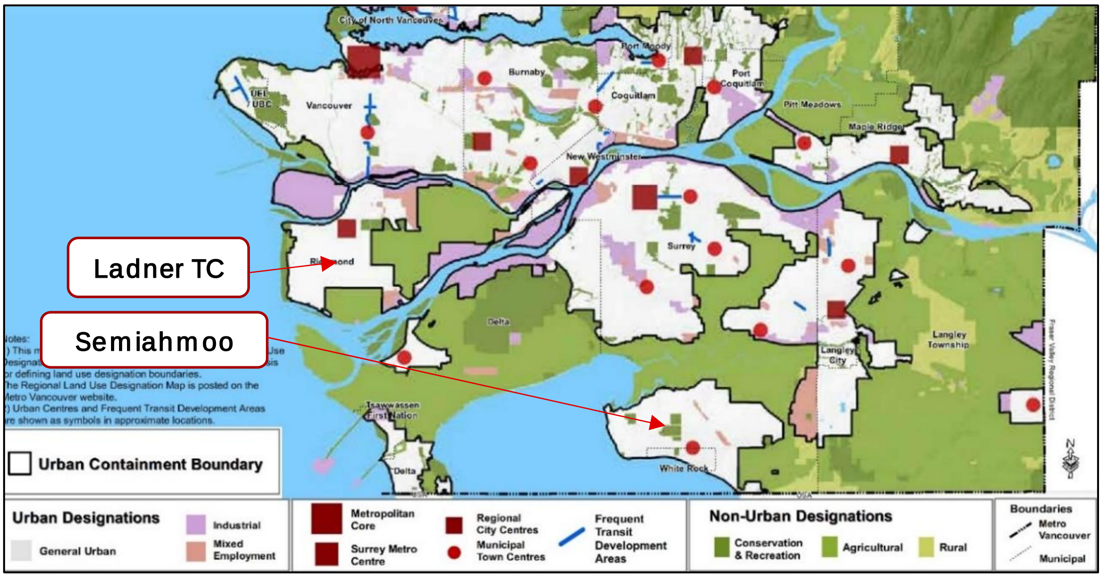

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Figure 2-4 and Figure 2-5 illustrate the density of population and employment in communities immediately north and south of the Fraser River. As illustrated, the densities for those areas of Ladner, Tsawwassen, and much of South Surrey and White Rock are lower than communities north of the Fraser River and other parts of the region. Further, the presence of the Agricultural Land Reserve (ALR) and natural areas between communities means that there are significant areas without development and with very few major generators of travel. In other parts of the Metro Vancouver, population and employment levels near rapid transit and RapidBus corridors are much higher than in the southern areas of the region.

2.3 HIGHWAY 99 TRANSIT SERVICES

Today, the transit system for Metro Vancouver generally includes four types of regional services that connect designated urban centres and the Frequent Transit Development Areas (FTDA), as illustrated in Figure 2-6. The rapid transit corridors provide frequent all-day, two-way service on major travel corridors linking major town centres across the region.

RapidBus corridors (formerly B-Line) are essentially an extension of the rail rapid transit network, providing frequent (e.g. 10 minute) two-way services with direct connections to regional centres as well as other rapid transit lines. Service design strategies such as limited stops, all-door boarding, and direct routing are used to enhance the customer experience. Beyond the service design, physical treatments such as transit priority, enhanced stops, and customized fleet may be added to improve travel times, reliability, and customer comfort.

The Frequent Transit Network (FTN) corridors consist of transit services running at least every 15 minutes in both directions throughout the day and into the evening, seven days per week. People travelling along the FTN can expect convenient, reliable, easy-to-use services where they do not need a schedule.

Beyond the main corridors, local bus and community shuttle services support travel within sub-areas of the region and between neighbourhoods.

Today, the Highway 99 corridor between Bridgeport Station and King George Boulevard in South Surrey is part of the designated FTN. Highway 99 transit services generally serve travel demands between Bridgeport Station in Richmond and communities South of the Fraser River (including South Surrey, White Rock, Ladner, and Tsawwassen), as well as the Tsawwassen Ferry Terminal.

Figure 2-4 Existing Population Densities

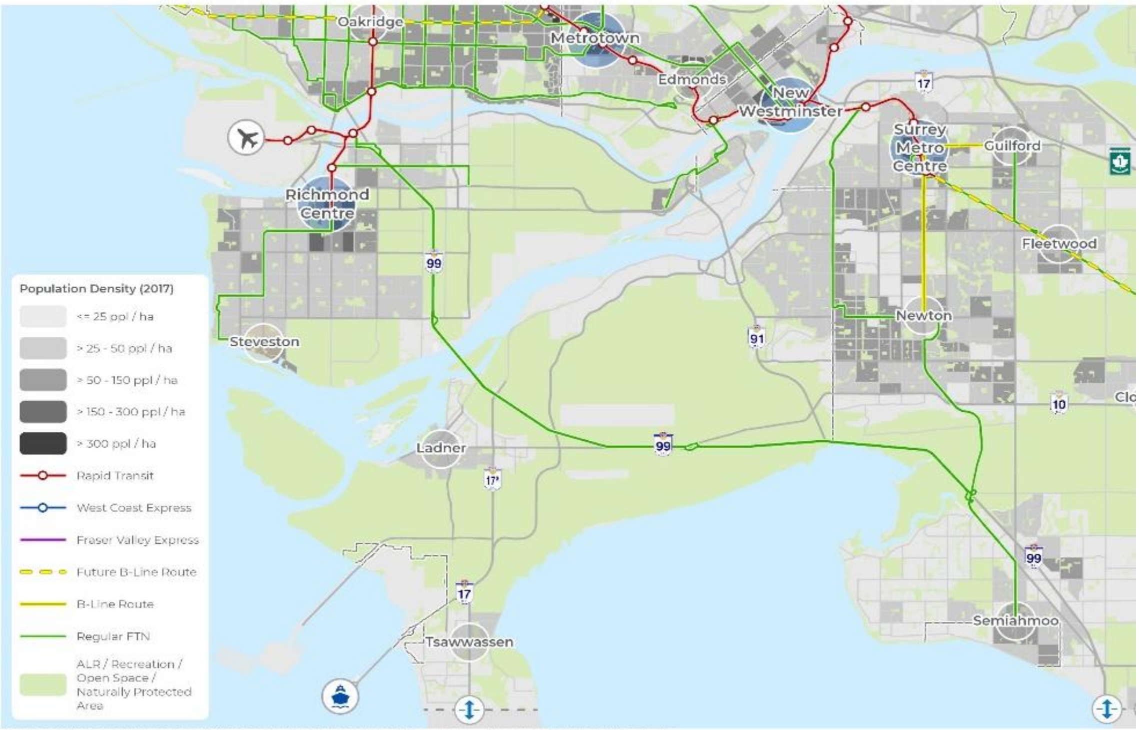


Figure 2-5 Existing Employment Densities

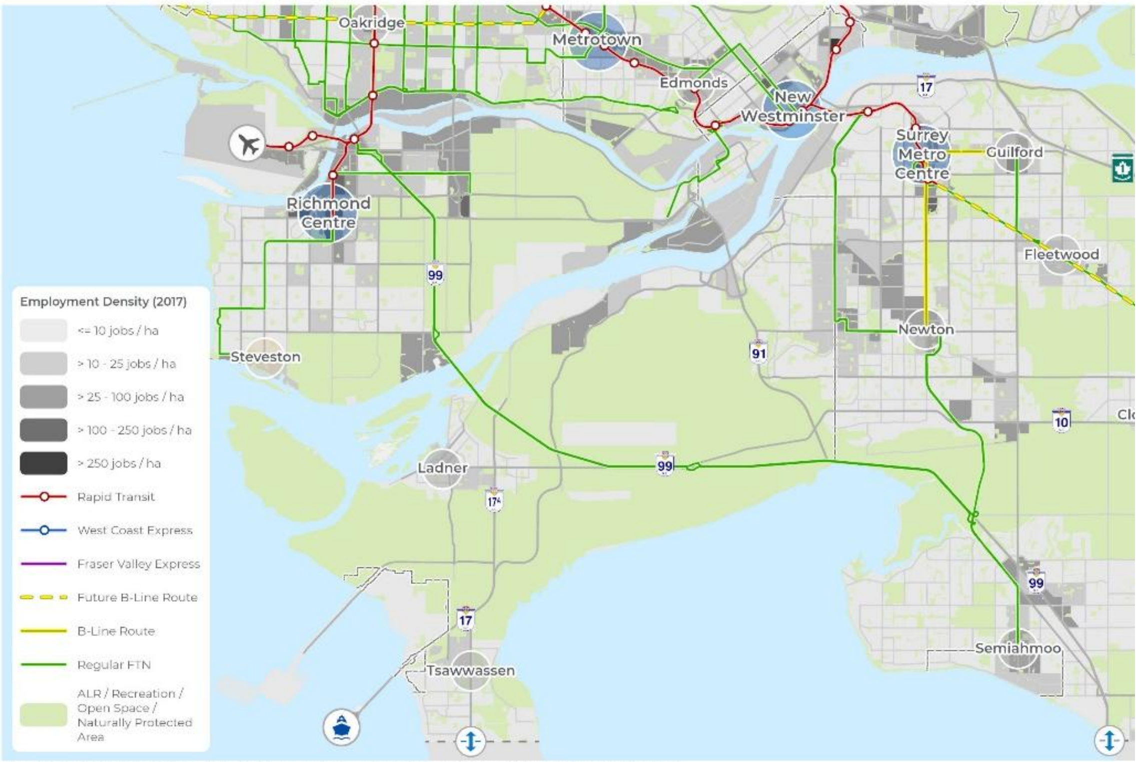
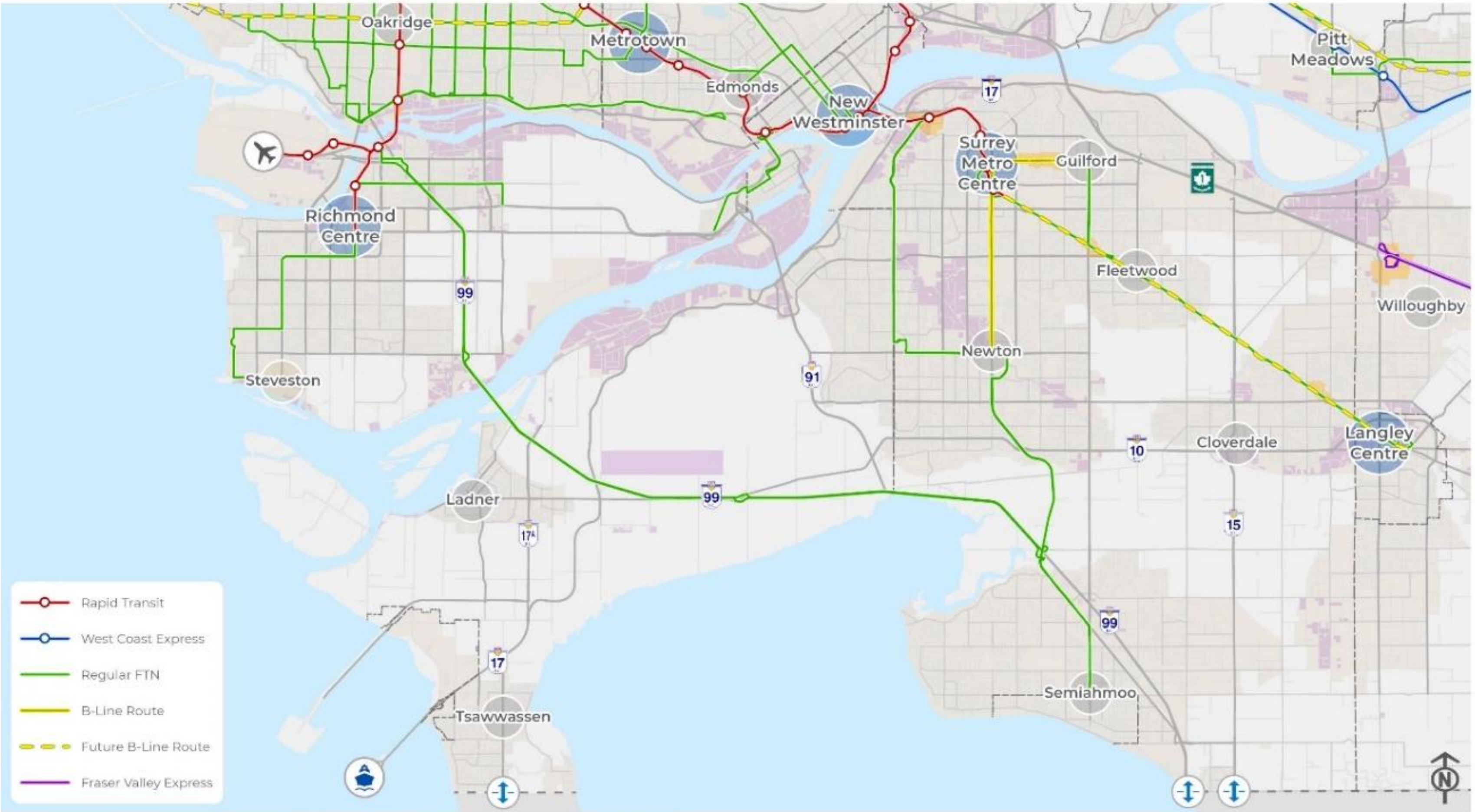


