Port Moody Cumulative Development Traffic Model

Final Report

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Mott MacDonald
Suite 1888
Bentall 5
550 Burrard Street
Vancouver BC V6C 2B5
Canada

T +1 604 681 4400
mottmac.com

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Executive summary

The purpose of the Cumulative Development Traffic Model (CDTM) is to assess the effect that additional land use development may have on the City of Port Moody's roadway network, and to discuss potential average vehicular trip time targets. To that end, the CDTM was developed as a mesoscopic-scale transportation model with several unique and project-specific objectives. This report documents inputs that were necessary for the mesoscopic-scale CDTM, including information from TransLink's Regional Transportation Model (RTM). The report also documents the modelling software platform selected to ultimately develop the CDTM, and how it may be maintained going forward. Finally, the report documents the model development process and outcomes, and summarizes the key findings. The key findings include a recommendation regarding potential vehicular trip travel time increase thresholds that the City may consider, given on-going land use development over time.

This report starts with a review of the TransLink RTM model to better understand its inputs, interoperability with other modeling software packages, and its embedded transportation and land use interactions.

The RTM has limitations with respect to capturing how changing land use influences transportation demands and trip-making over time. It may overestimate the impacts of land use density on vehicle trip generation, and underestimate the benefits of increased walkability or proximity (i.e. destination accessibility). To address this limitation, this work developed a "sketch" model approach[1] that provided further conceptual insight into the impacts that land use changes have on transportation outcomes over time. Typically, increased land use density improves residents' access to opportunities by sustainable transportation modes, thereby limiting their need to travel by vehicle and reducing overall vehicle trips. Yet, this may have some localized congestion impacts.

To understand the extent of localized impacts from development, there was a need to develop a Cumulative Development Traffic Model (CDTM) using a modelling software platform at a mesoscopic scale (i.e. at the scale of the City), and with more detail than is provided by the RTM. The report reviewed several potential software platforms that were potentially applicable for the CDTM. Based on the project objectives, Dynameq, Aimsun, and Visum SBA were initially recommended for further consideration and discussion. Ultimately, Visum SBA was selected as the preferred approach, given its ability to provide dynamic vehicle assignment while also providing the potential to undertake more detailed operational analysis.

The CDTM transportation network, travel demand and land uses were exported from the RTM at the 2017 and 2035 horizon year(s) and "cordoned-off" at the boundaries of Port Moody. Those cordoned-off locations on the network became new inputs for inbound and outbound transportation volumes (demand matrices). The land use information contained within the RTM for the model's 2035 horizon mostly aligned with known development applications in the city. The main exception is for Woodland Park, where the corresponding Traffic Analysis Zone (TAZ) was updated to account for that development's proposed land uses. As well, several TAZs were split to provide more precise vehicle assignment onto the network. The CDTM was calibrated with observed link and turning movement counts and validated against observed travel times along a key corridor. This process also accounted for COVID-19 impacts. The validation

[1] Sketch models are planning level tools that produce more generalized results with less detailed inputs, often times using statistical techniques such as regression analysis Traffic Analysis Tools: Types of Traffic Analysis Tools - FHWA Operations (dot.gov)

process found that the model was overestimating travel times in the westbound direction when compared to observed travel time information. However, on closer visual inspection it was determined that congestion at the Ioco Road & Barnet Highway intersection was likely underrepresented in the observed travel time information. Noting these considerations, the model was determined to be valid for the needs of this project.

The CDTM was then run for three different scenarios, focusing on travel time outputs along select travel routes.

- 2017 Existing conditions (baseline model) – with land uses as per the RTM
- 2035 Future Development Model – with land uses as per the RTM 2035 and refinements based on currently understood development applications
- 2035 Increased Destination Accessibility Future scenario – using an adjustment in vehicle trip demand, based on improved access to destinations by walking, cycling, and transit

The following lists the key findings and outcomes of the CDTM model development and analysis:

- The sketch model calculated that increased development in the city would result in a 4% mode shift toward sustainable transportation modes. This finding may also support parallel work being undertaken as part of the Master Transportation Plan update, which seeks to advance the City's mode share objectives.
- In addition to a 2017 base model, the CDTM ran two future scenarios. The first scenario ran the vehicular demand extracted from the RTM (2035 Future Development Model), the second scenario adjusted this demand based on the increased destination accessibility benefits calculated with the sketch model (2035 Increased Destination Accessibility Model). The Increased Destination Accessibility Model resulted in a 41% reduction in vehicular travel time increase estimated by the 2035 Future Development Model.
- The Increased Destination Accessibility model scenario is strongly considered to be a more accurate representation of 2035 future conditions in terms of development impacts on transportation.
- Based on this modelled scenario, it is recommended that the City considers guidelines that limit vehicular travel time increases as a result of development to 2 minutes (or 17 seconds per roadway km), and up to 5 minutes (or 32 seconds per roadway km) in exceptional cases. St. Johns Street should be considered as an exceptional case, owing to its unique context and role within the network.
- There will be a continued need to apply a context-sensitive approach toward any travel time threshold limitations. These should be considered as guidelines only, as there is no purely technical rationale for setting vehicular travel time thresholds. This is because vehicular travel time targets must be balanced against other community and strategic policy objectives. These include land use outcomes and improvements in the walking, bicycling, and transit networks to achieve mode shift and greenhouse gas reduction targets.
- The CDTM was undertaken on a limited budget, which necessitated addressing a limited number of key objectives and model time periods. To extend the CDTM's functionality and level of precision, as well as to use it for further tactical and operational analyses, additional ongoing resources will be required. Current understanding of needs suggests that an 'External Custodianship and Retainer' option would provide the City the most value for money.

1 Introduction

Mott MacDonald was engaged by the City of Port Moody (the City) to develop a Cumulative Development Traffic Model (CDTM). The purpose of the CDTM is to assess the effect that additional land use development throughout the city may have on the street network, and to discuss potential average trip time targets. To that end, the CDTM was developed as a mesoscopic-scale transportation model with several unique and project-specific objectives, which means that a regional (macroscopic-scale) model could not be directly used. As such, this report documents inputs that were necessary for the mesoscopic-scale CDTM including information from TransLink's Regional Transportation Model (RTM). The report also documents the modelling software platform selected to ultimately develop the CDTM, and how it may be maintained going forward. Finally, the report documents the model development process and outcomes, and summarizes the key findings.

1.1 Project Background

In late October 2021, Port Moody city council passed a motion to develop a model to better understand the effects of potential development on Port Moody's transportation system. The stated goal of the modelling project as per the motion is to "*enable a better understanding of the implications of potential land use development, and transportation policies, programs, and infrastructure, on traffic within Port Moody*."

The CDTM project has been undertaken in parallel with the City's Master Transportation Plan (MTP) update process that Mott MacDonald is supporting. The CDTM work may also inform the development of "Big Moves" in the MTP update, such that these two processes are intended to remain integrated. As well, the CDTM has been developed to avoid misalignment with MTP directions and the City's strategic objectives to shift vehicular traffic to sustainable modes.

1.2 Model Objectives

To support the overarching goal of the project, several initial objectives related to the development of the work and the CDTM were determined in consultation with City staff, as follows:

- Develop a model that requires fewer resources and less complexity than the Regional Transportation Model (RTM), such that it is not an RTM sub-area model.
- Avoid purely static approaches that are too limited, and instead pursue an approach that is capable of assessing transportation demand and behavioural changes dynamically and over time.
- Provide tactical and operational analysis outputs (such as, queue lengths, traffic signal timing updates and optimizations, and informing turning bay requirements) while enabling macroscopic level transportation demand redistribution (such as trip departure time, mode, or route shifts).
- Recommend potential average trip time targets during peak AM and PM periods on key streets, and other metrics related to an inclusive and healthy transportation system that align with the MTP Update directions.
- Potentially support the Master Transportation Plan Update and the development of "Big Moves" within that planning process.
- Provide output beyond traffic metrics to be inclusive of all main modes.
- Determine a model/software purchase and maintenance strategy.

2 Regional Transportation Model Review

The purpose of this section is to provide a review of TransLink's Region Transportation Model (RTM) to better understand how it links to a mesoscopic CDTM model in the City of Port Moody. The RTM provides outputs for three different time horizons, 2017 (typically used to represent existing conditions), 2035 and 2050.

The review highlights key inputs and parameters that may need to be considered, RTM land use inputs and how these align with existing land use development activity in the city, and the land use transportation relationship embedded in the RTM. As well, the review explores the RTM's EMME platform interoperability capabilities. As such, this includes a review of:

- The general structure of the RTM and the types of trips (trip purposes) it contains to better understand how it determines mode and routes choice dynamically.
- The Transportation Analysis Zones (TAZs) to better understand their scale and alignment with trip-generating land uses, and how or to what extent these trips can be directly used in the CDTM.
- The land use projections in terms of population and employment that are currently contained in each TAZ, and how these align with known development applications and intents in the City, such that the CDTM development accounts for these.
- The regional transportation flows currently output by the RTM and how they compare against traffic count data, to understand how and to what extent these can be used as direct inputs in the CDTM.
- The land use and transportation relationship embedded in the RTM to understand if and/or to what extent the RTM may be underestimating walkability and proximity benefits into the future, such that the CDTM can be adjusted using alternative modelling or analytical approaches.
- The EMME software platform's ability to tie into other software tools and export required inputs and outputs for use in software that may be used to develop the CDTM.

2.1 Background Information

The RTM was developed by TransLink to provide a 24hr modelling and forecasting tool for the Greater Vancouver Regional District (GVRD) and Fraser Valley Regional District (FVRD). The RTM is a travel demand multimodal macro transport model developed in Bentley's EMME software. Within the model (version 3.5) the following modes choices are available:

- Auto, single occupancy vehicles (SOV) and high occupancy vehicles (HOV)
- Commercial Vehicles (Light goods vehicles (LGV) and Heavy goods vehicles (HGV))
- Bus
- Rail
- West Coast Express (WCE)
- Active travel (walk and cycle) (not assigned[2])

[2] Active transportation trips are only generated and distributed in the model, meaning that the model is capable of estimating how many active transportation trips may start and end in certain areas, but not which streets or facilities they use to travel.

It should be noted that transit matrices are hierarchical, so if any part of a trip uses the WCE for example, the whole trip appears in WCE matrices; and then if any trip uses Rail the whole trip appears in Rail matrices and the rest of transit demand is assigned to bus.

The model time periods represent peak hours:

- Morning Peak (AM) – 07:30-08:30
- Midday day (MD) – 12:00-13:00
- Evening Peak (PM) – 16:30-17:30

There are 9 vehicle classes assigned to the highway network which include four Value of Time (VOT) parameters:

- Single Occupancy Vehicles VOT 1
- Single Occupancy Vehicles VOT 2
- Single Occupancy Vehicles VOT 3
- Single Occupancy Vehicles VOT 4
- High Occupancy Vehicles VOT 1
- High Occupancy Vehicles VOT 2
- High Occupancy Vehicles VOT 3
- High Occupancy Vehicles VOT 4
- Light Good Vehicles
- Heavy Goods Vehicles

There are three Transit user classes

- Bus
- Rail
- WCE

The value of time (VOT), a key behavioural parameter in the model, is based on trip purpose and income demographics. This means that user classes are provided as a range of trip purposes and incomes which relate to mode choice and single-occupancy vehicle route choice, as shown in **Table 2-1** below. The model can produce detailed segmentation during mode choice, which facilitates different behavioural responses among different income demographics from a network or policy intervention. These parameters allow the RTM to be dynamic in the sense that it can redistribute trips along different modes and/or routes.

Mesoscopic models typically do not incorporate these behavioural parameters. As well, mesoscopic models typically simplify the number of user classes, compared to those shown in **Table 2-1**.

Table 2-1: Value of Time by trip purpose and income used in the RTM

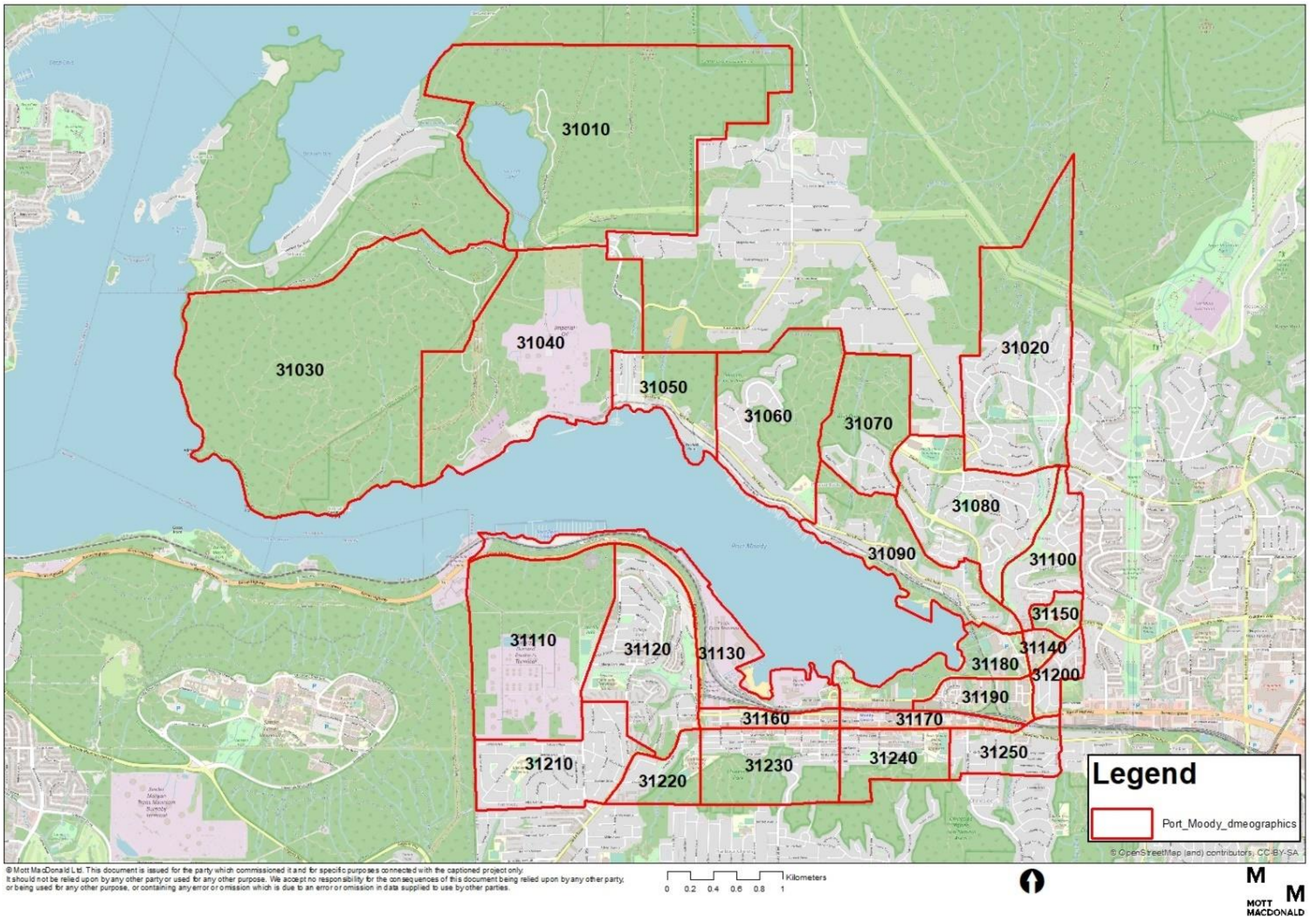
VOT Bin	Trip Purpose	% of Auto Trips	Income	Mode Choice VOT ($/hr)	SOV Assignment VOT ($/hr)
1	HB School	5%	All	5.0	6.3
1	NHB Other	13%	All	6.3	6.3
1	HB Shopping	3%	Low	8.2	6.3
2	HB Shopping	3%	Medium	8.2	10.3
2	HB Social	3%	Low	9.0	10.3
2	HB Personal Business	2%	Low	9.6	10.3
2	HB Personal Business	3%	Medium	9.6	10.3
2	HB Escorting	12%	All	10.0	10.3
2	HB University	3%	All	10.8	10.3
2	HB Work	3%	Low	11.2	10.3
2	HB Personal Business	2%	High	11.9	10.3
2	HB Social	5%	Medium	17.4	10.3
3	HB Shopping	3%	High	14.6	15.5
3	HB Work	9%	Medium	15.6	15.5
3	NHB Work	10%	All	15.7	15.5
3	HB Social	6%	High	17.4	15.5
4	HB Work	13%	High	18.2	18.2

* HB: home based trip – for trips that start at residents' homes in the region, NHB: non-home based trip

2.2 RTM TAZ System

The RTM Transportation Analysis Zones (TAZs) zoning system was designed to have realistic zoning for the network, meaning that they align with other structural features such as streets and general land uses, as well as with census-defined unit boundaries.. These TAZ sizes differ with population size and employment. For a sense of scale,the average TAZ in the RTM represents 1700 people and 900 jobs. In Port Moody there are 25 zones covering the municipality. These are show in **Figure 2-1** below.

Figure 2-1: Port Moody Zoning System



2.3 Land Use Demographics

To generate the demand and trip purpose for each zone, the model includes known or projected population and employment information for each TAZ. **Figure 2-2** and **Figure 2-3** show the total population and total employment for 2017.

