An *ex post facto* Evaluation of a Metro Vancouver Transportation Plan

by

Devon Robert Farmer

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Approval

Name:	**Devon Robert Farmer**
Degree:	**Master of Urban Studies**
Title:	**An *ex post facto* evaluation of a Metro Vancouver Transportation Plan**
Examining Committee:	**Chair:** Peter V. Hall Professor, Urban Studies Program

Anthony Perl
Senior Supervisor
Professor, Urban Studies Program and
Department of Political Science

Karen Ferguson
Supervisor
Professor, Urban Studies Program and
Department of History

Clark Lim
External Examiner
Principal, Acuere Consulting
Adjunct Professor, Department of Civil
Engineering, University of British Columbia

Date Defended/Approved: March 27, 2018

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Abstract

Plans ought to be evaluated upon completion to determine their impacts and the reasons for success or failure. With this information, future planning efforts can be improved. Accordingly, this thesis offers an e*x post facto* evaluation of Metro Vancouver's *Transport 2021* medium-range transportation plan to determine its effectiveness and recommend how to improve future plans. In 1993, this plan recommended regional transportation policies and projects for the horizon year of 2006. Using a mixed-methods approach adapted from Laurian *et al.,* the plan's logic, implementation, and outcomes were examined, and factors affecting the results were considered.

Although the plan proved technically capable of meeting its goals, it was not an effective plan, as it was only partially implemented, and its goals were not fully achieved. I identified factors that limited the implementation and outcomes, including politics and a failure to achieve the goals of the related land-use plan.

Keywords: Metro Vancouver; plan evaluation; transportation; planning; implementation; outcomes of plans.

Dedication

This research, and indeed my journey through the Urban Studies Program, would never have been possible without the support and patience of my wonderful spouse Kelly. Her support of my crazy idea to go to grad school and change careers is much appreciated. Thank you, Kelly.

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I would also like to acknowledge the contributions of Clive Rock, Ken Cameron, Gordon Price, and Martin Crilly, who all made themselves available for multiple interviews for this research. Without any hesitation, these four individuals provided invaluable information about the regional transport system and their contributions to the region continues to go above and beyond the call of duty.

Finally, I'd like to express my gratitude to Clark Lim, the external examiner, for his time and effort for my defense.

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List of Acronyms

BC	British Columbia
BCER	British Columbia Electric Railroad
BCIT	British Columbia Institute of Technology
BRT	Bus Rapid Transit
B-Line	Express Bus Route with Some BRT Characteristics
CAGR	Compound Annual Growth Rate
CBD	Central Business District
CMA	Census Metropolitan Area
GVRD/MVRD	Greater Vancouver Regional District/Metro Vancouver Regional District
GVTA/SCBCTA	Greater Vancouver Transportation Authority/South Coast British Columbia Transportation Authority (commonly referred to as TransLink)
GIS	Geographic Information System
HOV	High Occupancy Vehicle
ICBC	Insurance Corporation of British Columbia
ICTS	Intermediate Capacity Transit System
LRSP	Livable Regional Strategic Plan
MAE	Multiple Account Evaluation
MOTH/MOT/MOTI	Ministry of Transportation and Highways/Ministry of Transportation/Ministry of Transportation and Infrastructure
MTOC	Metro Transit Operating Company
MRN	Major Road Network
NDP	New Democrat Party
PIE	Plan Implementation Evaluation
POE	Plan Outcome Evaluation
PPHPD	People per Hour per Direction
RTS	Regional Transportation Strategy (regional transportation plan)
SFU	Simon Fraser University
SFPR	South Fraser Perimeter Road
TGR	TransLink Governance Review
TPM	Transit Priority Measures
TSP	Transit Signal Priority
VRTS	Vancouver Regional Transit System
VRTC	Vancouver Regional Transit Commission
PSN	Planning Solutions Network (local transportation consulting firm)
RAV	Richmond Airport Vancouver (light metro line, now known as the Canada Line)
RORO	Roll-On Roll-Off
SQL	Structured Query Language (database querying programming language)
T2021 LRP	Transport 2021: A Long-Range Transportation Plan for Greater Vancouver
T2021 MRP	Transport 2021: A Medium-Range Transportation Plan for Greater Vancouver
TDM	Transportation Demand Management
UBC	University of British Columbia
U-PASS	Universal Transit Pass
UTA	Urban Transit Authority
VKT/VMT	Vehicle Kilometres/Miles Travelled
WCE	West Coast Express
YVR	Vancouver International Airport (airport code)

Disclosure

This thesis and analysis are based on data generously provided by TransLink and the opinions expressed do not represent the views of TransLink.

Chapter 1. Introduction

Too seldom do planners reflect on the past and evaluate plans in a formal and systematic way, after their horizon dates. This is due to several reasons, including that *ex post facto* evaluations are difficult and complex (Alexander & Faludi, 1989; Talen, 1996b), plans are often remade before their completion dates (Calkins, 1979), and that, historically, methods for how to evaluate plans were lacking. More recently ,scholars have developed and published methodologies, and evaluations are becoming more commonplace (Laurian, Day, Backhurst, *et al*., 2004; Talen, 1996a). However unappealing *ex post facto* evaluation may be to planners, many academics believe that the credibility of planning suffers due to a lack of them (Baer, 1997; Berke *et al.*, 2006; Laurian, Day, Backhurst, *et al.*, 2004; Laurian *et al.*, 2010; Talen, 1996b). Metro Vancouver's regional planning efforts are no exception to this lack of review and reflection.

The primary goal of this thesis is to determine the effectiveness of a regional transportation plan in Metro Vancouver by attempting an *ex post facto* evaluation. In doing so, this thesis will explore themes related to transportation planning, regional authorities, and the politics of transportation. The selected plan is entitled *Transport 2021: A Medium-range Transportation Plan for Greater Vancouver*. This evaluation represents an opportunity to learn from the past in order to ameliorate the future.

1.1 The Transport 2021 Plans

The Transport 2021 plans, with its long-range (T2021 LRP) and medium-range (T2021 MRP) components, were published in 1993. The T2021 MRP provided recommendations for projects and policies for the Metro Vancouver transportation network, including road and public transit networks between 1993 and 2006. Recommendations in the plan ranged from grand and expensive projects such as the Millennium Line rapid transit and the South Fraser Perimeter Road (SFPR) to new transportation policies such as increasing the tax on fuel and encouraging telecommuting. Many of the projects and policies described in the plan were implemented, but many were not.

The T2021 MRP and T2021 LRP were developed as part of a two-year joint project between the Greater Vancouver Regional District (GVRD) and the Province of British Columbia Ministry of Transportation and Highways (MoTH). The GVRD had no ability to implement the recommendations, while the MoTH had the ability to implement portions of the plan.

The T2021 MRP does not set out an implementation strategy, however, there are "staging" recommendations for the implementation of rapid transit on trunk corridors, High Occupancy Vehicle (HOV) lanes, and road network improvements. In the case of rapid transit, the plan recommends two "paths" that can be chosen depending on the level of financial commitment that is available; refer to Figure 1 below for the path structure.

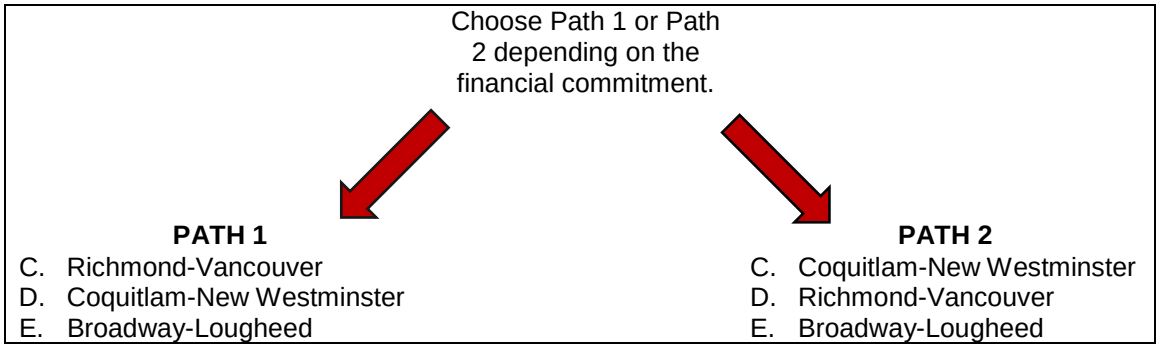


Figure 1: Phasing Approach for Rapid Transit
Source: Adapted from GVRD (1993)

With HOV and road network improvements, only a very general order is provided. For example, the T2021 MRP recommends HOV lanes (or another HOV priority system) be implemented on major crossings before being implemented on other corridors. Specific dates for implementing projects or policies are not provided in any case. The T2021 MRP also does not assign specific agencies with specific tasks and does not provide any estimated capital costs, operating costs, or funding arrangements.

After the T2021 MRP passed its horizon date, it was not directly replaced with a new short or medium-range regional transportation plan until the 10-year Mayors' Council Vision was released in 2014-2015. Well before its 2021 horizon, the T2021 LRP was replaced by TransLink's Transport 2040 (in 2008), which in turn was updated in 2013 as the Regional Transportation Strategy Strategic Framework (RTS). These newer

plans are long-range (30-year) strategic plans only and are not accompanied by a medium-range (15-year) projects plan such as the T2021 MRP.

1.2 Research Questions

The main research question that this thesis will answer is:

- Was the T2021 MRP effective?

Before I can find an answer to this question, there are five sub-questions that must be answered first (Laurian *et al.*, 2010). Those questions are:

- Were the T2021 MRP's goals achievable?
- To what degree was the T2021 MRP implemented by the horizon date (2006)?
    - Beyond the horizon date, were any delayed projects or policies implemented?
- To what degree were the expected outcomes listed in the T2021 MRP achieved by the horizon date (2006)?
    - Beyond the horizon date, were the expected outcomes ever achieved?
- What factors affected the implementation and the outcomes?

One additional sub-question became possible to answer with the results obtained in the evaluation:

- Did the establishment of TransLink in 1999 aid in achieving the expected outcomes of the plan?

To find the answers to these questions, the literature was examined, and suitable methodologies were chosen and adapted for use on the T2021 MRP. These methodologies were specifically developed to evaluate plans by examining their implementation (Laurian, Day, Berke, *et al*., 2004), outcomes, logic, and associations or causations to help explain the results (Laurian *et al*., 2010).

1.3 Significance of Research

There is a gap in knowledge in Metro Vancouver's regional transportation planning efforts. To understand what has caused the gap, we need to understand the "evaluation cycle" developed for policy and program evaluation (Weiss, 1998). In planning terms, this cycle becomes Plan-Implement-Evaluate-Assess, depicted in Figure 2 below.

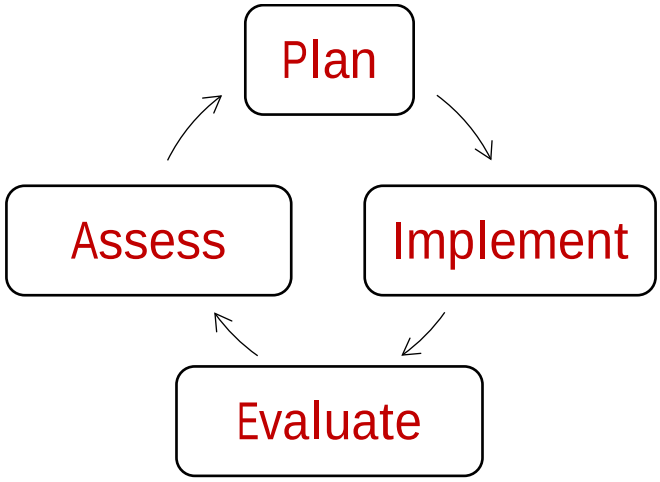


Figure 2: The Planning Cycle
Adapted from Kaiser, Godschalk, & Chapin (1995)

When followed completely and consistently, this cycle is very useful for planners to understand what went wrong or what worked well with a plan and its implementation. While planning academics may disagree on many things, one thing that they tend to agree upon is the importance of evaluation in planning practices (Baer, 1997; Hoch, 2002; Khakee, 2010; Laurian, Day, Backhurst, *et al*, 2004; Talen, 1997). Laurian *et al.* (2004) unequivocally state that "without an understanding of the degree to which plans are implemented and of the determinants of effective implementation, then improvement to plans or their implementation cannot be made."

This evaluation will help to fill in the planning cycle knowledge gap, allowing future plans to improve upon past efforts. While this evaluation will be especially useful for local Metro Vancouver planners, it will also benefit the wider planning community by contributing to the growing field of urban plan evaluation; especially, *ex post facto* implementation and outcome analyses, a field where empirical evaluations and practical

examples are lacking *(*Baer, 1997; Berke *et al.*, 2006; Laurian, Day, Backhurst, *et al.*, 2004; Laurian *et al.*, 2010; Talen, 1996b).

Before an examination into how the plan can be evaluated is pursued, in the next chapter a description of Metro Vancouver and its transportation network is provided. Important contextual information concerning local regional and provincial bodies, governments, politics and governance of transportation described.

Chapter 2. Context and Background

Understanding the context in which the T2021 MRP operated is important for developing an understanding of how the plan was created, as well as what exogeneous factors influenced its implementation years and beyond. In this section, I first provide a brief introduction to the Metro Vancouver metropolitan area as well as provide information regarding the regional district body which created the plan. Later, I describe the current and historical Metro Vancouver transportation network and provide additional context regarding the many different public bodies and political parties who influence and control transportation within the region, including TransLink.

2.1 Metro Vancouver – Region and Regional Body

Metro Vancouver is the third-largest metropolitan region in Canada with a total population of 2.4 million people as of 2016 (Statistics Canada, 2017a), Historically, the Metro Vancouver population has steadily grown between 1% and 3% annually and is projected to continue to grow. Projections show that by 2041, the population of Metro Vancouver will increase to around 3.4 million people (Ministry of Technology, Innovation, and Citizens Services, 2017).

There are 23 municipalities and one First Nation that make up the Metro Vancouver Census Metropolitan Area (CMA), the borders of which match those of the Greater Vancouver Regional District[1] (GVRD). The 23 municipalities form the federated regional district, with a selection of mayors and councillors forming the governing board of directors. The GVRD is responsible for regional land-use planning including developing regional growth strategies. Previously, they were also responsible for transportation planning, forecasting, and project coordination within the region until those duties were transferred to TransLink in 1999.

The Metro Vancouver region is often referred to as a polycentric urban area (Sweet, Bullivant, & Kanaroglou, 2017). The Vancouver Central Business District (CBD) and surrounding area is characterized by high population and employment density

[1] Also referred to as Metro Vancouver, and as of 2017, officially as the Metro Vancouver Regional District (MVRD)

concentrations, but being polycentric, other pockets of concentrated job and population density are scattered throughout the Metro Vancouver area[2]. A map of Metro Vancouver area with population and employment density is shown below in Figure 3.

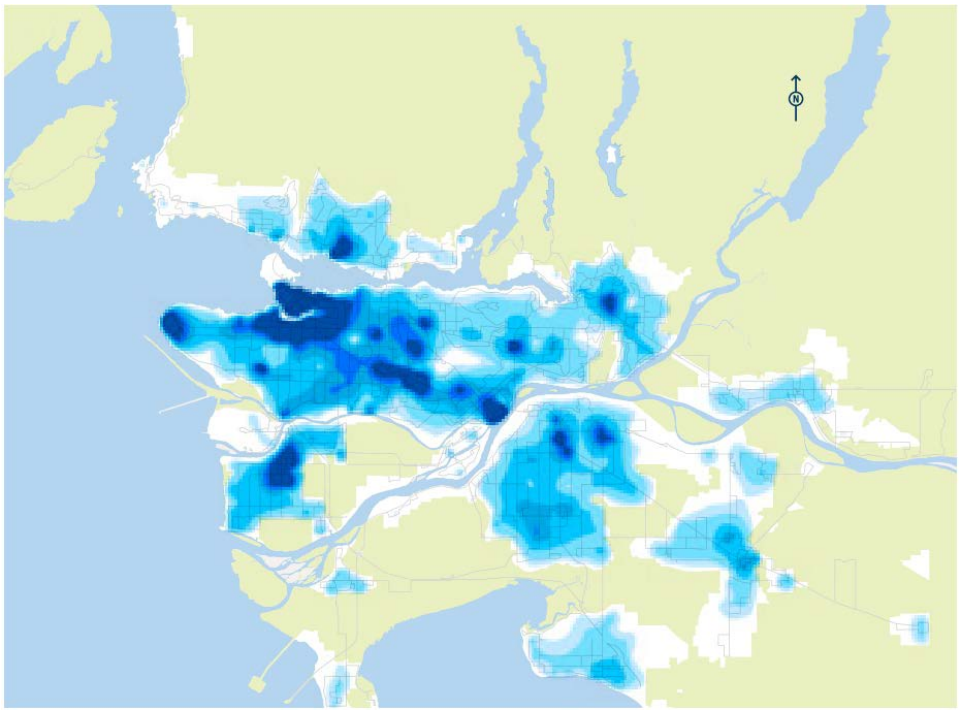


Figure 3: Metro Vancouver with 2011 Population and Employment Density
Image Source: © TransLink, 2013. Used with permission.

2.2 Transportation Network

Metro Vancouver has a comprehensive transportation network including major highways, local and arterial roads, roll-on roll-off (RORO) ferries, public transit, and long-distance rail and bus connections. Geographically speaking, waterways (such as the Fraser River and Burrard Inlet), mountain ranges, and the Canada-USA border play a significant role in shaping transportation origins and destinations within the region.

Metro Vancouver has many kilometres of restricted access highways, including a small portion located within the City of Vancouver city limits, as well as in all other municipalities within the region. Major crossings on the Fraser River and its tributaries include the Port Mann Bridge, George Massey Tunnel, the Knight Street Bridge, the

[2] The GVRD maintains an official list of these areas calling them Urban Centres (formerly known as Regional Town Centres).

Pattullo Bridge, and the Golden Ears Bridge, Pitt River Bridge, Oak Street Bridge, and Alex Fraser Bridge. Across Burrard inlet linking the North Shore with the rest of Metro Vancouver are the Lions Gate Bridge and Second Narrows Bridge. The City of Vancouver owns and maintains the three False Creek crossings: the Cambie Street Bridge, the Granville Street Bridge, and the Burrard Street Bridge.

The Metro Vancouver public transit network is multi-modal and consists of the SeaBus passenger ferry, the West Coast Express (WCE) commuter rail, the SkyTrain light metro[3], express bus routes with some BRT characteristics (referred to as B-Lines[4]), and a comprehensive bus network. The current rail, passenger ferry, and B-Line network is shown below (Figure 4). SkyTrain opened in 1985 in anticipation of the Expo 86 World's Fair held in Vancouver. The SkyTrain system has grown in length and capacity over the years and as of 2017 consists of about 80 kilometres of track with 53 stations on three lines. The system is fully automated, driverless, and grade separated with elevated, underground, and segregated at-grade sections.

[3] [3] Referred to as intermediate capacity transportation system (ICTS) in T2021 and also sometimes as medium-capacity rail transit, light rail, advanced rapid transit, rail rapid transit, or advanced light rail transit.

[4] Referred to as "SuperBus" in T2021.

Figure 4: SkyTrain, WCE, and B-Lines Map (2017)
Image source: © TransLink 2017. Used with permission.

Demand for transit services within Metro Vancouver has been consistently rising, especially since 2001, to more than 200 million trips annually by 2012, see below (Figure 5).

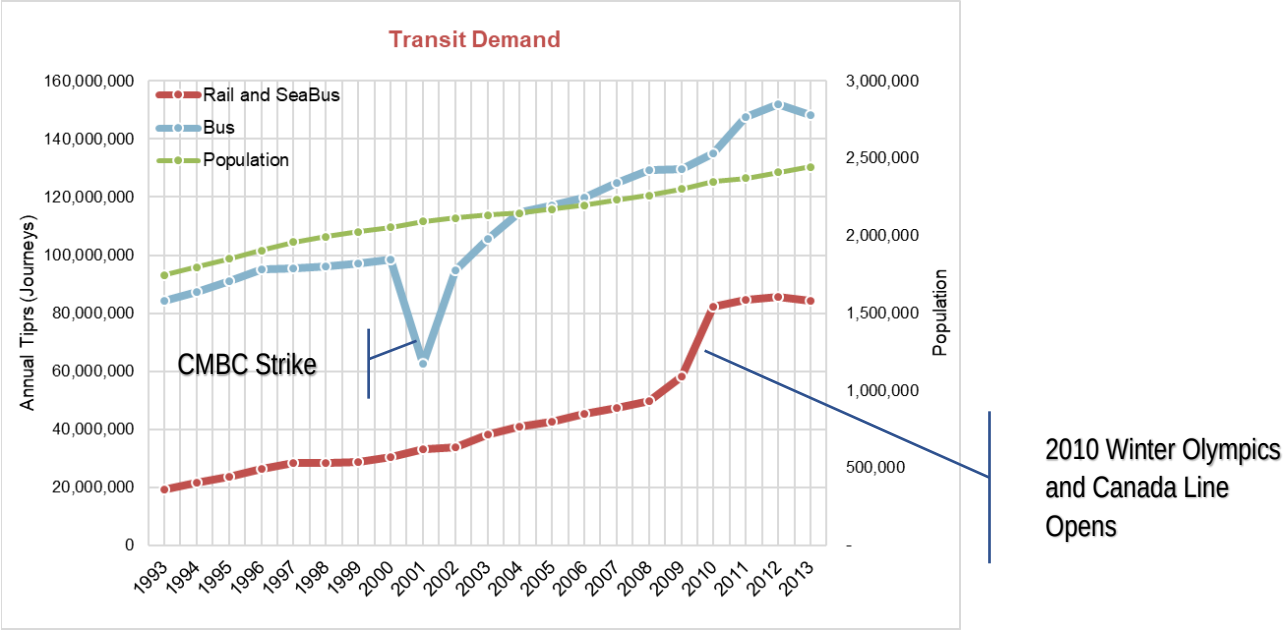


Figure 5: Annual Transit Demand
Created from annualized transit ridership data publicly available on Metro Vancouver website. (Metro Vancouver, 2014b).

2.3 Transportation Planning, Governance, and Politics

Like many North American cities established in the 19th century, Vancouver at one time had an extensive privately-operated streetcar network (BC Transit, 2016). The network of private companies operating streetcars eventually amalgamated into the British Columbia Electric Railway (BCER), which later became BC Electric. BC Electric either built or acquired an extensive streetcar and interurban rail network that stretched all the way from Steveston to Vancouver to Chilliwack. In 1961, BC Electric, which was later renamed BC Hydro, was purchased by the provincial government and continued to operate as a crown corporation. For many years it was the *de facto* agency in charge of transit planning and the official agency in charge of transit operations.