Figure 2-6 Existing Transit Service Structure



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In total, five transit routes serve the Ladner and Tsawwassen areas and four routes provide connections to South Surrey / White Rock. The primary features of services in terms of route design and coverage, periods of operation, and frequencies, as well as service expansion plans are outlined below.

- ### SERVICE DESIGN & COVERAGE

Consistent with the characteristics of the FTN, services to the South Surrey and Ladner/ Tsawwassen areas provide a direct connection to Bridgeport Station, which in turn provide direct connections to several regional destinations via the Canada Line, such as Vancouver, Richmond Centre, and the Vancouver Airport.

On the south side of the Fraser River, however, the routing and service design provides coverage to areas of relatively low population and employment densities, as illustrated in Figure 2-7. Typical for most suburban areas, these commuter services are designed to operate as local services within the outlying areas of the route to provide reasonable coverage and localized access to regional transit services. This route design also minimizes transfers and in turn reduces overall transit travel times for customers to maximize ridership. By design therefore, local services are inter-lined with regional-serving corridors to optimize travel times and improve the customer experience by not forcing transfers.

Figure 2-7 Highway 99 Bus Service Coverage

- ### SERVICE PERIODS & FREQUENCIES

Transit services along Highway 99 generally operate between 5:00am and 12:00am, with over 200 trips per day in each direction. Consistent with commuter services to suburban areas, the frequencies of buses in the morning and afternoon peak directions are substantially higher than all other periods of the day and the off-peak directions (see Figure 2-8). During the morning peak, northbound services are three times more frequent than in the southbound direction (every two minutes versus every 6 minutes). In fact, the off-peak directional frequencies are similar to the midday periods and are a reflection of existing demands and ridership potential.

Figure 2-8 Existing Weekday Hourly Transit

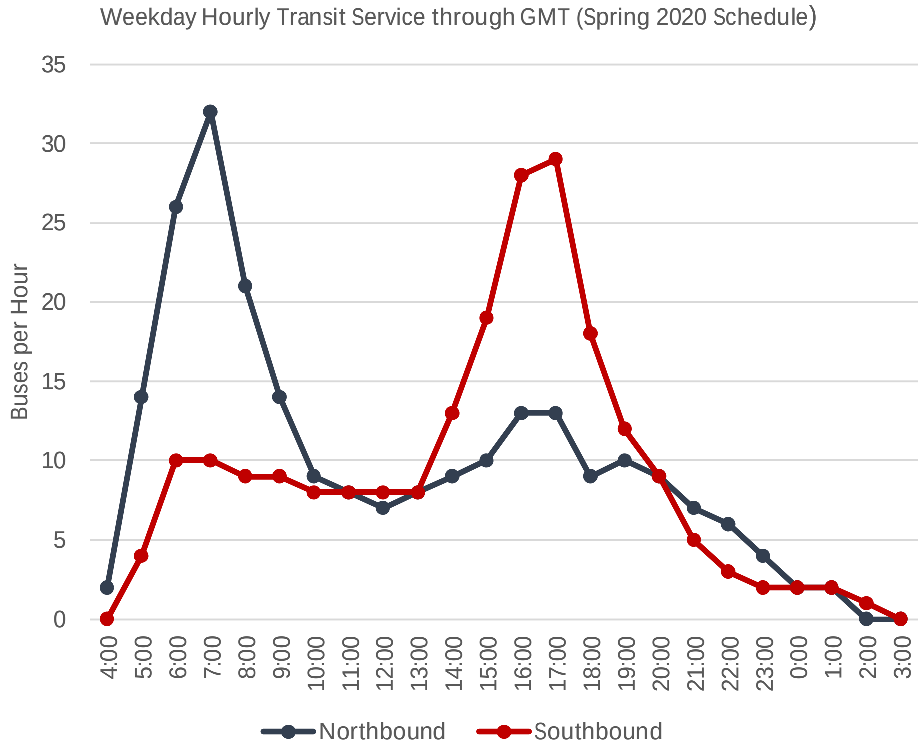
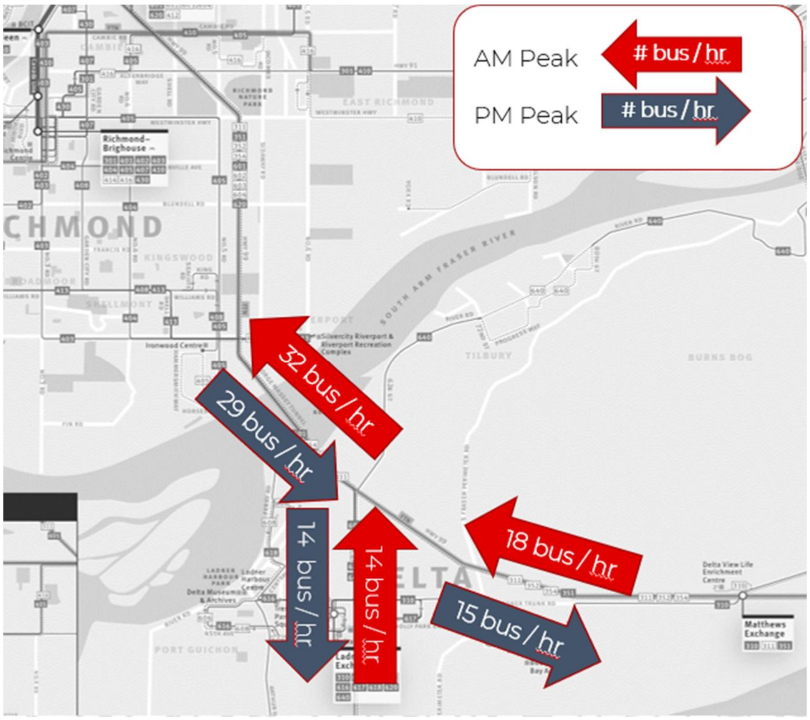


Figure 2-9 illustrates the split in morning and afternoon peak directional services on Highway 99 south of the GMT. As illustrated, approximately 50% of the buses are serving the South Surrey/White Rock area and the other half to Ladner and Tsawwassen.

Figure 2-9 Existing Weekday Peak Directional Bus Service Frequencies



- **SERVICE EXPANSION PLANS**

  In 2018, TransLink worked with the Cities of Delta and Richmond on the *Southwest Area Transport Plan*. The Plan recommended changes to transit services connecting areas of Ladner, Tsawwassen, and the Tsawwassen Ferry Terminal, including increased frequencies of services on the FTN and improving reliability through transit priority treatments. Many of these service changes over the next 15-years mean that more buses – and transit passengers – will travel through the George Massey Tunnel (GMT).

Overall, the profile of daily service levels, service design, and plans for expansion are generally consistent with many other lower density areas in Metro Vancouver and other communities in Canada.

2.4 EXISTING TRAVEL DEMANDS

In addition to the land use patterns and transit services as previously described, when and where people are travelling also affect the design of services and mode choice. Understanding travel characteristics can help to ensure transit services and facilities are designed to support the primary trip patterns. Figure 2-10 illustrates the distribution of morning peak period trips utilizing the Highway 99 corridor through the GMT from the South Surrey/White Rock and Ladner/Tsawwassen areas.

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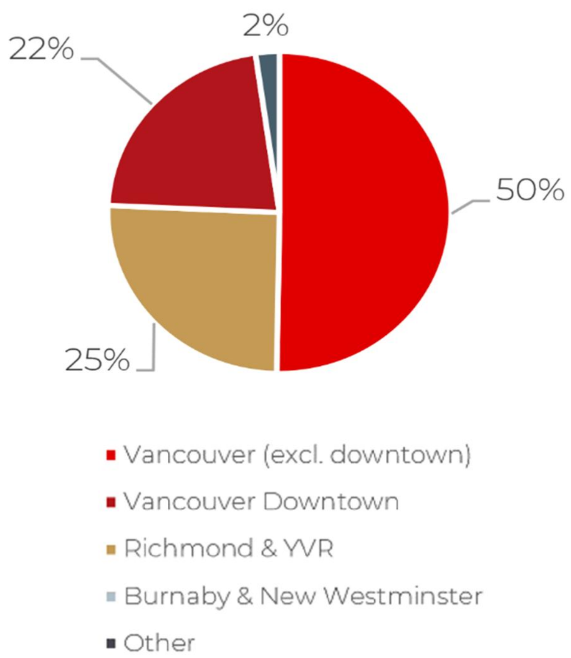
During the morning peak, approximately 65% to 70% of all trips crossing the GMT are destined to Vancouver and approximately 25% are going to other parts of Richmond. In fact, 25% of all morning trips through the GMT are destined to downtown Vancouver.

In an effort to serve the existing travel markets and to minimize travel times, direct services between communities south of the Fraser River and the Bridgeport Station remain a priority in the design of routes as previously described. This approach will maximize ridership and increase transit mode share through the GMT.