Figure 2-2: 2017 Total Population for TAZ zones in Port Moody

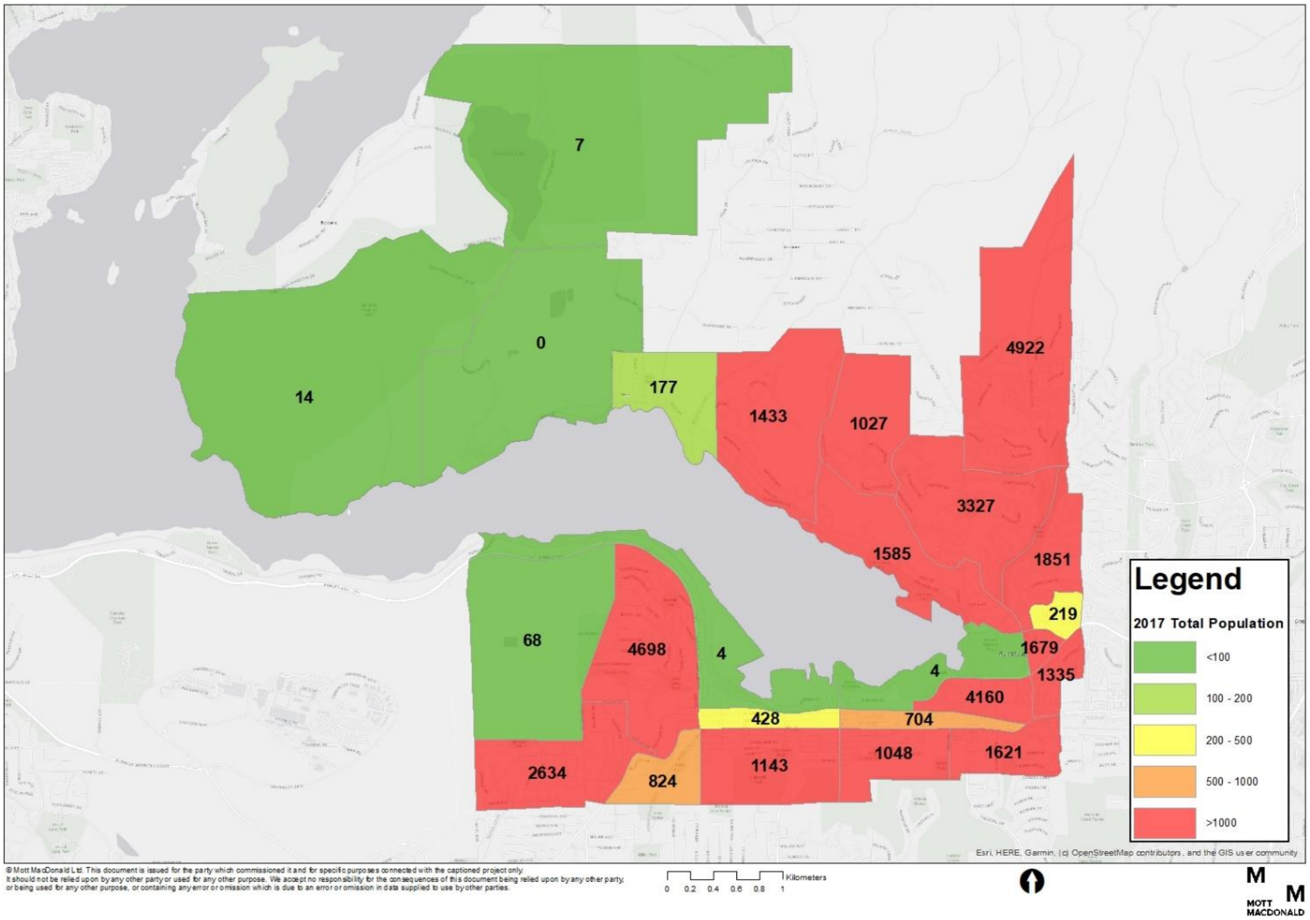
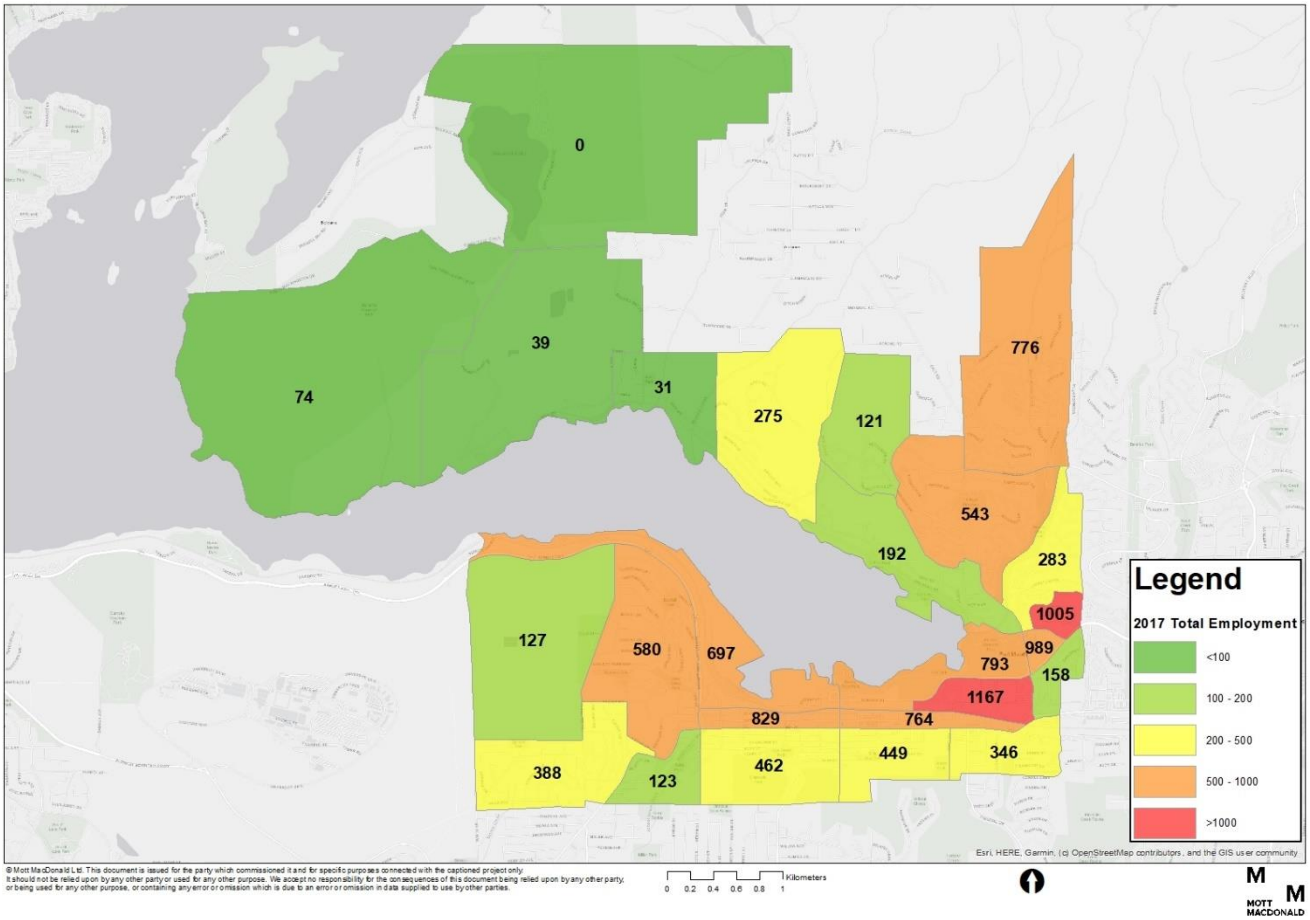


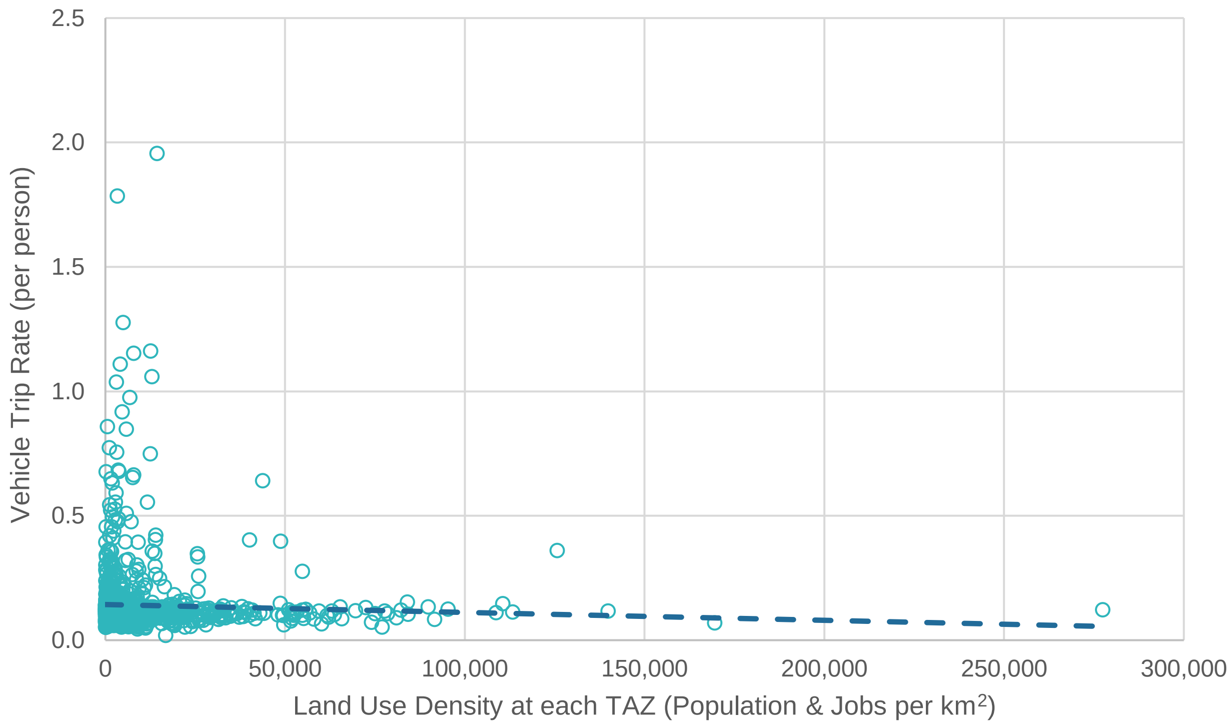
Figure 2-3: 2017 Total Employment for TAZ zones in Port Moody



2.4 Land Use Relationship

The main land use characteristics used in the RTM include the population, the number of jobs, and the number of education opportunities per each TAZ (as previously noted above). The RTM embeds the relationship between high-level land use characteristics and trip generation, including trips by vehicles. This relationship can be assessed more closely, as shown in **Figure 2-4** below. In the figure, the density is represented by a combined metric of jobs & population per area to account for mixed land uses.

Figure 2-4: Density Relationship with Vehicle Trips per person (AM Peak - 2017)



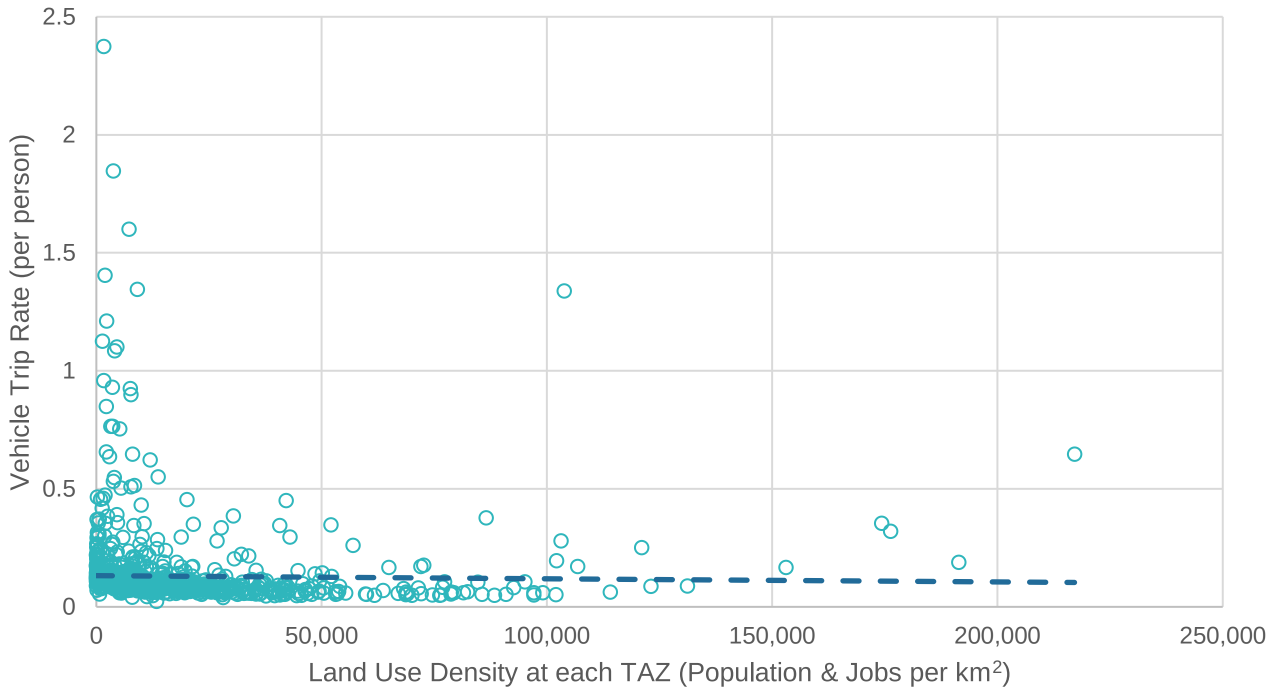
It is clear from the figure that vehicle trip rate can be highly variable, particularly in lower population zones, and are dependent on factors beyond land use alone. The variability is also a function of the amount people living in a zone, where these zones are generating vehicle trips through land uses with a high proportion of jobs or schools relative to the zone population. Noting these details, the figure nevertheless indicates that areas in the region that have a higher concentration of jobs and population tend to have lower vehicle trip generation per person. This is consistent with considerable previous academic study[3]. This means that for a given number of jobs and population in a wider community, spreading them out over a larger area will create more vehicle trips. More vehicle trips leads to more regional congestion overall; however, it may be that increased density in some areas contributes to more localized congestion.

The same information as shown in **Figure 2-4** can be assessed for the year 2050[4] with updated land uses that reflect Metro Vancouver population & growth projections. This is provided in **Figure 2-5** below.

[3] Litman 2022 *Land Use Impacts on Transportation* documents recent studies on land use and transportation interactions, noting decreases in vehicle kilometres travelled and number of vehicle trips as density increases.

[4] The 2050 time horizon is used here instead of the 2035 to better highlight the changing relationship over time.

Figure 2-5: Density Relationship with Vehicle Trips per person (AM Peak - 2050)



The key point to note when comparing the above two figures (2017 & 2050), is that for TAZs that continue to show large density growth, the projected vehicle trip rate also increases (goes up in the y-axis). However, the 2017 model information, which is validated against actual conditions, suggests a relationship that sees vehicle trip rates declining slightly with increased density. This suggests the RTM may be overestimating the impact of land use density with regards to vehicle trip generation, and underestimating walkability benefits. It is beyond the scope of this study to review the trip generation parameters and formulae used to develop the model. It is also not the intent to portray the RTM as incorrectly developed. Instead, this comparison highlights the limitations of projecting existing conditions considerably into the future, particularly when it comes to something as complex as the interaction between land use and transportation. This is also one of the main reasons for developing a mesoscopic model and supportive tools that are catered to address some of the main policy and technical questions of interest to the City.

2.5 Land Use and New Development

The RTM captures the growth in each TAZ based on development assumptions provided by the regional municipalities, including Port Moody. This section compares the growth in population and employment of the RTM TAZs from 2017 to 2035 to the known large-scale land use developments in Port Moody. **Figure 2-6** and **Figure 2-7** below show the RTM growth in absolute terms (the number of people and jobs) and percentage from 2017 to 2035. Several areas indicate a significant relative drop in population; however, this is due to the very low initial populations currently in those areas. The actual drop in population in those areas is negligible with respect to transportation modelling.