It was with the development and subsequent release of the Livable Region Plan in 1975 that planners in this region began to seriously consider the *region's* future. Following its release, in 1979, the province created two new crown corporations called the Urban Transit Authority (UTA) for financial considerations of transit and the Metro Transit Operating Company (MTOC) for the operation of transit within BC. While the UTA was designated to coordinate some transit planning functions and funding for all

other BC municipalities, most transit policy and planning responsibilities for Metro Vancouver were transferred to the GVRD. That same year, the transit operations division from BC Hydro was transferred to the UTA and regional transit planning duties for Metro Vancouver were passed on to the GVRD. The UTA and MTOC were combined and renamed BC Transit in 1983. Around this time, transit planning responsibilities of the GVRD were eliminated (along with all their other planning responsibilities) by the Social Credit[5] government of the time (Acuere Consulting *et al.*, 2013). Those duties were transferred a new entity called the Vancouver Regional Transit Commission (VRTC) which governed the operation of the BC Transit Vancouver Regional Transit System (VRTS). Vancouver mayors and councillors formed the board of directors of the VRTC. At this time, the mandate of the VRTC was to "prepare, plan, set fares, and determine service and performance standards for the Lower Mainland" (BC Transit, 1993). However, the VRTC did not prepare or release regional multi-modal transportation plans during this time – their mandate was solely to focus on transit.

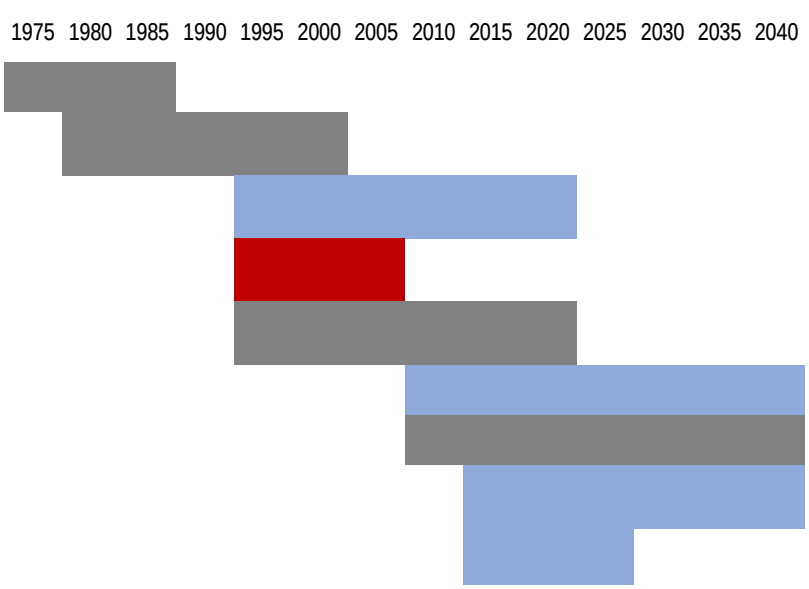
No regional multi-modal transportation plans were completed until the 1990s. Despite having their transportation planning duties revoked by the province, by 1989 the GVRD board developed a regional planning policy called the *Creating Our Future* program (Graham & Smith, 1998). From the course set by *Creating our Future,* the GVRD later developed regional land-use and transportation plans in the early-to-mid 1990s. Between 1993 and 1996, the T2021 MRP, T2021 LRP transportation plans, and the land-use and regional growth strategy, the Livable Region Strategic Plan (LRSP), were released. These regional plans were developed through consultation with multiple stakeholders including provincial ministries, crown corporations such as BC Transit, and the public.

Transportation planning and governance continued to be run by the VRTC and GVRD in this manner up until the late 1990s, when TransLink was established (discussed later). TransLink, which is partially controlled by regional politicians, continues to release regional transportation plans on a regular basis. Table 1 below summarizes the titles and time spans of the various regional plans released since 1975. Growth strategy/regional land use plans are shown in dark grey, regional transportation plans in blue, and the T2021 MRP in red.

[5] The British Columbia Social Credit party was the dominant right-wing political party of British Columbia from the 1952 election up to their collapse in the 1991 election (Dunn, 2015).

Table 1: Timeline of Regional Plans

Title	Release Year
Livable Region Plan	1976
Plan for the Lower Mainland of BC	1980
Transport 2021 (Long Range)	1993
Transport 2021 (Medium Range)	1993
Livable Region Strategic Plan	1996
Transport 2040	2008
Metro Vancouver 2040	2011
Regional Transportation Strategic Framework	2013
Mayors' Council Vision	2014-2015



The regional transportation system continues to be governed by multiple governments, bodies, and agencies. The federal government plays a minor role in transportation within the Metro Vancouver region: Vancouver International Airport (YVR), located on Sea Island in Richmond, is a federally-owned asset operated by the Vancouver Airport Authority. Several kilometres of the road network located on Sea Island and the Arthur Laing Bridge are maintained by the Vancouver Airport Authority on behalf of the federal government. The federal government has also contributed funding to major transportation projects including the Canada Line and Expo Line.

The province of BC has an influential role in operating and governing the regional transportation network. Most sections of major highway located in Metro Vancouver, including restricted-access and some non-restricted access, are under the jurisdiction of the Ministry of Transportation and Infrastructure (MoTI)[6], with some exceptions. Bridges and tunnels associated with these highways are also owned, operated, and maintained by MoTI. Only the Knight Street Bridge, Golden Ears Bridge, Pattullo Bridge, and Westham Island Bridge are owned and maintained by TransLink. A BC government-owned corporation called BC Ferries owns and operates the intercity ferry system which has two major terminals in Metro Vancouver.

[6] Formerly known as the Ministry of Highways and Transportation (MoTH) and Ministry of Transportation (MoT).

As the provincial government is responsible for the operation, funding, and planning for a sizable portion of the Metro Vancouver transportation network, the transportation network is subject to the politics of the provincial government. Since the collapse of the Social Credit party in the run-up to the 1991 provincial election, British Columbia elections have been dominated by two political parties: The Liberals and the New Democratic Party (NDP) (Elections BC, 2002, 2014)[7]. The NDP has been positioned as either left (Dunn, 2015) or left-of-centre (Perl & Newman, 2012, p. 91) and possessing social democratic ideology (Carty, 1996). Historically, they have dominated the more urban and inner suburban ridings in Metro Vancouver such as East Vancouver or Burnaby. The BC Liberals have been placed as either right (Carty, 1996; Dunn, 2015), centre-right (Evans & Smith, 2015), or centre (Perl & Newman, 2012, p. 91) on the political spectrum and processing conservative/neo-liberal ideology (Maniates & Meyer, 2010; Willmott, 2017). They have traditionally had success in the more outer suburban regions, such as Langley, South Surrey and Richmond. Suburban/urban/inner suburban differences have been noted in Canadian politics, leading Walks (2004, 2006) to conclude that "… there is a clear pattern in which inner-city residence is associated with increased likelihood of holding left-wing views […]. Outer-suburban residence is associated with increased likelihood of holding views considered to be on the right of the Canadian political spectrum." Inner suburban residents tend to fall in the middle of these extremes (Walks, 2004). Walks (2004;2006) concludes that intra-urban location an important indicator of political preference, even as important as other factors such as religion or region.

Throughout the implementation period of the T2021 MRP, both political parties had control of the legislature, with the BC NDP ruling between 1991 and their defeat in the 2001 election. The BC Liberals won four consecutive elections until their eventual defeat in the 2017 election after the NDP and Greens formed a coalition government with just over half of the seats of the legislature (R. Shaw, 2017). As we will see in the evaluation, the role of provincial politics was significant in determining which transportation projects and policies were implemented and where they were implemented and whether that influenced the effectiveness of the plan.

[7] Refer to Appendix D for maps of the provincial election results in Metro Vancouver, 2001-2017.

2.4 TransLink and its History

After 1999 many transportation-related duties were transferred to a newly-created regional multi-modal transportation authority commonly referred to as TransLink. TransLink is responsible for transportation planning, maintenance and planning of the major road network, transportation demand management, coordination for major transit projects, operating the public transportation system, AirCare (vehicle emissions testing) until the program was retired in 2014, and formerly operating a RORO ferry on the Fraser River, called the Albion Ferry, which connected Maple Ridge with Langley[8]. Roads under their mandate, the Major Road Network (MRN), is a "network of approximately 600 km of road that facilitates the safe and efficient movement of people and goods across the region. It connects the provincial highway system with the local road network" (TransLink, 2017a).

2.4.1 Establishment

TransLink was established through a negotiation process between the province and the Metro Vancouver region as represented by the GVRD. At the time of its founding, it was the first multi-modal transportation authority in the world (Wells, 2008). The huge cost of the projects recommended by the T2021 plans is one of the main reasons why the negotiations with the province, which eventually led to the establishment of TransLink, began (Acuere Consulting *et al.*, 2013, p. 2; Wells, 2008, p. 13). Significantly, T2021 MRP recommended three rapid transit lines be built by 2006 – the province (controlled by the NDP government at the time) made it clear to the GVRD that they would be unable to fund these expensive projects by themselves (Wells, 2008). Some of the funding would have to come from the region via the GVRD. However, after holding transportation governance workshops, the GVRD ultimately reached the conclusion that, if the region was going to be providing part of the funding, then the region would need to play a central role in saying how that money would be spent (Wells, 2008, p. 13).

The negotiation process was led by Vancouver councillor George Puil (chair of the GVRD in the 1990s) representing the region, and NDP finance minister (and minister

[8] This ferry service was discontinued shortly after the opening of the Golden Ears Bridge in 2009.

responsible for transit) Joy McPhail representing the province. It was decided that a new regional authority would be better suited to implement the regional plans and would also better set up to raise the regional funds that would be required (Acuere Consulting *et. al.*, 2013). Shortly after this was declared, the GVRD board ratified the changes, followed by the province. The Greater Vancouver Transportation Authority Act was passed by the BC Legislature in June of 1998 and TransLink officially began operation in April 1999. Officially termed the Greater Vancouver Transportation Authority (GVTA), TransLink has been described as the "most complex and most powerful regional transportation authority in Canada" (Sancton, 2015).

2.4.2 Governance

The original governance structure of TransLink was similar to that of the GVRD, with a board consisting of up to 15 elected officials; typically, with 12 mayors or councillors representing the region (Acuere Consulting *et al.*, 2013, p. 2). However, this structure was radically changed in 2007 by the then BC Liberal government following the recommendation of the purportedly independent commission charged with performing a review of the TransLink governance structure. This project was known as the TransLink Governance Review (TGR)[9]. At the recommendations of the TGR, control of most of TransLink's decision-making was removed from the mayors and councillors and transferred to a board consisting of un-elected business-persons and other individuals.

The decision by BC Liberals to commission the review and make the changes stems from a history of conflict with the local mayors and councillors who made up the TransLink board. In the early 2000s, there were two rapid transit lines recommended by the T2021 MRP yet to be constructed: a further extension of the Millennium Line (or new rapid transit line) into the northeast area and a north-south line connecting Richmond to downtown Vancouver. Although the T2021 MRP made it clear in which order the lines should be built, the NDP did not follow the recommended order. They built the lowest priority line first, so accordingly, it was not clear which line should be built next. Many local politicians were pushing for the northeast region (Evergreen extension) to get rapid

[9] Not to be confused with a different 2013 report, also entitled the *TransLink Governance Review.* The 2007 TGR was commissioned by the BC Liberal government, whereas the 2013 TGR was completed by a team of transportation consultants commissioned by the Mayors' Council on Regional Transportation. Both these reports are referenced in this thesis. Their conclusions and recommendations differ quite substantially.

transit first, as this had been previously proposed by the NDP and was listed as priority in the T2021 MRP. However, this all changed after the BC Liberals won control of the legislature in the 2001 provincial election[10], and further complicated in 2004 when Vancouver was awarded the 2010 Winter Olympics. After the successful Olympic bid, the provincial and federal governments pushed hard for the Richmond to Vancouver line to be built first with an additional branch to YVR Vancouver International Airport (P. Smith & Oberlander, 2006). This line, termed the Richmond Airport Vancouver (RAV) line during construction, would connect to several of important Olympic games-related locations including stadia, the athlete's village, and the airport. While not officially on the games budget, the RAV Line was considered an essential part of the bid process and touted as an "Olympic legacy project" (C. Shaw, 2012). The position of the both the province and the federal government of Canada (controlled by the Conservative Party of Canada) was that the RAV line should be built first and each provided up hundreds of millions in funding for the project. However, initially, a majority of the TransLink board members were opposed to the project. The opposed members provided several reasons to be opposed, including that they felt that the Evergreen extension should be built first, they were opposed to private-public-partnership aspect of the project, the massive expense, and the fact that the project was to be tunnelled rather of a cheaper surface light rail option (P. J. Smith, 2013; P. Smith & Oberlander, 2006).

When the vote to approve the RAV line was presented to the TransLink board in May of 2004, a majority of board members voted to cancel the project (GVRD, 2004a). The vote was repeated with the same result in mid-June of 2004 (GVRD, 2004b). After significant pressure was put on the board members (P. J. Smith, 2013), finally a third vote confirmed the RAV line with 8-4 in favour followed by an additional re-confirmation in December (GVRD, 2004c; 2004d). Two years later, with the BC Liberals still in control of the legislature, Kevin Falcon commissioned the TransLink Governance Review (TGR). The TGR Panel completed their review in 2007 and made a number of recommendations, including the following:

> We recommend a new three-part governance structure. We recommend a new Council of Mayors who will be accountable for approving TransLink's 10-year Strategic Plans, including revenue measures. We recommend a new, non-political TransLink board of 11 directors. This Board will be responsible for planning, constructing and operating the

[10] Refer to Appendix D for maps of the provincial election results.

> regional transportation system. To further improve public accountability and confidence in TransLink, we recommend the establishment of an independent TransLink Commissioner responsible for approving fare increases, for assessing and reporting on the consistency of TransLink's 10-year strategic plans with the provincial vision (as well as the reasonableness of the financial assumptions included in the 10-year plans and for auditing TransLink's customer satisfaction performance (TGR Review Panel, 2007).

Legislation drafted by the BC Liberals was enacted as the South Coast British Columbia Transportation Authority (SCBTA) Act on November 29, 2007 and matched the recommendations of the TGR nearly exactly. The final board meeting of the old GVTA was held on December 12, 2007. After these changes were made, local politicians had significantly less control over regional transportation decisions. In 2013 a new TGR was commissioned by the Mayors' Council on Regional Transportation. This review found that the new governance structure was 'worse' than the previous one, and should be re-imagined once again (Acuere Consulting *et al.*, 2013; P. J. Smith, 2013). The Mayors' Council continues to advocate for a change in the governance structure.

2.4.3 Funding

TransLink is funded through transit fares, a hydro levy, a fuel tax, property tax, parking tax, retail sales, and transfers from the provincial government's general revenue (Mayors' Council on Regional Transportation, 2013b). Past revenue sources have included AirCare fees and Golden Ears Bridge tolls. Through its legislation, TransLink has some authority to increase its funding sources independently through increase to fuel taxes and transit fare revenues. However, they are limited legislatively in their scope. In practice, TransLink is required to ask the provincial government for major increases to funding or to implement new sources of revenue. Since its inception, several new funding sources have been proposed and discussed, just two have been seriously considered.

The first such example was a proposed $75.00/year vehicle levy, recommended by both the TransLink and GVRD boards in 2000 to increase TransLink's revenue to support transit service expansion and fund new projects. The vehicle levy was to be collected by the provincially-owned automobile insurance company, the Insurance Corporation of British Columbia (ICBC), when drivers in the Metro Vancouver region

renewed their car insurance (McDougall, 2018). The province and the public were generally opposed to the concept of a vehicle levy (Fershau, 2003). In 2000, the TransLink board voted 7-5 in favour of implementing the vehicle levy, however the NDP refused to implement the legislative changes to the Act governing TransLink (Fershau, 2003). The NDP chose not to do so due to a variety of reasons ranging from the technical to the "political needs of the provincial government [… being] prioritized over the region's planning and policy efforts." (McDougall, 2018). The vehicle levy also "sparked urban-suburban tensions" due to perceived differences in the transit network coverage between central core and outer suburban regions, with some arguing that the vehicle levy was unfair to suburban drivers living in areas with limited mobility options (McDougall, 2018). Doug McCallum, the mayor of the mostly suburban municipality Surrey, lead a campaign against the vehicle levy (McDougall, 2018).TransLink's business plan of that era prematurely assumed that the vehicle levy would be in place and consequently a plan to expand transit services had to be rolled back when TransLink had to trim its 2001 budget by $7 million (Wells, 2008, p. 35).

More recently, TransLink, with the support of the Mayors' Council, once again put forth a proposal to implement a new revenue source: a 0.5 percentage point increase to the provincial sales tax, in the Metro Vancouver region only, to partially fund the 10-year Mayors' Council Vision (Willmott, 2017). As it was a new funding mechanism, it was required to be approved by plebiscite (Willmott, 2017). The plebiscite was an election campaign election promise from the BC Liberals under Premier Christy Clark in the run-up to the 2013 provincial election – an election which they won. Shortly after the election, the SCBTA Act was amended so that any new sources of funding for TransLink would require a plebiscite in order to be approved. The plebiscite forms were mailed out to all eligible households in the spring of 2015 and the official result was announced in July 2015. The new plebiscite failed to gain the necessary number of votes, with 62% of voters voting no (Johnson & Baluja, 2015). Many have described the plebiscite process as doomed to failure, deriding the whole process as a way for the BC Liberals to "evade any direct responsibility for tax increases" (Willmott, 2017). During their short and tenuous grasp on power after the 2017 provincial election, the BC Liberals announced that the referendum would no longer be required (Bitten, 2017). Stable funding for the authority and its proposed projects and plans continue to be challenging for the authority. TransLink's board, Mayors' Council and leaders have often suggested that

some form of road pricing should be used to fund transportation (Mayors' Council on Regional Transportation, 2013a). However, no plan to do so has emerged.

In the next chapter, I review and summarize planning literature on evaluation and the effectiveness of planning. The literature review draws upon many examples of evaluations complete elsewhere to assess diverse plans, programs, and policies. Key questions that I sought out include: what it means to evaluate a plan, what precisely should be evaluated, how should it be done, and importantly, how can the results be interpreted? In the next chapter I establish this interpretive framework.

Chapter 3. Literature Review

The following literature review draws on primarily planning theory to understand the concepts and principles of evaluation in planning. The literature review will first examine the many different types of evaluations in planning that exist. Next, the literature review will determine what type of plan the T2021 MRP is, and correspondingly which of the different types of evaluations is most appropriate to use. Finally, it will examine how effectiveness can be determined and will finally conclude by exploring the reasons for why other plans have failed or have not been effective.

3.1 Evaluation in Planning

Evaluation is perhaps best defined by Weiss as the "… systematic assessment of the operation and/or the outcomes of a program or policy, compared to a set of explicit or implicit standards, as a means of contributing to the improvement of the program or policy" (1998, p. 4). While this definition is borrowed from the field of policy and program evaluation, the same principles apply to planning. Weiss' definition is useful, but it does not answer all the questions. What should be evaluated? The substance of the plan, the plan documents themselves, alternatives, inputs, outputs, or outcomes (Baer, 1997)? Each of these requires a definition of what is being evaluated, and an understanding of how to do it. As such, I explore the different types of evaluations in the literature summarized by scholars.

3.1.1 Evaluation Typologies: Talen

Talen (1996b) provides a summary of works written about plan evaluation and subsequently developed a typology of plan evaluation which I summarize here. Talen's evaluation typology is broken down into the following categories and sub-categories:

- Evaluation prior to plan implementation
    - Evaluation of alternative plans
    - Analysis of planning documents
- Evaluation of planning practice

    - Studies of planning behaviour
    - Descriptions of the impacts of planning and plans
- Policy implementation analysis
- Evaluation of the implementation of plans

According to Talen, evaluation of alternative plans consists of examining methodologies used during the plan creation phase, and analysis of planning documents is defined as focusing on the understanding of the language of the plan and determining what value the plan has. Both evaluation practices take place prior to plan implementation, and may produce valuable information regarding plan quality. An example of this type of evaluation is the Multiple Account Evaluation (MAE). MAE was developed by the BC provincial government in the 1990s (Crown Corporation Secretariat, 1993). Often used to evaluate different options against many different categories or sub-categories, it has become a commonly used evaluation technique in planning practice. These types of evaluations are not *ex post facto* and are thus not applicable for *this* thesis research question.

For studies of planning behaviour, Talen points the reader to Dalton's (1989) comprehensive review of more than one hundred case studies of planning behaviour in the United States. Dalton shows that there are numerous studies on topics such as planners' political behaviour, communication between public agency planners and private project applicants, and case studies of political difficulties faced by agencies trying to survive as well as to perform their planning functions under difficult conditions. Talen's criticism of these types of evaluations is that they assume that plans are being implemented and therefore miss an important aspect of planning practice; they are thus of little use to those interested in *ex post facto* evaluation. Talen suggests that most works describing the *impacts* of planning and plans have assumed that implementation was successful and completed. She suggests that these types of evaluations are more useful in determining what factors *other* than plans influence the outcomes.

Thirdly, Talen recognizes policy implementation as a type of plan evaluation, but specifically separates it from urban plan analysis (even though it shares many of the same characteristics). Policy implementation analysis focuses on the administrative process involved and why that process may or may not have gone as expected (Younis,

1990). Policy implementation research is now in it's so-called "third generation" (Howlett, Ramesh, & Perl, 2009) and there is a vast amount of information readily available to researchers. However, Talen is adamant that urban planning evaluation is quite different than policy implementation due to different data collection methods and goal measurements.

Finally, Talen examines the methods used to evaluate the implementation of plans specifically. She further divides this into two categories: quantitative, and non-quantitative methods. Talen is dismissive of the non-quantitative methods, suggesting that methods produced by academics such as Smith (1991), which identify a vague "planning attitude" as an indicator of success, are of little benefit for those interested in studying plan implementation due to their impossibility to measure empirically. For quantitative methods, Talen agrees with Bryson, Bromiley and Jung's (1990) argument that implementation evaluations methods should be rigorous, empirical, and quantitative. She strongly suggests that the planning community develop evaluative procedures – she and others have since developed such procedures (Laurian, Day, Berke, *et al*., 2004; Talen, 1996a). An example of this type of evaluation is produced by Talen (1996a). In examining a parks plan, Talen measures the "degree of conformity", by measuring the new accessibility using GIS methods, as opposed to determining whether the parks were placed exactly where they were supposed to be according to the plan. Since the main goal of the plan was to increase accessibility to parks, Talen measures the 'success' of the plan through her evaluation purely by examining the outcome. Although she is measuring the outcome, she believes that this method is also a good measure of implementation. This final sub-category as defined by Talen is the most appropriate type for this evaluation as it is the only one that is *ex post facto*, however, it would only tell us if the plan met its goals, and we would have to assume it was implemented, and not just a coincidence that the goals were met - more information is needed.