Figure 2-11 illustrates the existing morning peak transit mode shares for communities north and south of the Fraser River based on the Regional Transportation Model (RTM 3.3). Consistent with the land use patterns, those communities with higher scale and density of population and employment and are served by rapid transit generally have the highest transit mode shares. For example, the transit mode shares in areas of Vancouver, Burnaby, New Westminster, Surrey Centre, and Richmond Centre range anywhere from 10% to more than 35% of all trips. Conversely, many areas south of the Fraser River in South Surrey, White Rock, and Tsawwassen have morning peak transit mode shares of less than 5%.

Figure 2-10 Highway 99 AM Peak Trip Destinations Patterns

A: From South Surrey/White Rock



B: From Ladner/Tsawwassen

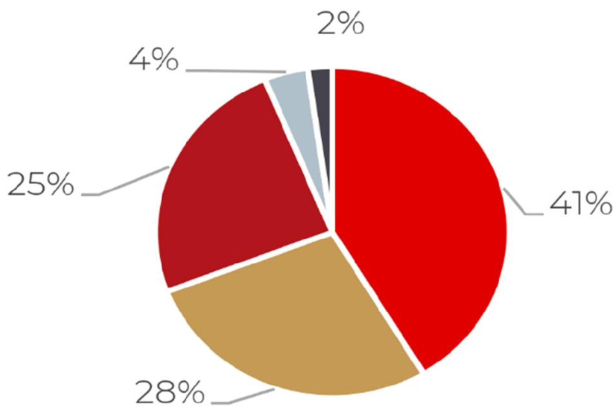


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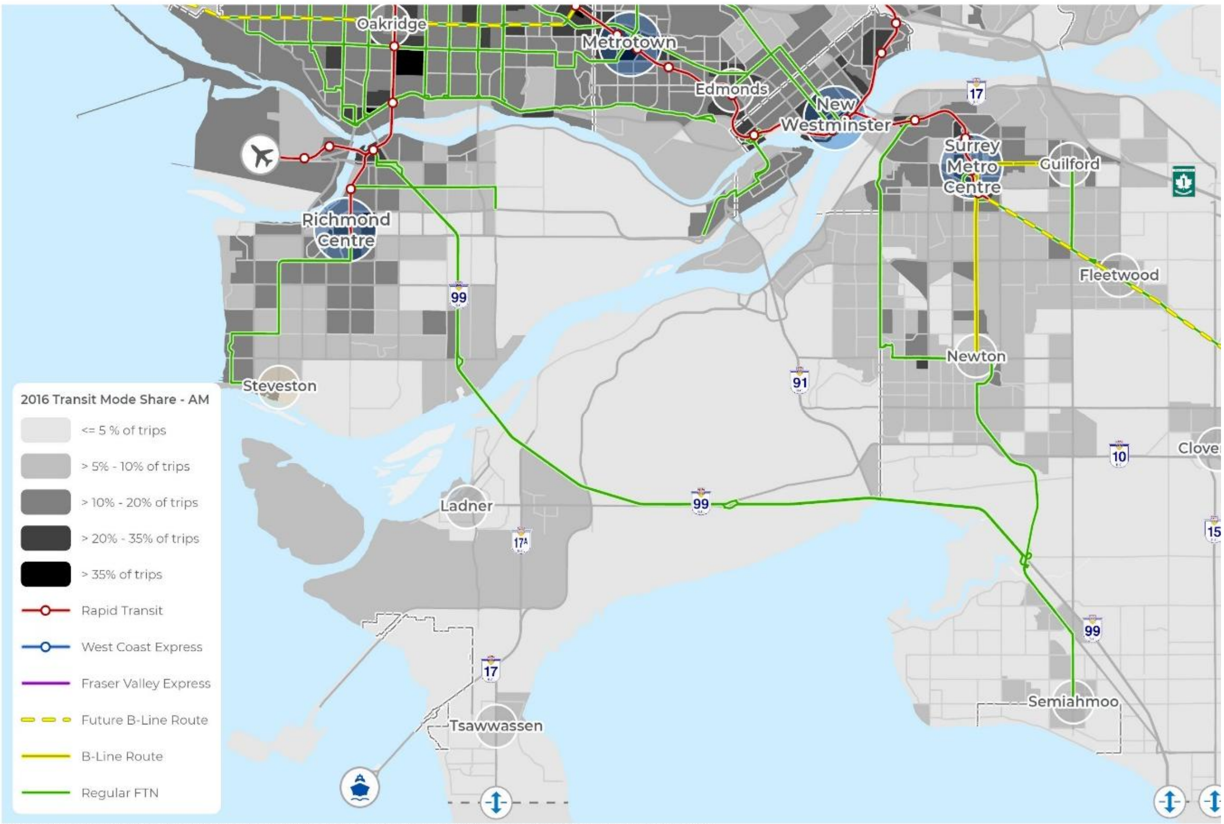
Figure 2-11 Existing AM Peak Transit Mode Shares (by area)



Although the transit services that utilize the Highway 99 corridor generally operate at similar frequencies to and from both the South Surrey/White Rock and the Ladner/Tsawwassen areas, the former accounts for approximately two thirds of the peak period transit ridership. Figure 2-12 illustrates the morning and afternoon peak directional ridership on Highway 99 across the GMT. During the morning and afternoon peak hours, approximately 1,100 to 1,200 transit passengers/hour travel across the GMT in the respective peak directions. Of those crossing, approximately 60% originate from and are destined to the South Surrey/White Rock area, and 40% to Ladner/Tsawwassen. Consistent with service levels, the off-peak directions as well as the midday ridership is significantly lower than the peak directions.

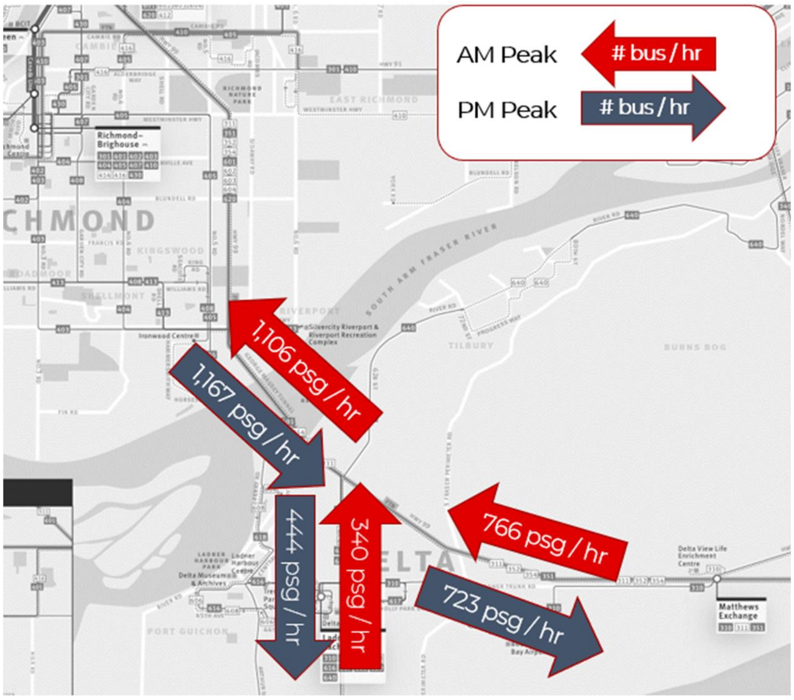


Figure 2-12 Existing Morning and Afternoon Peak Directional Transit Ridership (passengers/hour)

Comparing these service levels and travel patterns with other Lower Mainland crossings provides insight to the relative demands for transit and opportunities for enhanced services. Table 2-1 provides a comparison of transit service levels, vehicle trips, ridership, and transit mode shares for the George Massey, Lions Gate, and Second Narrows crossings.

Of the three crossings, the Lions Gate Bridge has the highest service levels, morning peak directional ridership, and transit mode share. Further, the all-day, two-way ridership across the Lions Gate Bridge and Second Narrows Bridge is substantially higher than the GMT. This can largely be attributed to the two-way peak and all-day travel demands between the North Shore and Vancouver. It should be noted that transit operates in shared general-purpose lanes on all crossings, with priority treatments to the GMT and the Lions Gate Bridge.

Table 2-1 Crossing Comparisons for Peak Directional Travel & Mode Shares

	GEORGE MASSEY TUNNEL	LIONS GATE BRIDGE	SECOND NARROWS BRIDGE
AM (PM) Frequency (bus/hr)	32 (29)	43 (30)	22 (16)
AM (PM) Ridership (psg/hr)	1,106 (1,167)	1,582 (1,010)	587 (477)
AM (PM) Traffic (vehicle/hr)	5,000 (4,800)	3,500 (3,000)	4,900 (5,000)
AM (PM) Transit Mode Share	16% (17%)	27% (22%)	9% (7%)
Daily Transit Ridership (people/day)	15,900	33,250	26,530

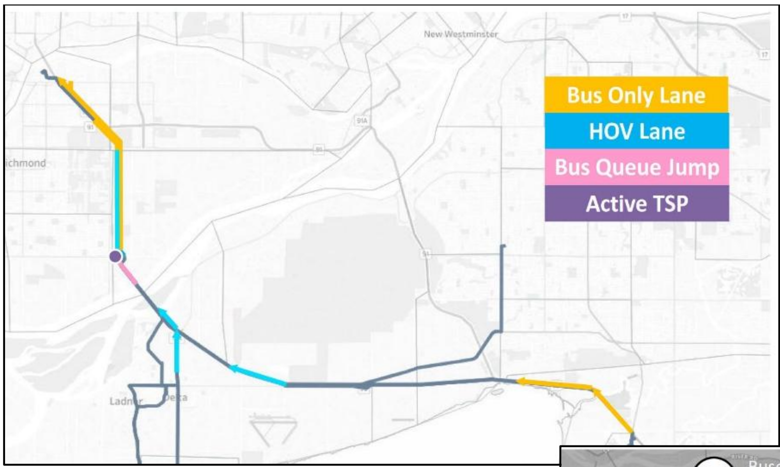
2.5 TRANSLINK'S TRANSIT RELIABILITY ANALYSIS

TransLink's 2019 *Bus Speed and Reliability Report* has identified twenty corridors that generate the most hours of passenger-delay across the system. The Highway 99 corridor is ranked second in the region for passenger delay (approximately 772 person-hours of delay) and carrying 1.7% of the total bus ridership across the Metro Vancouver.