Figure 2-6: 2017 to 2035 population change in Port Moody

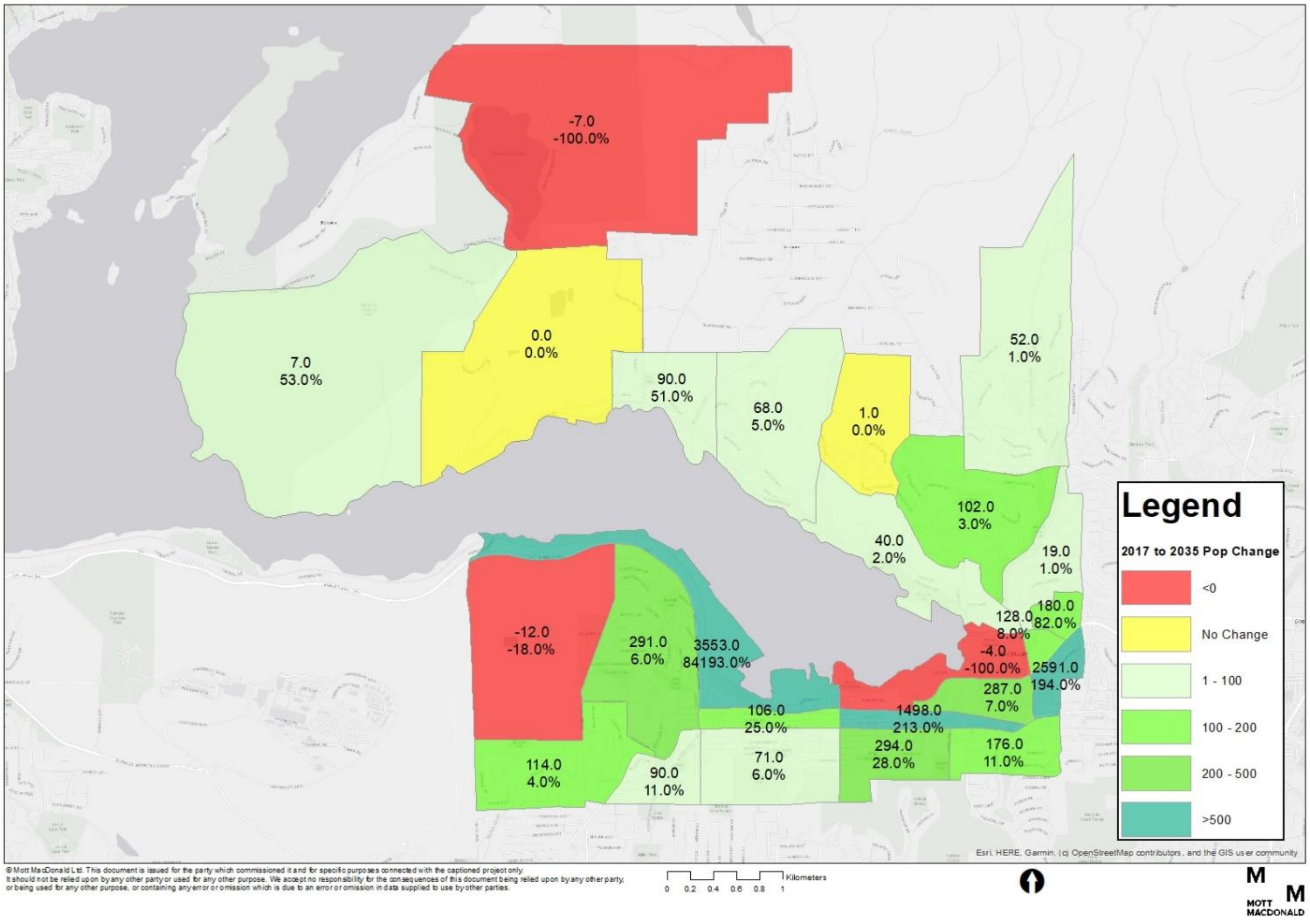
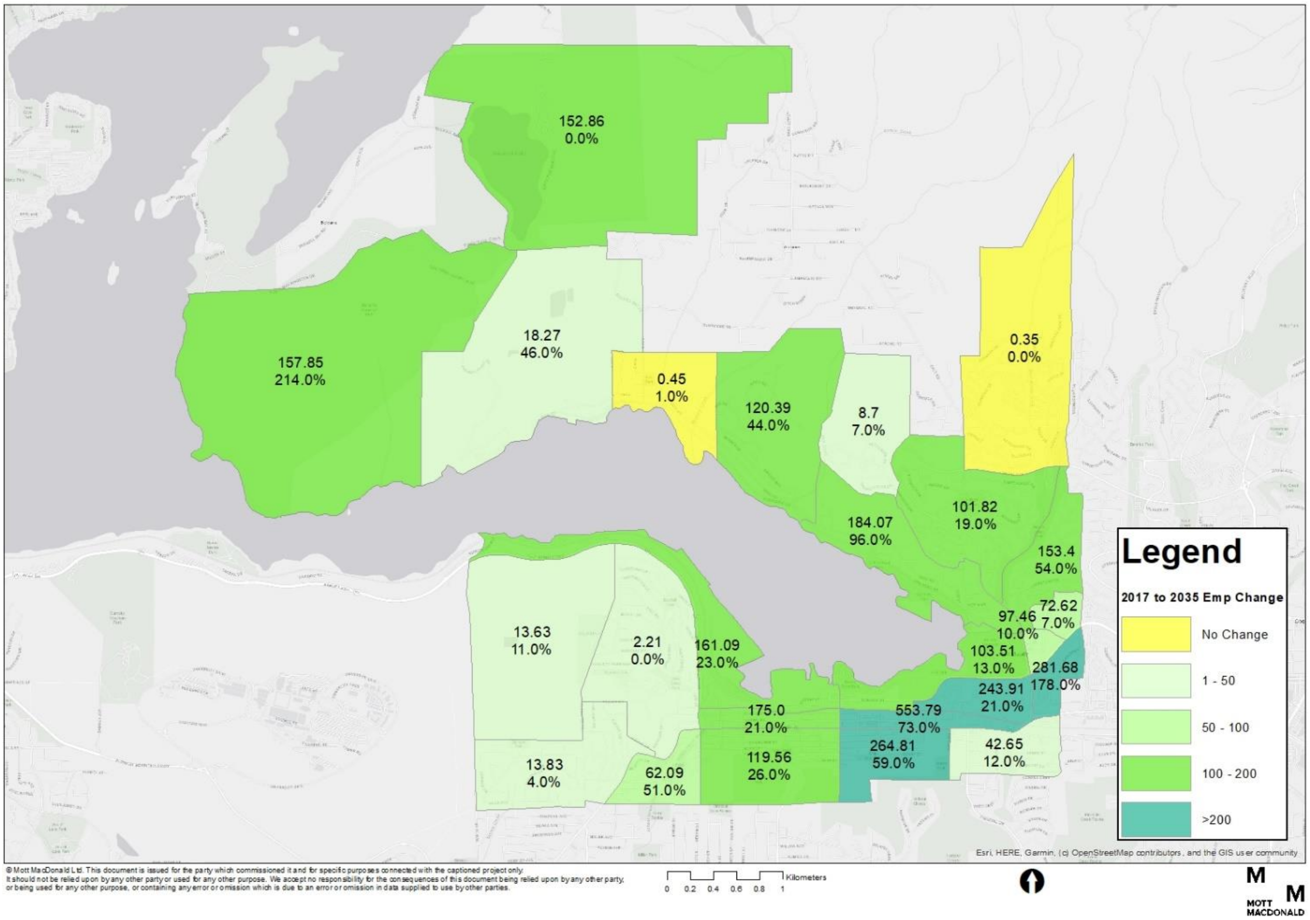
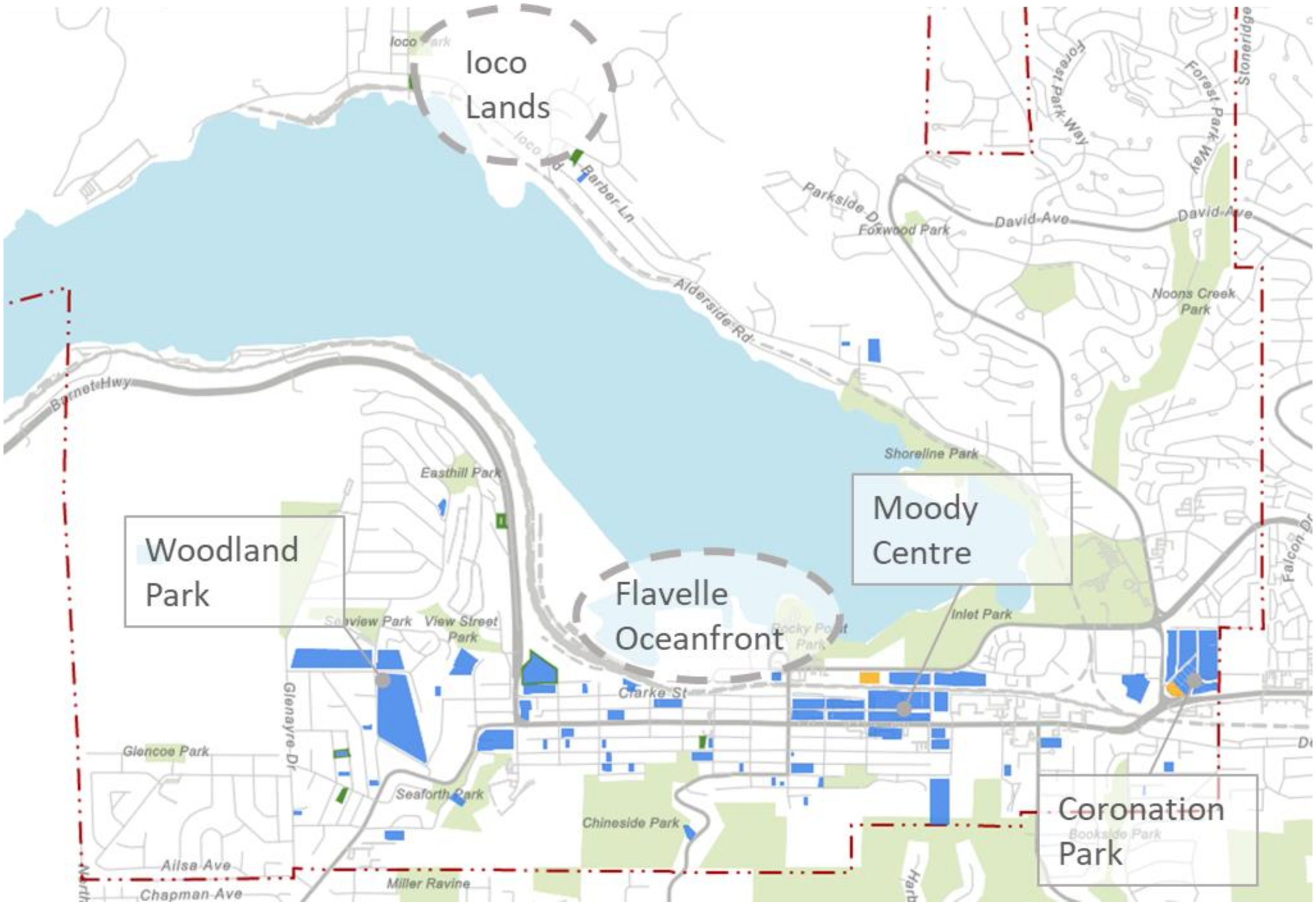


Figure 2-7: 2017 to 2035 employment change in Port Moody



Port Moody keeps an interactive map of current land use development applications. A screenshot of this map as well as annotations indicating known large-scaled developments is shown in **Figure 2-8** below.

Figure 2-8: Map showing current development applications in Port Moody



As noted earlier, the RTM's land use inputs are provided to TransLink by Metro Vancouver, who in turn compiles this information from constituent municipalities based on their OCPs and ongoing land use planning activities. These inputs have been updated recently by the regional agencies. As such, the population growth in the TAZs are assumed to generally align with known development applications and intents. Key developments and potential discrepancies are noted here:

- Moody Centre and Coronation Park (two major developments) align with the growth projections in the respective TAZs.
- The Flavelle Oceanfront development is reflected in the 2035 TAZ land use inputs, although it is not shown in the development applications map – this is because there is current application; however, it is approved in the Metro Vancouver Regional Growth Strategy.. We recommend retaining this in the CDTM model.
- The Ioco Lands development on the north side of Burrard Inlet is not accounted for in the TAZs and is not shown on the development map.
- Woodland Park is a major development with an active application that is moving forward. This development was unaccounted for in the 2035 TAZs. As such, it was identified for inclusion in the CDTM model development, including its new road connection.

The employment increases in some of the TAZs within the City appear to be natural and reflect an ongoing growth in jobs. There is significant growth in jobs in the city centre, which is expected.

2.6 Model Flows

The RTM highway (vehicle) and transit flows are shown in **Figure 2-9** to **Figure 2-12**. This covers both AM and PM. The plots show high level of flow on major roads as expected. **Section 2.7** shows comparison with counts collected by Port Moody.