As her method is measuring *conformance*, in this instance, Talen is subscribing to the rational-comprehensive model of planning. Laurian *et al.* (2010) write that a rational-comprehensive viewpoint is positivist, and "assumes that plan goals and objectives translate into policies and methods, which are implemented to address specific problems and yield expected outcomes" (Laurian *et al.*, 2010, p. 743). Under this planning model, to evaluate outcomes is to measure conformance. In the planning context, conformance often used in the usual sense of the word, as "concurrence

between the original plan and changes in the outside world" (Mastop & Faludi, 1997, p. 820). There are also other ways of thinking about plans and planning. The communicative-social model, focuses more on "consensus-building" and whether plans are used as a guide for decision making (Laurian *et al.,* 2010, p. 842). Thus, what is defined as a plan's *performance* is what matters. Performance in this case "has to do with the way in which a strategic plan holds its own during the deliberations which follow its adoption" – essentially whether the plan was used in making planning decisions (Mastop & Faludi, 1997, p. 820).

Hoch (2002) does not focus on conformance versus performance, but is critical of a purely rational-comprehensive approach to plan evaluation. Hoch argues that Talen's approach is "only loosely tied to the purpose and plan" (Hoch, 2002, p. 60). He does not believe that Talen has fully evaluated the plan's success since she does not know anything relating to the circumstances, or context, that led to the outcome. Hoch instead argues that a more pragmatic approach is required when evaluating plans. Using the analogy of a plan as a statistical forecast model, Hoch suggests that one can understand that the predictions of the planners who made the plan are only as good as their assumptions at the time of the writing of the plan. As such, those assumptions should be understood when determining a plan's success or failure; Hoch also believes that evaluations must determine whether plans serve the public good. Ultimately, Hoch argues that plan evaluations should use multiple methods and consider multiple aspects of planning when measuring success. These aspects include, in addition to whether plans *have* achieved their goals, unanticipated events and unintended consequences, whether the plan *can* achieve its outcomes (and if not, what alternative plan would be capable of doing so), whether plans serve the public good, and whether they improve competence and practice.

3.1.2 Evaluation Typologies: Laurian *et al.*

Laurian *et al.* (2010) further adds to the planning evaluation typologies developed by Talen, specifically for *ex post facto* outcome evaluation methods. The different types of outcome evaluations categorized by Laurian *et al.* are:

- goal or objective-driven evaluation;
- theory-driven evaluation;

- utilisation-driven evaluation; and
- a-theoretical data-driven evaluation.

Firstly, objective-driven evaluations determine whether the goals, or objectives, of the program, policy, or plan are met. Goal or objective-driven outcome evaluation is conformance based as it emphasizes the association between goals and outcomes. It therefore belongs falls under rational-comprehensive planning model (Laurian et al., 2010, p. 743). Laurian *et. al* (2010) notes that it is difficult to link observed outcomes to the plans or policies.

Theory-driven outcome evaluation emphasizes causal links between programs and outcomes, and focuses on modelling the program (or plan) logic (Laurian *et al.*, 2010, p. 745) or a "holistic assessment of the congruency between the major components of program theory, especially the portion of the action model, and their actual implementation" (Chen, 2011). This type of evaluation has been described as pragmatic and can be considered part of the rational-comprehensive or social-communicative planning models, depending on what is being evaluated. An example of an theory-driven evaluation was undertaken by Chen (1997) to evaluate a drug use-prevention program in Taiwanese high schools. In this evaluation, Chen compared the normative (planned) to actual outcomes and determine that there was large "discrepancy between the program as planned and the program as delivered". He also looked at each part of the process in detail and was able to make recommendations to improve the program including communication problems between implementers and decision-makers.

Utilization-driven outcome evaluation was first proposed by Patton (1989). This type of outcome evaluation, corresponds to the communicative-social planning model (Laurian *et. al.*, 2010, p. 745). An evaluation of this type, is based entirely on input from stakeholders who select and evaluate the goals.

The last type, a-theoretical data-driven evaluation, "tracks changes over time rather than assess[ing] the specific impact of … plans" (Laurian et al., 2010, p. 745). An example of this type of evaluation is an alternative outcome evaluation completed by

Planning Solutions Network (PSN) consulting on the T2021 MRP in preparation for a TransLink symposium on the subject. (DeMarco, 2013)[11].

3.2 Evaluating the T2021 MRP

With an understanding of the types of evaluations that are available and of evaluation in planning more generally, one can determine which type of evaluation is most appropriate for the T2021 MRP. The T2021 MRP plan is inconsistent on what constitutes success. On the cover letter accompanying the plan, the following statement is boldly proclaimed: "our recommendations are interdependent. A 'pick and choose' approach will not work" (GVRD, 1993). However, later, the plan states that it is "more guidance than prescription for the future" (GVRD, 1993, p. 4). If the plan *is* only guidance, then why would a "pick-n-choose" approach not work? The T2021 planners are clear about what outputs and outcomes they expect to be achieved, even supplying specific numeric "performance" targets as "a method of measuring success of the plan" (GVRD, 1993, p. 52). At the heart of this confusion is the question: are urban plans blueprints for the future, or are they simply "signposts" (Laurian *et al*., 2010, p. 743)? If the planner believes that a plan is a blueprint for the future, then they may subscribe to the rational-comprehensive model of planning, and conformance (how closely do the implementation and/or outcomes match the plan) is what should be evaluated. If the planner believes that a plan is a signpost, or a guide, then the planner probably holds to the communicative-social planning model; in this case, performance is what should be evaluated (Laurian *et al.*, 2010; Mastop & Faludi, 1997).

Thankfully, the literature gives us clues about how a conclusion can be made. Mastop and Faludi (1997) develop definitions of what differentiates a strategic plan versus what they term a projects plan. They write that a projects plan "provide[s] blueprints of the intended end-state of the physical environment, including the measures necessary to achieve that state" (Mastop & Faludi, 1997, p. 819)." Whereas a strategic plan deals with the "coordination of a multitude of actors" and are a "frame of reference" (Mastop & Faludi, 1997, p. 819) for negotiations, or a simply a record of agreements reached. They write that a social-communicative planning model works better if the plan being evaluated is a strategic plan. Their arguments are based on the idea that strategic

[11] A complete description of the approach taken for this evaluation can be found in Section 4.6.

plans are different than other types of plans. They argue that because strategic plans require the coordination of multiple actors, or agencies, they are more like a "record of agreements reached" than blueprints for the future (Mastop & Faludi, 1997). Therefore, they suggest success be determined by "whether the plan plays a role in those decision situations in which it was meant to be used" (Mastop & Faludi, 1997, p.820). They also make it clear that plans are not the only object that affect outcomes, and not the only information that decision-makers use to make decisions. The authors consider success to occur when the actual outcomes resolve the issues that were identified in the plan. In their conclusions, Mastop and Faludi (1997) admit that these types of evaluations are difficult, and that "simple solutions are not available." They do not provide a methodology for which to apply the performance principle – but others have applied the performance principle with success (Berke *et al.*, 2006). Consequently, Mastop and Faludi suggest that if the plan to be evaluated is what they term a project plan, then the rational-comprehensive model is more appropriate. Ranasinghe and De Silva (2013, p. 24) concur with Mastop and Faludi; they suggest that a communicative-social planning model is best suited for evaluating plans with broad visions or goals that do not have specific expected outcomes.

While the T2021 MRP certainly has elements of a strategic plan, it's medium-range time frame, abundance of geographically-specific recommendations, and performance targets make it less strategic and more prescriptive, similar to an investment or projects plan. The T2021 MRP does have specific expected outcomes, therefore an evaluative method that focuses at least partially on *conformance* to both outcomes and implementation, must be used for this evaluation. While this will be strategy used for this thesis, others have found that "conformance- and performance based criteria complement […] each other" (Zhong, Mitchell, & Huang, 2014). An additional look at the T2021 MRP or LRP with a performance-based methodology could also yield interesting and potentially useful results.

As previously discussed, Laurian *et al.* (2010) systematically categorize and assess the pro and cons of each type of outcome evaluation. They also consider the differing viewpoints of Talen, Hoch, and Mastop and Faludi, among others. They argue that an outcome evaluation should be pragmatic and contain elements of the theory-driven and objective-driven evaluations as they are the most useful. Such an evaluation would contain elements of both the rational-comprehensive and communicative-social

planning models, and is pragmatic, as recommended by Hoch (2002) as it would rely on "expert knowledge and multiple [data] sources" (Laurian *et al.*, 2010, p. 747), while also having rational elements, as recommended by Talen (1996b). Laurian *et al*. also stress that any outcome evaluation must be preceded by an evaluation of implementation, "to ensure that the plan could yield expected outcomes" (2010, p. 747).

Clearly, a focus on either implementation or outcomes will not give us an answer as to whether the T2021 MRP was effective; a holistic and pragmatic approach is required. Indeed, to fully know how effective the T2021 MRP was, we must know if the plan was implemented, what the outcomes were, and whether those outcomes were as expected by the plan.

3.3 Determining Effectiveness

In this section I examine how I would actually determine the effectiveness of a plan, using a conformance-based evaluation type. How will I conclude if the T2021 MRP was effective? First, I discuss *ex post facto* implementation. Talen (1996b) summarizes a range of ideas from other thinkers describing what success, or effectiveness, means in planning, including implementation. At the most extreme, she points to academics such as Wildavsky (1973) who wrote that failure simply occurs when plans are not implemented. Since that time, other thinkers have come up with other very different ideas, including as previously discussed, Mastop and Faludi (1997) who argue that success occurs when plans are actually used by decision makers, regardless of whether the ultimate decisions are what is written in the plan. A plan implementation evaluation that Talen (1996a) develops measures successful implementation, and falls somewhere in between these two extremes. As discussed earlier, her method measures the "degree of impact" of a plan's implementation by measuring the important feature of the output – as opposed to determining whether the outputs were placed exactly where they were supposed to be according to the plan.

In a subsequent article, Talen (1997) argues that success should not be limited to implementation only and be measured with still other, yet to be developed, methods. Admitting that it "may be possible to view plans as having 'failed' to be implemented but having 'succeeded' in procuring other, less tangible though positive, effects" (Talen, 1997, p. 585), Laurian *et al.* (2004) heed Talen's call and develop a conformance-based

implementation evaluation methodology, aptly titled Plan Implementation Evaluation (PIE). PIE is, by definition of the authors, a methodology to determine "the degree to which plan policies are implemented through the application of specified development techniques in planning practice" (Laurian *et al.*, 2004). Similarly to Talen's (1997) methodology, PIE determines the "degree of conformity" of implementation. Using PIE, the authors were able to score plans in terms of both implementation breadth (proportion of plan policies that are implemented at least once) and implementation depth (proportion of policies that are implemented by each permit by using the techniques specified in the plan). PIE is designed for use with plans that require permits, such as, for example, a heritage conservation plan. Notably, permits don't apply in the case of the T2021 MRP, but adaptations can be made so that the principles of PIE are applied[12]. However, we still have not yet determined what constitutes "success" in implementation. Laurian *et al.* (2004) do *not* provide an answer to what numerical value of a score constitutes success versus failure. However, by examining multiple plans they are able to benchmark the plans against each other to determine which plans fared the based, and the ultimately they are able to find the determinants of plan implementation using rigorous statistical methods (Lauriant *et al.*, 2004).

As this evaluation is a case study, statistical analysis and comparison will not be possible. However, it may be possible to benchmark the T2021 MRP with the results of other evaluations published in the literature. In a study of the implementation of the Guangzhou, China land-use master plan Tian and Shen (2011) determine that the degree of conformity of the plan is "very low" at between 20%-44% and conclude that overall the plan had little impact on the outcomes. Tian and Shen utilize a methodology that is similar to PIE, but they do not distinguish between depth and breadth. Alfasi *et al.* (2012) determine that an Israeli land-use plan had a degree of conformity of less than 50%, which was also a disappointing result. Bulti and Sori (2017) conceptualize failure in Ethiopian land-use land use plans as occurring when more non-conforming land is present than conforming land. Still others refuse to assign scores or place the plan into the success and failure binary, simply stating that the plan did not meet its objectives (Feitelson *et al.*, 2017; Velotta, 2008). While it is not possible to distinguish between implementation breadth and depth with the T2021 MRP, degree of conformity is possible to measure as others have done with land-use plans (Alfasi *et al.*, 2012; Bulti & Sori,

[12] Discussed fully in Section 4.2

2017; Talen, 1997; Tian & Shen, 2011). As has been the case with previous studies, if the degree of conformity, by category, is less than 50%, then one can conclude that implementation was poor. If it is more than 50%, then one can conclude that implementation was *not* poor.

Next, I discuss results of the outcomes. A methodology to evaluate planning outcomes is also developed by Laurian *et al.* (2010). Their methodology is (also) aptly named, as Plan Outcome Evaluation (POE). POE is described by the authors as an *ex post facto* evaluation which is "pragmatic, reflexive, and hybrid" (2010, p. 747) considering and incorporating the findings of past scholars (Hoch, 2002; Talen, 1997). It relies on three steps: plan logic mapping (adapted from theory-based evaluation); determining whether plan goals and observable outcomes match (based on objective-driven evaluation); and an explanation of the outcomes observed (an additional theory-based step). Laurian *et al*. apply their methodology on specific local plans from New Zealand. Instead of determining whether the plan was effective or not, they showed if plans achieve their intended outcomes and explained the causes (2010, p. 753).

Using POE, Day *et al.* (2009) lay out the rules for what they consider to be an effective plan. They state that full success (or full effectiveness) occurs when the "observed [outcomes] align with the plan's stated [outcomes and] the [logic] was shown to have worked" (2009, p. 27). Day *et al.* also believe that a plan is only effective when a plan is fully implemented. However, as we have previously seen, it is more useful to be pragmatic, flexible, and measure the degrees of conformity.

3.4 Insights into Causality

In this section, I examine the literature to determine the underlying *reasons* for a plan's effectiveness. Why are some outputs implemented and others not? It is admittedly difficult to make generalizations regarding implementation and outcomes, as most evaluations are case studies, and every region and every plan unique. This is why POE relies on expert testimony to provide insight into what external factors affected the outcomes and why certain outputs were implemented while other were not (Laurian *et al.*, 2010). However, all experts are subject to their own biases, or perhaps simply may not know the answers to these complex questions. However, by examining multiple local plans and applying the PIE methodology to evaluate implementation, Laurian *et al.*

(2004) and later Berke *et al*. (2006) are able to benchmark plans against each other to determine which plans fared the best. Ultimately, they find determinants of plan implementation using rigorous statistical methods. They find that two factors are largely responsible for poor implementation: the implementation capacity of the planning agency and the quality of the plans themselves[13].

Although he uses only a purely qualitative assessment, Ardila (2002) described the determinants of plan implementation with regards to a transportation plan in Bogota, Colombia. He examined two long-standing rapid transit plans for Bogota, one suggesting subways and the other BRT. The BRT plan eventually won out over the subway plan, resulting in the implementation of the city's celebrated BRT system, the TransMillenio. His conclusions regarding the determinants of successful plan implementation are that plans must be politically realistic; plans must be financially realistic; implementation agencies must have sufficient capacity; and plans should be implemented and that planners should pay attention to developing plans which are actually implementable.

3.5 A Definition of Effectiveness for the T2021 MRP

What has been written about evaluation is vast and sometimes contradictory. Thinkers often challenge others' conclusions, do not provide explicit answers, debating what planning is even for. It is difficult, or perhaps impossible, to define what a successful plan is as all plans and their contexts are unique. However, I conclude based on previous work that an effective plan is one that has a logic model that is sound, achieves its goals, and has at least 50% of its policies (or categories) implemented. Anything else can be considered 'not effective' but what should be focused on is the reasons for its success or failure to be effectiveness. The POE and PIE methodologies will be applied to the T2021 MRP. However, since every plan is unique, certain changes and adaptations to the basic methodology will have to be made. In the following section, the application of the methodology to the T2021 MRP is described in detail with adaptations noted.

[13] Determined using eight criteria including: internal consistency of the plan, the quality of its fact base, the clarity of issues, the provisions for monitoring, and planning capacity (Berke *et al.,* 2006).

Chapter 4. Methodology

The methodologies known as PIE (Laurian *et al*., 2004) and POE (Laurian *et al.*, 2010) were selected as the preferred methodology. Although the PIE methodology was specifically developed for local plans involving permits, the same principles can be applied to a regional transportation plan. The main principles of PIE are to:

- determine if the each of the outputs or policies have been implemented; and
- assign a measure, or score, of how well it conformed (*i.e.* degree of conformity).

POE has several known applications (Laurian, 2016, Personal Communication) and has shown to be adaptable and flexible; it has been used to a diversity of plans including storm-water management and heritage building protection. POE is a methodology first proposed in the planning literature by Laurian *et al.* (2010) as response to a lack of existing outcome evaluation methods. The analysis involves four analytical steps, which should be completed in the following order:

1. analysis of plan logic and corresponding due diligence;
2. analysis of the implementation of the plan;
3. quantitative analysis of monitoring data for outcomes; and finally
4. expert-driven qualitative attribution analysis.

The unit of analysis for this evaluation is Metro Vancouver, also known as Greater Vancouver. In this case the area refers specifically to the Greater Vancouver CMA which exactly corresponds with the borders of the GVRD. While the T2021 MRP occasionally refers to portions of the transportation network and area geographically located in the FVRD, the focus of the plan is on Metro Vancouver as defined by the borders of the GVRD.

The T2021 MRP officially covers the years between its publication in 1993 and its horizon year 2006. For that reason, the implementation analysis uses 1993 as the base year. Trip Diary Survey results from 1991 were used as the base year for the outcomes analysis and 2006 was used as the horizon. However, since there was no Trip Diary Survey completed in 2006, most values for 2006 are linearly interpolated between the

1999 and 2008 Trip Diary Survey results. With post-implementation period data available from 2013 (for implementation) and 2011 (for outcomes), these dates were used as an 'expanded horizon' in certain cases. Table 2 below summarizes the different time periods used.

Table 2: Time Periods Used

Item	Base	Horizon	Expanded Horizon
Implementation (outputs)	1993	2006	2013
Outcomes	1991	2006 (interpolated between 1999 and 2008)	2011
24-Hour Trip Diary Data	1994	2006 (interpolated between 1999 and 2008)	2011
Attribution	The experts were asked to comment on the period of 1993-2006, however, they frequently strayed into other time periods before and beyond the official study time period. Justifiably, as the study time period is somewhat arbitrary.		

4.1 Logic Model and Due Diligence

The purpose of this first analytical step is to determine if the plan is logically capable of achieving its goals (Laurian *et al.*, 2010). To determine this, a basic plan logic model was developed, and the literature was reviewed to ensure that the concepts and recommendations in the plan are reasonable grounded in established transportation planning theory.

4.2 Implementation

While Laurian *et al.* (2004) distinguish between implementation depth and breadth, others do not (Alfasi *et al*., 2012; Bulti & Sori, 2017; Tian & Shen, 2011; Velotta, 2008). In any case, it is not possible to distinguish between implementation breadth and depth with a transportation investment plan like the T2021 MRP. Talen's (1996) philosophy regarding implementation can be used; when Talen measured implementation to a parks plan, she did not measure whether the parks were placed exactly where they were supposed to according to the plan, but whether the parks that were implemented increased accessibility to parks for residents. She measures the feature that is important (accessibility). The same principle can be applied to the measuring the implementation of the outputs in the T2021 MRP. A total of three

categories were created, re-classified from the total list of recommendations in Appendix A:

- bus priority-related outputs have been combined into *Introduce Transit Priority Measures* (3.8);
- all HOV lane projects have been combined into *Build HOV Lanes* (3.9);
- all other road improvement projects have been classified into *Other Road Improvements* (3.10)

The T2021 MRP already engaged in this type of "categorizing" as certain outputs were as vague or general as "increase mainline and feeder bus capacity and coverage" (GVRD, 1993). A full list of the plan's recommendations is presented in Appendix A.

While SuperBus isn't an official 2006 output in the T2021 MRP, SuperBus services are important phasing tools to prepare affected communities for high capacity, high frequency rapid transit and to build ridership. Since the Expo line was built, every corridor eventually converted to rapid transit has had a B-Line bus service in place fist. SuperBus corridors were not included with the rest of the outputs listed in Section 3.2 of the T2021 MRP as ultimately, they were designed to be discontinued once rapid transit was implemented on those same corridors (GVRD, 1993, p. 44). However, SuperBus implemented on the same three corridors identified for ICTS as well as commuter rail on the Hastings/Barnet Coquitlam-Vancouver corridor is planned as part of the Transit Staging for the T2021 MRP (referenced on page 13). The staging process is critical for developing ridership within the corridor in anticipation of higher order transit such as ICTS. For that reason, SuperBus on all four corridors were included as outputs for this evaluation. The plan's definition of a SuperBus is as "fast, frequent, comfortable, limited stop bus service (up to 5,000 passengers per hour), using bus priority measures and HOV lanes as available" (GVRD, 1993, p. 44).

Appendix 1 of the T2021 MRP is dedicated to the idea of implementing a Commuter Rail system on a Coquitlam-Vancouver corridor. The T2021 MRP defines commuter rail as the following "limited-stop rush-hour trains on heavy rail tracks hauling conventional passenger coaches, trackage shared with heavy rail freight" (GVRD, 1993, p. 44). The plan suggests that the commuter rail service would be phased out when the ICTS connecting Coquitlam with the rest of the rapid transit network is implemented.

Finally, after the re-categorization and adaptations there are a total of 16 output categories. A numbering scheme was also used, the list of output categories and numbering scheme is shown in the logic model diagram (Figure 6 in Section 5.2). Two of these categories are land-use policy related, and covered by the LRSP; they were not analyzed as part of this evaluation. The following data were required for the implementation analysis:

- VRTC and TransLink transit schedules;
- VRTC and TransLink transit vehicle fleets sizes;
- TransLink transit network GIS files[14];
- VRTC and TransLink transit service hours records;
- TransLink transit vehicle capacities; and
- TransLink network maps including transit priority areas.

Unless otherwise noted, the data were all available to freely download on the various agency's websites. Evidence that outputs were implemented are that they are included on network maps, schedules, satellite imagery, or other documentation. In some cases, basic calculations were required and are discussed immediately below.

Capacity

To calculate capacity, expressed as persons per hour per direction (pphpd), the following formula is used:

$$Capacity, ppdph\ \left[\frac{people}{hour}\right] = \frac{Frequency\ [mins] * Vehicle\ Capacity\ [people]}{60\ \left[\frac{mins}{hour}\right]}$$

This capacity formula can be applied to any transit mode: SkyTrain, bus, or SeaBus The population of Metro Vancouver was constantly increasing during the plan implementation period, and beyond[15], therefore, wherever possible, I used per capita when comparing different years.