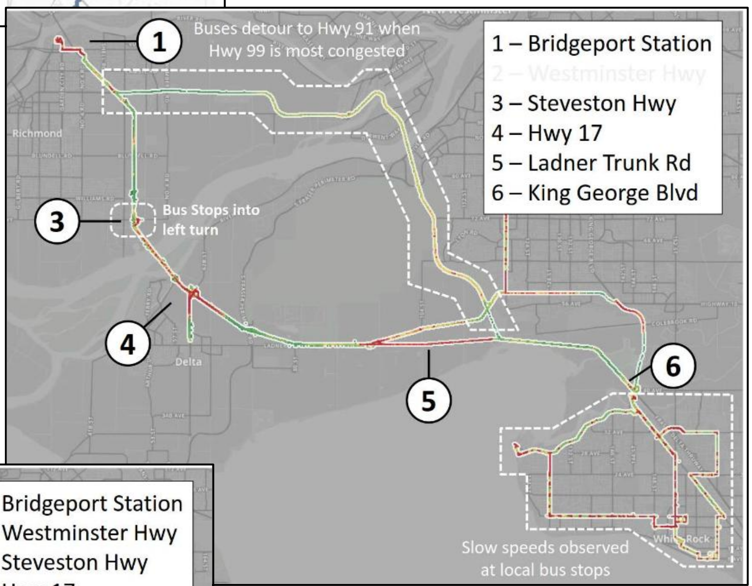
As part of the George Massey Crossing Project (GMCP), TransLink provided detailed summaries of the bus speed analysis for Highway 99 highlighting areas of greatest concern. These areas are illustrated in Figure 2-13 along with comparisons of where bus-on-shoulder and shared HOV/bus lanes currently exist. In the northbound direction, bus speed reliability issues are identified at the King George Interchange on-ramp, Highway 99 between Highway 91 and Ladner Trunk Road, Highway 99 from south of Highway 17A to Steveston Highway, and the Highway 99 off-ramp/Bridgeport/Great Canadian Way connection to the Bridgeport Station. In the southbound direction, bus reliability issues are identified on Great Canadian Way and Sea Island Way, Highway 99 between Highway 91 and Steveston Interchange, Highway 99 between Highway 17A and Highway 17 and Highway 99 near Highway 91.

As part of the proposed Phase 1 transit priority improvements, many of the northbound issues on Highway 99 around the Tunnel as well as the southbound challenges at Great Canadian Way / Sea Island Way, and Highway 99 between Highway 17A and Highway 17 will be addressed with transit priority treatments and extension to the bus-on-shoulder lane system. The Ministry's Region and District staff continue to work with TransLink to address other areas on the corridor. In general, the intent for TransLink and the Ministry has been to continue to advance the provision of bus-on-shoulder and transit priority treatments throughout the corridor as described in the Ministry's *Highway 99 – Shoulder Bus Lane Study*.

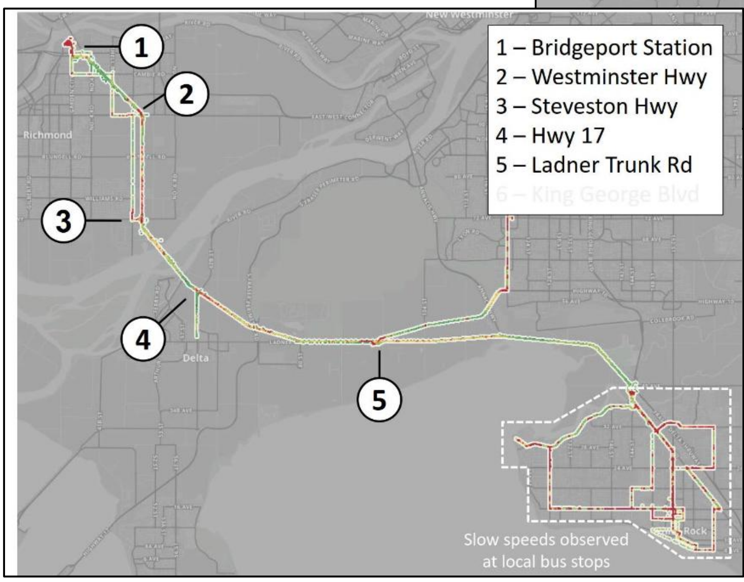
Figure 2-13 TransLink's Bus Speed & Reliability Summary for Highway 99



Existing Bus Priority Lanes



Northbound Areas of Recurring Delay

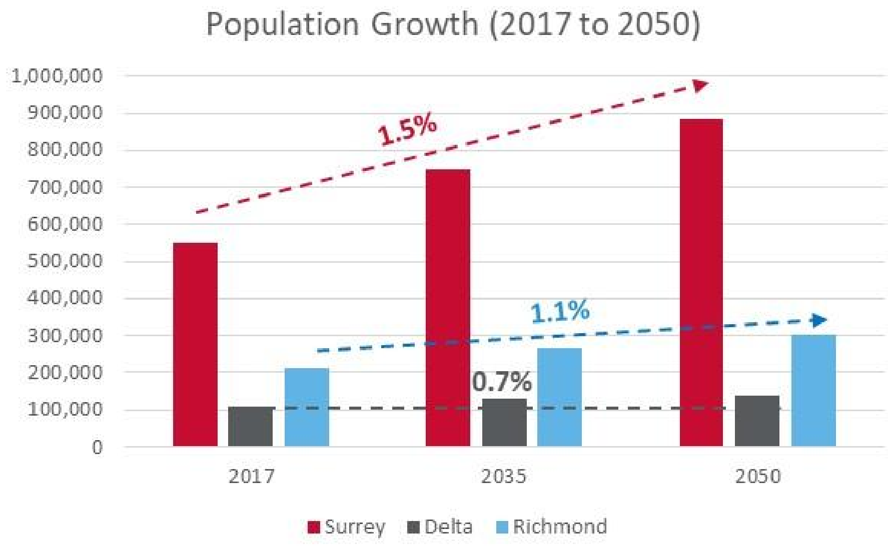


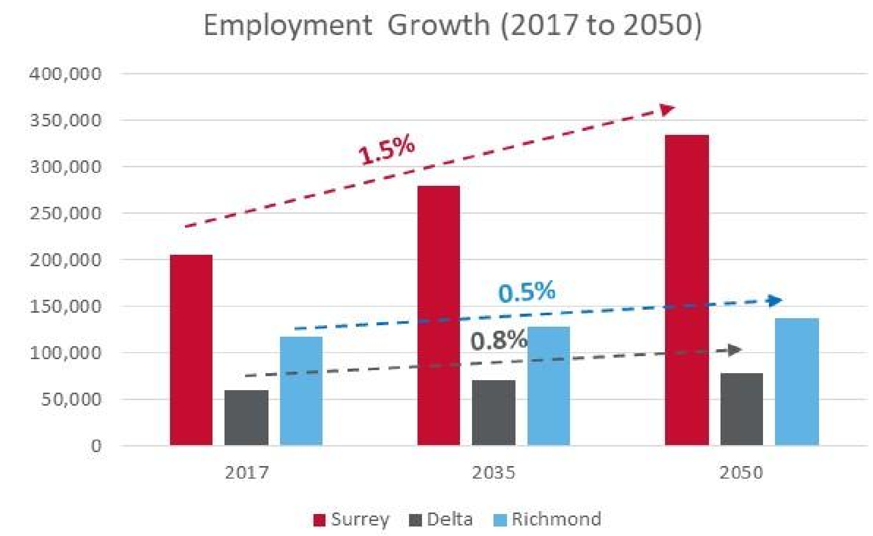
Southbound Areas of Recurring Delay

2.6 FORECAST TRAVEL GROWTH

Over the next 30 years or so, the population and employment of Metro Vancouver will increase by approximately 1.2 million people and 470,000 jobs. Almost 40% of that growth is planned for communities south of the Fraser River. Around the Highway 99 corridor, the population and employment growth rates in Surrey are projected to increase by approximately 1.5% per year with 350,000 more people and 150,000 more jobs. The population and employment growth in Richmond and Delta are projected to increase by 0.5% to 1.1% per year over the next 30 years. Figure 2-14 illustrates the projected growth for each community north and south of the Fraser River.

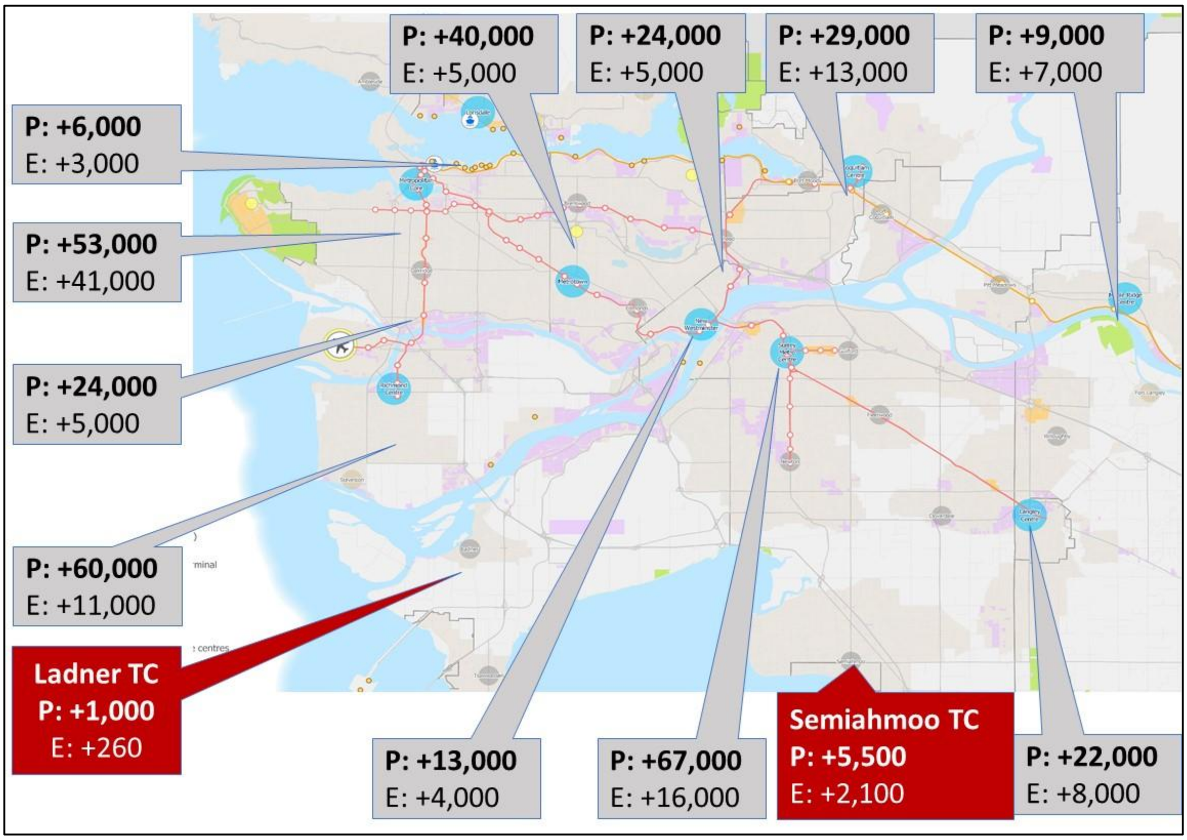
Figure 2-14 Planned Population & Employment Growth (2050)





Beyond the magnitude of growth across Metro Vancouver and south of the Fraser River, the shape of growth is also expected to influence travel patterns and mode choices. In short, compact, mixed-use areas of growth promote more opportunity for walking, cycling, and attractive transit services that reduce the need to drive. The Regional Growth Strategy (RGS) highlights the importance of designated urban centres that include the Metropolitan Core, Surrey Metro Centre, Regional Centres, Municipal Town Centres, and Frequent Transit Development Areas. In fact, Metro and Regional Centres are planned to accommodate approximately 30% to 35% of the region's growth over the next 30 years. In comparison, the population and employment growth in communities connected by Highway 99 bus services such as the Ladner and Semiahmoo Town Centres are not expected to increase by the same levels as illustrated below in Figure 2-15. In this regard, the scale, distribution, and mixture of growth to Town Centres south of the Fraser River are relatively modest and do not suggest a substantial change in transit markets.