Figure 2-9: AM Highway flow from the RTM

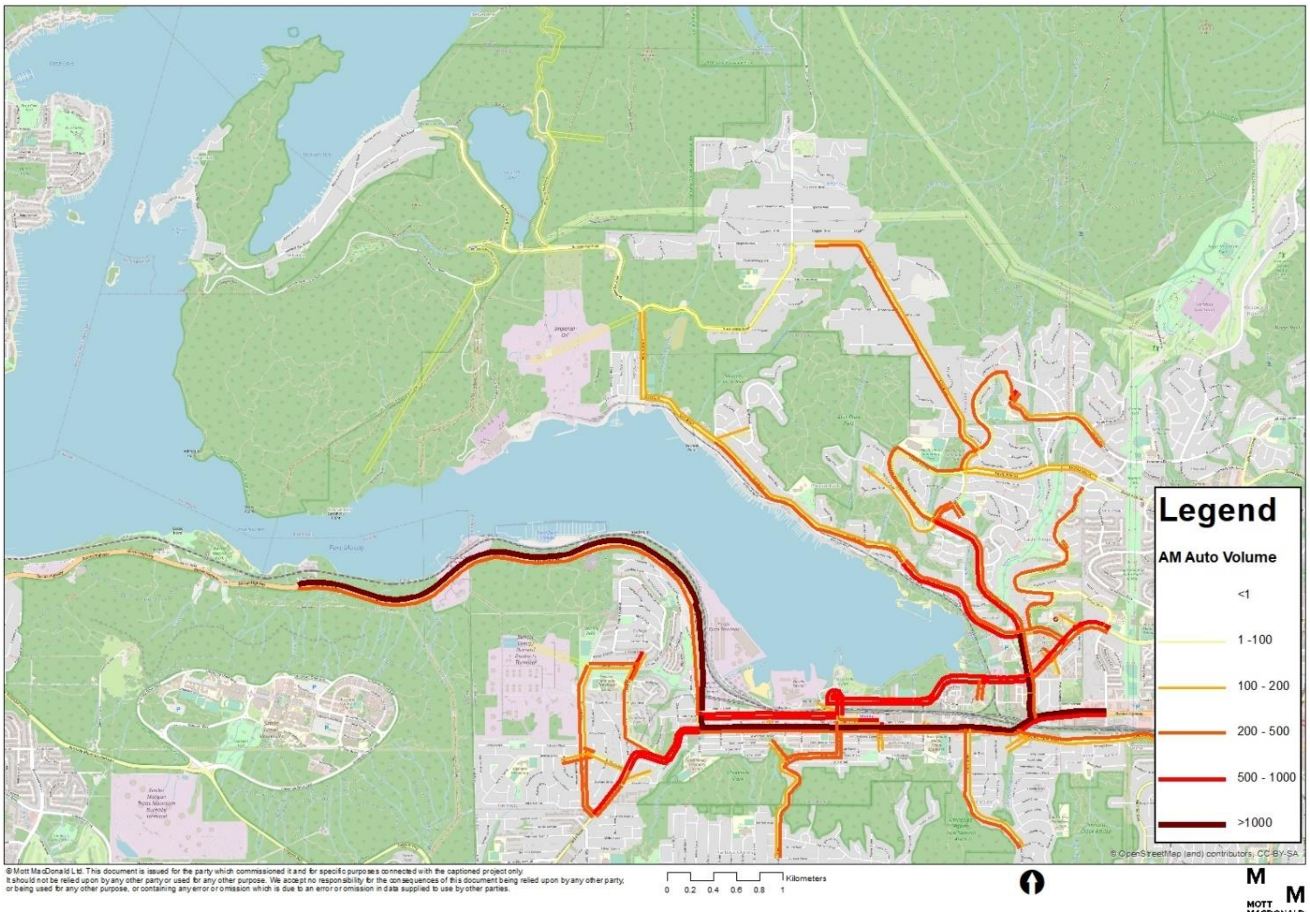


Figure 2-10: PM Highway flow from the RTM

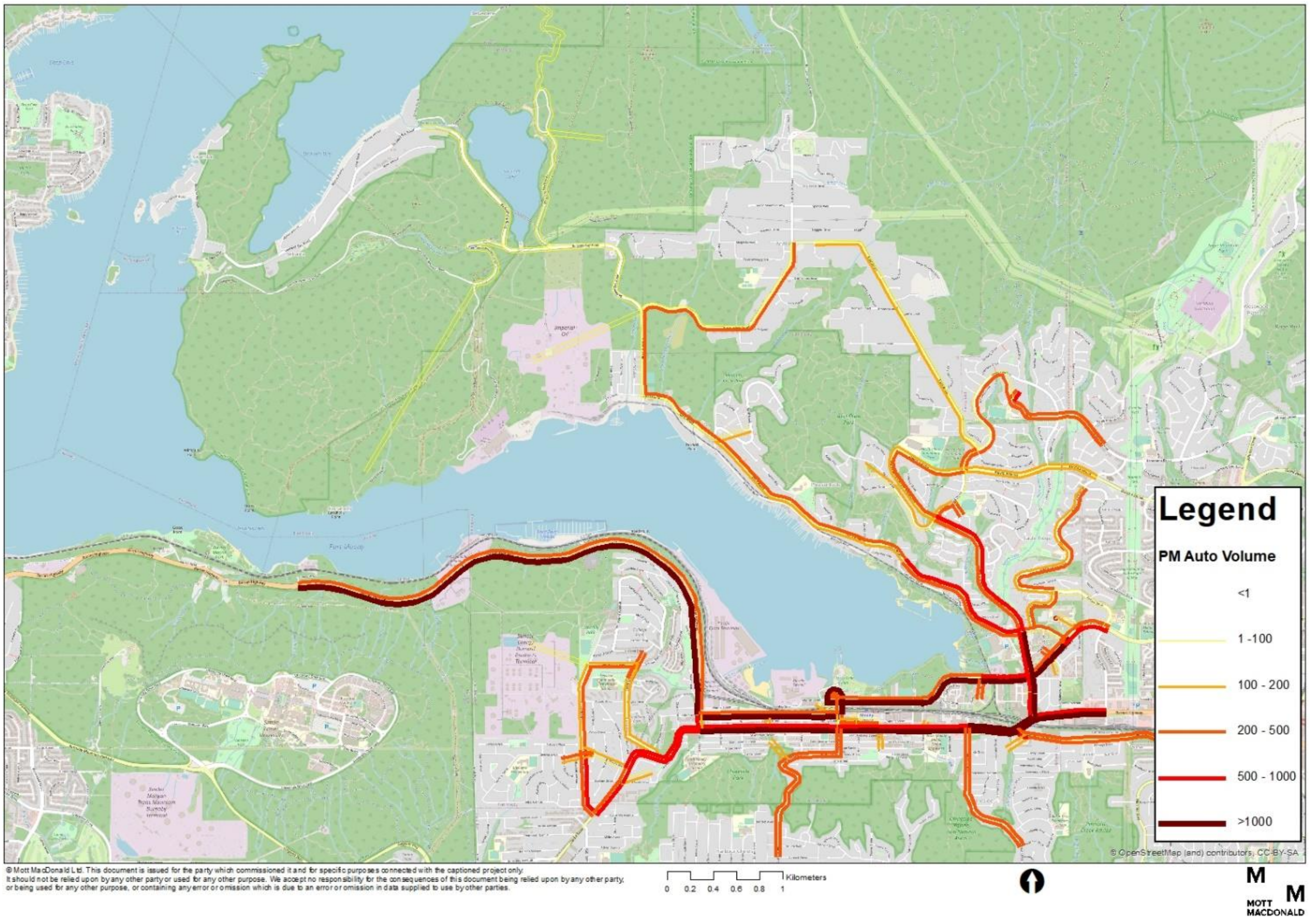


Figure 2-11: AM Transit flow from the RTM

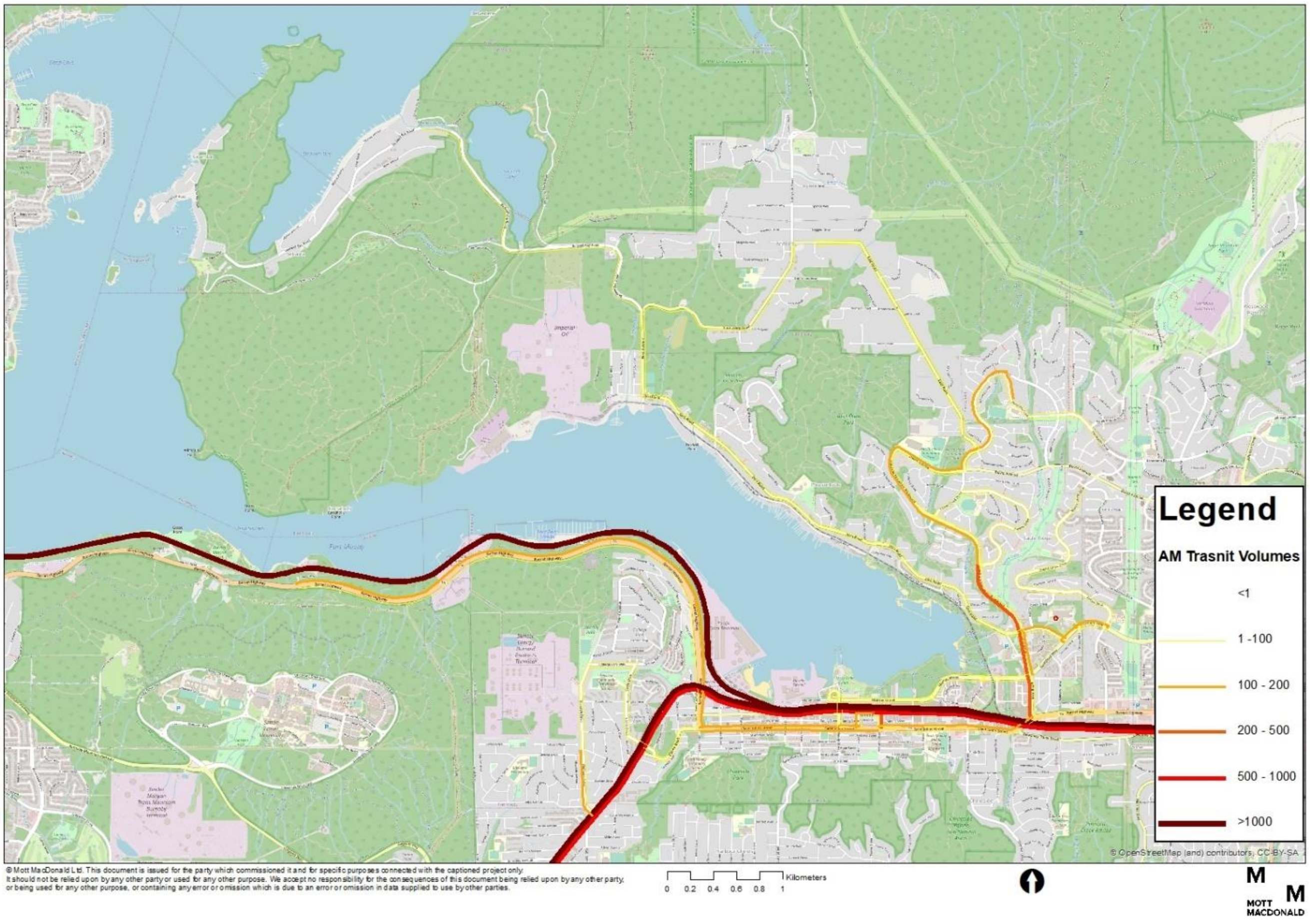
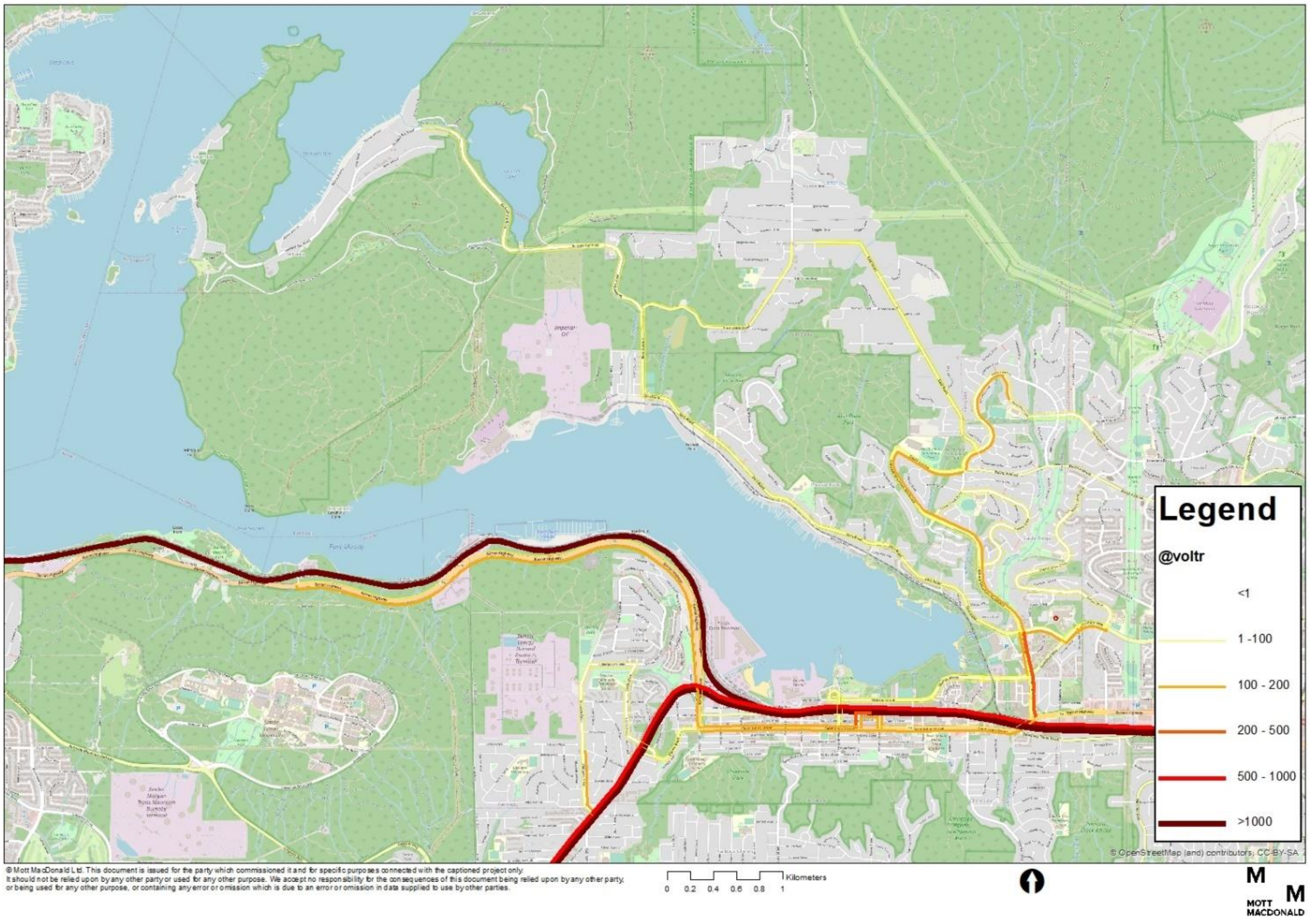


Figure 2-12: PM Transit flow from the RTM



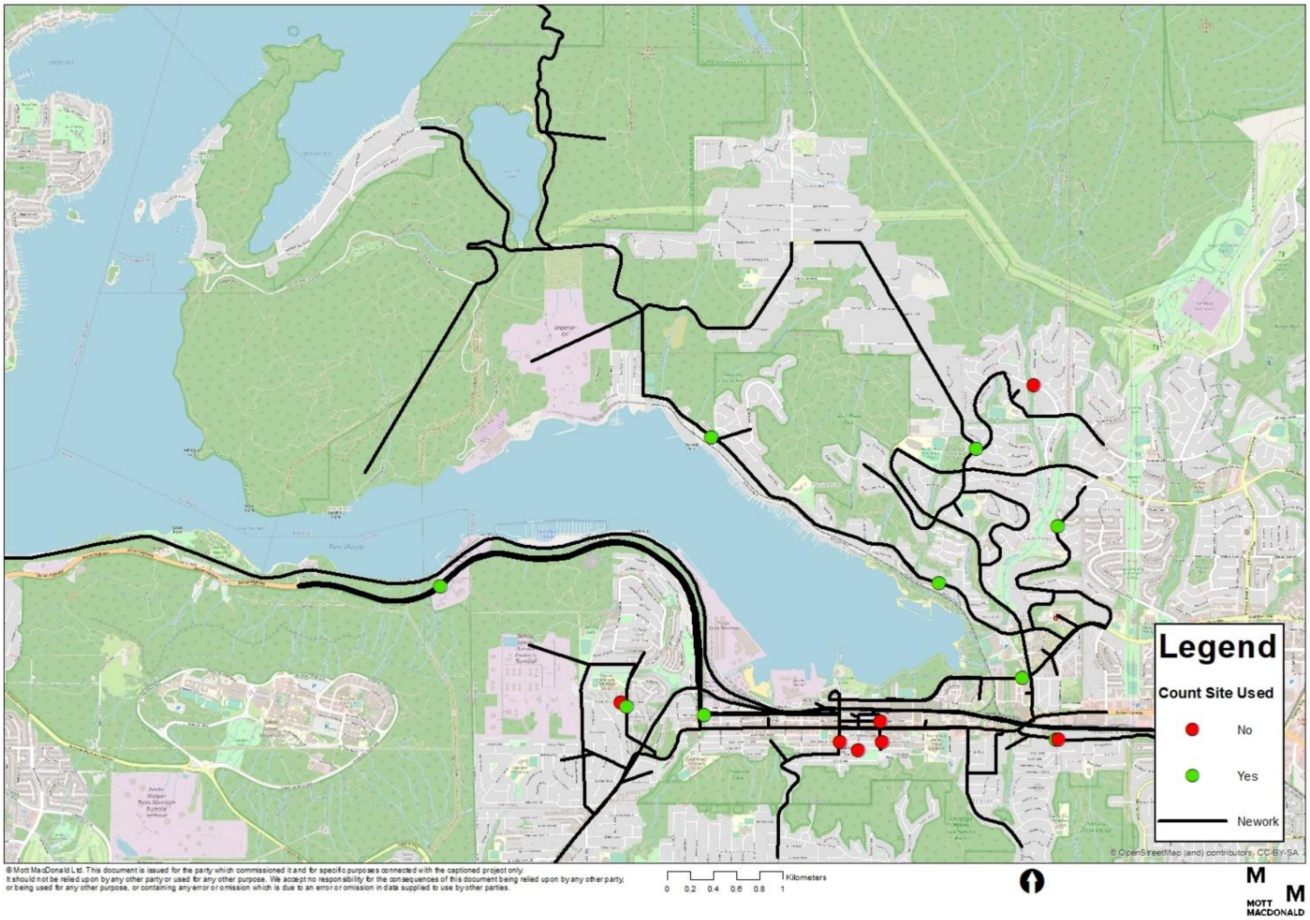
2.7 Model Flow Comparison with Count Data

The RTM original baseline was based on 2011 inputs and was calibrated and validated using data from 2011. A new 2017 RTM baseline was developed using the latest 2017 trip diary data. TransLink also conducted new screenline surveys in 2017 as shown in **Figure 2-13** below. The plot shows a screen line east and west of Port Moody but no counts within the boundary of Port Moody.

Figure 2-13: Screenlines from the RTM 2011 and 2017

The City has provided historic count data from 2017 and 2018, with the count locations shown in **Figure** below.

Figure 2-14: Port Moody count locations used



These counts were compared against the RTM model flow and shown in **Table 2-2** below, including a GEH[5] statistic for each comparison. GEH is a measure of percentage change that reduces the influence of a low sample size or comparison value. This allows comparison of counts on major highways and minor roads that have significantly different levels of traffic. A GEH of less than 5% for a count comparison location is considered a pass. Good overall compliance is achieved when 85% of count locations achieve a GEH of less than 5%. Several caveats are noted here: Because the peak model time period are on the half hour, the average of 7:00-9:00 and 16:00-18:00 count flow was used. The counts were also taken from a variety of months (April, July, September, and November) and years (2017 and 2018) without using a factor to convert to RTM 2017 neutral month.

Table 2-2: Number of count sites passing below a GEH of 5%.

Time Period	Total Count site	Number of Count Site Passing (GEH <5%)	% Passing
AM	18	8	44
MD	18	6	33
PM	18	5	28

[5] Named after its inventor Geoffrey E. Havers

The count compliance (less than 5% GEH) was found to be poor. This is one reason an RTM subarea model of the City would pose additional challenges, reinforcing the need for a bespoke model. This also suggested that the development of the mesoscopic model would need to undergo matrix estimation, rezoned, or provided with additional network modifications to better reflect observed conditions.

2.8 EMME Model Interoperability

The RTM is modelled in EMME v3.5. EMME builds its networks, transit systems, timetabling from text files. The RTM has a rich amount of network and demand information such as link speed, link distance, demand by segmentation and transit timetables. An issue with the network information is that EMME uses volume delay function (VDF) and TPF (Turn penalty function) defined in minutes. These are insufficient for mesoscopic modelling, and greater intersection detail (number of lanes turning, length of flares, signal timings) was identified as a need for the CDTM after importing the Emme Network.

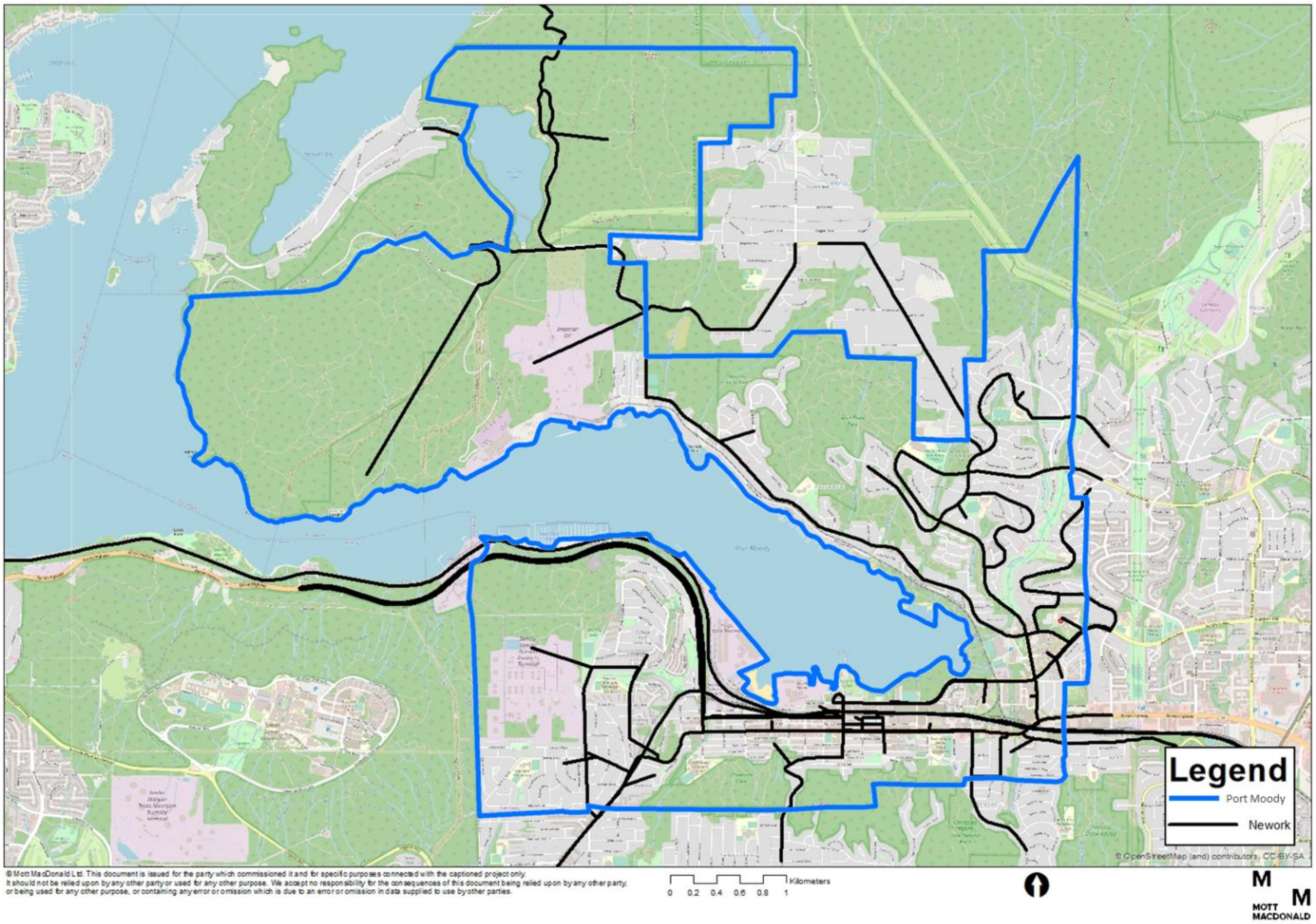
Many mesoscopic modelling software packages have import functionality from EMME. If the chosen software package does not have a direct import function from EMME, the text files EMME uses may have enough detail for links details. Matrices can be exported in a range of different formats and file types.

EMME allows its network to be cordoned using a subarea process. This process cuts the network along a boundary. Where a road meets the boundary, a zone is added, inbound and outbound traffic is then converted into a matrix. During the assessment of the RTM the boundary defined was based on the boundary of the city of Port Moody shown in **Figure 2-15** below. While the CDTM is not a subarea of the RTM, this boundary provides an effective starting point for producing demand and supply for the model. The boundary can be expanded if required in the future.

The network coverage in the RTM covers all the major roads within Port Moody. However, these major roads (ie Barnet Highway) have several intersections not represented in the RTM.

As such, this review found that additional network detail and rezoning is required as part of the CDTM development.

Figure 2-15: Map showing the Subarea of the RTM based on Port Moody boundary



3 Alternative Land Use & Transportation Model Approaches

Section 2.4 above noted a limitation with the RTM (and modelling software packages generally) with respect to forecasting land use & transportation interactions into the longer-term future: existing tools typically underestimate walkability and proximity benefits and overestimate the vehicle trips generated by denser land uses. Several tools have been developed in recent years to contribute to closing this limitation gap. This section explores these at a high-level and suggests how they may be used alongside the main CDTM to complement or directly factor growth horizon transportation volumes.

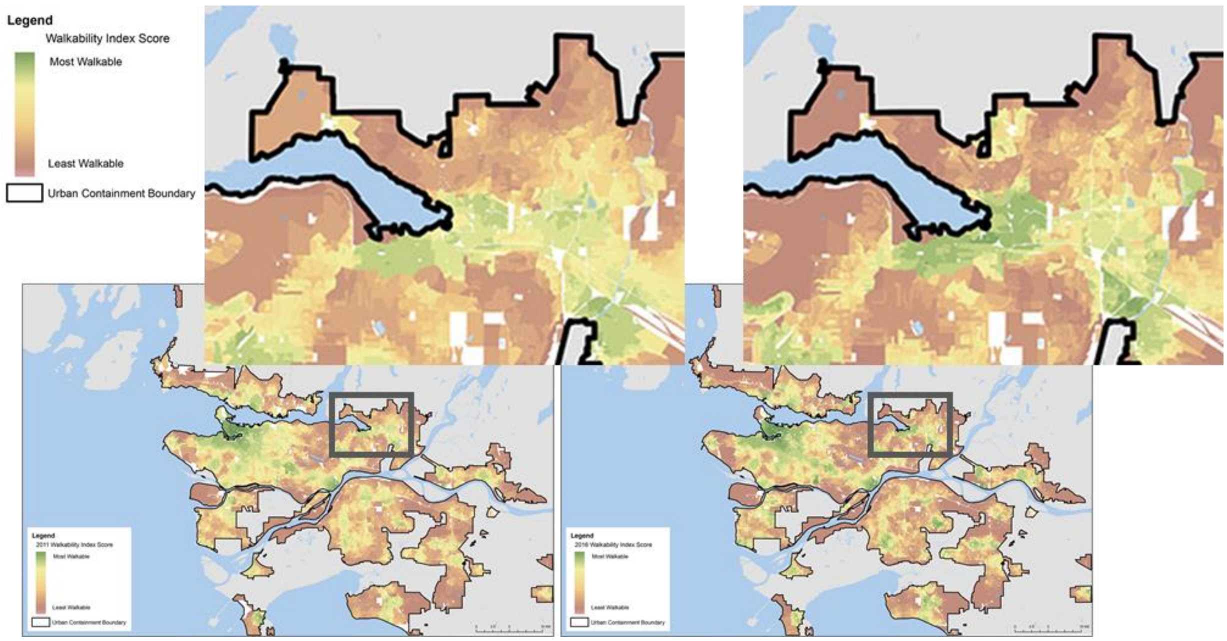
3.1 Walkability Analysis

The Walkability Analysis developed by UBC's Health and Community Design Lab provides a model of "walkability" throughout the region. It uses five factors to develop a walkability index, the first three of which pertain to land use intensity:

- residential density
- commercial floor area
- land use mix
- intersection density
- sidewalk completeness.

The walkability index was developed against walking outcomes, meaning that the more walkable areas as measured by the above factors closely correlate to walking outcomes. **Figure 3-1** illustrates the level of walkability in the region and Port Moody in 2011 and 2016. The level of walkability closely aligns with the denser areas of Port Moody and those with higher walking mode shares. As such, the index can be directly related to walking mode shares to develop a "sketch" model. In turn, this sketch model could be used to estimate walking outcomes from land use impacts over time.