[14] This data was provided via request for this research through the TransLink Data and Information department.

[15] Refer to Section 2.1

4.3 Outcomes

This purpose of this component of the analysis is to systematically prove whether or not the expected outcomes were achieved (Laurian *et al*., 2010). As with the implementation analysis, this evaluation categorized the expected outcomes into eight basic categories, each of which have specific indicators. The basic categories are listed in the diagram of the plan's logic model (Figure 6 in Section 5.2). To determine whether the outcomes were implemented, multiple sources of secondary data were used. Those date are as follows:

- TransLink Trip Diary surveys (1994, 1999, 2004, 2008, and 2011) at 'gy'[16] or municipal aggregation/ensemble;
- Canadian Census of population data at Dissemination Area (previously known as Enumeration Area) aggregation in GIS format (1991, 1996, 2001, 2006, and 2011);
- transit network Geographic Information System (GIS)[17] files including rail and bus (2001 and 2007); and
- Metro Vancouver Air Quality Reports (2005 and 2010).

TransLink Data and Information agreed to share the 1994 through 2008 Trip Diary surveys and a 2007 transit network GIS shapefile (Bell, 2017; Gaspar, 2016 Personal Communication). The TransLink Trip Diary Surveys contains information about trips made by individuals in the Metro Vancouver region, generally over a one-week period in the Fall. For privacy reasons, the trip data has been de-linked from household data and aggregated to municipal or sub-regional level. Historic Trip Diary surveys are comparable (DeMarco, 2013), however, there are some key differences that may have resulted in different, incomparable results. Table 3 below summarizes the differences between the different surveys used for this research.

[16] GY is an ensemble of Traffic Analysis Zones (TAZs) based on local geographic areas, e.g. Burnaby/New Westminster. The GY ensemble terminology comes from the EMME/2 software.

[17] 2006 GIS data was not available, so 2007 was used.

Table 3: Regional Travel Surveys Summary of Differences

	Season	Household Sample Rate	Time of Day	Geographic Coverage	Sample Frame	Sponsor(s)
1991	Fall	2.30%	AM Peak	GVRD	All residents	GVRD, Munis, MoTH, BC Transit, Transport Canada
1994	Fall	0.20%	24-Hour	Lower Mainland	All residents	GVRD, MoTH, BC Transit
1999	Fall	0.40%	24-Hour	GVRD	Adults aged 16 and over	TransLink, GVRD
2004	Spring	0.50%	24-Hour	Lower Mainland	All residents	MoTH, TransLink
2008	Fall	1.90%	24-Hour	Lower Mainland	All residents	TransLink
2011	Fall	2.20%	24-Hour	Lower Mainland	All residents	TransLink

Sources: Halcrow, 2010; NFO CFGROUP INC., 2000; TransLink, 2013

Although 24-hour data is available for most years, the AM Peak period is often used as 1991 forms the basis of the T2021 MRP. Additionally, the 2004 results are shown for only reference; this Trip Diary Survey is the only one completed in the spring and therefore the results are significantly different than the others and can be considered an outlier. In cases where 2006 data is needed, this data was interpolated between the 1999 and 2008 survey results as opposed to the 2004 and 2008 Trip Diary Survey results (Train, 1986, p. 195). In all cases, the GVRD was used as the unit of analysis. Results from the FVRD were sometimes available but not used. The AM Peak hour historically for the Metro Vancouver region has been 7:30-8:30 AM (DeMarco, 2013, p. 8). Trip Diary Survey data can be queried using this time-period. A trip will be considered to be within this time range if it *ends* within the range (DeMarco, 2013).

Land Use

The related analysis of T2021 completed by DeMarco (2013) was referred to for the portion of total population growth in sub-regions (refer to 4.6). In her analysis, DeMarco used Canadian Census data from 2006, 2011, and 1991 to calculate the growth portions.

Mode Shares and Trips

Structured Query Language (SQL) queries were developed and applied to the Trip Diary Survey datasets. The following equation was used to calculate mode share:

$$Mode\ Share_{mode\_n} = \frac{\sum Trips_{mode\_n}}{\sum Total\ Trips}$$

As Trip Diary Survey data was provided at the 'gy' aggregation level, it is possible to query the dataset for only trips with destinations in the Vancouver CBD (a performance target listed in the T2021 MRP). SQL queries were developed and applied to the data sets and the mode share was calculated. The T2021 MRP provides multiple target values for performance monitoring. Some of these values are specific values whereas others are relative (mode shares). Most of these values are based on AM Peak values as the 1991 Trip Diary Survey and T201 MRP AM Peak based. Since 1994, all Trip Diary Surveys have covered a 24-hour period, so these values were also used in this evaluation.

Auto Occupancy

SQL queries were developed and applied to the data sets. The following equation was used to calculate average auto occupancy:

$$Auto\ Occpucany = \frac{\sum Auto\ Trips}{\sum Vehicle\ (Driver)\ Trips}$$

Supply of Rapid Transit

Although referred to as route-kilometres in the T2021 MRP, for this research, length of bi-directional SkyTrain track (elevated guideway, underground, or at-grade) was calculated. Although the Millennium Line operated from Waterfront Station to VCC-Clark Station, sharing tracks with the Expo Line between Waterfront Station and Columbia Station, this is irrelevant to the length calculation for this analysis. The length was measured using GIS software.

Total Population Living Close to Transit

Both population located close to rapid transit and bus were considered. As previously stated, TransLink was not able to provide a GIS dataset of the 2006 transit network. Instead, a 2007 transit network GIS dataset was provided and was used for this research. The rapid transit and bus lines were isolated from the dataset. For population, an additional GIS dataset containing the 2006 Canadian Census of Population at the smallest available aggregation, dissemination areas, was used. GIS software was used to create the appropriately sized buffer around the rapid transit lines which was then

intersected with the population data. For dissemination areas which were not entirely covered by the buffer, the population was assumed to be evenly distributed and therefore a ratio was used to determine the population within the buffer zone.

Missing Data

Several additional performance targets listed in the T2021 MRP were not examined by this evaluation. This was due to a lack of the necessary data to do so. For example, the target *Transit mode share in AM Peak Hour (to Regional Town Centre)* cannot be measured in 2006 due to a lack of data at the level of aggregation necessary to do so. Due to privacy concerns, the Trip Diary Survey data that was provided by TransLink for this research, is only available at the municipal or sub-regional 'gy' level (*e.g*. 'gy' 5 is Burnaby/New Westminster). The following targets, although listed in the plan, are not covered by this research:

- Transit Mode share in AM Peak Hour (to Regional Town Centres)*
- Auto occupancy rate (to Regional Town Centres)*
- Percentage of roads badly congested at rush hour
- Cars: rush hour average speed (km/hr)
- Trucks: 24-hour average truck speed (km/hr)
    - Cost of congestion delays ($m/year)
    - Total truck running costs ($m/year)
- Total vehicle kilometres travelled (VKT)

4.4 Factors

The purpose of this step is to determine the factors that affected both the implementation and outcomes of the T2021 MRP. The main data source is qualitative interviews with local transportation experts. The resulting qualitative data was used to identify associations and factors that affected both the outcomes and the implementation. While Handy (2005, p. 163) states that "[…] countless exogenous factors also come into play: attitudes and socio-demographic characteristic influence travel patterns, land development patterns are influenced by land use policies, transportation investments may reflect political forces ", planning scholars do attest that

“associations between plans and outcomes or between intended goals and actual implementation can be ascertained'' (Talen, 1997) confirmed by triangulating evidence from expert opinion, case studies, and other sources (Laurian *et al*., 2010).

Laurian *et al*. (2010) recommends completing the attribution analysis in a workshop-like environment with 4 to 6 local experts for half a day or so. However, this approach would not be logistically practical for this research. Instead, a series of one-on-one interviews was conducted. In a personal communication, Dr. Laurian was supportive of the use of POE for this research, and agreed that one-on-one interviews could work (Laurian, 2016 Personal Communication). Accordingly, a pseudo-Delphi (Charlton, 2004) approach was used. This approach consisted of first showing the results of the implementation and outcomes analyses to the interviewees Then, an initial face-to-face interview where I asked them a series of questions regarding the implementation, outcomes, and planning period of the T2021 MRP. After these initial interviews were completed, the responses were analyzed and compared. All responses to the questions were then summarized into a document, which was then emailed to the interviewees in preparation for a second round of interviews. In the second round of interviewing, they were asked if, based on the answers and insights of the other experts, they would like to change, or add to, any of their answers with the goal of coming to a consensus.

To develop a sampling strategy, other applications of POE available in the literature were examined. In a partial application of POE, Ranasinghe & De Silva (2013) use quota sampling, including interviews with those “involved with the project”. In Oliveiro and Pinho’s (2010) application of their outcome evaluation methodology (which is similar to POE), they suggest interviewing politicians. As with these examples of previous studies, a quota sample was used for this research. Further criteria were developed: all interviewees should be familiar with the plan, all interviewees should have some involvement with the creation or implementation of the plans, and finally all should be considered to be transportation experts within the industry. Laurian *et al*. do not specify what an “expert” should be, so the generally accepted definition of the term (an individual with special skills or knowledge) will suffice. The sample frame included the T2021 MRP contributors page and the SFU Urban Studies advisory council. A total of four interviews with experts were conducted. These four individuals included two planners/managers, one politician and one director/administrator. All individuals

contacted chose to not remain anonymous for the interview process. The individuals and their connection to the T2021 MRP are explained here:

- Ken Cameron – Manager of Development Services at the GVRD at the time of T2021 development (Rock, 2017a)
- Clive Rock - Vice President of Planning and Marketing at BC Transit, later manager of Engineering at the City of Richmond during T2021 development (Rock, 2017a)
- Gordon Price – Former City of Vancouver councillor – tangentially involved with development of T2021 as GVRD board member and City of Vancouver councillor (Price, 2017)
- Martin Crilly – Transport 2021 Project Director, later Commissioner for TransLink (Crilly, 2017a)

It is very unlikely that the experts are aware of, or have accounted for, all the factors that have affected the outcome. However, their answers reflect what they believe to be the most crucial factors that have affected both the implementation and the outcomes. However, being experts, all the experts interviewed had great familiarity with the plan, the regional transportation system, the politics, and the individuals involved with the planning of the regional transportation network throughout the implementation period. In short, their opinions and perspectives matter much more than a layperson's and are very likely the 'best we can get' when speaking to causality and factors affecting the implementation and outcomes.

Potential sources of bias may exist and were considered. There is some evidence that confirmation bias and other attribution cognitive biases may be present. However, they are likely minor in comparison to the insights provided by them. However, they should be considered when interpreting their responses. A summary of the potential biases and the implications is discussed more thoroughly in Section 8.1.

4.5 TransLink's Influence

TransLink's establishment in 1999 was a significant event in the history of regional transportation in Metro Vancouver and occurs mid-way through the implementation period of the T2021 MRP. As one of the reasons for the establishment of the authority was to take on the responsibilities of implementing the T2021 MRP (refer to Section 2.1 for more information), the question of TransLink's role is important.

Specifically, this thesis will establish the effect of TransLink on the goal achievement of the T2021 MRP. To do this we will examine the Compound Annual Growth Rates (CAGRs) of the goal achievement during the implementation period in two different time periods: before TransLink (between 1993 and 1999) and after TransLink (between 1999 and 2006 or between 1999 and 2013). If the CAGR in the post-TransLink era is higher, we can see whether the goal achievement rate changed positively, implying that the establishment of TransLink has aided in goal (outcome) achievement.

4.6 Alternative Evaluation of Transport 2021

In 2013 a symposium sponsored by TransLink focused on the T2021 LRP and MRP. As a precursor to that symposium, TransLink commissioned Christina DeMarco of Consulting firm Planning Solutions Network (PSN) to create a background report entitled *Transport 2021 Revisited* (2013). The document was never made public but was provided to me by TransLink via Martin Crilly for reference due to the similar research subject matter. The document provides context and history of both the long-range and medium-range plans, a summary of the plan performance targets compared to present-day actuals (2013) (quantitative outcome analysis), and an evaluation of success of the implementation of the plan's fours "levers" (implementation analysis). The document's key conclusions regarding T2021 (considering both the long-range and medium-range plans) were that the target transit mode split for 2006 has been achieved [in 2011]; some TDM measures (such as a vehicle levy or road pricing) did not materialize; land-use patterns were generally transit-oriented in most parts of the region; necessary monitoring was not carried out and the plan was not adjusted as originally intended; and no implementation plan was created.

PSN's work analysis takes a somewhat different approach than this thesis. There is however, overlap in two areas of the analysis: the outputs portion of the implementation analysis, and the quantitative outcomes analysis. These analyses help to answer the main research question of this research (regarding the extent of implementation) and on sub-question (regarding the outcomes). Table 4 and Table 5 below summarize the main differences between the analytical approaches.

Table 4: Summary of Analytical Approaches to Implementation Anaylsis

Item	Farmer, 2017	PSN, 2013
Base year	1993	1993
Horizon year comparator	2006	2013
Implementation classification system	Ternary: Yes/No/Partially	Ternary: Harvey Balls
Number of output categories checked	16 (13 Infrastructure, 3 Policy) and Land-Use	40 (35 Infrastructure, 5 Policy) and Land Use
Considers B-Lines (SuperBus) & Commuter Rail	Yes	No

Table 5: Summary of Analytical Approaches to Outcomes Analysis

Item	Farmer, 2017	PSN, 2013
Base year	1991	1991
Horizon year comparator	2006 (Interpolated between 1999 and 2008 Trip Diaries)	2011 (Latest Trip Diary)
Implementation classification system	Ternary: Yes/No/Partially	Binary: Yes/No
Number of performance targets checked	12	9 (different targets in some cases)
Number of goals	7	N/A

Overall, the approaches for these two portions of evaluation are similar – the main difference being that PSN used 2013 as the future year, whereas this evaluation used 2006. The analysis completed by PSN is useful and allows for an expansion of this research which would have otherwise not been possible. PSN's research was used and integrated into the analyses in most cases when an output or outcome is analyzed past 2006. The benefit of the PIE and POE methodology are that they are practical and flexible. The methodological framework can easily conform to the requirements of this thesis. In the following chapters I complete the analysis using this framework's recommended four analytical steps: firstly I examine the plan's logic model with a due-diligence review of the literature to determine that the plan's intervention theory would work in practice; secondly, a review of the network by the horizon year to determine if the recommendations were implemented in practice; thirdly, a review of the goals of the plan and analysis of the quantitative data to assess whether those goals were achieved in practice; and finally, an analysis of the qualitative interviews with local transportation experts to assess which factors were responsible for affecting the implementation of the plan, as well as the outcomes.

Chapter 5. Logic Model and Due Diligence

The purpose of this analytical step is to determine if the plan's goals were achievable (Laurian *et al.*, 2010) and provide an additional due diligence review of the transportation literature.

5.1 Performance Targets Modelling Process

The T2021 MRP performance targets were developed through a modelling and forecasting process using the regional EMME/2 travel demand model. There are many performance targets listed in the T2021 MRP, a full list is shown in Figure 22. Performance targets include values for trips and mode shares, auto occupancy rates, emissions from vehicles, length of rapid transit, portions of populations living within fixed distances of transit, and truck and car speeds. This modelling process showed that it was indeed possible to achieve the goals by 2006. However, Mr. Martin Crilly, who oversaw the modelling process, stated that he was skeptical of the ability of planners (including the T2021 team back in early 1990s) to model the complex and ever-changing urban system, as he put it:

> There are so many moving parts. It would be a huge coincidence if we were able to simulate the future that occurred. I remain skeptical and humble about attempting to model the behaviour of a city (Crilly, 2017a Personal Communication).

Correspondingly, in this section I will perform a due-diligence check of the literature to ensure that the T2021 MRP recommendations have achieved the performance target goals in other localities. By doing so, the argument that meeting the targets would have been just "a coincidence" can be partially mitigated.

5.2 Goals and Logic Model

The T2021 MRP hoped to achieve the following general goals, based on the performance targets (without the numerical specificity) (Adapted from GVRD, 1993):

1. an increase in population in the inner suburbs (*i.e.* prevent future urban sprawl);

2. a decrease in single-occupancy automobile trips with a corresponding mode shift to carpool, transit, and active modes (especially for trips with destinations to the Vancouver CBD and Regional Town Centres);

3. an increase in carpooling;

4. a decrease in atmospheric pollutants from cars;

5. an increase in the portion of residents living close to transit;

6. an efficient road network for cars and trucks with a decrease in “congestion”; and

7. a decrease in total driving (vehicle-kilometres-travelled).

To achieve these goals, the planners understood that there are four “levers” that governments can “pull’ to influence transportation. Those levers are:

- land use (Chapter 1 of the T2021 MRP);
- transportation demand management (TDM) (Chapter 2 of the T2021 MRP);
- adjusting transport service levels (Chapter 3 of the T2021 MRP); and
- supplying transport capacity (Chapter 3 of the T2021 MRP).

These categories are further broken down into sub-categories, and eventually, specific recommendations. Each of these levers is examined with respect to how they were meant to be implemented in the T2021 MRP, and whether the literature aligned with the logic of each lever. The plan’s logic model, including the outputs and outcomes, is presented below in Figure 6. Because they share similar characteristics, Levers 3 and 4 were combined for the purposes of the logic model.

Inputs		Outputs		Outcome	Final Outcome
-Finances/funding -Business Cases -Staff -Studies -Operators -Vehicles -Equipment	1. Control Land Use	1.1 1.2	-Encourage density in inner suburbs -Encourage development in urban centres	-Creates feedback loop with transportation investments - density surrounds transit which leads to increased transit use.	1. An increase in population in the iner suburbs (prevent future sprawl and reduce). 2. A decrease in single-occupancy automobile trips with a corresponding mode shift to carpool, transit, and active modes (especially for trips with destinations to the Vancouver CBD and Regional Town Centres). 3. An increase in carpooling. 4. A decrease in atmospheric pollutants from cars. 5. An increase in the portion of residents living close to transit. 6. An efficient road network for cars and trucks with a decrease in “congestion”. 7. A decrease in total driving (vehicle-kilometres-travelled).
	2. Transportation Demand Mangement (TDM)		Incentives:		
		2.1	e.g. Promote telecommuting & encourage medium-size	-Reduces overall trips -Increases "cost" to drive	
			medium-sized and large employers to help cut vehicle trips to their worksites		
			Discentives		
		2.2	-Raise fuel prices		
		2.3	-Road pricing		
	3. Supply Transport Capacity & Adjust Service Levels		Transit:		
		3.1	-Increase SeaBus capcity	-Increases capacity and access to rapid transit and bus -Reduces travel times for transit	
		3.2	-Increase Expo Line capacity		
		3.3	-Rapid transit Coquitlam to New Westminster		
		3.4	-Rapid transit Richmond to Vancouver		
		3.5	-Rapid transit Lougheed to Vancouver		
		3.6	-Commuter rail Coquitlam to Vancouver		
		3.7	-Increase mainline and feeder bus capacity and coverage		
		3.8	-Introduce transit priority measures (TPM)		
			Auto:		
		3.9	-Build HOV lanes	-Reduces travel times for high-occpuancy vehicles -Increases efficiency of road network	
		3.1	-Other road improvements		

Figure 6: The Plan's Logic Model

In the next four sections I review the transportation literature to ensure that this logic model is sound.

5.3 Lever 1: Land-Use

The T2021 MRP recognizes that land-use patterns are crucial to affecting regional transportation when they state that:

> "the geographical settlement or land-use pattern of people and economic activity is crucial to transport. It is one of the most important drivers of the demand for travel—how much travel is desired between any two points" (GVRD, 1993, p. 19).

The T2021 MRP recognizes that the reverse statement is also true – that the transportation system can be used to influence land-use development. The plan also admits that the "strength of the shaping effect [of transportation investments] is not well understood" (GVRD, 1993, p. 25). Ultimately, the plan recommends that transportation investments should be used to shape land-use (mostly focused on population, but also for employment), but that these investments should only be made if it is likely that the appropriate land-use plan will be implemented in conjunction with the transportation investments, and that governments should give priority to investments which improve accessibility in the inner suburbs (GVRD, 1993). Targets for population growth in sub-regions, shared with the LRSP, are provided in this plan.

Land-use has long been discussed in the literature as a major contributing factor to transportation behaviour. Handy (2005) provides a summary of evidence from the literature to support the truthfulness of several propositions related to this connection; however, she is not explicit with her endorsement of the propositions. Handy remarks that while theory and casual observations lend credence to the notion that development patterns shape travel patterns, empirical evidence is "surprisingly mixed […] leaving room for debate among researchers" (Handy, 2005, p. 147). Handy further remarks that there are, however, some truths within the debate. An example that she uses is highway construction. Highways are explained as a "necessary but not sufficient condition" (Handy, 2005, p. 148) for sprawl to occur, but at the same time, sprawl has been sufficient, but not necessary, for automobile dependence. In her article, she has summarized the evidence to support various "propositions" which are commonly stated in planning circles. Handy admits that "the more we know [about the transportation-land-use connection], the less we seem to know" (2005, p 149). Two of these propositions are highly relevant to this search as they are claims also made by T2021. Those claims are:

- building more highways will contribute to more sprawl; and
- investing in light rail transit systems will increase densities.

Literature does paint a clear picture that additional traffic capacity can “induce significant additional travel” (Noland, 2001). By examining travel patterns and additional lane-miles constructed in the USA, Noland proves that induced demand is real, and measurable. However, whether that implies that building more highway capacity will increase *sprawl* is more difficult to prove and measure. However, based on her comprehensive review of works published, some of which contradict each other, Handy (2005) states that “it is reasonable to conclude that new highway building will enable or encourage additional sprawl to some degree” and that urban highways “available research provides no evidence of generative impacts but does provide evidence of redistributive impacts.” (2005, p. 152). Building highways therefore *does* contribute to sprawl, by influencing where the development and growth occurs. It does not generate growth by itself (2005, p. 152). Therefore, we can conclude that building highways out to suburban areas, will tend to generate suburban growth.

On using light rail investments to increase density, Handy (2005) finds that the evidence from the literature supports the notion that light rail investments under the right circumstances will increase densities. These circumstances are:

- a region experiencing significant growth;
- a system that add significant capacity to the areas that they serve;
- located in areas which are conducive to development; and
- supportive land use policies (and capital investments) from the public sector.