Figure 2-15 Urban Centre Population and Employment Growth (2050)

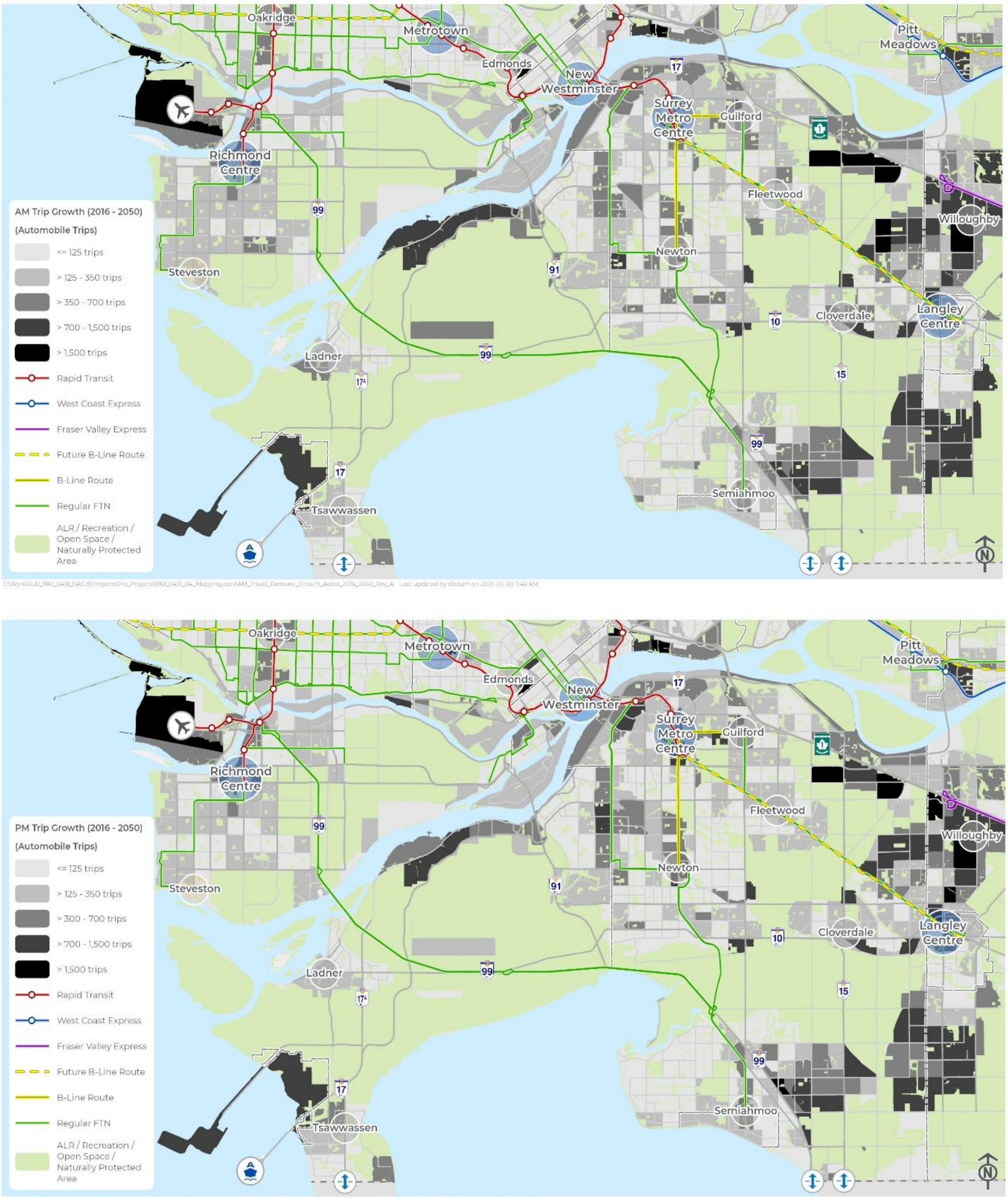


The projected population and employment levels have been incorporated into the Regional Transportation Model (RTM 3.3) prepared by TransLink to forecast the changes in travel demands. The RTM provides a broad-based approach to forecasting travel demands across the Lower Mainland based on existing and planned land uses, major roadways and transit connections (bus and rail), as well as provincial and national / international trips across key gateways such as airports, borders, ferry terminals and port facilities. The model has been used to project the amount, where, and how (mode and route) people choose to travel between all areas of the region.

Figure 2-16 illustrates the projected increases in auto-based trips generated by areas south of the Fraser River over the next 30 years for the AM and PM peak periods. These patterns highlight that the largest changes in travel south of the Fraser River are in areas of east Surrey, the Langleys, and industrial areas around Metro Vancouver Ports. With the exception of the Grandview area in South Surrey, forecast growth in travel demands from the areas of Ladner, Tsawwassen, South Surrey, and White Rock are relatively modest. Consistent with land use patterns, areas outside the Urban Containment Boundaries along the Highway 99 corridor will continue to generate very few trips in the long-term. Overall, these land use and resulting travel patterns are generally not consistent with areas where rapid transit has been successful.

Without examining the distribution of forecast trips in detail, the general patterns of growth suggest that only a portion of these trips would be travelling across the Fraser River and the George Massey Crossing in the long-term. For those trips that may utilize the Highway 99 corridor and the crossing, two distinct patterns may influence the shape of future transit services. The first observation is that projected 2050 travel increases are generally distributed across the Urban Containment Boundaries and not just within designated urban centres. In this regard, transit service coverage will remain an important feature of Highway 99 related services in the south of Fraser areas. The second principle observation is that growth is projected for both residential and employment areas across Delta, Surrey, and White Rock. In this regard, the increase in two-way ridership in the long-term between Bridgeport Station and the south of Fraser communities will create opportunities to improve efficiencies and cost-recovery for Highway 99 transit services.

Figure 2-16 Increases in 2050 AM & PM Peak Auto-Trip Origins & Destinations



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As part of the George Massey Crossing (GMC) Project, 2050 traffic and transit ridership projections were prepared for the Highway 99 corridor and crossing. The forecasts travel demands for the shortlisted bridge and Immersed Tube Tunnel (ITT) alternatives were developed using the RTM with planned regional growth and committed transportation improvements through 2050. For the Highway 99 corridor, the GMC project includes a total of 8-lanes with a dedicated bus lane. Transit frequencies were defined in the RTM by TransLink based on assumed service level increases for the 2050 timeframe without specific plans or commitments. The RTM model validation and forecasts for the Highway 99 corridor and the George Massey crossing may be found in the BC Ministry of Transportation and Infrastructure project site and documents library (https://engage.gov.bc.ca/masseytunnel/document-library/).

Future service levels and projected morning and afternoon traffic and transit ridership for 2050 on the new crossing are summarized in Table 2-2. For the purpose of this Discussion Paper, the orders of magnitude in forecast ridership levels are considered to assess capacity and alignment with bus versus rail rapid transit technologies.

Table 2-2 Existing & Forecast Peak Demands for George Massey Crossing

	EXISTING	FORECAST 2050 (*)	% GROWTH
AM (PM) Frequency (bus/hr)	32 (29)	62 (59)	93% (100%)
AM (PM) Ridership (psg/hr)	1,100 (1,170)	1,480 (1,670)	34% (43%)
AM (PM) Traffic (vehicle/hr)	5,000 (4,800)	5,660 (5,210)	13% (13%)
AM (PM) Transit Mode Share	16% (17%)	18% (22%)	-

(*) George Massey Crossing Project, Appendix H – Traffic and Geometrics, 2020

These forecasts provide insight to the scale of change in travel demands across GMC and the potential for increasing capacity and frequency of bus transit services as highlighted below:

- Vehicle travel demands across the GMC are projected to increase by 13% over the next 30 years in the morning and afternoon peak directions. This may be attributable to the relative balance of population and employment growth in communities south of the Fraser River.
- Transit ridership is projected to increase by approximately 35% to 45% despite modelled service levels being increased by 100%. This pattern underscores the challenge of serving lower density areas by transit and the need for purposeful design when services are increased. Rather than simply applying more of the same services between Bridgeport and communities south of the Fraser River, service levels may be increased for those routes generating the highest ridership today (such as South Surrey/White Rock and Ladner/Tsawwassen) and to expand coverage to growth areas such as Grandview Neighbourhoods in South Surrey and Tsawwassen First Nations.
- With transit ridership growth outpacing traffic growth, the projected transit mode share on the Highway 99 corridor also increases. Transit customers and operations will benefit from continued investments in transit priority treatments in the form of bus-on-shoulders and queue jumpers at ramps.

2.7 HIGHWAY 99 & GMC RAPID TRANSIT ALTERNATIVES

As previously described, there are various forms of rapid transit in Metro Vancouver that include rail, RapidBus services and some FTNs where transit priority is provided. This section outlines key considerations for determining the appropriate type of rapid transit service for the Highway 99 corridor between south of Fraser communities and Richmond's Bridgeport Station.

Today, existing transit services between Richmond/Bridgeport Station and South of Fraser communities are part of the Frequent Transit Network (to South Surrey) and regular commuter services. Regardless of the branding convention, the service design and ridership have common features, including:

- Routing of bus services are designed to gather passengers from multiple points with greater coverage in low density areas and provide direct connections along Highway 99 to a single point at Bridgeport Station.
- Majority of transit customers are headed to Vancouver (65% to 70%) followed by Richmond (25% to 30%), a pattern that is not expected to change in future.
- Service levels are designed to support ridership patterns, with a majority of the ridership demands in the peak directions for a few hours in the morning and afternoon periods. Without strong two-way travel, service levels for the off-peak directions and times of day are significantly lower.
- Significant increase in the frequency and capacity of the same transit services does not necessarily result in proportional increases in ridership at the GMC. As noted, additional services should be designed to support population and employment growth areas rather than the same areas of transit service coverage today.

Over the last decade or so, studies for the GMC and overall Highway 99 corridor have largely utilized TransLink's plans and other technical studies to support long-term provisions for RapidBus services. As part of TransLink's Transport 2040, the Highway 99 corridor was identified for rapid transit between Bridgeport and King George in South Surrey, as was illustrated in Figure 2-17.

Around this same time, the Ministry of Transportation and Infrastructure advanced the planning, design, and implementation of bus-on-shoulder facilities and transit priority treatments at ramps along the Highway 99 corridor to serve bus transit services.