Figure 3-1: Walkability in 2011 & 2016[6]



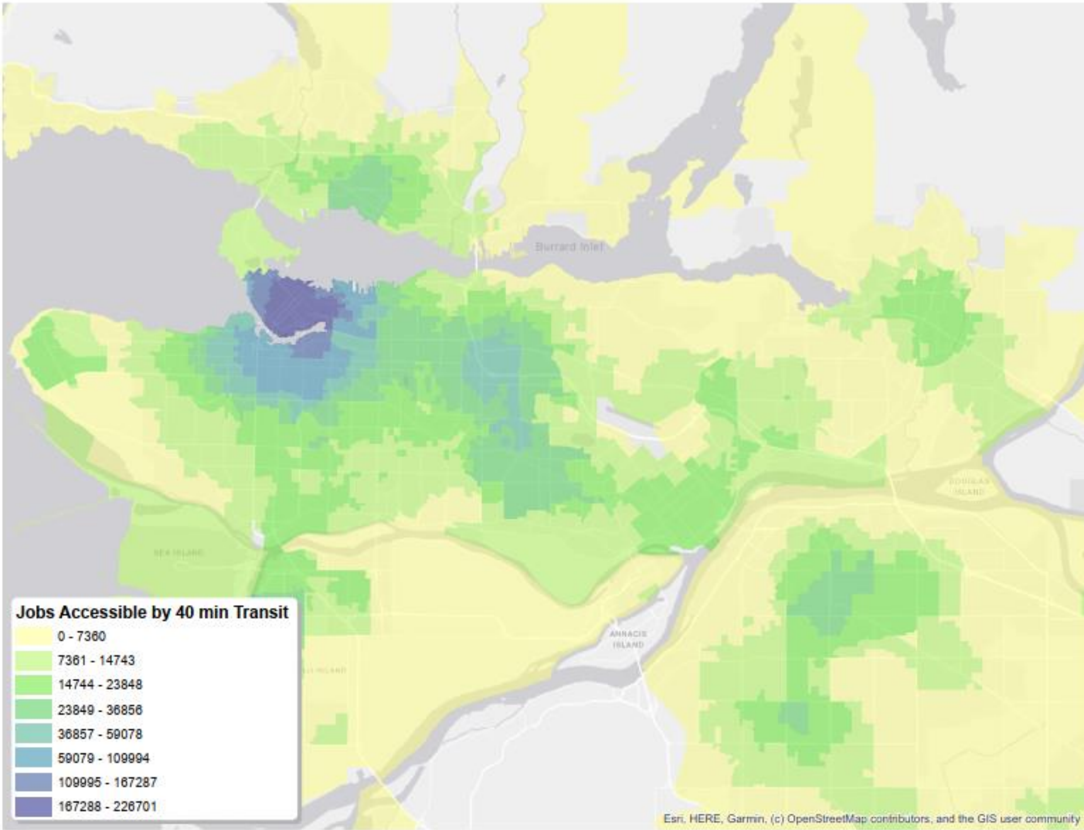
Relating the walkability index to mode share outcomes is beyond the scope of this memo, as this would require a data agreement with Metro Vancouver and UBC. As well, the walkability index presents several additional challenges. It has been developed to capture walking outcomes. It is less clear how it relates to sustainable mode shares as a whole. It is also data intensive requiring detailed land use knowledge, which typically cannot be estimated many years in advance, i.e., the City is unlikely to have information on what the commercial floor area or land use mix will be in a given area 20 or 30 years into the future. This suggests the tool is better used as a performance indicator—as is the intent for Metro Vancouver—as opposed to a forward-looking estimation tool.

3.2 Accessibility Analysis

A destination accessibility (aka access to opportunities) model can also be used to relate land use and transportation outcomes. This approach was explored in this study at a high-level, with the results shown in **Figure 3-2** below. Access modeling is increasingly used in contemporary transportation planning practise to better reflect the underlying reason why people travel – to access opportunities such as jobs, services, recreation areas, and other activities. It also explicitly accounts for land use and transportation simultaneously. If the objective is to increase access to opportunities (in line with TransLink's Transport 2050 Vision), then it expands the potential policy measures to include land use changes in lieu of, or complementary to transportation network improvements. For clarity, this means that access (to opportunities) can be increased purely by intensifying land uses with more and varied uses, which limits the need for residents to travel longer distances.

[6] Adapted from source: Walkability Index (metrovancouver.org)

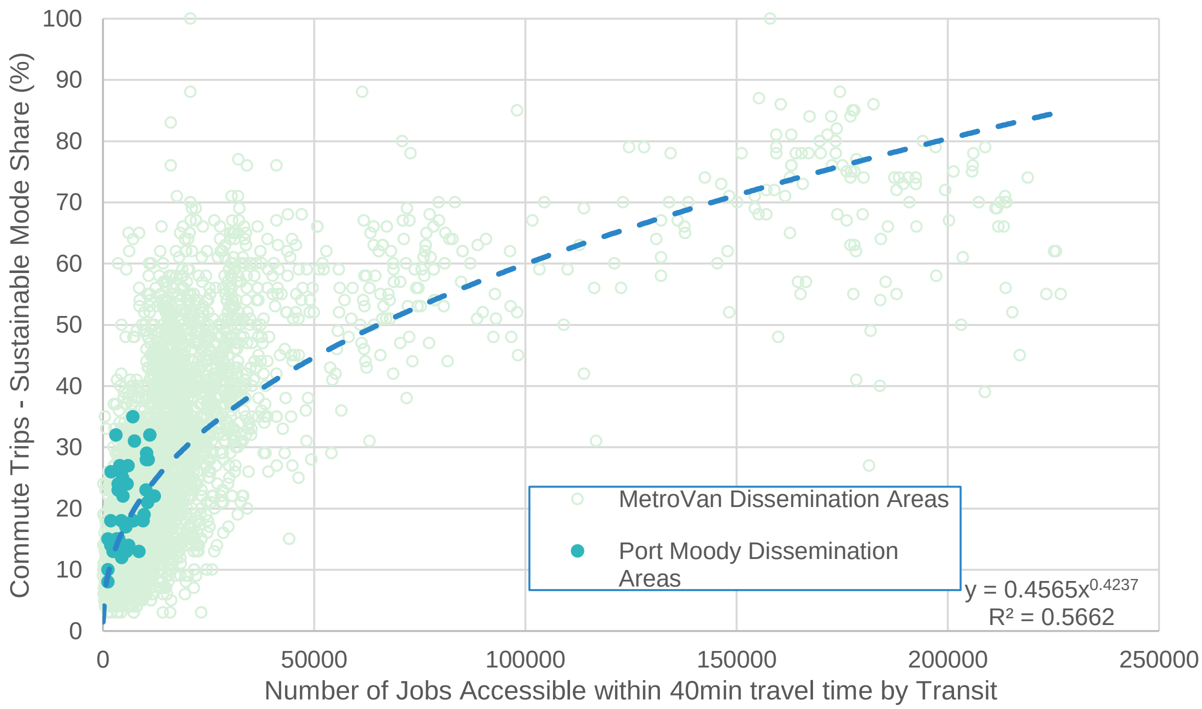
Figure 3-2: Access to Jobs by Transit in 2016[7]



The access levels in **Figure 3-2** are measured for each dissemination area. These are then set against the sustainable mode shares for each dissemination area to provide a graphical representation of the relationship between access levels and sustainable mode share outcomes to form a "sketch" model (**Figure 3-3** below).

[7] This is prior to the opening of the Evergreen Line and implementation of several B-Lines / RapidBuses.

Figure 3-3: Relationship between Destination Accessibility and Sustainable Trip Making



The results of a high-level access model show a close relationship between access levels and sustainable mode share for commuting trips. It is important to note that the access analysis also accounts for walking trips—to transit or job opportunities themselves. As such, the measured outcome (the dependent variable) in the analysis is for all sustainable modes, not only transit[8]. This sketch model indicates that an increase in access by sustainable modes will result in improved sustainable mode share outcomes, and subsequently less vehicle trips.

The City has a strategic goal to increase its all day transportation mode share from 17% to 40% by the year 2030. The Master Transportation Plan update is intended to develop Big Moves to reach this goal. The accessibility sketch model above illustrates that to reach this goal, the City will need to continue improving access by sustainable modes in one of two general ways:

- Increased land use close to transit or other sustainable mode facilities
- Significant improvements in the sustainable transportation mode network

The accessibility sketch model developed here is high-level in nature yet is robust in its concept, such that it can be applied in further work. Compared to the walkability index, it has the benefit of requiring less data, and can be used to estimate the impacts from land use changes using inputs from the RTM horizons.

This accessibility sketch model is intended to complement the CDTM, and should be considered by the City more generally as part of ongoing transportation planning efforts. It provides further insight into the broader transportation system, including sustainable mode outcomes, and better aligns the transportation system metrics with the City's strategic transportation goals.

[8] This non-linear relationship as shown in the figure has been established in previous academic work (see Cui et al 2020, Accessibility matters: exploring the determinants of public transport mode share across income groups in Canadian cities). This work also noted that at a certain level of transit accessibility, transit mode share did not increase, but that sustainable mode share as a whole would continue to do so, due to higher active transportation use. Therefore, overall sustainable mode share is used in this sketch model.

4 Model Development Review

4.1 Software Platform Comparison

The CDTM requires a software package that is capable of performing mesoscopic scale modelling. A mesoscopic model provides more detailed traffic interactions (individual cars modelled) and better range of time than a macro model but is far more scalable than a micromodel. Micro models are typically used for detailed intersection analysis consisting of a few intersections. They are also far more data intensive than mesoscopic models. The software should have the ability to dynamically assign traffic (DTA). Some software packages will be able to handle multi modal inputs, including auto, commercial, and transit. However, the ability for typical commercial software packages to adequately model active travel remains limited.

This section of the report discusses each of the different software platforms available. It outlines:

- The ability to provide the capabilities being sought for the model.
- The software interaction with EMME.
- Cost.
- Useability.
- Local familiarity and expertise in the lower mainland.

Note that software prices reflect budgetary estimates that are typical for consultant use. Public agencies, including the City of Port Moody may receive a discount from vendors, and actual prices for most software packages are negotiated on a case-by-case basis.

Table 4-1: Description of potential software platforms.

Software	Brief Description	Cost
Vistro	Vistro is a deterministic mesoscoping modelling tool developed by PTV, who also produce macro and micro modelling software. It is uses static demand, and is often used to analyze development impacts, local-scale networks, and individual intersections, and can be used to optimize specific routes, by taking model flows to optimize signals on a corridor. Vistro does not have the built-in ability to dynamically assign traffic. Vistro requires the input of trip generation and routing before running the model. Vistro has no import from Emme but can import from PTV Visum, PTV Vissim and Synchro. Vistro has gained more popularity in recent years, but is not ubiquitous among consultants or municipalities.	$2,900 per year.
Synchro / SimTraffic	The Synchro / SimTraffic software package is produced by Trafficware. The Synchro portion of the software is deterministic, and the package as a whole uses static demand. SimTraffic facilitates high-level microsimulation. It does not have the built-in ability to do dynamic assignment of traffic. The Synchro/SimTraffic package is used ubiquitously in North America for traffic analysis, development impacts,	Depending on the exact license, costs from $2,500 to $6,500, with the recommended license size costing approx. **$3,300** incl 3 years of support

	signal optimization. Effectively all consultants and many municipalities have a Synchro / SimTraffic license.	
Visum SBA	Visum Simulation Based Assignment (SBA) can convert regional flow inputs into more detailed flows at a local level to dynamically assign traffic (redistribute in time and route), within one platform. SBA simulates individual vehicles using a simplified car following model, and can model a level of detail that sits between traditional microsimulation and macro models. While Visum is typically a macro modelling tool, Visum dynamic assignment module (SBA) is an add-on to the PTV modelling platform Visum, giving Visum the ability to function as a mesoscopic modelling tool. One advantage of SBA is the ability to view the simulation to observe the progression of traffic and congestion over time, as well as create outputs that are produced by traditional macro modelling platforms. Visum allows for the importing of Emme matrices and networks. However, the Emme networks lack of detailed intersection coding would mean additional network coding would be required. Another feature is the ability to use dynamic matrix estimation in model calibration: a matrix estimation procedure that works with the dynamic assignment. If count data is available at suitable intervals (e.g. 15 minute intervals), matrices are automatically adjusted to match the traffic profiles over time, as well as the total volume of traffic. There is good linkage to other PTV products including Vissim, Viswalk and Vistro to do further micro simulation and operational analysis. PTV Visum is currently used for occasional applications in the lower mainland and BC. There is a reasonable practitioner-base locally, and the skillsets exist within Canada and globally.	Consultant price: $19,000 ($11,500 base + $7,600 for SBA) With a government agency discount, total price is $7000 These prices are per year, PTV operates on a subscription model with no perpetual licences
Vissim	Vissim is typically used to undertake microsimulation analyses, but also provides a hybrid mesoscopic capability including dynamic assignment at a detailed level. Vissim mesoscopic simulation takes place within the same modelling platform as microsimulation analyses, but a simplified vehicle following model is used in order to reduce runtimes for dynamic traffic assignment on large networks with parallel routes. Vissim has no functionality for importing a network directly from Emme. However, origin-destination matrices produced by Emme can be imported into Vissim, and networks can be imported from Visum and Synchro. Due to their level of detail required, coding Vissim models is very resource intensive. Modelling even small intersection or network changes can take considerable effort.	$9,600 per year, includes Viswalk

	An advantage of developing a mesoscopic model in Vissim is that any future work requiring the increased detail of a microsimulation analysis would require only minor additional resources since the same network could be used. The mesoscopic simulation in Vissim does not support modelling of pedestrians, cyclists, stop signs, and travel time measurements, and some other function typically modelled with microsimulation. However, the platform allows for hybrid micro/mesocopic simulation to allow for those elements to be assessed if desired. Vissim is widely used in BC and most local modelling firms have expertise and using the platform in the Metro Vancouver context.	
Dynameq	Dynameq is developed by Bentley (formally INRO), the makers of EMME. It has the ability to export demand from EMME and then dynamically assign traffic (redistribute in time and route) in more local-scale networks. Dynameq is a combination of mesoscopic and micro modelling to provide individual vehicle simulation. Dynameq allows more detailed intersection interactions than Emme. This would require further network coding input after importing the Emme network. There are tools ready made for calibration and validation of traffic flows using counts. The Dynameq GUI allows for the addition of basemaps backgrounds and visualisation and video playback of vehicle flow on the network, showing bottlenecks and congestion. Dymameq is vehicle based and has limited ability to handle multi-modal modelling. Buses and LRT can be used to interact with highway but transit flows are not possible. As Dynameq was developed with Emme in mind it is easy to import network and matrices from Emme. Emme is also the dominate macro software package in Canada, so there is considerable localised expertise using Emme and RTM. In theory, this should translate to Dynameq; however, there is not yet a large practitioner and license base for this software	Size 1 Standalone licence is $15,500
Aimsun	Aimsun next provides an integrated package (macro, meso, and micro). This allows clients to purchase only the required level of detail. This one platform approach has allowed larger mesoscopic models to be produced. For the needs of the city Aimsun Pro - Meso will provide the DTA functionality needed. It can dynamically assign traffic and transit (redistribute in time and route) and assess modal shift. Pro meso does not model vehicles' interaction within a link but has a simplified model to determine travel time. Background mapping can be imported for quick creating of networks, with intuitive network creation. Aimsun allows the importation of Emme network but requires an add-on.	Pro – Meso cost $18,900 for perpetual or $7,600 per year. There is a 12% maintenance cost. Importing from EMME add-on is $2700 for perpetual or $1080 per year

	Aimsun has importer and exporter function for Synchro and Vissim. Python scripting can be added to the automate some processes within Aimsun. Within Canada, Aimsun is used mostly in the Greater Toronto and Hamilton Region. We are unaware of it being used thus far in Metro Vancouver. As such, there may be limited local practitioners, although the skillsets exist within Canada and globally.	
MATSim	MATSim is an open-source agent-based simulation, which can be used to assess dynamic demand and is highly flexible. It can simulate both highway and transit, MATSim is very popular in the academic realm rather than commercial. MATSim is coded in Java and only has a basic graphic user interface (GUI). MATSim has a very steep learning curve, and requires considerable time to develop and use. There is no official support, instead using community forums. MATSIM does not have detailed intersection information. Emme can provide population and link description input into an MATSim model. The high level of disaggregation in the demand data included in the RTM by time could provide a rough trip plan for the agents. We are unaware of any project application of MATSim in BC; however, it remains a popular transport modelling tool in academic contexts.	Open source (free)

Table 4-2 below summarizes the modelling platforms in terms of their ability to meet project objectives, and whether they were to be considered further to develop the CDTM. The costs presented in **Table 4-1** are indicative of license costs without consideration to start-up costs or ubiquity of availability across consulting firms, including Mott MacDonald. As such, the costs are indicative and have not been directly considered as part of the software recommendations below.

Table 4-2: Summary of Software Platforms Review and Recommendations

Software	Ability to meet Objectives / Applicability	Recommendation
Vistro	Deterministic, with no dynamic assignment. Does not have ability to meet objectives.	Not recommended for the CDTM
Synchro / SimTraffic	Largely deterministic. No dynamic assignment. Does not have ability to meet objectives.	Not recommended for the CDTM
Visum SBA	Can generally meet objectives.	For CDTM consideration, subject to further discussion and licensing capacity
Vissim	Can generally meet objectives but requires considerable resources to develop and use for network improvement analysis.	Not recommended for the CDTM, given current understanding of project resources and scope
Dynameq	Can generally meet objectives.	For CDTM consideration, subject to further discussion and licensing capacity
Aimsun	Can generally meet objectives.	For CDTM consideration, subject to further discussion and licensing capacity
MATSim	Can generally meet objectives, but has not commercial support, requires considerable on-boarding.	Not recommended for the CDTM

* None of the above platforms contain a 4-stage travel demand model that facilitates full redistribution across modes and routes, and some software are limited to only vehicle modes. As well, there currently is no single modelling software package that can capture the interaction between land use and transportation demand over time.

4.2 Software Platform Recommendation

Based on the objectives of the project, it was initially recommended that the City consider Aimsun, Dynameq, and Visum SBA as potential candidates for the CDTM. It was found that Vissim may meet project objectives, but it requires considerable resources to build one at the scale required. It was also found that Vistro and Synchro may remain a consideration, as these tools would remain applicable for detailed operational assessments of intersections and development traffic superimposition.

In further discussion with the City it was highlighted that no single software platform can fully meet all of the objectives originally specified at the project onset (see Section 1.2). It was determined that the ability to provide an approach that used dynamic vehicle assignment, and the ability to obtain tactical analysis output were the highest priority objectives from a technical perspective. As such, multimodal outputs would be limited, and these would need to be assessed qualitatively only under any selected approach.

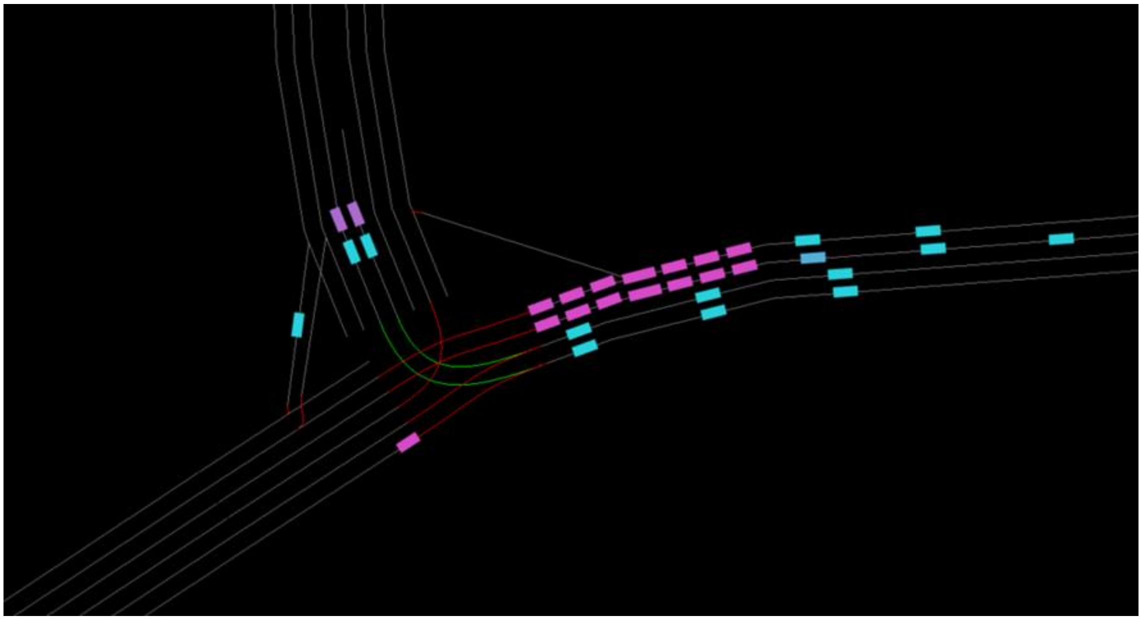
It was also determined that the appropriate software would need to meet licensing and level of effort objectives—such that licensing, whether for the City or a third party would not be a challenge at this time, and that a workable maintenance strategy is in place (see Section 4.2.1 below).