In the case of Metro Vancouver throughout the 1990s and 2000s, all Handy’s (2005) criteria are met: the population was increasing; the SkyTrain light metro added huge amounts of additional capacity to the existing transit system; numerous areas were conducive for urban development, physically visible by the many new condo towers built near Joyce-Collingwood Station, Metrotown Station, Lougheed Town Centre Station and Brentwood Town Centre Station, and Edmonds Station (Ohnemus, 2016); and this was all supported by the land-use policies or the LRSP. Because of this, we can conclude that the plan’s intervention logic, that of using transportation investments (rapid transit development on trunk corridors) to shape land use, is correct, are corroborated by

established literature. There is also evidence in the literature supporting the notion that locating jobs in close proximity to housing can help to reduce driving (vehicle-kilometres-travelled) by 15% (Cervero & Duncan, 2006; Ewing, 1996). A number of communities in the USA have various policies in place to increase the housing-employment balance (Cervero & Duncan, 2006), as did the LRSP.

5.4 Lever 2: Transportation Demand Management (TDM)

In Chapter 2 of the T2021 MRP, several TDM measures are recommended. TDM has been defined in the literature as "measures used to improve the efficiency of the existing transportation system" (Winters, 2000) and reduce congestion (Meyer, 1999). The T2021 MRP TDM measures expected to be in implemented by 2006 are shown below (Table 6). Two of the measures categorized the by T2021 MRP as TDM measures are discussed later under the Supply Transport Capacity, lever 4. The measures categorized into incentives and disincentives, which are sometimes referred to carrots and sticks, respectively.

Table 6: T2021 MRP TDM Measures

Incentives	Disincentives
Promote telecommuting.	Raise fuel prices, through higher fuel taxes (25% increase in the real price of gasoline by 2006).
Encourage medium-sized and large employers to help cut vehicle trips to their worksites.	Introduce bridge tolls ($1 peak toll on all bridges leading onto the Burrard Peninsula - roughly equivalent to a 2-zone transit fare today). Could also be considered road pricing/congestion charges.
Install HOV lanes.*	
Give buses priority in the streets (TPM).*	

* Discussed as part of Lever 4.

A summary of the findings of the literature review for the effectiveness of the T2021 MRP TDM practices is shown below (Figure 7). The literature suggests that road pricing is the most effective TDM measure to reduce automobile trips (Meyer, 1999). Unfortunately, as we will see in the implementation analysis, it was the only measure of the four identified that was not implemented.

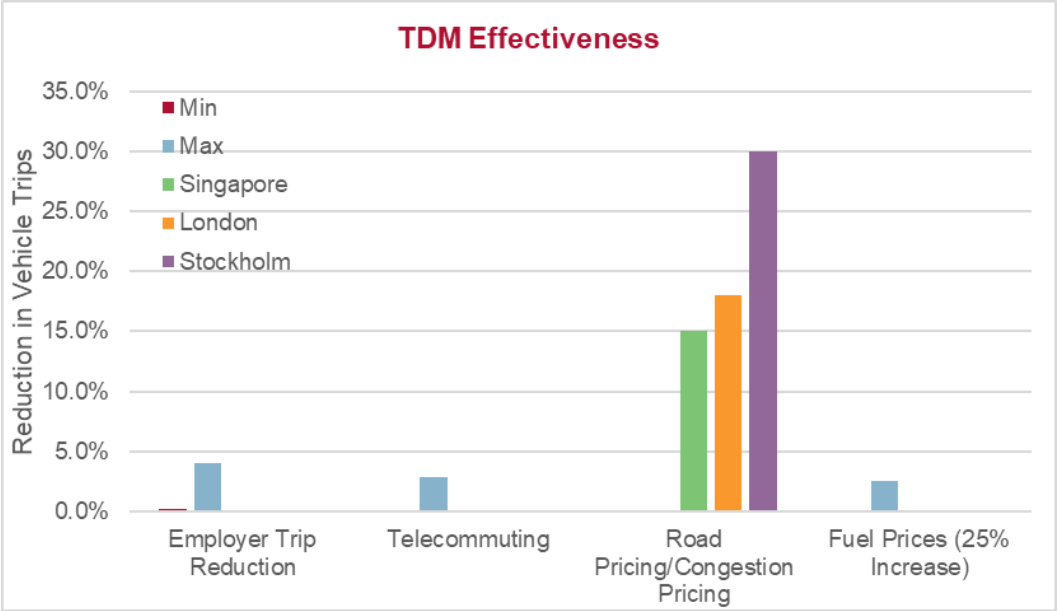


Figure 7 Potential Effectiveness of T2021 MRP TDM Measures
Sources: Employer Trip Reduction, Telecommuting: Meyer (1999); Fuel Prices: Litman (2017); Stockholm Road Pricing: Borjesson *et al.* (2011); Singapore Road Pricing: Hong Kong Department of Transportation (2007); London Road Pricing: Transport for London (2007)

Notes: The above graphic depicts the percentage of the reduction of automobile trips in the study area.

5.4.1 TDM Incentives

TDM incentives measures have also been studied in the Metro Vancouver area: a case study report by Transport Canada found that, among individuals who participated in TransLink's *TravelSmart* TDM programs, car-driver trips decreased 8%, public transit use increased by 12%, and cycling increased by 33% (Transport Canada, 2008, p. 4). Meyer (1999) found incentive-based TDM programs moderately effective, but with some mix of incentive and discentives being most efficient and effective.

5.4.2 Road Pricing

It is noted in the T2021 MRP that TDM charges could significantly impact travel demand throughout the region by postponing the need for large capital investments, decreasing the peak hour trips by 10%, increase transit ridership by 25%, and raise $1 billion (1992 dollars) in user charges by 2021 (to pay for infrastructure) (GVRD, 1993, p. 26). Tolling of the regional bridges and, to a lesser extent, increasing fuel taxes are

forms of ‘road pricing’ which aim to increase the generalized cost to travel by automobile, which in turn should decrease the number and distance of automobile-based journeys (Litman, 2017). The main purpose of implementing such policies are, according to the plan, to use this phenomenon to reduce sprawl and thus automobile dependence and use.

In their 2011 paper, Anas and Lindsey (2011) review the literature and produce a summary of road pricing and its theory and practice. Their conclusions are that in practice, road pricing has reduced congestion, and the costs of the programs have been less than their measured benefits. They find that road pricing has worked very well to reduce congestion. They also conclude that the provision of public transit services is an important complement to road pricing, as it would enable motorists to ‘switch’ to those modes from driving, and that “road pricing is more likely to be accepted in cities with good existing public transport” (Anas & Lindsey, 2011, p. 82). Like most studies on road pricing, their paper does not address the possibility that road pricing can be used to affect land-use or reduce sprawl. Fortunately, an earlier study by Langer and Winston (2008) described a model they produced to answer this question. Their conclusion is that road pricing (referred to as congestion pricing by the authors) could significantly increase land use density in response to the changes in pricing. However, this study is based on a theoretical model – examples of sprawl reduction have not occurred in the three major cities that have implemented road pricing, as in those three cities, the purpose of the policies was to reduce congestion, not sprawl.

Road pricing measures have generally met with resistance by the public, especially suburban residents and car users (Schuitema, Steg, & Forward, 2010). A 1997 survey-based study from the Netherlands concluded rather feebly that road pricing was “not completely socially unacceptable” but that only 25% of respondents indicated that they thought of road pricing as a good idea (Verhoef, Nijkamp, & Rietveld, 1997, p. 272). Further, road pricing was “found overall to be unacceptable” but more acceptable to non-car users and those who perceived pollution to be a serious problem (Jaensirisak, Wardman, & May, 2005). However, studies from Stockholm show that, post implementation, the public’s general perception is as much more accepting of road pricing than pre-implementation, especially if it was perceived that the scheme solved serious problems. They conclude that effective road pricing schemes can “be acceptable when people experience the benefits of [the] scheme” (Schuitema et al., 2010).

Therefore, people must have experienced the benefits of a road pricing scheme before it can be found to be acceptable.

5.4.3 Fuel Prices

Fuel prices have also been shown to be one of the factors that are positively correlated with increases in transit, and decreases in automobile travel (Litman, 2017). Elasticities have been shown to be relatively inelastic at around -0.1 for car driver with respect to fuel prices increases, and +0.2 for public transport (commuting trips). This means that a 10% decrease in the price of fuel will, in general, result in a 1% decrease in car driver trips and a 2% increase in transit trips.

5.5 Lever 3: Adjust Service Levels

According to the T2021 plan, this “lever” was included “partly to emphasize that the choice of service level can and should be a conscious decision, and that service levels directly influence the demand for transportation” (GVRD, 1993). Adjustments to service levels recommended by T2021 MRP include those that affect the transit network and road network Recommendations in the plan are not officially provided as part of this lever, however, there are several recommendations relating to increasing the levels of service on the SeaBus, SkyTrain, and bus networks. Additionally, since the T2021 MRP recommends that “more [automobile] capacity for mixed traffic should not be provided across Burrard Inlet, the North Arm and South Arm [of the Fraser River] during the medium-range planning period” (GVRD, 1993, p. 47), the planners are thus recommending that decision-makers simultaneously increase the supply of transit and allow the road congestion levels to naturally increase. This would be as opposed to increasing road network supply, and thus automobile demand (Handy, 2005; Litman, 2017), by widening arterials or building new bridges. In this section, I review the literature to determine to what extent the transit and road network service levels are related to demand for those services.

5.5.1 Transit

With regard to transit supply, the literature confirms that there is a statistically significant relationship between transit use and transit service supply in North American cities (Alam *et al*., 2015; Taylor & Fink, 2003). Both Taylor and Fink (2003) and Alam *et al.* (2015) conclude that the supply transit service, both in terms of quality and quantity (*e.g.* route locations, headways, hours of operations etc.) is positively correlated with transit demand; supply is even more important than pricing. However, due to the complex nature of urban trips and other factors, supply and demand actually influence each other (B. Taylor & Fink, 2003, p. 5). Other statistically significant factors that affect transit ridership, identified by Alam *et al.* (2015), include transit pricing, gas prices revenue hours, safety, and coverage of the network.

5.5.2 Road Network

Supply and demand in terms of road congestion service levels is more complex than with transit. The effects of purposefully allowing congestion to slowly worsen are less studied and its effects are not well known. However, Handy (2005, p. 155) found that, based on previous studies, "VMT[18] [in the USA] has grown faster than highway capacity, population, [and] the economy". Therefore, she concludes that generally, *not* building highways (and thus allowing congestion levels to naturally increase) does *not* decrease driving. Consequently, the literature also does not agree, generally, with the effectiveness of *not* building highways as a sprawl reduction technique. Handy (2005) states that "not building more highways will probably not slow the rate of sprawl, at least not much". In explicit terms, the T2021 MRP never specified that not building additional highway capacity would reduce sprawl, and it is not clear what the planners hoped to accomplish by letting congestion levels increase, other than not contributing to additional sprawl or additional driving. The T2021 MRP hoped to increase densities in inner core urban areas through other policies and means.

[18] Vehicle-Mile-Travelled (VMT) is typically used in the USA, whereas Vehicle-Kilometres-Travelled (VKT) is normally used in Canada.

5.6 Lever 4: Supply Transport Capacity

Chapter 3 of the T2021 MRP is dedicated to describing the transit and auto transportation network envisioned for 2006 with numerous additional transport capacity supply projects. The planned transit network recommendations can be grouped into three main categories:

- basic transit improvements (increasing the service levels of existing services);
- transit priority treatment measures across major crossing and in key corridors; and
- providing new ICTS lines (*i.e.* light rail or rapid transit) on trunk corridors.

Auto network improvements are grouped into just two categories:

- HOV lanes on key corridors; and
- other (miscellaneous) improvements to the road network.

A complete list of the transportation improvements can be found in Appendix A.

5.6.1 Transit Network

The purpose of the T2021 MRP recommendations were twofold:

- increase transit supply, and
- decrease travel times for buses to make transit service more competitive.

In the previous section, I already determined that the supply of transit is one of the most important factors that will lead to more transit use in urban areas (Alam *et al.*, 2015; B. Taylor & Fink, 2003). Increasing the speeds of transit vehicles will also increase demand for transit (Litman, 2017). To obtain increased transit vehicle speeds, Transit Priority Measures (TPM) were recommended to be implemented. Recommended TPM included bus lanes, Transit Signal Priority (TSP), and bus-only queue-jump lanes for chokepoints. TPM have proven to be effective methods to reduce transit travel times and thus increase the competitiveness of transit – which is known to also increase the demand for transit. Presented below is a chart depicting the effectiveness of the various TPM recommended by the T2021 MRP (Figure 8). TPM can result in increases in bus travel speeds by up 40% in some cases, with TSP having the highest possible maximum

impact. Bus lanes implemented in Seoul, in particular, were especially effective, increasing bus average speeds by about 100% (Agrawal *et al.*, 2012).

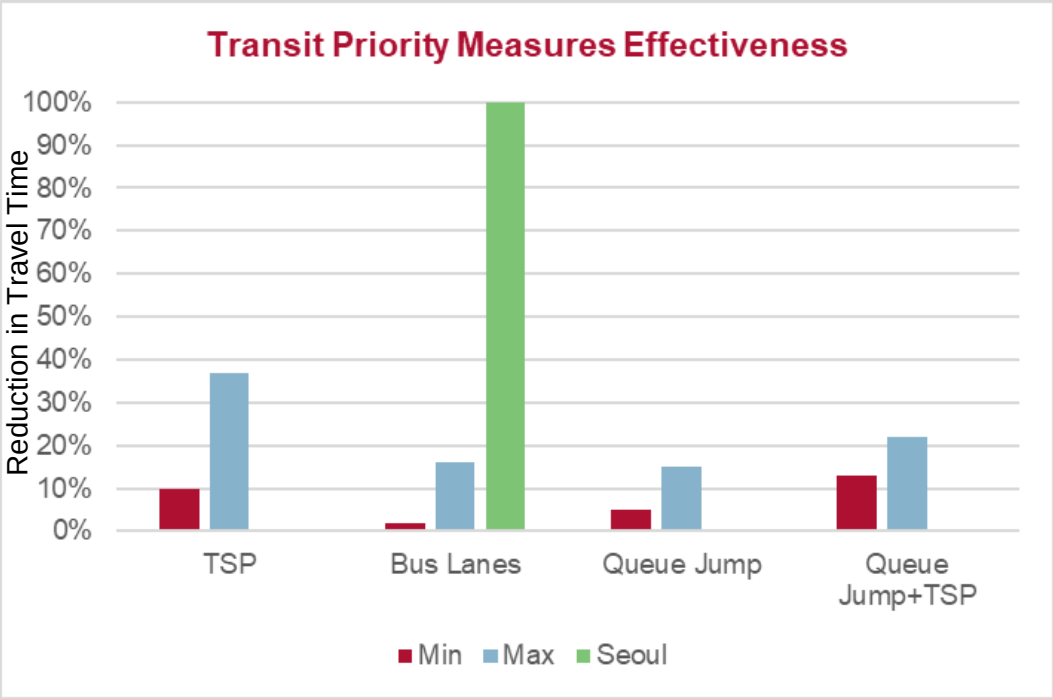


Figure 8: Transit Priority Measures Effectiveness
Sources: TSP: Chada & Newland (2002, p. 8); Bus Lanes: Agrawal *et al.* (2012); Queue Jump, Queue Jump+TSP: Kittelson & Associates (2007)

Notes: The above graphic depicts the average increase in bus speed. In Seoul, an up to 100% improvement was noted after bus lanes were implemented. Many of Seoul's bus lanes are never shared with general traffic and are painted red to distinguish them from standard travel lanes (Agrawal et al., 2012, p. 135).

5.6.2 Road Network

As I have already reported, supplying additional un-restricted highway capacity will induce demand and lead to more urban sprawl, and ultimately to more driving (Handy, 2005; Noland, 2001). For that reason, the T2021 MRP did not recommend widening or adding to the regional limited access highway network. Instead, the T2021 MRP recommends that HOV lanes be installed on specific corridors – the planners also consider HOV lanes to be a TDM measure. Studies from elsewhere on the supply of HOV lanes to increases carpooling have been mixed. A 2007 study by Kwon and Varaiya (2008) found that, in California, HOV lanes did not provide a statistically significant travel time savings and thus did not encourage additional carpooling. Kwon

and Varaiya (2008) also found that HOV lanes were under-utilized and did not increase the people-moving capacity of the highway system. They conclude that HOV lanes are unlikely to provide a carpooling incentive. However, studies on HOV supply in BC have found the opposite - HOV lane projects in this region *have* increased the vehicle occupancy rate by nearly 4% (BC Transportation Financing Authority, 2001). The Barnet-Hastings Highway in particular has triggered an increase in the average vehicle occupancy rate from 1.22 to 1.35 persons per vehicle in the AM peak hour, increasing the person-carrying capacity of the highway by about 12% (Schijns, 2006).

5.7 Feasibility Considerations

As Ardila (2002) found in Bogota, if plans are to be implemented, then they need to be both financially and politically feasible. Others have come to the same conclusion (B. D. Taylor, Kim, & Gahbauer, 2009)[19]. With regards to feasibility, there are some obvious flaws in the T2021 MRP. Although there are numerous, and likely effective, transportation network improvements recommended for the more suburban regions (such as in Surrey and the Langleys), the large and expensive projects (such as rapid transit lines) are focused, purposefully, on the inner urban core. Further, since major highway expansion was not recommended, there was little in the way of major projects that would appeal to automobile drivers. This was problematic as politically, inner urban core sub-regions tend to vote for the left-wing NDP and outer suburban sub-regions tend to vote for the right-wing BC Liberals[20] (Elections BC, 2002, 2014, Walks, 2004, 2006).

There are some policies which would be, politically, especially challenging for any party to implement. TDM disincentives such as road pricing have been shown to be disliked by drivers who are used to totally free access to the road network (Jaensirisak *et al.*, 2005; Verhoef *et al.*, 1997). It would have been the provincial government's responsibility to ultimately give the final say on road pricing. Since the T2021 MRP-recommended scheme was comprehensive and region wide, any such move would have no doubt angered voters from across the political spectrum, but especially those in the suburbs. The more recent political climate is perhaps even less receptive to such a scheme. Indeed, during the 2017 election campaign, NDP party leader John Horgan

[19] Discussed more fully in Section 3.3.

[20] Refer to Appendix D for maps showing the historical election results of BC Elections.

characterized the existing tolls on Metro Vancouver bridges implemented under the BC Liberals as “unfair” and that people “shouldn’t have to pay tolls because of where [they] live” (Rees, 2017). The BC Liberals also made toll-related 2017 election campaign promises to cap the amount of money that drivers would pay annually (Jeong, 2017). Despite rhetoric from the Green Party, who were not in favour or eliminating tolls, tolls were eventually removed by the NDP-Green alliance government in September 2017 (Bailey, 2017). This removal will likely make instituting some new form of regional road pricing by the NDP-Greens very challenging. The public and media could potentially perceive such a move as the government reneging on their promises, especially for those residents who were regular bridge users.

The construction feasibility of the T2021 MRP is also uncertain, especially when considering the rate at which rapid transit projects were expected to be constructed. As the T2021 MRP calls for three, long, rapid transit lines to be constructed within 15 years It would have been quite remarkable if the plan was successfully implemented. In Metro Vancouver rapid transit lines or extensions have been constructed at a rate of one every approximately 6-7 years[21]. The T2021 MRP expected this rate to be much quicker – a new line every 5 years. Considering that it has typically taken around 5 years to construct a rapid transit line, and there have previously never been simultaneous rapid transit construction projects in this region, the construction of the first line would have had to start almost immediately after the plan’s release. What’s more, the capital costs for these three projects was in the multiple billions and beyond the capability of any one government to fund (Wells, 2008). In addition to the rapid transit projects, the plan also calls for several hundred lane-kilometres of HOV lanes, transit priority systems, new bridges and highway segments, and the procurement of additional transit vehicles. Although the T2021 MRP does not provide an estimation of capital needs nor any comprehensive funding schemes, upon review, it is clear that the a 15-year time frame, from both a funding and construction feasibility perspective, was unrealistic.

5.8 Were the T2021 MRP’s Goals Achievable?

As I have shown through the creation of the logic model and additional literature review, the logic of the T2021 MRP is technically sound and in accordance with the

[21] Between 1993 and 2016, that rate was approximately one expansion every 7-8 years.

literature. All the intervention theories and concepts discussed by the plan are correct, and have been shown to work in practice: the land-use/transportation connection is real (Handy, 2005); TDM incentives (Transport Canada, 2008) and disincentives such as road pricing are effective (Anas & Lindsey, 2011); an increase in the supply of transit will lead to more transit use (Alam *et al.*, 2015; Litman, 2017) and consequently an increase in the supply of automobile capacity will lead to more driving and increase sprawl (Handy, 2005; Noland, 2001); and finally building HOV lane supply will help to increase the average vehicle occupancy (Schijns, 2006). While the director of the original modelling process has expressed some doubts about the accuracy of the modelling process (Crilly, 2017a Personal Communication), the original EMME/2 modelling process showed that the numerical performance targets were achievable. However, as I have discussed, the T2021 MRP had several issues related to its feasibility. The plan was probably not fully politically or financially feasible, and it would have involved impractical construction timelines.

In the following implementation analysis, we will see that, unfortunately, we will never know whether the plan really could have achieved its goals as the recommendations were not fully implemented. Later, reasons for why this occurred will also be discussed.

Chapter 6. Implementation

This analytical step of POE is used to determine if the outputs listed in the plan have been implemented (Laurian *et al.*, 2010). A summary is provided towards the end of this section.

1.1 and 1.2: Land-Use Policies

These policies are not covered by the T2021 MRP and LRP. They were implemented as part of the LRSP. As such, they are not covered by this evaluation, but could be studied in future evaluations.

2.1: Incentive TDM Measures

Various incentive TDM measures were implemented leading up to 2006, mainly by TransLink through their *TravelSmart* program which started in 2005/2006. *TravelSmart* is a TDM program whose aim is to make better use of the existing transportation system by shifting individuals to more sustainable transportation modes such as walking, cycling, and using public transit; it was the first of its kind in Canada (Transport Canada, 2008). TransLink implemented both TDM measures identified by the T2021 MRP: promoting telecommuting and encouraging large and medium-sized employers to cut vehicle-trips to their work sites. An additional TDM incentive measure, the TransLink-sponsored Employer Pass program, was implemented in 2000. This program allowed for a 15% discount on transit passes for large employers. TransLink cancelled this program, along with several other transit fare discount schemes, between 2013-2014.

2.2: Increase Fuel Prices

Since 1993, the price of fuel has increased quite significantly in Metro Vancouver. The T2021 MRP asked decision-makers to increase the real price of fuel by 25% in real terms through fuel taxation. Market forces largely drove the fuel price increases. The real price of fuel in Metro Vancouver increased by more than 45% by 2006, and by nearly 80% by 2013. Non-federal fuel taxation did not increase between 1993 and 2006, but had increased by around 38% between 1993 and 2013 (refer to Figure 9 below). After 2007, fuel taxation increased more dramatically. This increase in

taxation is partly due to the implementation of the province's carbon tax, which was introduced in 2008, and the fuel tax collected by TransLink, which has been increased quite significantly up to 17 ¢/L by 2013. The amount of fuel tax that TransLink can collect is legislatively limited.