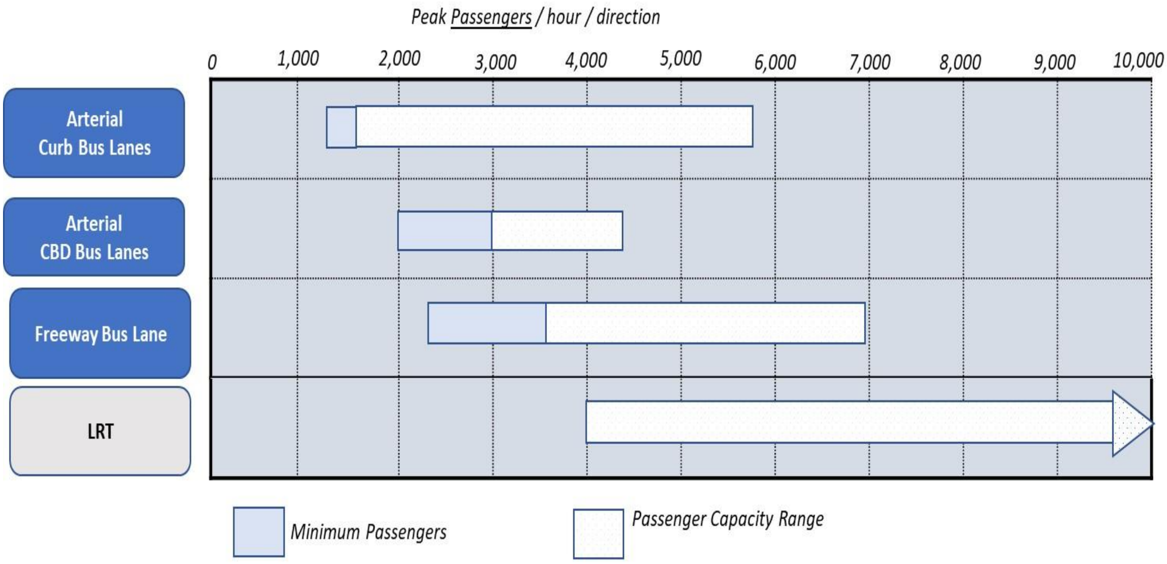
While there may be challenges to increasing transit ridership (as described in Section 2.3), planning and designing for future rapid transit services beyond the 30-year planning horizon should consider two key factors as follows:

A) TRANSIT DEMANDS & CAPACITY

In general, there are varied experiences and analysis of thresholds or capacities (passengers per hour or buses per hour) that can be achieved with different types of rapid transit services and facilities. For bus-based, rapid transit systems operating in dedicated lanes, the capacity is influenced by several factors including: the ability of stops or loading areas to pick up and drop off passengers; the number of vehicles operated; and the distribution of boardings and alightings along a route.

The Transportation Research Board, *Transit Cooperative Research Program (TCRP), Transit Capacity and Quality of Service Manual (2nd Edition)* provides technical guidance on identifying the ranges of when to consider dedicated bus-only lanes for urban streets and highways as well as the upper end thresholds of capacity for buses and passengers per hour. Figure 2-17 summarizes these threshold ranges for various bus transit operations along with Light Rail Transit (LRT). Although there are many other reasons for moving from transit priority treatments to dedicated bus lanes or even LRT (such as improved reliability, operations, ridership along with other community goals), these patterns should be considered for guidance and discussion purposes only rather than as absolute thresholds or capacities. Further, the minimum ranges for planning dedicated lanes may be influenced more by policies and strategic aspirations as well as corridor delays and reliability than passenger volumes.

Figure 2-17 Ranges for Rapid Transit Ridership Technologies



Source: Bus passenger capacities have been determined from the Transportation Research Board (TRB), Transit Cooperative Research Program (TCRP), Transit Capacity and Quality of Service Manual.

As illustrated, the ridership thresholds for advancing from transit priority treatments to dedicated lanes for arterial systems range from approximately 1,300 to 2,000 passengers / hour / direction (pphpd). For highway operations, the guidance from TRB suggests that bus lanes may be considered where ridership levels are above 2,200 pphpd. Even with dedicated lanes, limited constraints at intersections, multi-door boarding, and dedicated stops, bus rapid transit systems may theoretically serve up to 4,300 pphpd on CBD arterial roads and up to 5,800 pphpd on other arterial roads. Constraints on highways are much lower than urban streets where the theoretical capacity of dedicated bus lanes could be as much as 6,900 pphpd. Assuming rail rapid transit such as Light Rail Transit (LRT) would be implemented when ridership reaches or approaches 4,000 pphpd, this technology can support up to 13,000 passengers per hour on dedicated rights-of-way. It

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should be noted that there are examples in North America where the ridership levels are known to have exceeded the capacity thresholders included in Figure 2-17.

Considering the Highway 99 corridor, the existing and projected 30-year peak directional ridership levels (up to approximately 1,200 to 1,700 pphpd respectively) are well within the ridership ranges of a bus rapid transit system with dedicated lanes and priority treatments. Theoretically, the higher capacity RapidBus system with dedicated facilities could technically support three times the projected 2050 ridership levels for Highway 99.

B) SERVICE DESIGN & MARKET POTENTIAL

Beyond the capacity of a bus-based form of rapid transit serving communities south of the Fraser River, land use must be considered in the design and selection of rapid transit. As previously stated, rapid transit and RapidBus services in the region are designed to provide a higher quality service and experience to customers. Stations are generally larger, more comfortable and provide real-time information to notify customers when the next bus is expected to arrive. Vehicles are designed to support higher capacity ridership, with additional amenities and information as well as all-door boarding to reduce dwell time and improve overall travel times. Further, RapidBus systems are supported by transit priority treatments that include dedicated bus-only lanes along the corridor and queue jumpers at intersections. Since these and other features can be implemented over time to support and attract growing transit ridership, RapidBus is scalable to meet demands and to deliver a similar customer experience as a rapid transit system.

Designated agricultural and conservation areas identified in the Regional Growth Strategy (RGS) will generally limit growth patterns along the Highway 99 corridor. Ultimately, transit facilities and services must be designed to support the land use characteristics and the travel markets being served. In the case of the Highway 99 corridor, transit routing should still be designed for coverage to lower density areas within the Urban Containment Boundary south of the Fraser River to minimize transfers and associated wait times. Support facilities in the form of park-and-rides can also be enhanced in Ladner and South Surrey to encourage transit for those that do not have direct access to attractive local services.

Moving toward RapidBus service design with a larger dedicated fleet, unique stations, and other transit priority treatments across the network would provide long-term transit capacity to the Highway. In some cases, local services may be interlined with the Highway 99 corridor to provide transferless connections to primary destinations such as Bridgeport Station. This mixed approach to service design is not possible with rail rapid transit. Unfortunately, more transfers would be added to the trip where most people already transfer between bus services and Canada Line. The concepts of RapidBus and interlining local services are illustrated in Figure 2-18 and Figure 2-18 . For discussion purpose only.

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Figure 2-19 Conventional and/or Frequent Transit Network Corridors

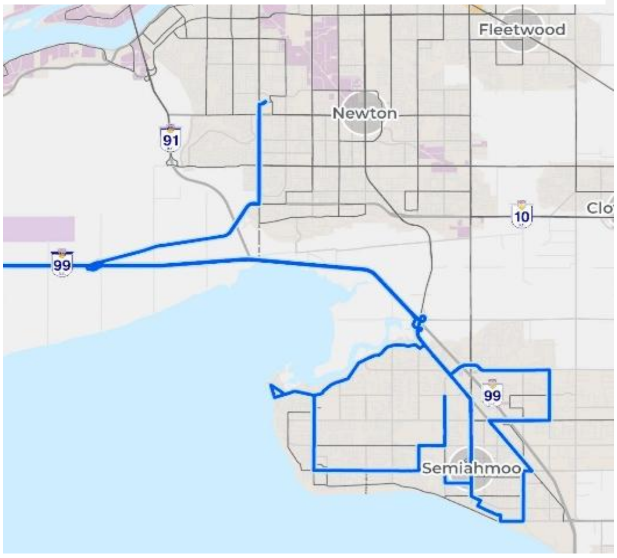


Figure 2-18 RapidBus Corridor Concept

In summary, the long-term ridership levels and travel markets along the Highway 99 corridor and the GMC are best supported with a bus-based system. Rail rapid transit services providing frequent all-day, two-way services on the Highway 99 corridor would generally not be aligned with the transit markets and would not be required to support long-term demands, even if the 30-year projections doubled. Rail rapid transit would force customers to transfer from the local service areas and potentially again at Bridgeport Station which in turn increases travel times. Without greater scale, mixture, and density of contiguous development, travel markets along Highway 99 will not be well aligned to a rail transit service.

As an alternative to rail, a RapidBus provides the flexibility needed to support the travel markets and facilities that can provide the required capacity for the next 30 years or more. As population and employment in Metro Vancouver continue to grow, bus service levels along the Highway 99 corridor may increase as well.

Rather than simply providing more of the same however, combinations of service types could be operating on the Highway 99 corridor between the South Surrey/White Rock as well as Ladner / Tsawwassen areas and Bridgeport Station and other parts of Richmond. For example, RapidBus branded services would provide direct connections between the Ladner and Semiahmoo Town Centres and Bridgeport Station. The frequencies and capacities of the vehicles could be increased for longer distance travel (such as the double decker fleet recently introduced) and designed to provide attractive two-way services during the peak and off-peak periods as the demand evolves.

Additional bus services that continue to provide local coverage within the South Surrey, White Rock, Ladner and Tsawwassen areas could be inter-lined with the RapidBus corridors to provide a transferless trip to Bridgeport Station and Canada Line where possible. This would add capacity and improve frequencies on RapidBus corridors and support local connections and transfers where required. This approach to service design and coverage to suburban areas separated by a Greenbelt had been in place in Ottawa for more than 30 years prior to the introduction of LRT once larger scale centres were developed in outlying urban areas. Within the Richmond side, service coverage for connecting routes from Highway 99 may also be extended to provide direct service to employment areas in other parts of the Richmond Centre and the Commerce Business Park areas.

RapidBus corridors to Ladner / Tsawwassen as well as to South Surrey / White Rock can evolve over time and shape travel demand patterns. Supportive facilities along the corridors can be provided to improve access to transit with attractive bus exchanges, park-and-ride lots, bike parking and accessible connections for walking and cycling. Dedicated bus facilities such as the bus-on-shoulder lanes will support the long-term capacity needs, reduce the impacts of traffic delays, and improve travel time reliability. In this regard, dedicated bus lanes along Highway 99 and Highway 17A would generally operate at speeds consistent with rail rapid transit and could process significant passenger volumes with larger buses.

3.0 IMPLICATIONS OF DESIGNING FOR RAIL RAPID TRANSIT

Independent of the potential long-term demands and design of transit services on Highway 99, the implications of incorporating provisions for rail rapid transit (either SkyTrain or LRT) in the design of the George Massey Crossing (GMC) Project need to be considered. This assessment does not imply that there will ever be a need for rail rapid transit. Rather, this section of the Discussion Paper outlines the requirements for the GMC alternatives – Bridge and Immersed Tube Tunnel (ITT) – without and with provisions for future rail rapid transit in the project design.

The section briefly highlights the 'base' GMC Project design features for a bridge and ITT with bus-only lanes, identifies key considerations for planning and designing rail in and around highway rights-of-way, and examines the physical implications of preserving for rail rapid transit within the shortlisted crossing alternatives.