On the above basis, VISUM SBA was selected as the preferred software approach.

4.2.1 Software Highlight

As discussed in **Table 4-1** above, VISUM SBA can convert regional flow inputs into more detailed flows at intersections, such that it simulates individual vehicles at intersections. **Figure 4-1** below provides an example visual that indicates this capability.

Figure 4-1: CDTM showing individual vehicles at an intersection



Pink denotes vehicles not in motion (i.e. queueing). Teal and purple vehicles are in motion.

5 Model Maintenance

As noted in the previous section, VISUM SBA has a typical yearly subscription cost of up to $19,000 Cad per year. PTV, the makers of the software, offer a government agency discount of over 50%. However, this is an introductory price. It is likely that the discounted price would not be carried forward indefinitely. As such, a conservative assumption suggests the City would need to allocate about $20,000 per year to carry VISUM SBA. Additional start-up and maintenance costs may be incurred, including the need for adequate computing hardware, and troubleshooting support, etc. As well, specific expertise is required to run VISUM SBA, which requires staffing resources. Noting this context, consider following potential options were considered:

- Internal Acquisition
- External Custodianship & Retainer
- Hybrid – Acquisition and External Retainer

5.1 Internal Acquisition

In this option the City would own and have custody of the model. The City could then utilize the model internally as-and-when needed, including for tactical-level intersection modelling. The City could also handle 3rd party requests for the model for use as part of future land development proposals, or for other transportation-related projects where a 3rd party is engaged.

Pros	Cons
• Build internal capacity and expertise to be able to inform project and decision-making more easily when desired. • May facilitate a more uniform analytical framework for projects and development applications	• Comes with an annual software carrying cost (licensing and tech support, etc) cost of up to $20,000 per year, as well as potential hardware costs. • Additional staffing resources would be required, and a involves a steep initial learning curve (in the absence of hiring an experienced staffing resource) • May give outside perception that transportation recommendations (using the model as input) is not impartial / from a neutral party

5.2 External Custodianship and Retainer

In this option, the City would retainer ownership of the model; however, it would be in the custody of a qualified consultant and the files would reside on their server. The City could engage the qualified consultant on a retainer basis to test projects and policy questions of interest, and to update or refine the model as base conditions change or as otherwise deemed necessary. If needed or desired, the retained consultant could issue model files to 3rd parties and answer questions about model files for development related studies, or city-lead initiatives that are intended to be procured on the broader market.

Pros	Cons
• Model software licensing cost borne by retained consultant, reducing these costs for the city. • Retained consultant will have dedicated expertise and a window into industry advances that provides the City with value for money. • Retained consultant can be engaged on a time and material basis (with upset limit), such that the City bears minimal costs when no modelling work is being undertaken. Retained consultant would continue to provide level of effort estimates for individual engagements. • Under a retainer contract, a consultant can respond to modelling requests in a timely manner.	• It is likely a typical retainer arrangement will carry a small fixed costs required for consultant disbursements, and general model maintenance (updating software, administration, etc). Estimated to be less than $4,000 per year. • The City would lose the opportunity to build internal staff capacity, and therefore the ability to respond quickly for minor analyses / operational modelling.

5.3 Hybrid – Acquisition and External Retainer

In this potential hybrid option, the City would own and have custody of the model, while having an external consultant on retainer to run analyses or model updates on an as-and-when basis. An external consultant would either physically work from the computer containing the software, or potentially remote in. This approach could also be used or extended to facilitate on-site staff training.

Pros	Cons
• Model sits directly with City, who then has full control. • Minimizes potential fixed costs as part of a retainer type contract • May allow staff to learn more directly from experts over time, mitigating the steep learning curve. • Will mitigate potential outside perception that transportation recommendations (using the model as input) are not impartial / from a neutral party.	• Comes with an annual software carrying cost (licensing and tech support, etc) cost of up to $20,000 per year, as well as potential hardware costs. • May require additional internal IT resources to initiate a more complex retainer engagement. • The City may build internal staff capacity only over a prolonged length of time

5.4 Summary and Modelling Level of Effort

The development and maintenance of larger mesoscopic models (at the scale of a city) requires considerable resources and level of effort. The CDTM as outlined in this report was undertaken on a finite budget, which required focusing on key objectives and limiting the scope of model time periods. To extend the CDTM's functionality and level of precision (as detailed in the following section), significant resources will continue to be required. In selecting a preferred maintenance approach and to ensure value for money, the City should consider its analytical needs going forward into the future. Current understanding of needs suggests that the External Custodianship and Retainer option would provide the City the most value for money. However, it should be noted that the City will need to identify some additional resources and budget regardless of the chosen option.

6 Model Development

This section of the report documents the development, calibration, and validation process of the CDTM. It also discusses the model scenarios runs and their results.

6.1 Model Development Overview

Based on the reviews and information documented in the prior sections of this report, the following key considerations and tasks shaped the model development:

- The need to work within a constrained budget, such that the model development was limited to the AM peak period. This period was selected on the basis that the AM peak period often has a more pronounced peak than the PM, and in terms of perception, is when travellers are most schedule sensitive (need to arrive at work punctually, etc)[9]. This budget limit also required a constrained calibration and validation approach.
- Several TAZs were refined in terms of their geographical coverage and the land use updated to align currently planned development programming with the information already contained in the TAZs (e.g. Woodland Park).
- The model included various vehicle user classes, transportation network elements, and travel demand. This information was drawn from the Regional Transportation Model, which provides the foundation for the CDTM development work.
- Additional model development steps are documented in greater detail in the following sections:

6.1.1 Model Scenarios

The following scenarios were modelled as part of the CDTM work:

- 2017 Existing conditions (baseline model) – with land uses as per the RTM
- 2035 Future Development Model – with land uses as per the RTM 2035 and refinements based on currently understood development applications
- 2035 Increased Destination Accessibility Future scenario – using an adjustment in vehicle trip demand, based on improved access to destinations by walking, cycling, and transit

For the purposes of the CDTM and to align with the RTM horizon years, the 2017 time horizon is used to model existing conditions[10].

[9] This information relates to typical pre-COVID patterns. Work-from-home and flexible work arrangements continue to influence travel behaviour. The PM peak may continue to increase in prominence, and overall have greater volumes spread over a longer period. For the purposes of this study, it can be reasonably assumed that impacts in the AM peak would be similar in the PM peak.

[10] During the project process, Statistics Canada has released updated population statistics. As these have not yet been used to update the RTM, 2017 remains the base year and the most accurate account of existing conditions.

6.2 Model Inputs

6.2.1 Time Periods

The CDTM model represents a morning (AM) weekday peak period. As it is simulation based, vehicle demand is entered into the model at 15 min intervals between 7:30 and 8:30 with a 30 minute prior "warm-up" period.

6.2.2 User Classes

The CDTM focuses on highway vehicle classes as a subset of all the user classes discussed in Section 2.1 above. As such these highway user classes match the highway user classes in the Region Transport Model, and are as follows:

- Single Occupancy Vehicles VOT 1
- Single Occupancy Vehicles VOT 2
- Single Occupancy Vehicles VOT 3
- Single Occupancy Vehicles VOT 4
- High Occupancy Vehicles VOT 1
- High Occupancy Vehicles VOT 2
- High Occupancy Vehicles VOT 3
- High Occupancy Vehicles VOT 4
- Light Good Vehicles
- Heavy Goods Vehicles

The light good vehicle (LGV) and heavy good vehicle (HGV) classes have a passenger car unit (PCU) equivalent factor of 1.5 and 2.5 respectively. The PCU factor accounts for the additional impact these modes have on traffic flow, given that they typically have longer acceleration and deceleration times, and consume a larger amount of road space. Additional volumes attributable to the bus vehicle class were excluded.

6.2.3 Traffic Signals Data

The RTM (and many other macroscopic demand models) makes simple assumptions about intersection signal timing information, and all signals function in the same way causing the same limitation on capacity. As a mesoscopic model using Visum SBA, the CDTM requires more detailed signal timing information. The City of Port Moody provided signal timing specifications for each signal in the area. The signal timing information was entered for each intersection individually. Any missing signal data was assumed to operate similar to a neighbouring traffic signal.

6.2.4 Transportation Demand

The CDTM required traffic volume inputs. These inputs are provided in the form of vehicle travel demand at origin locations indicated by the TAZs. The demand matrices for 2017 and 2035 were extracted from the RTM model. As the CDTM split and modified several TAZs, the demand matrices were likewise split further using census data and visual accounting of land use concentration within a modified TAZ. Trip generation and distribution—the number of trips generated by an origin TAZ and the proportions travelling to TAZ destinations from that origin—was not amended.

6.2.5 Transportation Supply

The EMME software and its interoperability were discussed in **Section 2.8**. The software facilitates the export of the RTM road network to a shapefile. This was exported and then imported into the Visum SBA platform. Because the RTM is a regional model, the road network it contains has less granularity than is required for a mesoscopic model. As such, additional links were added to the road network used in the CDTM. Each link was then checked manually and adjusted to represent 2017 conditions (in terms of number of lanes, speed limits, etc).

6.3 Key Performance Indicators

A core component of this project was to recommend key performance indicators to help the City understand the effects on the road network as development occurs. These types of effects are typically measured through several different indicators. The table below provides typical indicators, and provides a brief description, as well as pros & cons:

Table 6-1: Key Performance Indicators

Indicator	Description
• Travel time (minutes)	This indicator provides the vehicle travel time between select points on a few key corridors. It is straightforward to extract from the model, and easy for a larger audience to understand. However, it does not necessarily capture other key aspects of trip-making, such as travel time reliability, and is also sensitive to the study area size and corridors selected.
• Person travel time (person-minutes)	This indicator adds to the vehicle travel time indicator by incorporating vehicle occupancy. As such, it can also capture mode shifting toward HOV explicitly; however, requires more data and is less straightforward to extract from the model and convey to a broader audience.
• Travel time reliability	This indicator utilizes different travel time variance statistics to assess how reliable a typical vehicle journey may be. It is increasingly understood that reliability has a similar level of impact on transportation behaviour as does travel time. Given the nature of simulation-based assignment used in the CDTM, this indicator is possible to obtain but requires a larger level of effort to do so. As well, it requires a qualitative aspect to determine what can be considered a reliable trip (how much variance). It is also a less approachable indicator for a broader audience.
• Congestion index	This indicator typically compares free-flow travel times with those during peak times. It is less sensitive to selected corridors, as it normalizes values across all corridors; however, it is heavily influenced by the study area size and does not consider the absolute length of travel times experienced by residents. This indicator also requires a greater level of effort to obtain, while being less straightforward in its meaning to a broader audience.

Based on the table above, it is recommended that the Cumulative Development Traffic Model use travel time as the main key performance indicator and to inform potential travel time targets. This indicator can be easily understood by a broader audience, requires the lowest level of effort to obtain, and can be most easily monitored. As well, the indicator can be easily extended to other modes of travel, and/or be integrated into a more comprehensive inclusion of travel time – that beyond the Port Moody study area – and cross-referenced against census data, etc.

6.4 2017 Existing Conditions Model

6.4.1 Model Calibration & Validation Overview

The model calibration and validation steps were a key component of developing an existing conditions model. The calibration process typically uses observed vehicle count data as a direct input into the model and starting point to further refine model parameters or use additional procedures to improve the model alignment with observed counts. A calibrated model is one that is considered to replicate those input parameters within a specified margin of error. The validation process compares model outputs with an independently collected dataset, typically using travel times along certain routes or corridors. As such, a validated model is one that not only replicates well the key input parameters used to build the model, but also replicates well real-world information about the transportation system that was not used to directly build the model.

This process can necessarily only be done for a model of existing conditions. Once it can be said that the existing conditions model is valid, it can be used to confidently build and assess scenario models.

6.4.1.1 Model Calibration Data

To facilitate the calibration process, 60 link counts and 32 turning movement counts provided by the City were reviewed. The data covered historical counts from 2011 to 2021. For the purposes of model development and calibration, and to avoid using outdated counts or those heavily influenced by the pandemic, count data from 2015 to 2019 was used.

Model links that reflect HOV lanes, such as those on Barnet Hwy, were not used in the calibration process, as this would require more detailed data in terms of lane utilization. This left nine links available for independent calibration counts. A GEH statistical measure was used to evaluate the difference between observed and model flows[11]. For a count to be considered passing the difference between observed and model flow needs to be less than 5% GEH difference.

6.4.1.2 Model Calibration

The existing condition model was constructed with the RTM vehicle demand matrices as an initial input and calibration step. A matrix estimation procedure was then run to more closely align the RTM demand. This procedure—an algorithm within the Visum SBA software—used the observed vehicle count data to adjust the vehicle demand matrices to better align the model counts with said observed vehicle counts. **Figure 6-1** and **Figure 6-2** visually depict the two calibration steps (before and after matrix estimation), and the improved GEH outcome.

[11] For additional information on the GEH statistic, refer to Section 2.7. The GEH statistic does not weight different street classes differently. It is concerned only with the volumes on the respective links and how those compare between the model and observed.

Figure 6-1: Port Moody Visum SBA model pre calibrated results against observed counts

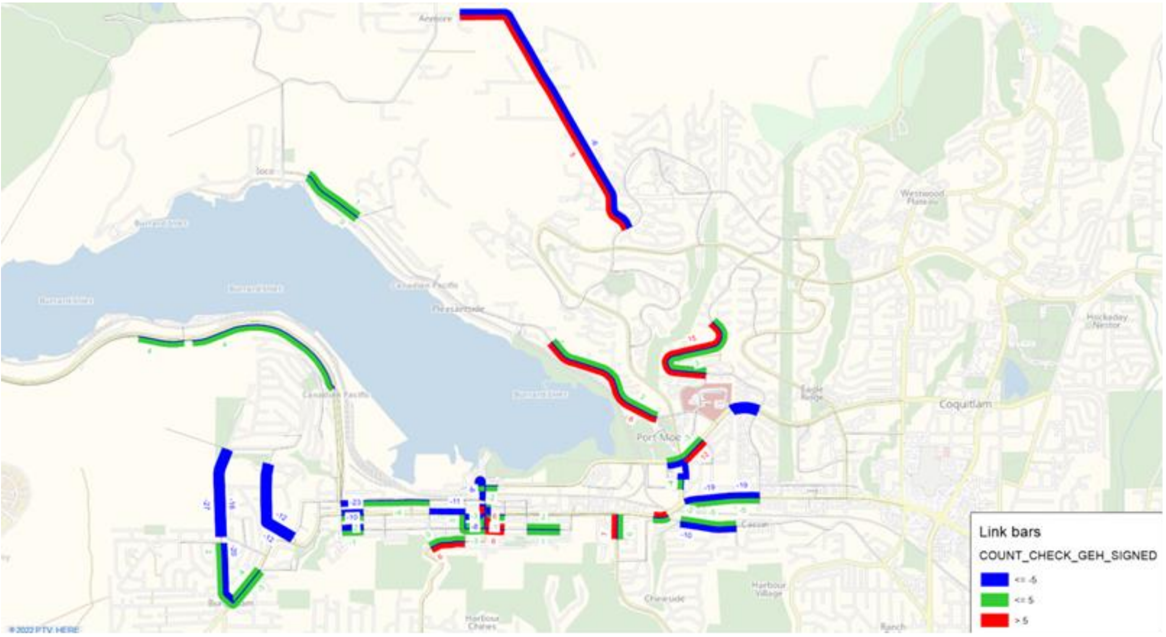
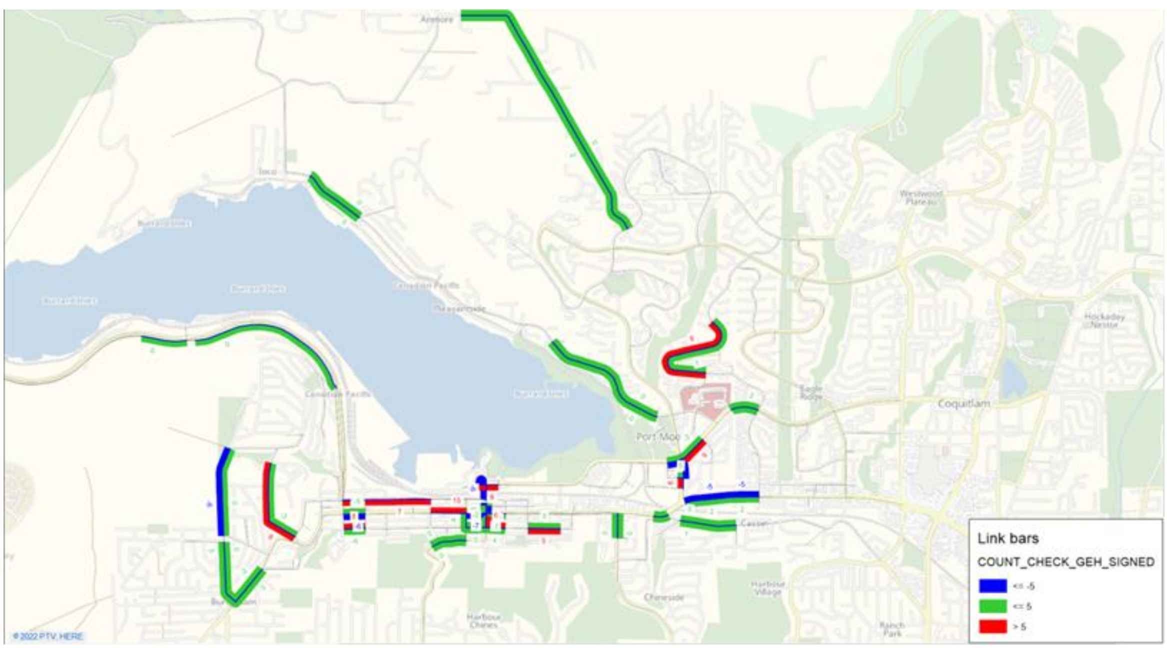


Figure 6-2: Port Moody Visum SBA model post calibrated results against observed counts



6.4.1.3 Model Validation

The model validation process made use of a route travel time (in both directions) between Clarke Road & Seaview Drive and 2729 Barnet Highway. The two points lie on either end of the CDTM study area, as shown in **Figure 6-3** below.