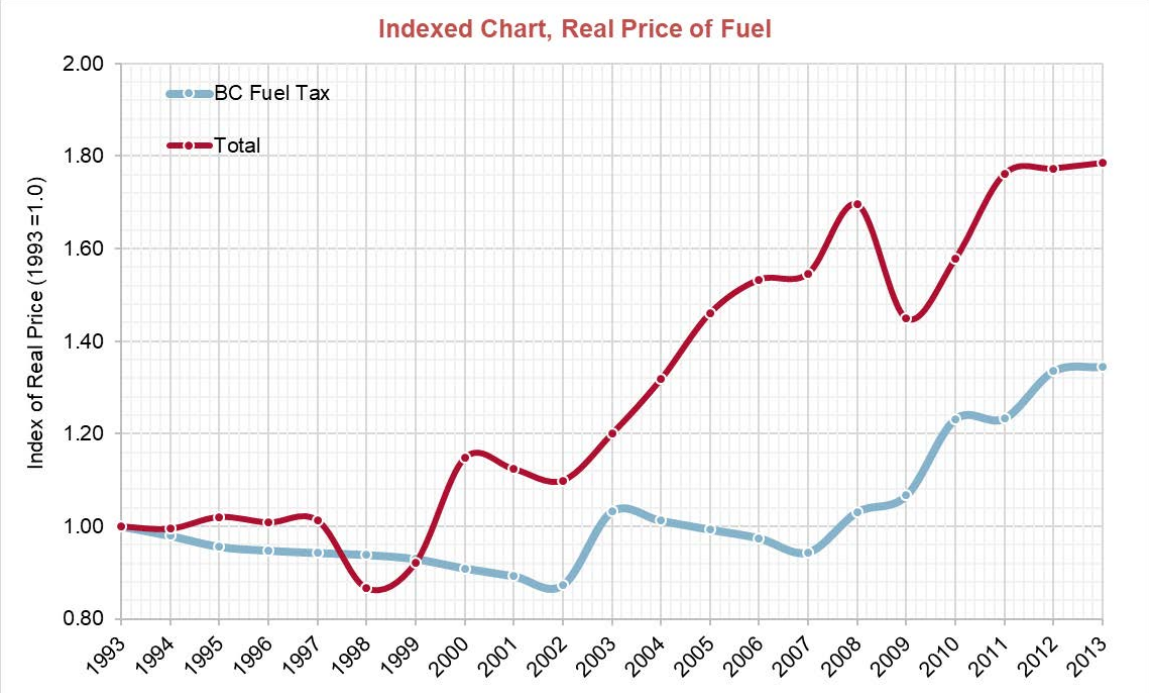


Figure 9: Real Price of Fuel
Created from Statistics Canada (CANSIM) data (Statistics Canada, 2017b)

2.3: Toll all Bridges (Road Pricing)

This output was not implemented by 2006 or 2013. While bridge tolls were later implemented on the Golden Ears Bridge (in 2009) and Port Mann Bridge (in 2013), they were not implemented as part of a road pricing scheme, their purpose instead being for cost recovery only. While a comprehensive road pricing strategy, including schemes to toll bridges, have been discussed for decades, as of 2017 no concrete plans to implement one have emerged. Tolls from all bridges were removed in September 2017 as an election promise of the newly-elected NDP and Green party alliance that won control of the BC legislature following the 2017 provincial election (Bailey, 2017).

3.1: Increase SeaBus Capacity

This output was not implemented by 2013 (DeMarco, 2013). By 2006 and 2013 the capacity of the SeaBus vessels was not significantly expanded, and the SeaBus service frequency was kept constant, as can be seen in Figure 10. While the nominal capacity of the SeaBus remained unchanged, the capacity per capita of the SeaBus decreased by 21% between 1993 and 2006 and by 28% between 1993 and 2013.

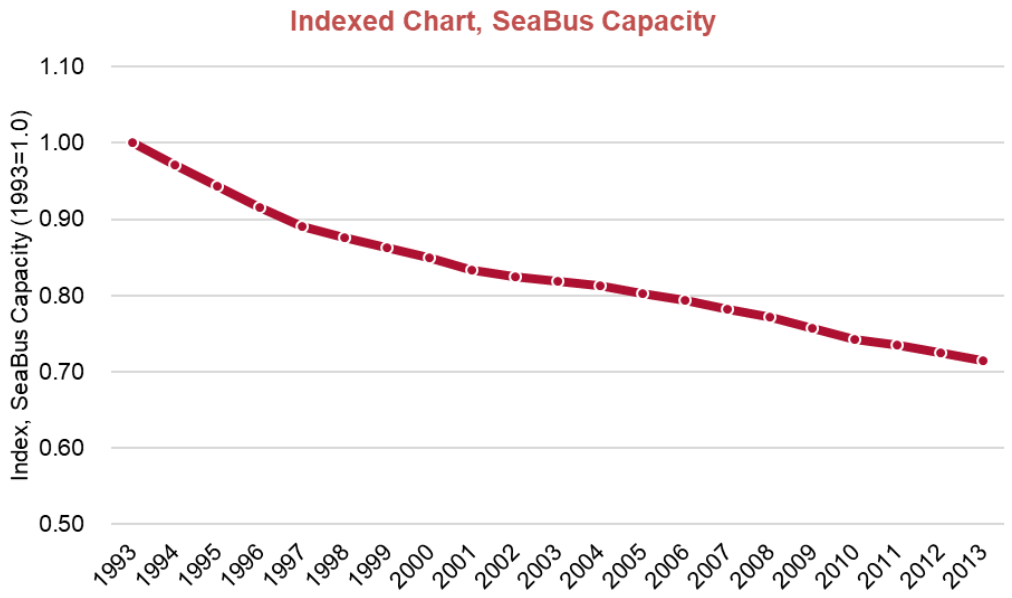


Figure 10: SeaBus Capacity (Per Capita)
Created from BC Transit and TransLink Transit Route Schedules & BC Statistics Population Data

3.2: Increase Expo Line Capacity

This output was implemented by 2006. The Expo Line fleet was expanded in 1994, and 2001/2002 – as was the frequency of service. Refer to Figure 11 below for the changes to the per capita capacity of the Expo Line up to 2013.

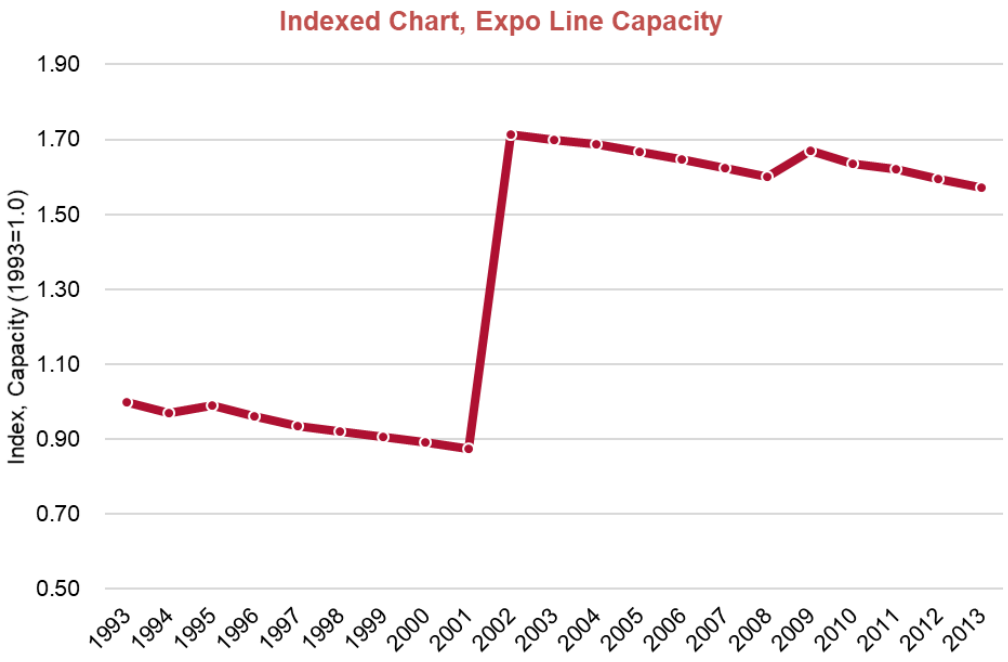


Figure 11: Expo Line Capacity (Per Capita)

Created from BC Transit and TransLink Transit Route Schedules, Vehicle Capacities, and BC Statistics Population Data.

Nominally, the average people-moving capacity of the Expo Line approximately doubled from 5,900 passengers per hour per direction (pphpd) in 1993 to 12,000 pphpd[22] in 2006 and 13,000 pphpd in 2011 for the AM peak hour. This is a per capita increase of approximately 65%. The successful implementation of this output occurred mainly due to the purchase of additional SkyTrain cars and the interlining with the Expo Line with the Millennium Line which significantly increased the service frequency between Columbia Station and Waterfront Station.

3.3: New Westminster-Coquitlam ICTS (Evergreen Extension)

This output was not implemented by 2006 but was under construction by 2013 (DeMarco, 2013). The extension finally opened in December 2016. Although part of the New Westminster to Coquitlam corridor (from Columbia Station to Lougheed Town Centre Station) was in place by 2006, it was implemented as part of the first phase of the Millennium Line project. Rapid transit on the corridor was eventually developed as the

[22] This represents the average people-moving capacity on the combined Millennium/Expo portion of SkyTrain network from Columbia to Waterfront. The capacity of the portion from King George Station to Columbia Station section is approximately 7,850 pphpd in 2006.

Evergreen Extension of the Millennium Line; this project extended the Millennium Line from Lougheed Town Centre station to Lafarge-Lake Douglas station via Port Moody and Coquitlam. The final alignment of the rapid transit line closely matches the corridor as shown in the T2021 MRP. It brought the total track-length to just under 80 kilometres.

3.3a: New Westminster-Coquitlam Town Centre SuperBus

This output was not implemented. Although the 97 B-Line, running on approximately the same corridor as the Evergreen Extension, started operation in September 2002, it does not meet any of the criteria for SuperBus as defined in the T2021 MRP.

3.4: Richmond-Vancouver ICTS (Canada Line)

This output was not fully implemented by 2006, however, the project had been designed, funding had been secured, and construction was under way. The Canada line opened in August 2009. The final alignment of the line was similar the T2021 MRP alignment with an additional branch to YVR airport.

3.4a: Richmond-Vancouver CBD SuperBus

This recommendation, known as the 98 B-Line, was implemented in 2000. The 98 B-Line was in operation until 2009, until is was replaced by the Canada. The 98-B Line meets all the criteria for SuperBus as defined in the T2021 MRP. Route-specific priority measures included curbside bus lanes, median bus lanes, queue jumps, and transit signal priority/pre-emption (Leicester, 2002).

3.5: Lougheed Town Centre-Broadway Business District ICTS (Millennium Line)

This output was only partially implemented by 2006 and 2013 (DeMarco, 2013). This line was anticipated to run from Lougheed Town Centre to the Broadway Business District[23] along Lougheed Highway and Broadway Avenue. While the rapid transit line that was finally built is generally the same as the Lougheed-Broadway line that was envisioned, it differs in a few key ways. Instead of starting at Lougheed Town Centre, the Millennium Line runs from New Westminster north towards the Lougheed Town Centre, then west along Lougheed Highway and Grandview Highway until it reaches Clark

[23] The exact terminus is not made clear in the plan, however the map appears to indicate Cambie Street.

Street, just south of the rail yards[24]. The line implemented contains portions intended to be part of the Coquitlam-New Westminster line (from Columbia Station to Lougheed Town Centre Station). It also terminates about 6 kilometres short of its intended terminus at Cambie Street and Broadway Avenue.

The opening of the Millennium Line was phased, with the first section (Columbia Station to Braid Station) opened in January 2002, the main section from Braid Station to Commercial-Broadway station opened in June 2002, Lake City Way Station opening in November 2003, and finally the VCC-Clark station opened in 2006. An extension to Arbutus Street under Broadway Avenue (and potentially to UBC) has been extensively discussed in more recent years (Mayors' Council on Regional Transportation, 2013a). The extension is anticipated to be open by the early 2020s. The T2021 MRP is quite clear about which order the rapid transit lines should be constructed, the Millennium Line was the lowest priority of the three possible rapid transit corridors, however, it was built first – possible reasons for why this occurred are discussed in Chapter 8.

3.6: Coquitlam-Vancouver Commuter Rail

This output was implemented in 1995. The West Coast Express commuter rail uses an existing right-of-way leased from Canadian Pacific Railway. The service runs from Mission to the Vancouver CBD (Waterfront Station) with stops in Maple Ridge, Pitt Meadows, Port Coquitlam, Coquitlam, and Port Moody; there are no stations in Burnaby or Vancouver, other than the terminus. As with most North American commuter rail systems, the West Coast Express is not a two-way all-day service; there are 5 westbound services in the AM period and 5 eastbound service in the PM period. It meets all the criteria for commuter rail as defined in the T2021[25]. Commuter rail on the Vancouver-Coquitlam corridor was not a priority project in the T2021 MRP, included only as an Appendix to the main plan. It was however referenced multiple times throughout the document. Despite this, it was one of the first T2021 projects to be implemented by the NDP government.

[24] From 2002-2016 the Millennium Line operated in a pretzel configuration from VCC-Clark to Waterfront Stations – sharing tracks with the Expo Line from Columbia to Waterfront Stations.

[25] Refer to Section 4.2.

3.6a: Lougheed Town Centre-Broadway Business District SuperBus

This output was fully implemented by BC Transit in 1995. When originally implemented, the 99 B-Line ran from Lougheed Town Centre to UBC via Lougheed Highway and Broadway Avenue. The 99 B-Line continues to operate as of 2017; the route was shorted to run only between Commercial-Broadway station and UBC shortly after the opening of the Millennium Line in 2002, however, some trips continue to run from Boundary Street to UBC.

The 99 B-Line meets most of the criteria for SuperBus as defined in the T2021 MRP. It had a minimum frequency of every 3-4 minutes during the day and every 15 minutes in the evenings. Due to long stop spacing, curbside bus lanes, and transit signal priority, the 99 B-Line is much faster than the equivalent trolley bus service (route #9) and completed the original 27-kilometre route with an average revenue speed of 23 km/hr. Previous travel speeds on the corridor were less than 19 km/hr (Leicester, 2002).

3.7: Increase Mainline and Feeder Bus Routes Coverage and Service Hours

This output was only partially implemented by 2006 and marginally implemented by 2013. Service hours for bus services increased from about 3.0 million in 1993 to 4.3 million in 2006 and 5.1 million in 2013. This is a nominal increase of approximately 24% and 31%, respectively. However, service hours per capita decreased by approximately 2% by 2006, and only increased marginally by 0.7% by 2013. It is crucial to note that although bus service hours per capita have generally decreased or remained unchanged, total transit service hours and also total transit-capacity-hours (service hours multiplied by the capacity of the transit vehicle) have increased. This can be seen in Figure 12 below.

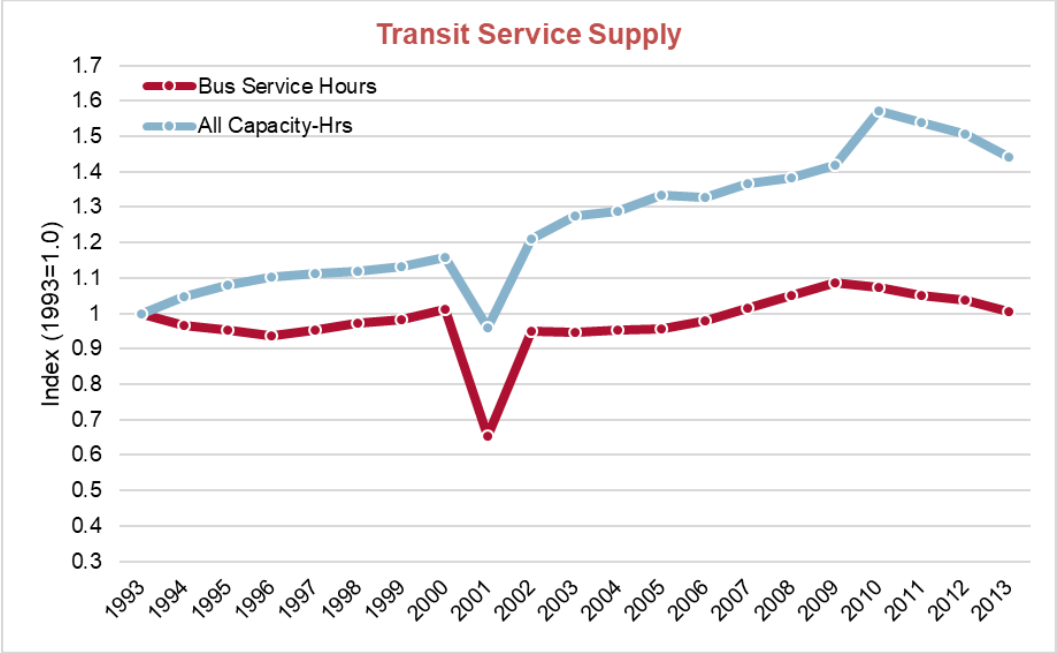


Figure 12: Transit Service Supply (Per Capita)
Create from Metro Vancouver Transit Ridership and BC Statistics Population Data.

Notable decrease in 2001 is due to CMBC strike.

The introduction of new services, such as the Millennium Line, Canada Line, and the West Coast Express and also increases in vehicle capacities (such as the introduction articulated buses) have increased the overall transit capacity of the network. On a per capita basis, total capacity-hours, for all transit service, increased by 33% by 2006 and by 44% by 2013.

While service hours give an overall picture of the increase in transit supply, it does not say much about the quality of the service. For example, it does not show if there have been increases in frequencies or new routes added. In addition to service hours, I also examined changes to the number of bus departures per hour and the total number of routes. Nominally, the mainline and feeder bus coverage did increase in terms of both the number of bus routes, and the number of departures per hour. In 1993, there were 172 different routes, and in 2006 there was 193 (a 12.2% increase). In 1993, the number of departures per hours, for all bus routes in Metro Vancouver was 549 departures during the AM Peak hour which increased to 666 departures during the AM Peak hour in 2006. This is a 21% increase nominally, or a 3.6% decrease per capita.

These changes were not applied uniformly throughout the Metro Vancouver area. In the City of Vancouver, the North Shore, and Richmond/South Delta the route capacity per capita increased by up to 17%. In the more easterly regions this pattern was reversed, with decreases in route capacity per capita as high as 22% (in Pitt Meadows/Maple Ridge) – refer to Table 7 below.

Table 7: Changes in Bus Service Characteristics by Sub-Region (Per Capita)

	Change in Num. of Routes	Change in Departure per Hour
Maple Ridge/Pitt Meadows	0%	-22%
Surrey/Langleys	-32%	-20%
Burnaby/New West	-42%	-11%
Northeast Sector	-16%	-10%
Vancouver	10%	9%
North Shore	-2%	11%
Richmond/South Delta	18%	17%

Created from BC Transit and TransLink Transit Route Schedules. Values shown represent the changes by sub-region, per capita, between 1993-2006.

We can see that, in terms of increasing the number of routes and departures per hour, Vancouver, the North Shore, and Richmond/South Delta have enjoyed a greater increase in service quantity and quality compared to Maple Ridge/Pitt Meadows, Northeast Sector, and Surrey/Langleys. Burnaby/New Westminster also show a large reduction in bus service, however this sub-region benefited the most from the introduction of the Millennium Line in 2002. The T2012 MRP encouraged investments in the inner suburbs take priority (GVRD, 1993, p. 21), and in this case it appears that these recommendations were followed. Both BC Transit and TransLink continuously had to make difficult decisions and balance regional priorities with limited funding. However, their decision to reduce service in outer suburban regions likely led to a reduction in transit use in those regions (Alam *et al.*, 2015; Litman, 2017).

3.8: Transit Priority Measures (TPM)

This output was partially implemented by 2006 and 2013 (DeMarco, 2013). In the T2021 MRP, TPM on multiple corridors was expected to be implemented by 2006. While certain priority measures were indeed implemented by 2006 and in subsequent years, they were not nearly implemented to the extent that the plan called for. Transit priority is

defined as any type of infrastructure intended to allow transit vehicles (in this case, buses) to travel faster along corridors. Examples of transit priority measures include dedicated bus lanes, HOV lanes that allow transit vehicles, transit signal priority or pre-emption, and queue jumps (at bridges, tunnels, or other traffic choke-points) (Agrawal et al., 2012; Chada & Newland, 2002). While the plan lists very specific measures at specific geographic locations most of them were not implemented at those specific locations. For example, TPM were expected to be in place across every major bridge in Metro Vancouver. For that reason, this output was only partially implemented by 2006/2013. Between 1993 and 2013, TPM were implemented at the locations summarized below in Table 8.

Table 8: Priority Measures Implemented Between 1993 and 2013

Priority Measure	Location	Year Implemented
HOV lanes permit buses, dedicated bus lanes	Northeast Sector & Vancouver Barnet Highway/Hastings corridor (Hwy 7A)	1996
TSP, pre-emption (3 intersections), dedicated median bus-only lanes, dedicated curb-side lanes, queue jump to Arthur Laing Bridge	Richmond & Vancouver Priority measures associated with the 98 B-Line on No. 3 Rd, Russ Baker Way, and Granville St	2001 (removed in 2009)
Queue jump	Pitt Meadows & Maple Ridge Westbound approaching the Pitt River Bridge	2009
Queue jump, bus lanes, TSP	North Shore North approach to the Lions Gate Bridge	2011 (Complete)
Queue jump	North Surrey/North Delta 96 Avenue and King George	2013
Multiple queue jumps	North Surrey/North Delta 72nd Avenue, westbound, between 112th Street and 118th Street	2004

Sources: Leicester (2002); Transportation and Ministry of Transportation and Infrastructure (2011), DeMarco (DeMarco, 2013); Corporation of Delta (2007).

The effectiveness of TPM in Metro Vancouver warrants further study. However, as previously discussed[26], TPM have shown to be effective in decreasing the travel times on transit vehicles in other regions which will lead to an increase in transit demand (Agrawal *et al.*, 2012; Chada & Newland, 2002; Litman, 2017).

[26] Refer to Section 5.6

3.9 Road Network HOV Lanes

This output category was partially implemented by 2006 and 2013 (DeMarco, 2013). More than 130 lane-kilometres of 3+ HOV/bus lanes were expected to be built by 2006; 69 lane-km were implemented by 2006 (52% of total), and 100 km (76% of total) by 2013, all were 2+. All the highway sections identified by the T2021 MRP for HOV lanes are under the jurisdiction of the province of BC except for one section of Lougheed Highway (Highway 7) approximately between the Cape Horn Interchange and central Coquitlam.