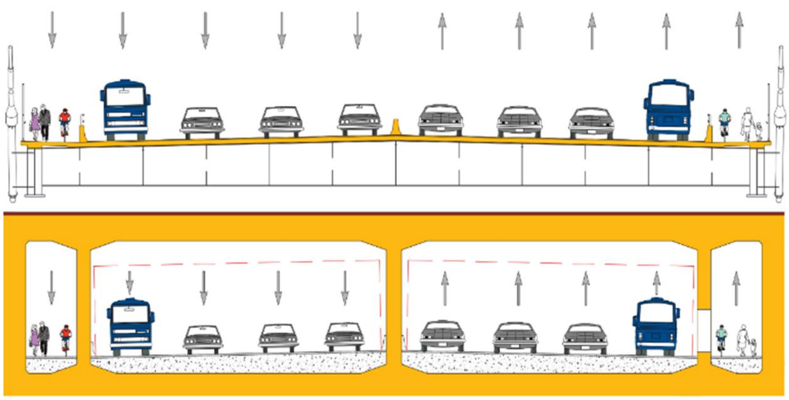
3.1 GMC BASE ALTERNATIVES (BUS LANES)

The base alternatives for the GMC at the time of writing this Discussion Paper include a new bridge and ITT with the following principle features:

- 8-lanes crossing with one dedicated bus-only lane in each direction.
- Bus-only lanes on the crossing would connect with bus-on-shoulder facilities on the Highway 99 corridor.
- Active transportation facilities in the form of multi-use pathways connecting to facilities on either side of the crossing.
- Connections to the existing Highway 99 corridor in terms of both grades and alignment south of Steveston Highway and north of Highway 17A.

The general configuration of the crossing alternatives as presented in the GMC Project are illustrated in Figure 3-1. The bridge crossing alternative accommodates four standard travel lanes with shoulders and median barrier. The ITT concept includes two cells of four travel lanes in each direction and multi-use path cells on both sides. The overall width of the bridge and ITT are approximately 44.5m and 47.1m respectively.

Figure 3-1 Conceptual Cross-section for Alternative Bridge & ITT Crossings (Source: Technical Services for George Massey Crossing Project, COWI, December 2019)



Bridge Lanes (top) and ITT lanes (bottom)

As previously highlighted, the profile and alignment for both the Bridge and ITT alternatives connect to Highway 99 south of Steveston Highway and north of Highway 17A. In both cases, the highway mainline is three lanes in each direction with transit priority treatments through the interchange areas that connect to the bus-only lanes on the crossing.

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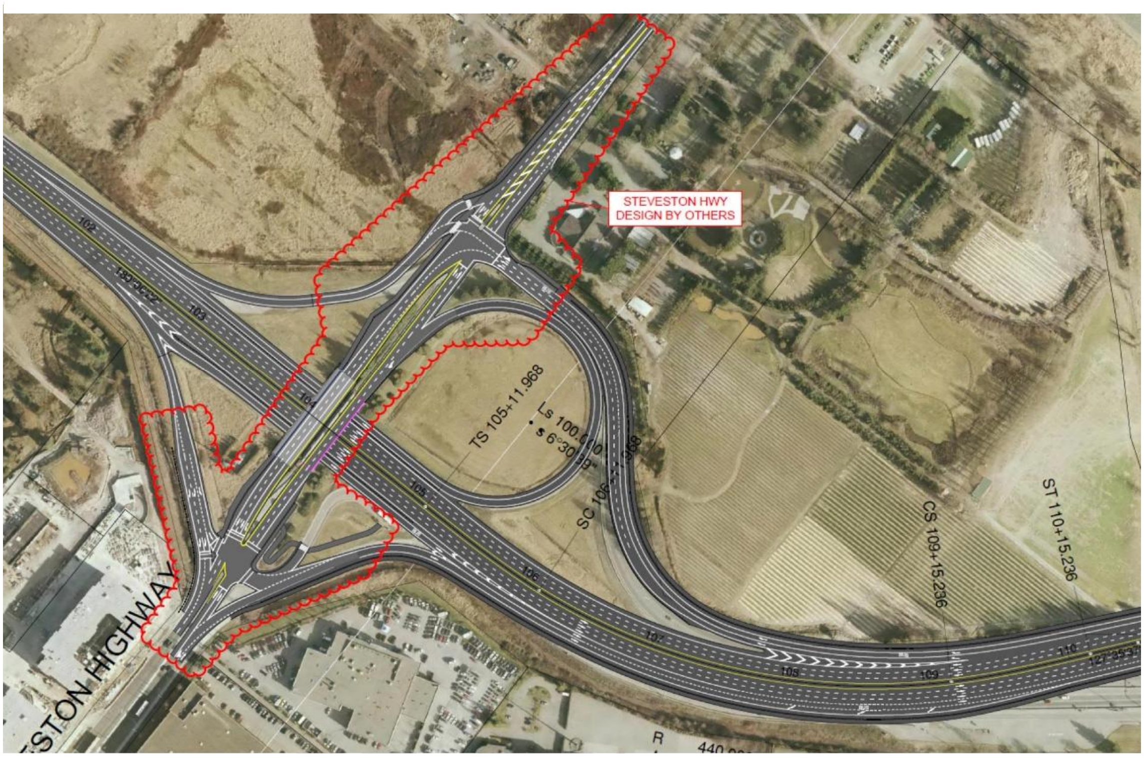
Figure 3-2 illustrates the concept designs for connections at Steveston and Highway 17A Interchanges. It should be noted that while highway transit services and station areas will see improvements, stops and exchanges between Highway 99, Highway 17A, and River Road need to be addressed as part of the overall crossing project.

Figure 3-2 GMC Crossing Connections at Steveston & Highway 17A Interchanges

Steveston Interchange



Highway 17A Interchange

3.2 GENERAL PLANNING AND DESIGN GUIDANCE FOR RAIL

Planning and design standards for rail rapid transit will vary depending on the technology. In basic terms, the general requirements for SkyTrain or Automated Light Rail Transit (ALRT) include complete separation to restrict access or crossings of the rail since traction power comes from the tracks. Conversely, Light Rail Transit (LRT) power is generally provided through overhead catenary systems which allow for at-grade crossings along urban roads and even operate in the same space where tracks are embedded below the surface. Thus, LRT can be easier to integrate into urban environments with on-street, at-grade guideways and stations.

Planning and designing rail rapid transit within and crossing highway rights-of-way are very different than in urban areas. ALRT must be physically separated from highways for technical reasons. Other than standards for heavy rail corridors and crossing however, there are no standards or guidelines in British Columbia for planning and designing LRT within or crossing provincial highways.

In the Cities of Edmonton and Calgary, LRT operations are generally physically separated by barriers when running alongside highway corridors such as Crowchild Trail (Highway 1A). More recently, Alberta Transportation has been reviewing at-grade LRT operations across highway interchange ramps and considering alternative designs as rapid transit systems are expanding beyond the Ring Roads and the Transportation Utility Corridors. The principle issues being addressed are safety and operations where speeds in highway environments for both vehicles and trains are much higher than in urban areas.

Over the last 20 years, there has been a growing body of research and experience with various at-grade LRT systems in urban, suburban and highway environments. The Transportation Cooperative Research Program (TCRP) examined common safety issues associated with LRT systems operating along lower and higher speed corridors. For higher speed conditions of greater than 55km/hr, the research points to some of the more critical safety concerns about potential conflicts between general purpose traffic and LRT vehicles around at-grade crossings that include:

- Inattention and confusion of drivers approaching the LRT alignment;
- Lack of appropriate separation between motorists, cyclists, pedestrians and LRTs;
- Risky behaviour by those approaching LRT alignments; and
- LRT operator error.

The general recommendations that have guided actions in many U.S. communities are that exclusive alignments are preferable from a safety perspective where the potential for conflicts would be eliminated, and LRT system capacity and reliability can remain high. Exclusive alignments mean that LRT utilizes full grade-separation from motor vehicles and pedestrians/cyclist crossings. This form of separated ‘guideway’ offers the highest speed and reliability for transit, the greatest passenger capacity, and the lowest potential for conflicts between motor vehicles, pedestrians, and cyclists. While the above or below ground structures cost more than at-grade operations, they would typically be provided along freeways and major arterial roadways in higher speed suburban environments.

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Consistent with this research, many transit systems in the U.S. have been considering changes to locations where there is no physical separation between LRT and highway or major arterial corridors outside urban environments.

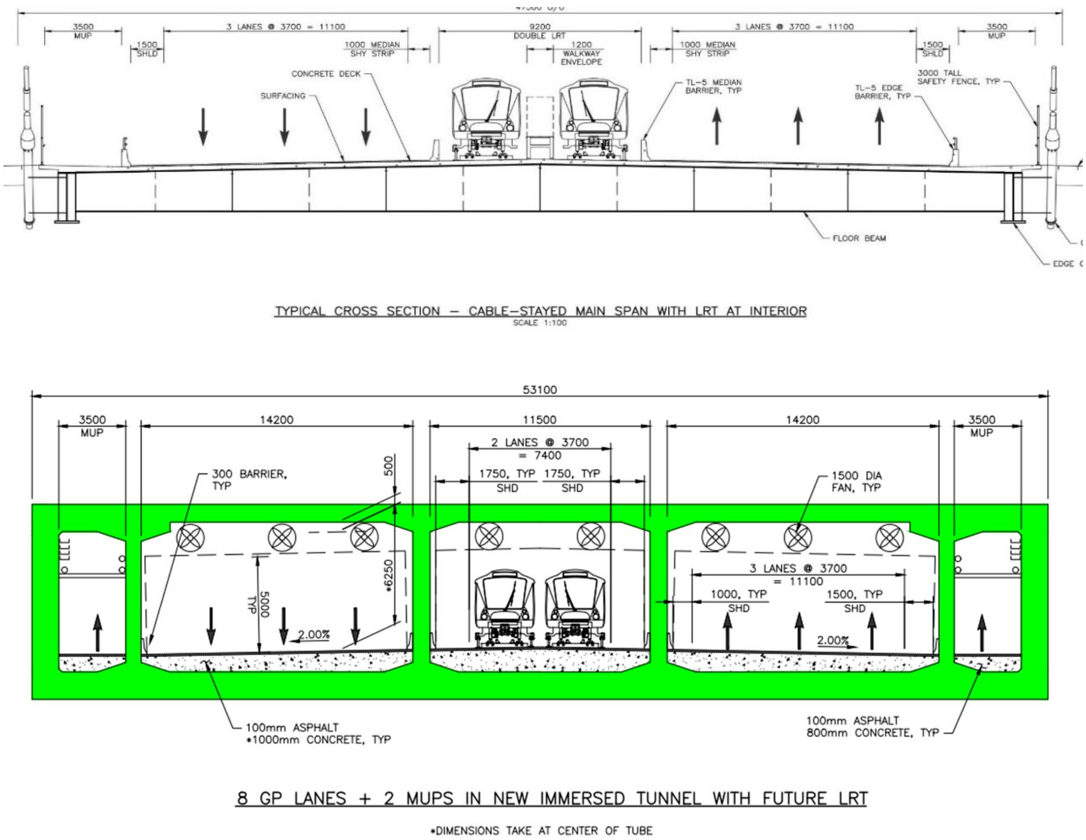
Unlike accommodating RapidBus with bus-on-shoulder treatments along Highway 99, preserving for rail would require additional space to physically separate highway traffic with LRT on the GMC and all interchanges.