Figure 6-3: Observed Travel Time Route

The travel time data along this route was obtained from StreetLight data. StreetLight provides historical transportation data compiled through various big data sources, including cell phone and GPS data sources. It is anonymized. As the CDTM is replicating existing conditions prior to the pandemic, historical data was required.[12] StreetLight data is a commercial entity. As such, data acquisition had a financial cost. Based on project budget, this limited the amount of observed route travel times which could be compared to modelled travel times as part of the validation process.

StreetLight provided hourly data including the periods 7:00 am to 8:00 pm and 8:00 am to 9:00 am. To obtain a 7:30 am to 8:00 am period travel time estimate, the two hourly periods were averaged. The hourly estimation, and the need to use historical data along one travel time route only, introduced a level of uncertainty into the validation process in terms of the precision related to the observed travel time.

After the calibration process discussed above, and with further refinements to how several links were coded, the modelled travel time along the validation route was obtained as shown in **Table 6-2** below.

Table 6-2: Journey time results after matrix estimation

Journey Time Route	Observed time	Modelled time	Difference (%)
1a – Eastbound	7 mins 51secs	8mins 25secs	7%
1b - Westbound	7 mins 21secs	9mins 23secs	28%

[12] Google map travel times were also extracted as a comparison in 2023. These were found to vary between 6 and 12 minutes, meaning there is a large variability in the travel time and which suggests that the modelled travel times are within this range.

Typical guidelines suggest the following criteria for model validation based on travel time:

- Average modelled route travel time to be within 15% or one minute (if greater than 15%) of average observed route travel time for the full length of a route for at least 85% of observed travel time routes

The results in **Table 6-2** above suggest that travel times along the route are being overestimated in the model in the westbound direction; the modelled travel times somewhat exceed 15% of that of the observed travel times.

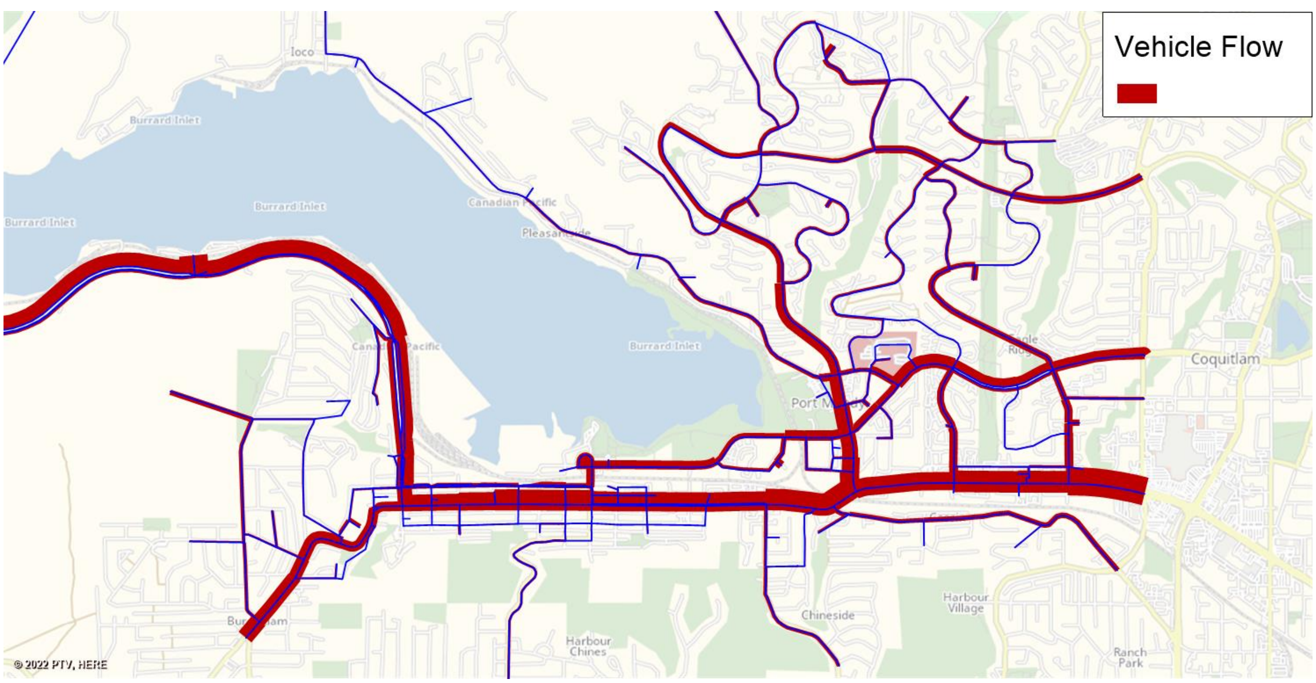
Further visual inspection of the model showed congestion at the Ioco Road & Barnet Highway intersection, which aligns with local understanding of that intersection. The StreetLight observed travel time data may not be fully capturing some of that intersection’s impacts on the overall route travel time.

Noting the above qualitative considerations and the uncertainty associated with the observed travel time, the existing conditions model can be stated to be reasonably approximating existing (2017) conditions. It is also important to highlight that for this project, the difference in travel times between the existing condition and scenarios are of key interest, with the absolute travel times of lower interest.

6.4.2 Traffic Flow

Figure 6-4 below shows the vehicle flows along the main network roadways. The main flows area along St. Johns St. Significant flows are also found along Ioco Rd, Guilford Way, and Clarke Rd.

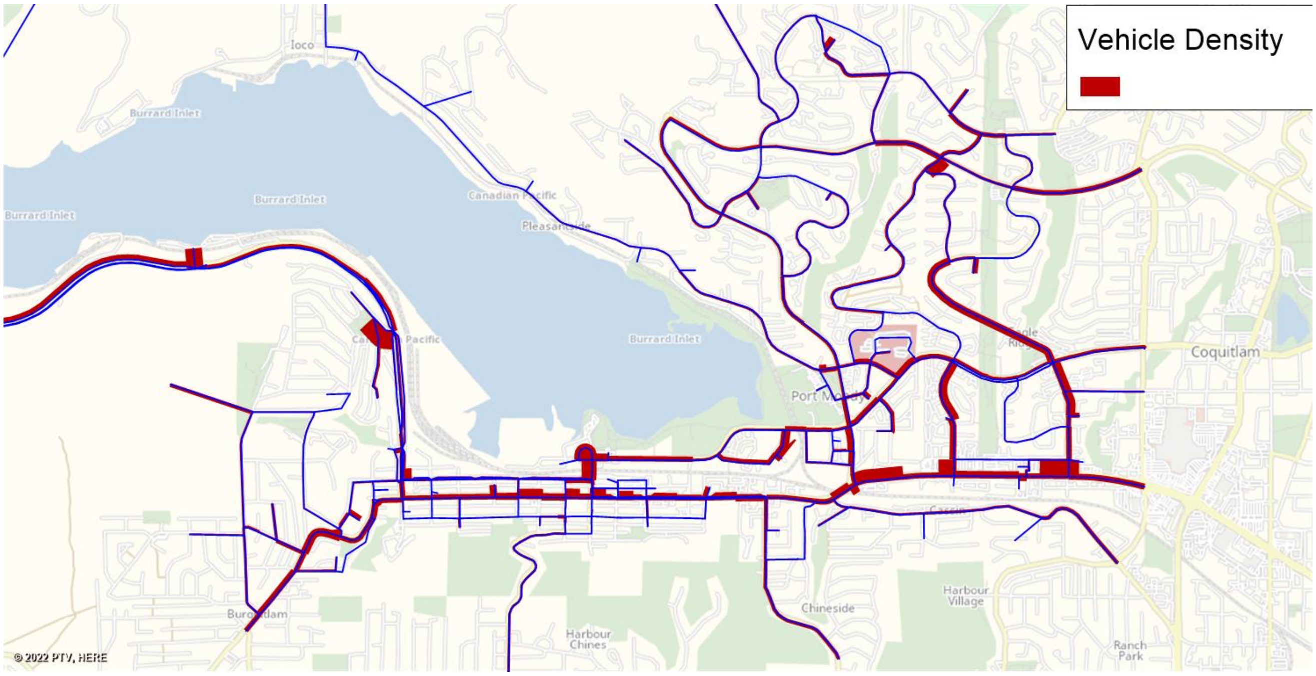
Figure 6-4: Vehicle Flows - Existing Conditions AM Peak Hour



6.4.3 Traffic Density

Figure 6-5 below illustrates traffic density. This shows areas on the roadway network where a larger amount of vehicles per roadway distance can be found, indicating areas of slower moving traffic or potential localized congestion. Several areas along St. Johns St, Moody St, and Murray St show higher vehicle density.

Figure 6-5: Vehicle Density - Existing Conditions AM Peak Hour



6.4.4 Travel Times

Modelled travel time was recorded for five indicative travel time routes. The routes were selected to provide a balance between travel times on key streets as well as throughout different areas of the city. The route for which observed travel time travel time was available (Route 1), was also used an indicative travel time route (journey). The route travel times routes are shown in **Figure 6-6** below.

Figure 6-6: Key Indicative Travel Time Routes

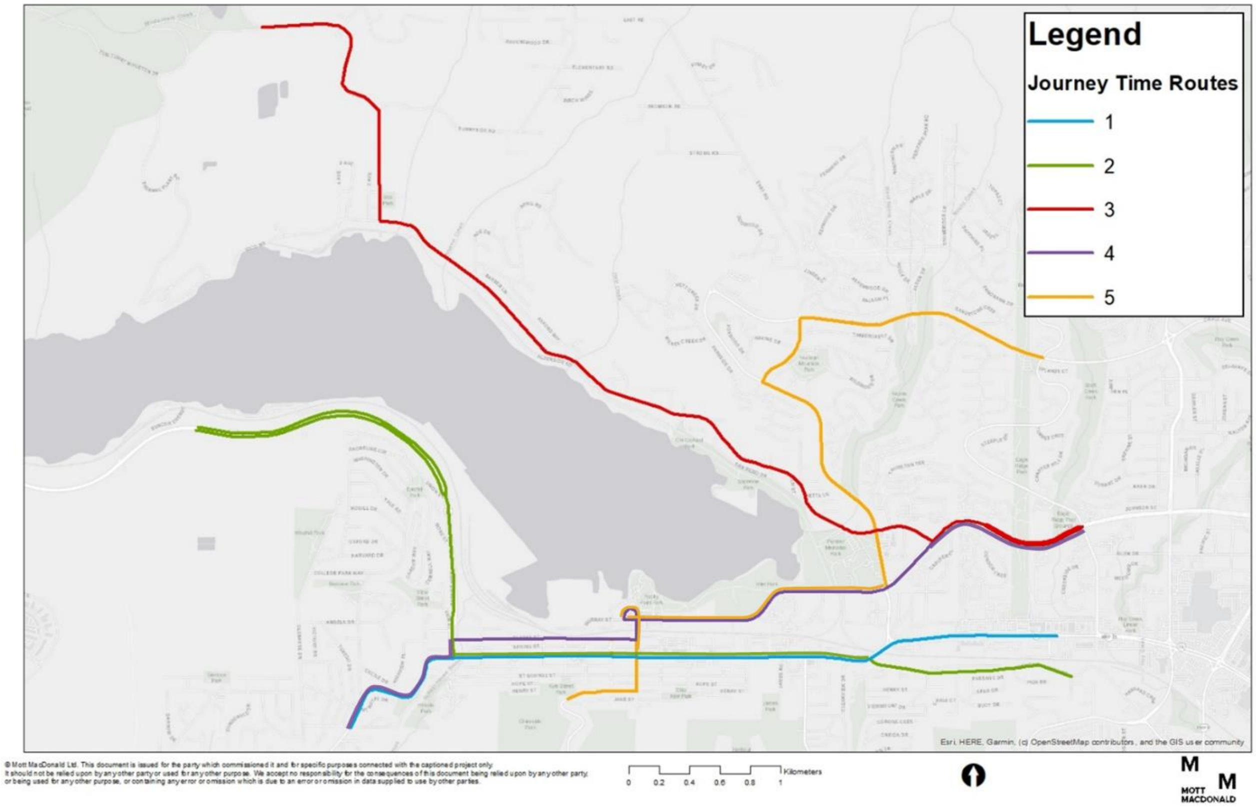


Table 6-3 below shows the estimated vehicular travel times along the travel time routes noted above. Travel times are provided in both directions. The table also provides the network distance of each route. These values are used as the basis of a comparison in model scenarios in the next section.

Table 6-3: Vehicle Travel Time Base Model Results

JT	Between		Via	Direction	Travel time	Direction	Travel time	Travel Distance (km)
1	Clarke Rd/ Seaview Dr	2729 Barnet Hwy	St John Street	EB	8 Mins 25 Secs	WB	9 Mins 23 Secs	5.02
2	Barnet Hwy/ Cariboo Rd	Dewdney Trunk Rd/ Hull Ct	St John Street	EB	9 Mins 38 Secs	WB	9 Mins 48 Secs	9.05
3	Bedwell Bay Rd/ White Pine Beach Rd	Guildford Way/Lansdowne Dr	Ioco Rd	NB	10 Mins 2 Secs	SB	10 Mins 25 Secs	8.23
4	Clarke Rd/ Seaview Dr	Guildford Way/Lansdowne Dr	Murray St	EB	12 Mins 27 Secs	WB	12 Mins 16 Secs	6.72
5	Gatensbury Rd/ Noble Ct	David Ave	Moody St	NB	13 Mins 56 Secs	SB	15 Mins 36 Secs	7.38

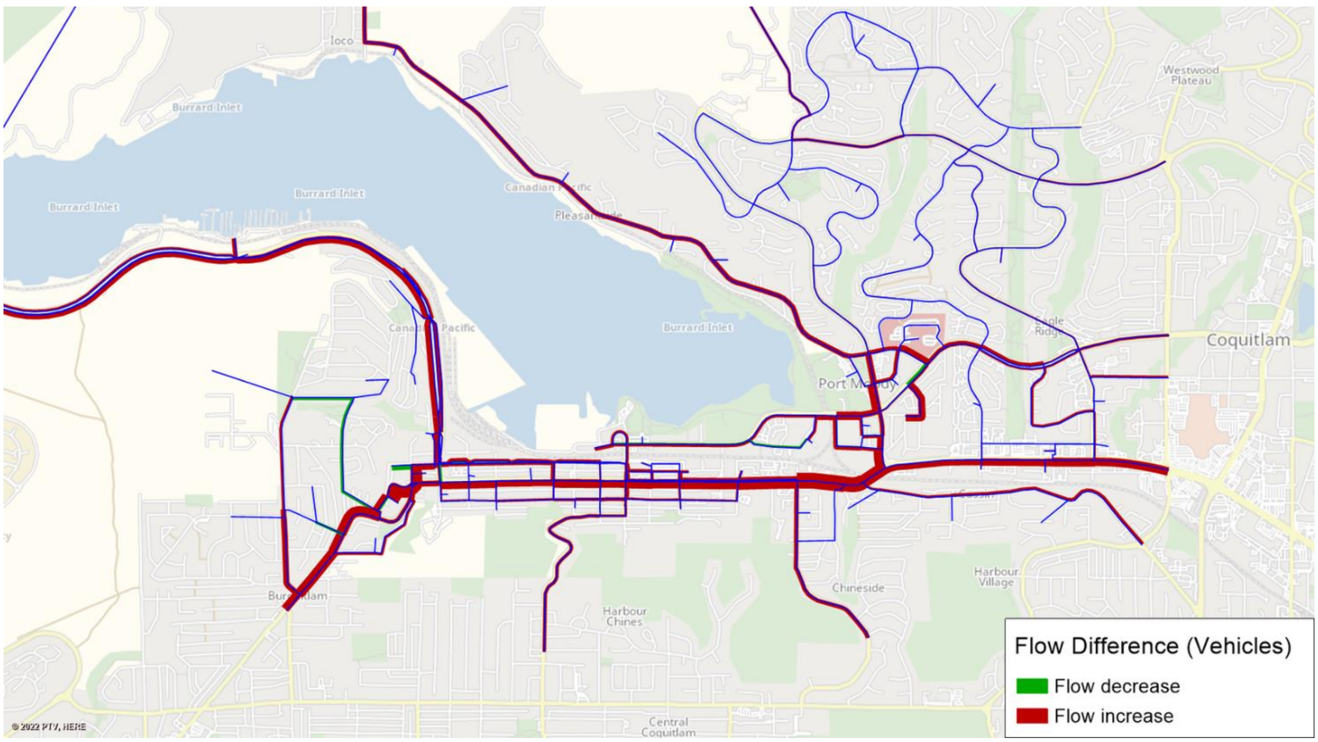
6.5 2035 Future Development Model

The 2035 Future Development Model includes the land use changes as discussed in Section 2.5 above. As well, the new roadway connection between Woodland Park and Barnet Highway (the “Highview Connector”) has also been included.

6.5.1 Vehicle Flow Comparison

Figure 6-7 below maps the differences in vehicle flow estimated by the CDTM between the existing and future condition. As expected, most of the network is anticipated to see increased vehicular flows. Notably, the CDTM estimates a minor decrease along Cecile Drive (around Woodland Park). This is likely due to the dynamic assignment procedure suggesting that the parallel Glenayre Drive become more preferable from a network perspective (i.e. for those heading southwest). As well, much of the increase in east-west flow is anticipated to be carried by St. Johns Street. Due to the dynamic assignment procedure, this also suggests that St. Johns Street currently has a greater available capacity and continues to be the most convenient route for many trips as compared to alternate routes.

Figure 6-7: Vehicle Flow Comparison – Existing & Future (2035)



6.5.2 Travel Time Comparison

Table 6-4 below compares the baseline model (existing conditions) vehicle travel times along the specified routes with the future development scenario model travel times. Depending on the travel time route, the model suggests vehicular travel times may increase between 0 and 5 mins under this scenario. Routes that utilize St. John Street or Murray Street are likely to see the largest travel time impacts in this scenario.

Noticeably, the westbound route from Dewdney Trunk Road & Hull Court to Barnet Highway & Cariboo Road (JT 2) shows a large increase; however, the westbound route from 2729 Barnet Highway to Clarke Road & Seaview Drive show a relatively small increase. This indicates that the intersection of Clarke Street & Barnet Highway is causing much of the travel time impacts; this was confirmed through further visual inspection of the model runs. This intersection will support the future Woodland Park development. The intersection was coded into the model; however, it was not optimized. Further optimization of the phasing and timing of this intersection may mitigate much of the travel time increase through this area, improving travel times on routes 1, 2 and 4 in Table 6-4.