Table 9: Summary of HOV Lanes Implemented

Location	Vehicles Allowed	Year	Head Agency
Northeast Sector & Vancouver Barnet Highway-Hastings Corridor	Regular vehicles 2+, Buses, Other special vehicles	1996	Province of BC (MoTH)
Vancouver & Burnaby/New Westminster Highway 1, Grandview Highway to Cape Horn Interchange	Regular vehicles 2+, Buses, Other special vehicles	1999	Province of BC (MoTH)
Vancouver & Burnaby/New Westminster Highway 1, 200th Street to Cape Horn Interchange	Regular vehicles 2+, Buses, Other special vehicles	2013	Province of BC (MoT)

Sources: MoTH Annual Report 1996-2013 and DeMarco (2013).

3.10 Other Road Improvements

This output category was partially implemented between 1993 and 2006 and 1992 and 2013 (DeMarco, 2013). A total of eight specific project areas recommended by the T2021 MRP, nearly all were addressed in some way or another through actual projects completed by 2013 – refer to Table 10 below. The Golden Ears Bridge, completed in 2009, was not recommended for the medium-range time frame, but was included here as it is a long-range T2021 project[27]. Projects that were not completed include the North Fraser Perimeter Road (part of the TransLink MRN) and improvements between Surrey City Centre and Highway 91 at the Nordel Way exit. Several additional major road projects, not planned for in the T2021 MRP were pursued after 2006.

[27] A topic for future study would be to determine why TransLink chose to pursue this project ahead of completing the medium-range plan projects.

Table 10: Summary of Other Road Improvements

Type	Location	Year Completed	Head Agency
Bridge	Richmond Sea Island Bridge	2002	Province of BC (MoTH)
Highway	Southern Region/Langleys Improvements to Highway 15, Highway 1 to USA Border	2008	Province of BC (MoT)
Bridge	Pitt Meadows/Maple Ridge & Southern Region/Langleys Golden Ears Bridge	2009	TransLink
Highway/Bridge	Northeast Sector Improvements to Mary-Hill Bypass (Highway 7B) between Port Mann Bridge and Replacement of Pitt River Bridge	2009-2011	Province of BC (MoTI)
Major Highway	Southern Region/Langleys & North Surrey/North Delta South Fraser Perimeter Road (Highway 17)	2013	Province of BC (MoTI)

Sources: MoTH Annual Report 2002-2011 and DeMarco (2013).

6.2 Projects and Policies Not Described in the T2021 MRP

Numerous major transportation projects and policies, not originally described or recommended by the T2021 series of plans were built during the T2021 MRP time-period. With regards to road network infrastructure, few major projects were completed by 2006 that were not described in the T2021 MRP. However, a considerable number of infrastructure projects were announced and built shortly *after* the implementation period ended.

6.2.1 Projects

One example of a major project not described in the T2021 MRP was the Gateway Program initiated by the BC Liberal government in 2006 (Government of British Columbia, 2006). Refer to Figure 13 below for a map of the major infrastructure projects. While certain aspects of the Gateway Program corresponded to some of the automobile network recommendations in the T2021 MRP, the project was much different in its scope. The T2021 MRP called for high-occupancy vehicle (HOV) lane expansion on Highway 1 and the Port Mann Bridge rather than an expansion of all lanes[28] (Clark,

[28] The Port Mann Bridge replacement was built with 10 lanes. It was the widest bridge in the world when it opened in 2013.

2010). T2021 also did not call for widening of Highway 1 or the extension of the SFPR through to South Delta.

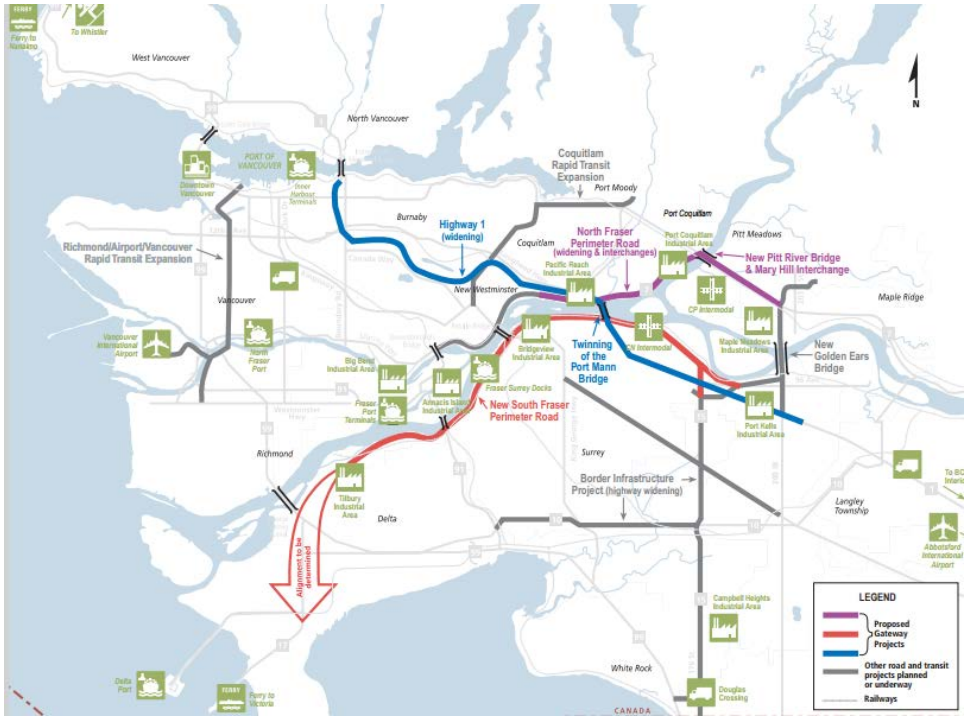


Figure 13: Gateway Program Defintion (2006)
Image source: Government of British Columbia (2006). Used with permission.

Together, the Gateway projects massively increased the capacity of the highway system to the eastern suburbs of Metro Vancouver. These investments were contrary to the stated goals of T2021 – the plan specifically dictated that "transport investments which make long haul commuting easier will tend to encourage [undesirable] sprawl; therefore, to support the shaping of the desired land use, investments which encourage inner suburbs to develop should take priority" (GVRD, 1993, p. 21). The BC Liberals justified the Gateway program as they argued that the T2021 plans and the LRSP goals were not met, and that traffic congestion had increased, so additional road infrastructure was required to meet the demand. They stated:

> The LRSP… [and] Transport 2021 have guided transportation investments in Greater Vancouver. The primary goal of the LRSP is to maintain regional livability and protect the environment in the face of anticipated growth … In reality, dispersed employment growth, changing social trends and increasing trade have caused Greater Vancouver's growth to evolve differently than anticipated by the LRSP… the region's

> transportation network shows increasing strain from riding traffic volumes and congestion… (Government of British Columbia, 2006).

Numerous groups and governmental bodies were against the projects including the City of Vancouver council (City of Vancouver, 2006), the Livable Region Coalition (Doherty, 2006), the David Suzuki Foundation (David Suzuki Foundation, 2007), among others. Additionally, certain bus-only lanes located north and south of the George Massey Tunnel on Highway 99 and Highway 17[29] were converted to HOV lanes in 2000/2001. The funding for this project was supplied by the province of BC and TransLink. Vanpool/bus lanes were also built and implemented on Willingdon Avenue from Still Creek Drive to Highway 1, this project was funded by the province of BC, City of Burnaby, and TransLink. The T2021 MRP recommended that HOV lanes be built on Hastings up to Highway 1 – however the HOV/bus lanes on Hastings were extended further to Downtown Vancouver.

6.2.2 Policies

Several transport policies, that were not originally described or included in the T2021 MRP (or T2021 LRP), were implemented during and shortly after the plan's implementation period. U-Pass (Universal Pass) is a program implemented in 2003 by TransLink. Since that time, university students attending UBC and SFU (the two major universities in Metro Vancouver) are required to pay for a reduced-price monthly transit pass. Since that time, the provincial government has extended the program to all post-secondary institutions in BC. In Metro Vancouver, in addition to SFU and UBC, Douglas College, Langara College, Kwantlen Polytechnic College, Vancouver Community College, British Columbia Institute of Technology (BCIT), Capilano University, Nicola Valley Institute of Technology, and Emily Carr University of Art and Design) were added to the scheme (Office of the Premier, Transportation and Infrastructure, 2010; TransLink, 2017b).

All students must purchase the pass, whether they intend to use public transit or not – exceptions are only granted if the student has access to a free pass via some other means (such as being a TransLink employee). An *ex post facto* review completed by Urban Systems (2005) found that, between 2002 and 2004, although transit ridership to

[29] Renamed Highway 17A in 2013 with the opening of the SFPR

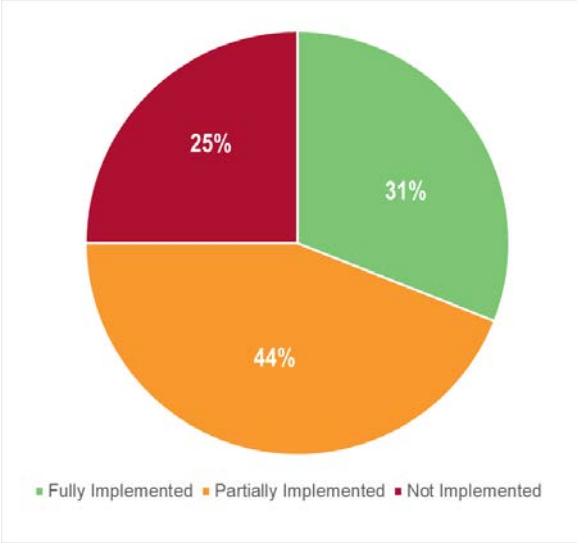
UBC increased massively by 68%, single occupancy vehicle trips decreased by only 10%. Cycling and walking decreased by 52% and 63%, respectively (during the same period, all trips increased by 5%). A similar pattern was reported for the SFU Burnaby Mountain campus (Urban Systems, 2005). Transit service to UBC and SFU was expanded to accommodate the increased demand. While the U-Pass program is generally regarded as successful and has many benefits, in the short term, the efficacy of U-Pass in achieving the regional goals is dubious given the decrease in the active mode shares.

The long-term effects of U-Pass may well prove to be beneficial. It has been theorized that if transit use is encouraged in the "formative young adult years", it can help make public transit a 'way of life' even after graduation (Cooper, 2009, p. 40). The theory may be true, as amongst 25-34 year old former U-Pass holders, 53% are frequent transit users (Cooper, 2009). This is much higher than the general 25-34 year old population at just around 18% (Statistics Canada, 2008).

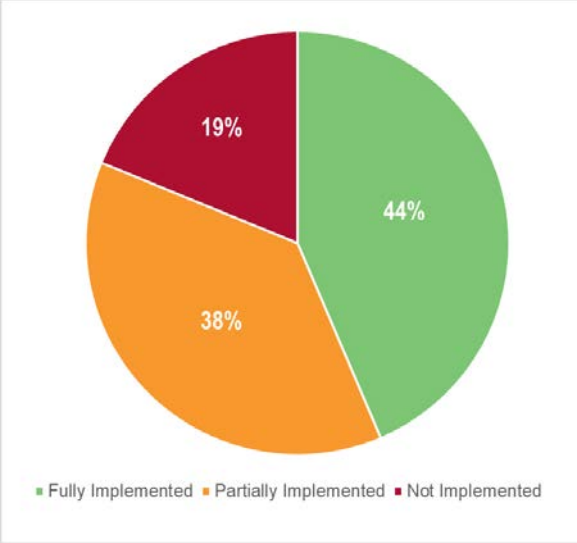
While the U-Pass program was not originally included in the T2021 MRP, its purpose it not so different from a related policy that was recommended, the Employer-Pass program. Both offer subsidized monthly transit passes with the intent to increase transit use amongst the recipients. The U-Pass program therefore does fit with the general intentions of the T2021 MRP.

6.3 Summary of Findings

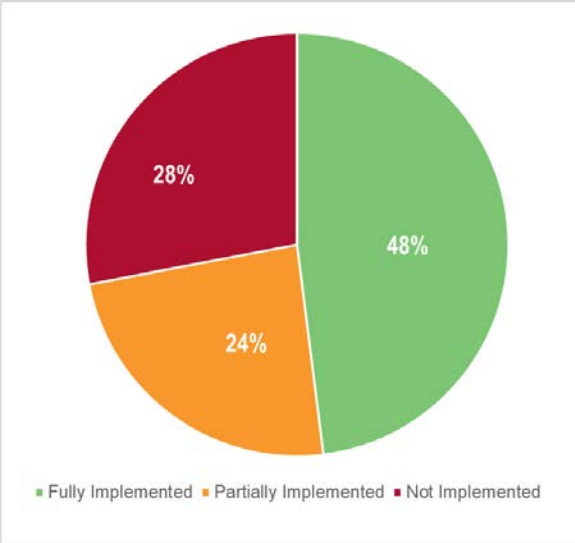
The T2021 MRP was only partially implemented by 2006 and by 2013. Charts summarizing the extent of the implementation by 2006 and 2013 are shown below (Figure 14).



2006 (Farmer, 2017)



2013 (Farmer, 2017)



2013 (PSN, 2013)

Figure 14: Summary of Implementation Analysis

My findings suggest that less than half of the outputs were fully implemented by 2006 meaning that it is unlikely that the goals of the plan would be achieved, as we will confirm in the next Chapter.

Chapter 7. Outcomes

The purpose of this analytical stage is to systematically assess whether the expected quantitative outcomes, or goals, of the plan were achieved (Laurian *et al*. 2010). The T2021 MRP planners specified numerical targets[30]; while these performance targets are useful for basic assessment, the targets were not ideal. While these performance targets are considered in this evaluation, to determine if the expected outcomes of the plan were met, the goals were re-categorized. In this evaluation, I distinguish between performance targets, and more general quantitative goals developed for this evaluation – the goals could consist of several performance targets grouped together.

7.1 Land Use

Although, I did not review the LRSP policies and processes that affected land-use development in Metro Vancouver, the outcomes of those policies can be determined through the data. The 2006 and 2011 land use patterns differ from the patterns projected by the T2021 MRP (DeMarco, 2013). The population increases in Vancouver for example, were much higher than expected at 22% versus an expected 9%.

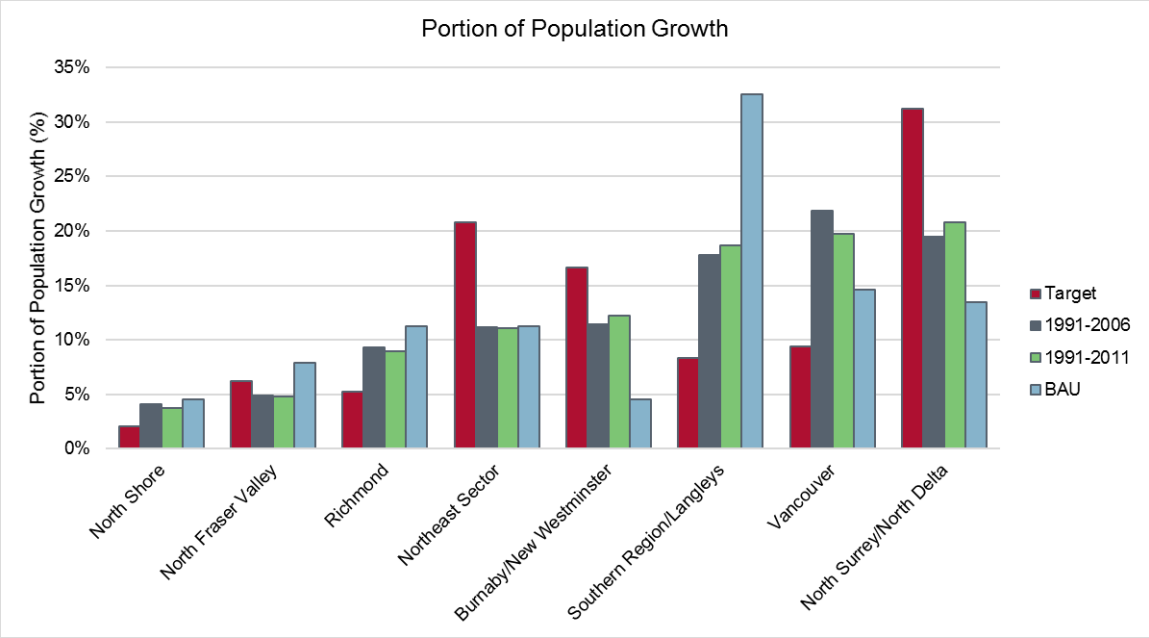
The data does help to support the notion that rapid transit can help to shape growth. The T2021 MRP expected that 80% of new growth would be contained within areas[31] which were predicted to be served by SkyTrain or other rapid transit. By 2006, 52% of regional growth, and by 2011, 62% had occurred in regions that were served by SkyTrain. It is likely that even the promise of rapid transit influences regional land use patterns and population growth, as anecdotal information from interviewees suggests (Price, 2017a). In the five core and inner sub-regions where rapid transit was planned, population growth portions were 72% in 2006 and 73% between 1991 and 2011. This is much higher than the forecasted trend in 1993, which estimated that only 55% of growth would be captured in these inner-suburb and core areas. Refer to Table 11 below.

[30] Refer to Table 17 for a list

[31] Five sub-regions: Vancouver, Burnaby/New Westminster, Northeast Sector, Richmond, and North Surrey/North Delta

Table 11: Population Growth Portions by Sub-Region

Population	1991	2006	2011	Target	1991-2006	1991-2011
North Shore	158,277	179,089	184,875	2%	4%	4%
North Fraser Valley	59,758	84,818	94,017	6%	5%	5%
Richmond	126,624	174,461	190,473	5%	9%	9%
Northeast Sector	140,178	197,524	218,788	21%	11%	11%
Burnaby/New Westminster	202,443	261,348	289,194	17%	11%	12%
Southern Region/Langleys	205,207	296,630	337,762	8%	18%	19%
Vancouver	477,748	590,243	617,871	9%	22%	20%
North Surrey/North Delta	232,267	332,470	380,348	31%	19%	21%
Total	1,602,502	2,116,583	2,313,328	100%	100%	100%

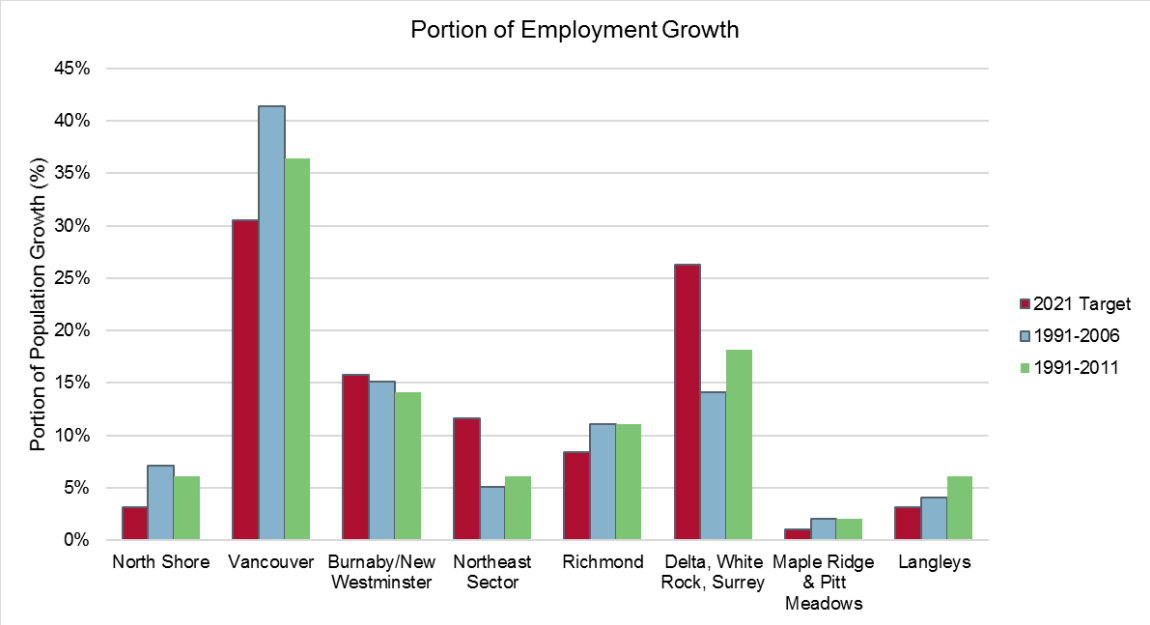


Source: DeMarco (2013) using Statistics Canada Census data

Regional employment growth has also not developed as anticipated, as shown in Table 12. The employment growth projections were not included in the T2021 MRP as they are long-range visions. However, many of the forecasted targets were predicated on the visions of the population growth being concentrated into Town Centres with significant population and employment growth. In 2006 and also in 2011, a larger share of the employment growth had occurred in Vancouver as opposed to the other regions, such as the Northeast Sector, which was expected to contain 12% of regional growth but had only 6% between 1991 and 2011.

Table 12: Employment Growth Portions by Sub-Regions

Employment	1991	2006	2011	Target	1991-2006	1991-2011
North Shore	59,025	64,815	65,325	3%	7%	6%
Vancouver	332,610	343,475	366,905	31%	41%	36%
Burnaby/New Westminster	120,090	136,840	143,955	16%	15%	14%
Northeast Sector	44,350	63,785	65,710	12%	5%	6%
Richmond	85,530	106,860	109,035	8%	11%	11%
Delta, White Rock, Surrey	113,165	170,965	186,120	26%	14%	18%
Maple Ridge & Pitt Meadows	16,965	23,375	23,595	1%	2%	2%
Langleys	34,585	55,035	59,335	3%	4%	6%
Total	806,320	965,150	1,019,980	100%	100%	100%



Source: DeMarco (2013)

7.2 Regional Mode Shares and Trips

The T2021 MRP provided AM peak performance targets for all modes. Specifically, the T2021 MRP stressed the transit mode shares and cycling trips as particularly important. Mode share targets were as follows:

- transit, regionally 17%;
- transit, to CBD 45%;
- transit to RTCs 20%;
- non-driver, regionally 47%; and
- cycling trips to work, 12,000.

The 17% transit mode share target was not fully achieved by 2006, but was achieved by 2011 (DeMarco, 2013). Refer to Figure 15 below for a graphic depicting the AM Peak mode share changes from 1991-2011.