Sections 3.3 and 3.4 of the Discussion Paper consider the physical implications of preserving for rail rapid transit on Highway 99 and the GMC which would require more space for the Bridge and ITT alternatives as well as the requirements for the Steveston and Highway 17A Interchanges immediately north and south of the crossing. With an exclusive alignment, ALRT / LRT guideway may either be centre running or side-running (both directions on one side) in principle.

3.3 CENTRE RUNNING CONFIGURATION

A centre running configuration along Highway 99 means that three travel lanes on the new GMC would be shifted to the outside in both directions and rail rapid transit would assume the inside area of the crossing and highway. Figure 3-3 illustrates the potential cross-sections with the Bridge and ITT alternatives.

Figure 3-3 Conceptual Bridge & ITT Crossings with LRT (Source: COWI, May 2020)



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The centre running bridge alternative would result in an increase to the total deck width of approximately 3m to preserve for rail rapid transit and barriers in the long-term (or a 7% wider structure). Further, the total width for ITT would need to be increased by approximately 6.0m to support future expansion with LRT (or a 13% increase).

It is noted that the governing factors influencing the significant increase in width for ITT are related to the need to change overall configuration. According to the ITT specialists working on the GMC Project, the additional width requirement to preserve for rail rapid transit would result in the need to increase the number of cells with fewer lanes that can be structurally supported within the ITT. Rather than two, four-lane cells serving northbound and southbound traffic (illustrated in the base design), the ITT design would include two, three-lane cells and one two lane cell in the middle.

Until rail was required (if ever), the centre two-lane cell illustrated in Figure 3-3 may need to be designed as a counterflow lane system similar to today. During the morning and afternoon peak periods, the counterflow lane system would serve the northbound and southbound directional traffic respectively – supporting four general-purpose lanes and a bus-only lane. In the off-peak directions, the three-lane cells would support off-peak travel demands.

North and south of GMC, preserving for centre running rail transit would also impact all interchanges along the Highway 99 corridor. Beyond the space for guideway, stations would ultimately be required at some interchanges where bus stops are in place today along the highway and/or where new transfers between bus and rail would be required. In this regard, rail rapid transit stations would be required the Steveston Interchange to replace existing Highway 99 bus stops and at Highway 17A Interchange as a new transfer between bus services and potential a park-and-ride.

The station areas for center running facilities within the highway corridor would need to support platforms for passenger boarding/alighting of three car train lengths (approximately 85m), buildings facilities with elevator/escalators, pedestrian walkways over Highway 99 and cross-over track areas on one side of the station. Power supply stations could be located within the interchange ramp areas. In total, the station area with tracks and barriers would be approximately 20m wide by 160m in length. The entire station and cross-over areas must be constructed on tangent (or straight) sections of the highway and must be on flat grades and therefore located away from the GMC bridge or ITT.

Figure 3-4 conceptually illustrates the Steveston and Highway 17A Interchanges with a centre running rail guideway and station for discussion purpose only. Although the concept drawing is shown for the bridge alternative from the GMC Project, the highway and interchange configuration would generally be the same for the bridge and ITT options.

As illustrated, the realignment of the GMC would be maintained as planned with slightly wider south side and north side sections before the transitions toward the station areas. The 10m track area between northbound and southbound travel lanes would be widened to 20m (barrier to barrier) through the station and cross-over areas.

Figure 3-4 Centre Running Rail Guideway & Stations at Steveston & Highway 17A Interchanges

Assuming the west side alignment of Highway 99 is maintained to limit property impacts at the Steveston Interchange, the widening for the transition and station areas would occur on the east side. In general terms, the shift in the northbound lanes to the east as illustrated, would result in four broad impacts:

- The loop ramp in the southeast quadrant of the interchange would need to be shifted east if a tighter radius with lower design speed could not be achieved.
- The existing pumpkin farm property and buildings would be impacted.
- More agricultural lands would be required north and south of Steveston Highway along Highway 99 with the overall widening and interchange reconfiguration.
- The Steveston Interchange would need to be replaced with a longer span over Highway 99 than currently planned in Phase 1 works.

On the south side, the potential impacts of a centre running rail rapid transit system would be similar in terms of the widening requirements approaching and within the station areas. **Figure 3.4** illustrates a conceptual layout of a station area at the Highway 17A Interchange for discussion purposes only.

The wider highway section through the station and cross-over track areas as well as widening to the south would result in a larger highway footprint with greater impacts on ALR lands than a base case configuration. Although the intent of this concept review was not to optimize a design, much of the widening for Highway 99 could technically occur on the east side (or north through this area) to minimize impacts on the interchange ramps. Within the immediate area of the interchange, the size or radius of the large northbound loop on-ramp to Highway 99 could technically be reduced to maintain a reasonable design speed and to minimize potential impacts on ALR. The widening of Highway 99 to accommodate the potential for rail, however, would require new overpass structure(s) at Highway 17A to accommodate the 20m width through the station area plus the highway mainline and ramp lanes.

Although bus stops are not provided and not needed at the Highway 17A Interchange today, the provision of rail rapid transit on Highway 99 means that this becomes a transfer point for bus services in future. Based on previous stages of planning for the GMC and Highway 99 corridor, the Highway 17A Interchange area was identified as a potential transfer point for transit customers utilizing Ladner and Tsawwassen bus services in addition to supporting a potential park-and-ride nearby.

More recently, a casino has been approved off River Road (north of Highway 99) and is currently under construction. As part of the recent GMC Project and planning for bus transit requirements, the City of Delta indicated that it would like to revisit the overall plan for accommodating bus transit services and a transit hub in the area. Either way, a potential station at Highway 17A Interchange as shown in Figure 3.4 would require pedestrian connections over the highway and exchange for bus transit services nearby.

Preserving for a centre running LRT / ALRT in the long-term means that the GMC and nearby interchanges as they exist and/or planned would need to be altered. In the case of the Highway 17A Interchange, the GMC Project did not anticipate that any alternations would be required other than the bus transit priority improvements identified as part of the Phase 1 works. As such, nothing would be required as part of the GMC Project at the Highway 17A Interchange to preserve for rail rapid transit in the long-term.

On the north side however, the Phase 1 works currently planned for the Steveston Interchange would need to be substantively altered. In particular, a longer bridge span across Highway 99 would be required, and the potential impacts on redesigning the ramps on both the east and west sides as well as adjacent properties would need to be considered if the interchange were to be replaced. It is anticipated that the current cost for the Steveston Interchange replacement could increase by as much as 75% to 100% and would have significantly greater impacts on ALR lands and a commercial property on the southeast quadrant of the interchange.

Preserving for LRT / ALRT in the long-term also means that additional space is required for the GMC crossing (ITT or bridge) and on the approaches and other structures. Without a full geometric design in place at this time, the incremental increases in cost would at minimum reflect the increase in width required for the crossing, plus other associated costs of a wider structure. For the bridge, a 7% wider GMC / Highway 99 corridor is required for the main bridge span across the Fraser River, north side structures, the Deas Slough bridge structure as well as the south side approaches and associated structures (such as the River Road overpass).

For the ITT, preserving for rail in the long-term would result in a 13% wider crossing, north and south side cut and cover sections approaching the ITT, bridge structure(s) across the Deas Slough as well as approaches to the north and south. Technology and transitions for the counterflow lane system on Highway 99 would also need to be incorporated into the design through to Steveston Highway and Highway 17 similar to today.

3.4 SIDE RUNNING CONFIGURATION

A side running configuration for rail rapid transit essentially shifts the centre two-way system to one side of the crossing and right-of-way along the Highway 99 corridor north and south. A side running configuration would ensure that all the infrastructure supporting the two-way guideway and stations remain together and yet are still separated from the highway. Side running LRT systems are most common in rural and suburban environments where cross-streets are often several kilometres apart, rights-of-way are large, and setbacks to adjacent buildings are significant.

As suggested by the guidelines and discussion in Section 3.3, a side running guideway could technically be accommodated with the same crossing widths as illustrated in Figure 3-3 for the bridge and ITT. In this regard, the bridge deck width would need to be approximately 7% wider to preserve for the long-term potential of rail rapid transit if desired. For the main spans of the Fraser River and Deas Slough, designs would need to be adjusted to account for side running loads of rail on the structure – such as using larger cables for a cable stay bridge.

For the ITT, preserving for rail on the side would require a wider crossing by at least 13%. In fact, the added complexity for the ITT relates to the additional width and design changes required to preserve for side running rail. The centre two-lane cell shown in Figure 3-3 for ITT would essentially be shifted to the side, with the two three-lane cells placed together. Unlike the centre running system that can technically function as counterflow lanes until rail were implemented, the design of a side running two-lane configuration could not operate as a counterflow system and would be extremely restrictive to traffic operations on the highway. Preserving for a side running rail system in the ITT means that Highway 99 would either need to be separated into three, three-lane cells. In the interim, the centre cell would function as part of a counter-flow lane system. Ultimately, the side running rail would leave three-lanes in each direction for traffic. In this regard, the side running rail system would likely cost more than the centre running system configuration for an ITT crossing.

Beyond the crossing, a side running rail system would be physically separated from the highway similar to the centre running system. However, the side running configuration across a bridge structure would need to be separated north and south of the main spans for the Fraser River and Deas Slough and leave the highway alignment. Once separated from the highway, the alignment and elevation of rail rapid transit would need to be grade-separated from ramps and cross-streets at Steveston Highway, River Road (existing and planned ramps/overpass) and Highway 17A.

There are literally dozens of alignment alternatives that may be explored for side running rail rapid transit beyond the crossing structures that may be considered. An east side alignment would generally avoid impacts on properties around the Steveston Interchange, but encroach on or impact ALR lands for the alignment and station area. On the south side, an east side alignment and station could serve the casino and a transit exchange off River Road.

The challenge for all possible alignments is to balance the design requirements (i.e. maintain grade-separation from the cross-streets and to ensure flat grades and straight alignments through the station areas as previously described) with the off-setting impacts on property, ALR and other sensitive environments.

For illustrative purposes only, an east side alignment through the Steveston and Highway 17A Interchanges are provided in Figure 3-5. As shown, elevated rail rapid transit structures could diverge from the highway and cross the interchange ramps and cross-streets above-grade. At both Steveston Highway and Highway 17A, the rail structure would need to provide 5.5m clearance above the already elevated highway crossings. Stations and track cross-overs would be located within the interchange areas to provide access to local transit and other walking and cycling connections to nearby uses and/or park-and-ride.

As previously noted, the alignments and elevations of the guideway and station areas may be shifted at the time of planning for rail rapid transit. At this stage of review however, it is evident that a side running rail facility in future would not impact plans for Highway 17A and Steveston Interchanges as part of the GMC Project. The design parameters for elevated side running LRT / ALRT are generally flexible enough to adapt to the general layout planned for both interchanges.

Preserving for side running LRT / ALT in the long-term principally affects the design and costs for the main spans and approaches to the Fraser River and Deas Slough Bridges. At a minimum, the incremental increase in the width of the crossings of 7% in addition to the changes in load requirements with side running rail would add significantly to the overall cost of the GMC Project.

Figure 3-5 Side Running Rail Guideway and Stations at Steveston and Highway 17A Interchanges

URBAN SYSTEMS