Table 6-4: Existing & 2035 Modelled Travel Time Comparison

JT	From	To	Via	Direction	Base	Future	Travel Time Difference	% Diff.	Normalized Difference (Secs per km)
1	Clarke Rd/ Seaview Dr	2729 Barnet Hwy	St John Street	EB	8 Mins 25 Secs	10 Mins 15 Secs	1 Mins 50 Secs	22%	21.9
1	2729 Barnet Hwy	Clarke Rd/ Seaview Dr	St John Street	WB	9 Mins 23 Secs	11 Mins 15 Secs	1 Mins 42 Secs	18%	20.3
2	Barnet Hwy/ Cariboo Rd	Dewdney Trunk Rd/ Hull Ct	St John Street	EB	9 Mins 38 Secs	11 Mins 10 Secs	1 Mins 32 Secs	16%	10.2
2	Dewdney Trunk Rd/ Hull Ct	Barnet Hwy/ Cariboo Rd	St John Street	WB	9 Mins 48 Secs	15 Mins 10 Secs	5 Mins 22 Secs	55%	35.6
3	Bedwell Bay Rd/ White Pine Beach Rd	Guildford Way/Lansdowne Dr	Ioco Rd	NB	10 Mins 25 Secs	10 Mins 25 Secs	0 Mins 0 Secs	0%	0.0
3	Guildford Way/Lansdowne Dr	Bedwell Bay Rd/ White Pine Beach Rd	Ioco Rd	SB	10 Mins 2 Secs	10 Mins 13 Secs	0 Mins 11 Secs	2%	1.3
4	Clarke Rd/ Seaview Dr	Guildford Way/Lansdowne Dr	Murray St	EB	12 Mins 27 Secs	15 Mins 34 Secs	3 Mins 7 Secs	25%	27.8
4	Guildford Way/Lansdowne Dr	Clarke Rd/ Seaview Dr	Murray St	WB	12 Mins 16 Secs	15 Mins 44 Secs	3 Mins 28 Secs	28%	31.0
5	Gatensbury Rd/ Noble Ct	David Ave	Moody St	NB	13 Mins 56 Secs	16 Mins 0 Secs	2 Mins 4 Secs	15%	16.8
5	David Ave	Gatensbury Rd/ Noble Ct	Moody St	SB	15 Mins 36 Secs	16 Mins 49 Secs	1 Mins 13 Secs	8%	9.9
	Average				**11 Mins 11 Secs**	**13 Mins 14 Secs**	**2 Mins 3 Secs**	**19%**	**17.5**
	85th Perc.						**3 Mins 20 Secs**	**27%**	**29.9**

Assuming the travel time routes are indicative of an overall network impact, the CDTM 2035 Future model estimates that travel times may increase on average by about 2 minutes for vehicle drivers within Port Moody during peak hours. This represents about an 18% increase. Only 15% of drivers may see an increase greater than 3.5 minutes.

6.6 2035 Increased Destination Accessibility Future Scenario

6.6.1 Destination Accessibility Demand Adjustments

As discussed above, additional development planned within the 2035-time horizon will increase the land use intensity with the city. This will also result in an increase in walkability, bike-ability, and transit accessibility to amenities and destinations (i.e. increased destination accessibility). This has historically been difficult for four-step macro-demand models to explicitly account for. As such, the accessibility sketch model discussed in **Section 3.2** above was used to better understand and quantify these benefits.

The access sketch model was updated with the 2035 land use inputs. The model was then re-run using the base (existing) transportation network to calculate the new number of jobs accessible within a 40 min travel time by transit[13]. The relationship between accessibility and commute trip sustainable mode share was then used to estimate a future 2035 mode share, which is shown in **Figure 6-8** below.

Figure 6-8: Mode Share Estimate based on Increased Destination Accessibility

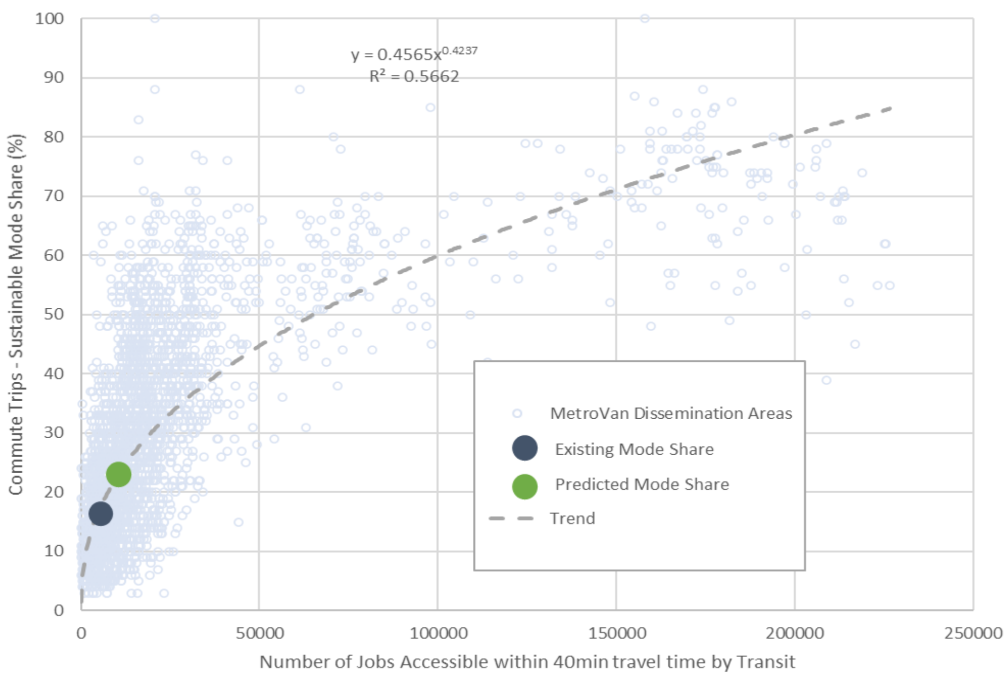


Figure 6-8 estimates that the sustainable mode share in Port Moody would increase to about 22% from the existing 18%. Importantly, this increase is a result of increased land use intensity and subsequent accessibility improvements only. The access modelling process isolates the impact of land use on mode share, meaning that it does not account for any potential network improvements implemented by 2035. **As such, the sustainable mode share in Port Moody is anticipated to increase by about 4% (a 4% mode shift) directly because of planned development. This is also a key finding that supports ongoing strategic policy development in support of the Climate Action Plan and the Master Transportation Plan update.**

[13] This procedure also accounts for walking trips, as these are part of any potential transit trip. Increased job opportunities within Port Moody will also increase the number of jobs people may be able to walk to.

Based on the existing mode share, a 4% mode shift translates to approximately 5% fewer vehicle trips. As such, the vehicle trip demand inputs into the CDTM were adjusted downward by 5%[14]. This scenario was then modelled in the CDTM. The following section provides the results and compares these against the base and 2035 Future Development model.

6.6.2 Model Result Comparisons

This section focuses on the travel time differences along the indicative model routes and compares results across the models developed in this study.

Table 6-5 below provides a comparison between the Existing (Base) model travel times and those determined from the CDTM Increased Destination Accessibility model scenario.

Table 6-5: Existing & 2035 Increased Destination Accessibility (IDA) Scenario Travel Time Comparison

JT	From	To	Via	Direction	Base	2035 IDA Future	Travel Time Difference	% Diff.	Normalized Difference (Secs per km)
1	Clarke Rd/ Seaview Dr	2729 Barnet Hwy	St John Street	EB	8 Mins 25 Secs	9 Mins 52 Secs	1 Mins 27 Secs	17%	17.3
1	2729 Barnet Hwy	Clarke Rd/ Seaview Dr	St John Street	WB	9 Mins 23 Secs	10 Mins 12 Secs	0 Mins 49 Secs	9%	9.8
2	Barnet Hwy/ Cariboo Rd	Dewdney Trunk Rd/ Hull Ct	St John Street	EB	9 Mins 38 Secs	10 Mins 49 Secs	1 Mins 11 Secs	12%	7.8
2	Dewdney Trunk Rd/ Hull Ct	Barnet Hwy/ Cariboo Rd	St John Street	WB	9 Mins 48 Secs	14 Mins 41 Secs	4 Mins 53 Secs	50%	32.4
3	Bedwell Bay Rd/ White Pine Beach Rd	Guildford Way/Lansdowne Dr	Ioco Rd	NB	10 Mins 25 Secs	10 Mins 27 Secs	0 Mins 2 Secs	0%	0.2
3	Guildford Way/Lansdowne Dr	Bedwell Bay Rd/ White Pine Beach Rd	Ioco Rd	SB	10 Mins 2 Secs	10 Mins 2 Secs	0 Mins 0 Secs	0%	0.0
4	Clarke Rd/ Seaview Dr	Guildford Way/Lansdowne Dr	Murray St	EB	12 Mins 27 Secs	14 Mins 22 Secs	1 Mins 55 Secs	15%	17.1
4	Guildford Way/Lansdowne Dr	Clarke Rd/ Seaview Dr	Murray St	WB	12 Mins 16 Secs	13 Mins 11 Secs	0 Mins 55 Secs	7%	8.2
5	Gatensbury Rd/ Noble Ct	David Ave	Moody St	NB	13 Mins 56 Secs	15 Mins 12 Secs	1 Mins 16 Secs	9%	10.3
5	David Ave	Gatensbury Rd/ Noble Ct	Moody St	SB	15 Mins 36 Secs	16 Mins 2 Secs	0 Mins 26 Secs	3%	3.5
	Average				**11 Mins 11Secs**	**12 Mins 29 Secs**	**1 Mins 18 Secs**	**12%**	**10.7**
	85th Perc.						**1 Mins 45 Secs**	**17%**	**17.2**

[14] This was applied uniformly through the demand matrix. In reality, it can be expected that each neighbourhood (and TAZ) would have differing reductions in vehicle trip demand. This level of detail is outside the scope of this work.

Assuming the travel time routes are indicative of an overall network impact, **the 2035 Increased Destination Accessibility Scenario CDTM model run estimates that travel times may increase on average by about 1 minute and 18 seconds for vehicle drivers in Port Moody**. Only about 15% of drivers may see a travel time increase of greater than 1.75 minutes, and no indicative route is anticipated to experience greater than a 5-minute increase in travel time in the future.

Table 6-6 below provides a more detailed account of the difference between the 2035 Future Model and the 2035 Increased Destination Accessibility Scenario CDTM by route. It shows that nearly all the indicative routes within the city improve when compared to unadjusted future. Travel times for route 3 NB show a very slight increase. This is due to the dynamic nature of the CDTM, such that some trips have been reassigned to this route (likely only a few vehicles), given the adjusted demand throughout the network.

The 2035 Increased Destination Accessibility Scenario estimates an approximately 41% reduction in vehicular travel time impacts as compared to the unadjusted CDTM 2035 Future model.

Table 6-6: 2035 Future Model & 2035 Increased Destination Accessibility (IDA) Scenario Comparison

JT	From	To	Via	Direction	2035 Future	2035 IDA Future	Difference
1	Clarke Rd/ Seaview Dr	2729 Barnet Hwy	St John Street	EB	10 Mins 15 Secs	9 Mins 52 Secs	-23 Secs
1	2729 Barnet Hwy	Clarke Rd/ Seaview Dr	St John Street	WB	11 Mins 15 Secs	10 Mins 12 Secs	-53 Secs
2	Barnet Hwy/ Cariboo Rd	Dewdney Trunk Rd/ Hull Ct	St John Street	EB	11 Mins 10 Secs	10 Mins 49 Secs	-21 Secs
2	Dewdney Trunk Rd/ Hull Ct	Barnet Hwy/ Cariboo Rd	St John Street	WB	15 Mins 10 Secs	14 Mins 41 Secs	-29 Secs
3	Bedwell Bay Rd/ White Pine Beach Rd	Guildford Way/Lansdowne Dr	Ioco Rd	NB	10 Mins 25 Secs	10 Mins 27 Secs	+2 Secs
3	Guildford Way/Lansdowne Dr	Bedwell Bay Rd/ White Pine Beach Rd	Ioco Rd	SB	10 Mins 13 Secs	10 Mins 2 Secs	-11 Secs
4	Clarke Rd/ Seaview Dr	Guildford Way/Lansdowne Dr	Murray St	EB	15 Mins 34 Secs	14 Mins 22 Secs	-1 Mins 12 Secs
4	Guildford Way/Lansdowne Dr	Clarke Rd/ Seaview Dr	Murray St	WB	15 Mins 44 Secs	13 Mins 11 Secs	-2 Mins 33 Secs
5	Gatensbury Rd/ Noble Ct	David Ave	Moody St	NB	16 Mins 0 Secs	15 Mins 12 Secs	-48 Secs
5	David Ave	Gatensbury Rd/ Noble Ct	Moody St	SB	16 Mins 49 Secs	16 Mins 2 Secs	-47 Secs
	Average				**13 Mins 14 Secs**	**12 Mins 29 Secs**	**-45 Secs**

6.7 Model Implications

The results of the CDTM 2035 Future Development scenario indicate that by 2035, increased development in the city will increase vehicular travel times on some streets. However, when more explicitly accounting for the benefits of increased land use intensity in the model through the 2035 Increased Destination Accessibility scenario, a larger shift in travel behaviour is anticipated, and the impact of increased development to vehicular travel times is lower. The

2035 Increased Destination Accessibility scenario is considered a more realistic estimate of future impacts than the unadjusted demand model (the 2035 Future Development scenario). As such, **the outputs of the 2035 Increased Destination Accessibility scenario should form the basis for network evaluation and potential policy development.**

It is important to note that the 2035 Increased Destination Accessibility scenario suggests an increased sustainable transportation mode share. This is due to an increased number of destinations accessible within an acceptable given travel time. This means that while vehicular travel times are anticipated to increase with additional development, travel times for other transportation modes decrease (specifically, active modes included walking to transit).

As well, the routes for which travel times were assessed are considered indicative. In reality, most residents will not be driving along the length of the specified routes, or through the main area of potential concern (Clarke St & Barnet Hwy). This means that a typical resident will actually experience a lower travel time impact than the average estimated travel time impact of 1 minute 18 seconds (78 seconds). As such, the 1 minute 18 second estimate can be considered a conservative estimate for Port Moody residents.

For some regional through trips travelling the east-west distance of Port Moody, the travel time impact may be larger (up to almost 5 minutes) according to the model. It should be reiterated that this impact is before any further optimization of signals, as noted above. As well, this travel time impact may contribute toward further regional mode shift, which would mitigate the impact itself.

6.8 Travel Time Threshold Recommendation

A key objective of this work was to recommend vehicular travel time impact threshold(s) related to increased development in the city. **Section 6.3** above discussed the use of this key performance indicator against other possible metrics. To develop these recommendations, several considerations were required:

- There is no purely technical basis for setting a maximum threshold on allowable vehicular travel time increases. Typically, communities strive to minimize time spent travelling to support economic vitality and a desired quality of life, and this is a worthwhile policy aspiration. However, this implies trade-offs with other community and strategic policy initiatives. Measures to minimize vehicular travel times (or stay within vehicular travel time increase thresholds) should balance these outcomes. As such, curbing any amount of travel time increase is not recommended.
- Vehicular travel time threshold targets should not be based on any one street or travel route and should also not be strictly applied to any one street or travel route. Each street will have its own context and needs.
- The Increased Destination Accessibility (IDA) model above accounts for a reduced vehicle trip demand. Increased destination accessibility typically results in positive local economic outcomes[15]. As such, this scenario aligns with the need to balance local economic vitality while minimizing vehicle travel times.

Based on these considerations and the model outcomes outlined above, **it is recommended that the City seeks to keep vehicular travel time increases within 2 minutes (or 17 seconds per roadway km), and up to 5 minutes (or 32 seconds per roadway km) in exceptional cases.**

[15] Deboosere, R., Levinson, D., & El-Geneidy, A. (2018). Accessibility oriented development. Paper to be presented at the 97th Annual Meeting of the Transportation Research Board, 42 Washington D.C., USA

- The 2 minutes represents the approximate 85th percentile travel time increase estimated by the IDA model across different streets. This is used instead of the average to account for most potential streets and residents' trips.
- The 5 minutes represents the largest modelled travel time increase in the IDA model. This sets an upper bound for what can be considered a reasonable allowable increase: current approved development patterns may result in this travel time increase for a small number of vehicular trips. As such, existing policy acknowledges this as a reasonable trade-off.
- An example of an exceptional case to consider is St. Johns Street. St. Johns Street facilitates significant vehicular movement, and for vehicular trips that travel along much of the arterial, a larger threshold is appropriate. While potentially counterintuitive, a larger threshold increase should be applied here than on many other travel routes because:
  - The fact that many other roadways with a lower travel time increase threshold feed into it means it requires a higher one: if this were not the case and were collector roads feeding into St. Johns allowed a higher limit, it would mean that significant congestion is accepted on collector or even residential streets as opposed to on the main vehicular arterial.
  - There are limited alternative travel routes to using St. Johns Street. Other travel time routes have more alternative options.
  - St. Johns has multiple functions and competing demands for space, and these need to be balanced.
- These recommendations are applicable for longer travel routes / street segments, and as indicated by the routes used within the CDTM (approx. 5 km or greater). For shorter street segments or travel routes, it is more appropriate to consider the upper bound range obtained from the CDTM in normalized terms, i.e. time per kilometer of street/travel time route. This means that a 32 second per km increase threshold would be more applicable on shorter roadway segments with typical urban travel conditions. This aligns with typical Highway Capacity Manual (HCM) Level of Service qualitative metrics[16].

[16] Assuming the travel time increase threshold being explored is isolated to one intersection in a shorter street segment, a LOS change from LOS A to C is about an additional 30 sec travel time. A change from LOS C (typical of many existing intersections) to LOS E (typical of constrained urban conditions) also suggests a ~30 sec increase in travel time. The HCM manual provides additional guidance on LOS metrics.

7 Model Summary Findings

This work developed a Cumulative Traffic Demand Model (CDTM) to better understand the potential impacts of future development on the vehicular traffic network, and to ultimately recommend potential travel time increase thresholds as a network performance indicator for the City to consider. The development of the CDTM and model runs resulted in the following key findings:

- The travel time impacts due to land development (increased land use intensity) are typically overestimated. Increased development also results in more walkable communities and increased destination accessibility, and these benefits are typically understated.
- To account for this, the CDTM utilized and adjusted vehicle trip demand input. This adjustment was calculated using an external GIS and spreadsheet-based accessibility “sketch” model.
- The sketch model calculated that increased development in the city would result in a 4% mode shift toward sustainable transportation modes. This finding may also support parallel work being undertaken as part of the Master Transportation Plan update, which seeks to advance the City’s mode share objectives.
- In addition to a 2017 base model, the CDTM ran two future scenarios. The first scenario ran the vehicular demand extracted from the RTM (2035 Future Development Model); the second scenario adjusted this demand based on the increased destination accessibility benefits calculated with the sketch model (2035 Increased Destination Accessibility Model). The Increased Destination Accessibility Model resulted in a 41% reduction in travel time increase estimated by the 2035 Future Development Model.
- The Increased Destination Accessibility model scenario is strongly considered to be a more accurate representation of 2035 future conditions in terms of development impacts on the traffic network.
- Based on this modelled scenario, it is recommended that the City seeks to limit vehicular travel time increases as a result of development to 2 minutes (or 17 seconds per roadway km), and up to 5 minutes (or 32 seconds per roadway km) in exceptional cases. St. Johns Street should be considered as an exceptional case, as should shorter roadway or travel route segments.
- There will be a continued need to apply a context-sensitive approach toward any travel time threshold limitations. These should be considered as guidelines only, as there is no purely technical rationale for setting vehicular travel time thresholds. Vehicular travel time increase targets must be balanced against other community and strategic policy objectives. These include improvements in the walking, bicycling, and transit networks to achieve mode shift and greenhouse gas reduction targets
- The CDTM was undertaken on a constrained budget, which necessitated addressing a limited number of key objectives and the scope of model time periods. To extend the CDTM’s functionality and level of precision, as well as to use it for further tactical and operational analysis, additional ongoing resources will be required. Current understanding of needs suggests that an ‘External Custodianship and Retainer’ option would provide the City the most value for money.