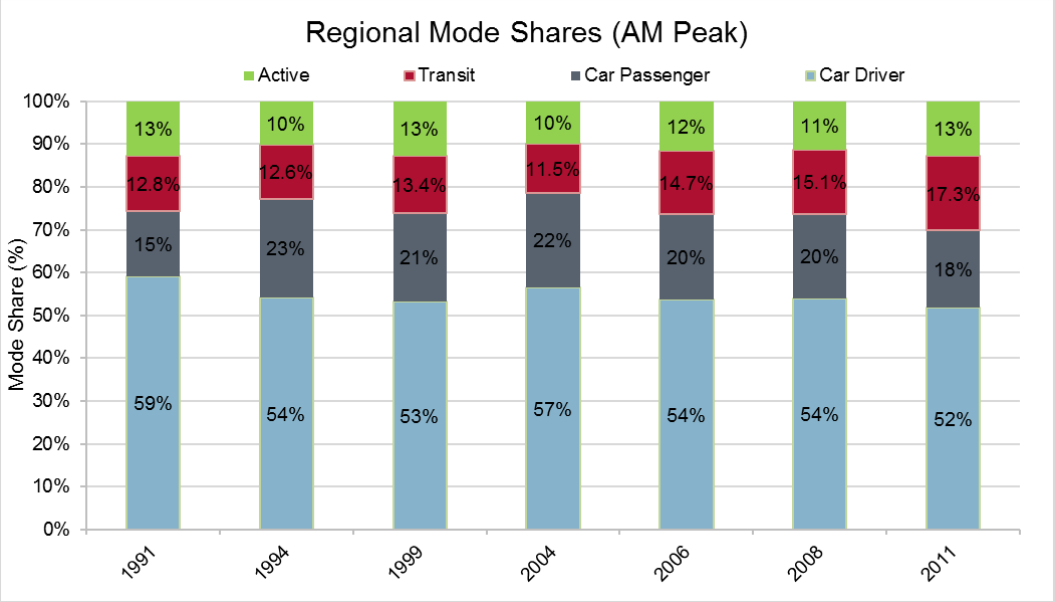


Figure 15: AM Peak Regional Mode Shares
Data source: 1991: Transport 2021 Medium Range Plan, 1994-2008: TransLink Trip Diary Survey, 2011: Christina DeMarco (Planning Solutions Network using TransLink Trip Diary Survey Data). 2004 data for reference only (survey taken in Spring).

During the T2021 MRP time-period, the transit mode share remained relatively constant (except for the 2004 outlier[32]) until 2006. The Compound Annual Growth Rate (CAGR) for the 1993-2006 period was 0.8% for transit, and 0.7% for non-driver (includes walking, cycling, transit, and vehicle passenger trips), a rate of change which was insufficient to achieve the target.

While the 1991 Trip Diary Surveys AM Peak hour results are used as the basis for comparison by the T2021 MRP, since 1994 Trip Diaries Surveys have provided 24-hour results. The all-day mode shares, and the year-to-year changes differ quite significantly from the AM Peak mode shares, as can be seen in Figure 16 below.

[32] Refer to Section 4.3 for more information.

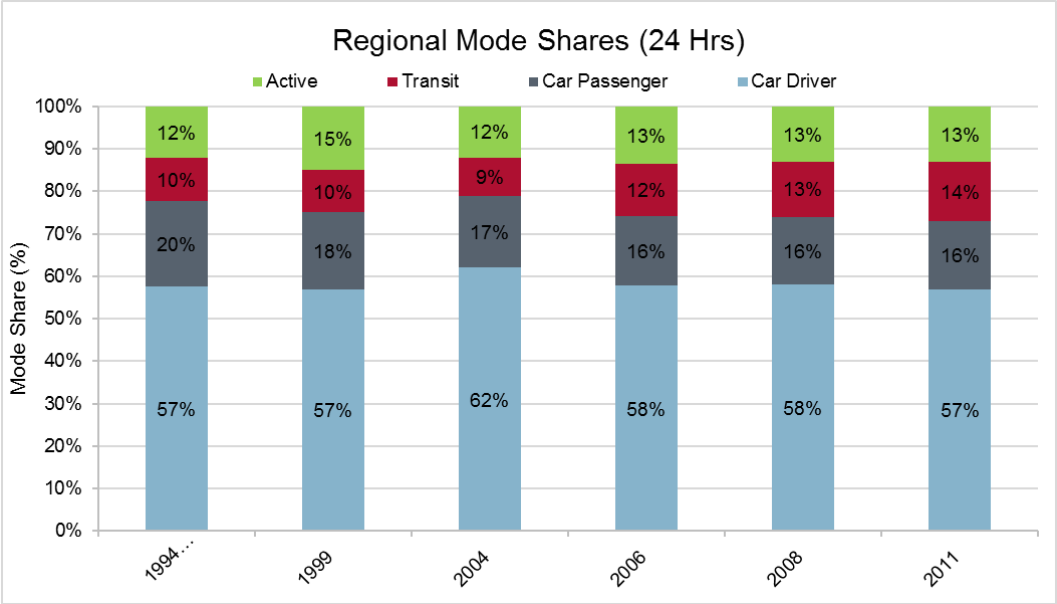


Figure 16: 24-Hour Regional Mode Shares
Data Source: 1991: Transport 2021 Medium Range Plan, 1994-2008: TransLink Trip Diary Survey, 2011: Christina DeMarco (Planning Solutions Network using TransLink Trip Diary Survey Data). 2004 data for reference only (survey taken in Spring).

As of 2011, the 24-hour auto driver mode share has remained the same as in 1994 at 57%. While the transit mode share increased to 14%, it appears to be at the expense of auto passenger trips as opposed to vehicle trips. The auto passenger mode share decline is discussed in more detail as part of the next category (auto occupancy). Consequently, the non-driver mode share also did not change between 1994-2011. While the 24-hour regional mode shares have remained relatively constant, the 24-hour data also shows that, sub-regionally, mode shares have been quite dynamic – refer to Table 13 below. A trend can be seen with decreases in the driver mode share in the inner core (more urban) regions with contrasting increases in the outer (more suburban) municipalities. While the portion of transit users is up across the region, the auto passenger mode share is down across the region, as is the active mode share, generally in the more suburban municipalities[33].

[33] Suburban nature was qualitatively assessed generally based on distance from the Vancouver CBD.

Table 13: Changes in Mode Shares by Sub-Region

Mode		Sub-Region	1994	2011	Difference
Driver	More Urban	Vancouver	50%	43%	-7pp
		Burnaby/New Westminster	62%	54%	-8pp
		Richmond/South Delta	61%	61%	1pp
		North Shore	62%	61%	-1pp
		Surrey/White Rock	57%	64%	7pp
		Northeast Sector	62%	64%	2pp
		Pitt Meadows/Maple Ridge	61%	68%	7pp
	More Suburban	Langleys	59%	70%	11pp
Auto Passenger	More Urban	Vancouver	18%	13%	-5pp
		Burnaby/New Westminster	17%	15%	-2pp
		Richmond/South Delta	22%	17%	-5pp
		North Shore	20%	17%	-3pp
		Surrey/White Rock	25%	17%	-8pp
		Northeast Sector	22%	17%	-5pp
		Pitt Meadows/Maple Ridge	20%	20%	-
	More Suburban	Langleys	31%	19%	-12pp
Transit	More Urban	Vancouver	18%	22%	4pp
		Burnaby/New Westminster	13%	21%	8pp
		Richmond/South Delta	6%	12%	6pp
		North Shore	8%	11%	3pp
		Surrey/White Rock	5%	10%	5pp
		Northeast Sector	5%	11%	6pp
		Pitt Meadows/Maple Ridge	2%	6%	4pp
	More Suburban	Langleys	1%	3%	2pp
Active	More Urban	Vancouver	15%	23%	8pp
		Burnaby/New Westminster	8%	10%	1pp
		Richmond/South Delta	12%	10%	-2pp
		North Shore	10%	11%	1pp
		Surrey/White Rock	12%	9%	-3pp
		Northeast Sector	10%	8%	-2pp
		Pitt Meadows/Maple Ridge	17%	7%	-11pp
	More Suburban	Langleys	9%	8%	-1pp

The transit share in the AM Peak hour, to the Vancouver CBD met the 2006 target, likely by 1998-1999 – refer to Figure 17 below. The Vancouver CBD is well-served by transit, with multiple rapid transit stations and multiple high-frequency bus lines serving the metropolitan core.

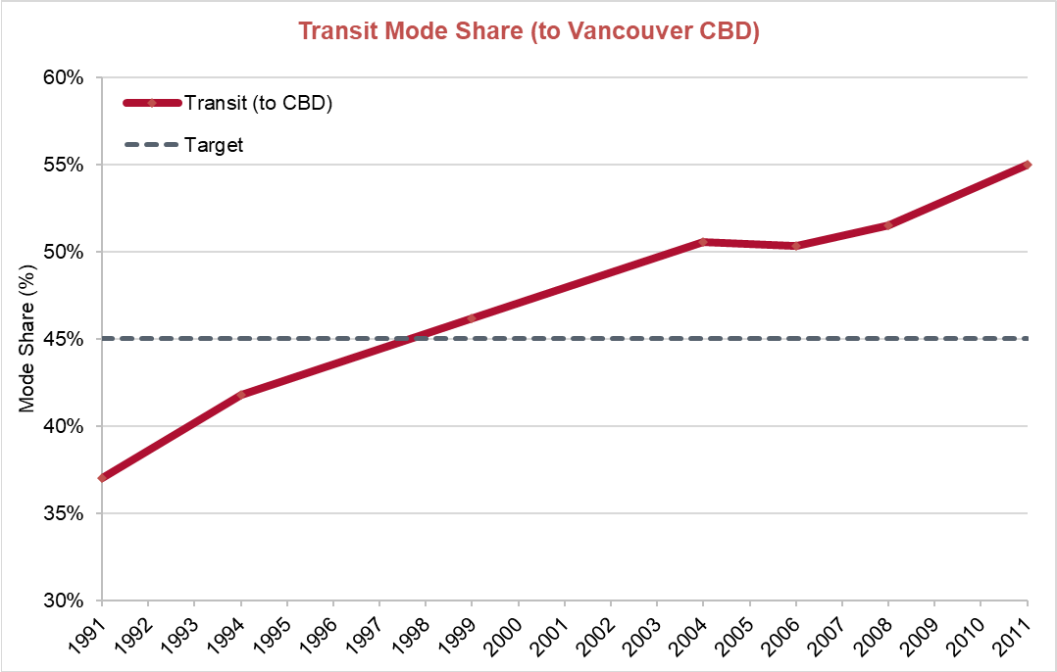


Figure 17: Transit Mode Share (to Vancouver CBD)
Data sources: 1991: Transport 2021 Medium Range Plan, 1994-2006: TransLink Trip Diary Surveys, 2011: Christina DeMarco (Planning Solutions Network) using TransLink Trip Diary Survey Data. 2004 data for reference only (survey taken in Spring).

Finally, cycling trips to work have increased steadily between 1991 and 2011. The 2006 target was 12,000 trips, to work, in the AM Peak hour. This target was not met by 2006 or 2011.

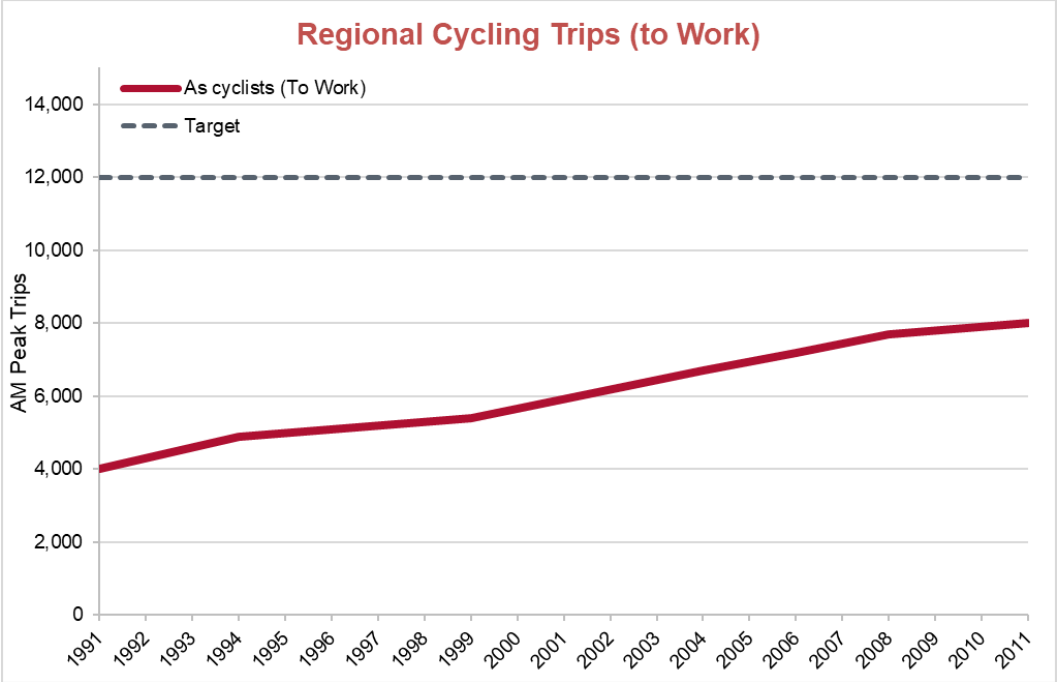


Figure 18: Regional Cycling Trips to Work
Data source: 1991: Transport 2021 Medium Range Plan, 1994-2006: TransLink Trip Diary Surveys, 2011: Christina DeMarco (Planning Solutions Network) using TransLink Trip Diary Survey Data. 2004 data for reference only (survey taken in Spring).

7.3 Auto Occupancy

The T2021 MRP provided two targets related to auto occupancy: AM Peak average auto occupancy regionally, and the AM Peak average auto occupancy for trips specifically to the Vancouver CBD. Both these targets were set to 1.35. The AM Peak target of an average auto occupancy rate of 1.35 was reached by 2006. However, the rate has been declining; by 1994 the average occupancy rate was at a high of around 1.42 (regionally). Since that time, the occupancy rate has been slowly declining over the years, 1.35 in 2011. Refer to Figure 19 below.

The 'to Vancouver CBD' target, also of 1.35, was not met by 2006 or 2011. The auto occupancy rate to the CBD, initially just under 1.20 in 1994 has slowly increased to a high of 1.25 in 2011, but still short of the target. The 24-hour auto occupancy rate, again available since the 1994 Trip Diary Survey, illustrates that the auto occupancy rate has also been steadily declining. From 1994-2011, the rate declined by more than 11%.

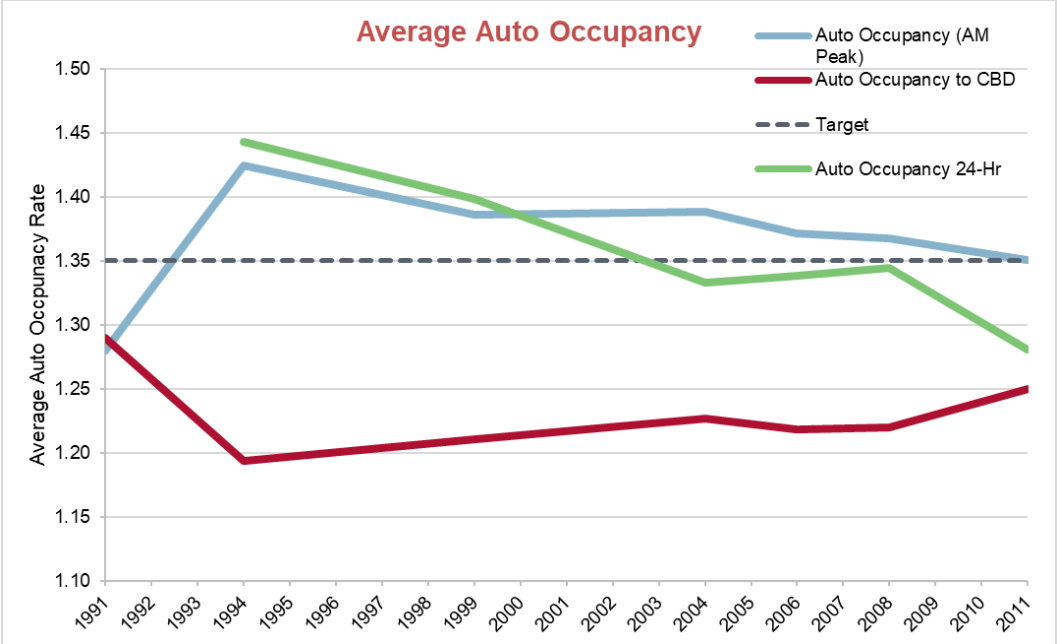


Figure 19: Auto Occupancy
Data sources: 1994-2006: TransLink Trip Diary Surveys, 2011: Christina DeMarco (Planning Solutions Network) using TransLink Trip Diary Survey Data. 2004 data for reference only (survey taken in Spring).

While the auto occupancy rate, as well as the regional auto passenger mode share, is declining, the auto driver mode share remains constant. One possible reason for this is, as we have seen with the implementation of U-Pass, is a significant number of individuals who were previously carpooling to university switched to transit. One survey respondent even likened transit to “a big carpool that leaves every few minutes, all day long” (Urban Systems, 2005, p. 6).

The decline in auto occupancy and carpooling trips throughout this period has also been seen across Canada and in other jurisdictions. In the 1996 Census of Population the portion of Canadian workers travelling to work as passengers in a car stood at 7.4% in 1996 (Statistics Canada, 1997) which declined to 5.6% 2011 (Statistics Canada, 2012). In the Southern California Associations of Governments (SCAG) region, which includes the Greater Los Angeles Area, carpooling declined from 14.3% to 11.4% between 2000 and 2004 (Kwon & Varaiya, 2008, p. 107). Furthermore, in the USA nation-wide between 1990 and 2007, carpooling’s mode share decreased from 13% to 10% (Mather, 2008).

7.4 Total Population Living Close to Transit

Two performance targets were provided for this category: total population living within 1 kilometre of rapid transit and total population living within 400 metres of a bus route. This target for total regional population living within 1 kilometre of rapid transit was not met by 2006 or 2011 (DeMarco, 2013). Analysis showed that the percentage of the regional population living within 1 kilometre of a rapid transit line was approximately 16% in 2006 and 21% in 2011 versus a target of 25%. This represents approximately 62% of the target percentage by 2006. Figure 20 below shows the 2006 population density in Metro Vancouver overlaid with the 1-kilometre buffer area.

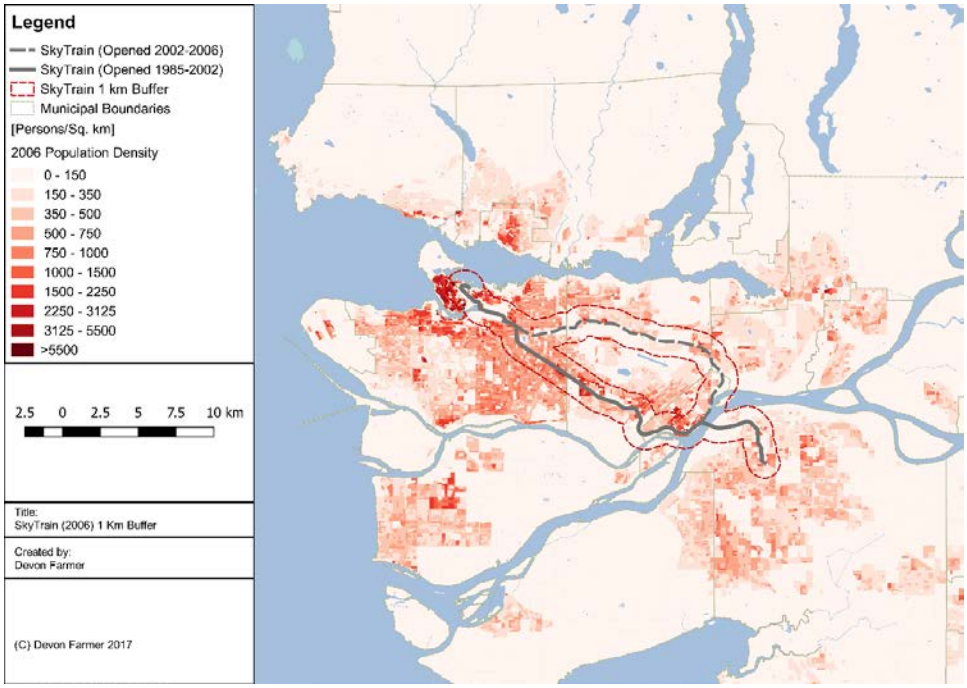


Figure 20: SkyTrain (2006) 1 kilometre Buffer
Created using data from Statistics Canada Population Data, and TransLink Transit Line GIS

Population density is significant surrounding the more established Expo Line, but as of 2006, had yet to become concentrated around the Millennium Line, the main reason the target was not met was because the three trunk corridor lines were not implemented as originally described in the plan. The distribution of population living close to rapid transit was not evenly spread out throughout the Metro Vancouver. Table 14 below shows that, in 2006, a much more significant portion of the populations residing in Vancouver and Burnaby/New Westminster lived within a kilometer of rapid

transit. In Burnaby/New Westminster more than 50% of the population had relatively easy access to rapid transit. In the Southern Region/Langleys, Pitt Meadows/Maple Ridge, Richmond, and the North Shore where the population was around 680,000 people in 2006, none of the population live within a kilometer of the SkyTrain light metro.

Table 14: Portion of Population Living within 1 Kilometre of Rapid Transit in 2006

2006	Population with 1 Km of Rapid Transit	Total Population	Portion
Burnaby/New Westminster	147,589	261,348	56%
Vancouver	158,730	590,243	27%
North Surrey/North Delta	26,529	385,028	7%
Northeast Sector	7,104	197,278	4%
Maple Ridge/Pitt Meadows	0	84,818	0%
Richmond	0	174,466	0%
North Shore	0	179,023	0%
Southern Region/Langleys	0	244,212	0%
Total Metro Vancouver	339,952	2,116,416	16.1%

Created using BC Statistics Population Data and TransLink Transit GIS

The target for total population living within 400 metres from a bus route was essentially met by 2006 and 2011 (DeMarco, 2013). GIS analysis showed that the percentage of the regional population living within 400 metres of a bus route was approximately 89% versus a target of 90%. This represents approximately 99% of the target, and is therefore considered achieved for the purposes of this evaluation. In total, nearly 340,000 people lived close to rapid transit in 2006 while about 1.8 million did not. The distribution of population living close to bus routes was also not evenly distributed throughout the region as can be seen below in Table 15.

Table 15: Portion of Population Living within 400 metres of a Bus Route in 2006

2006	Population with 1 Km of a Bus Route	Total Population	Portion
Vancouver	570,787	590,243	97%
Burnaby/New Westminster	254,050	261,348	97%
Northeast Sector	179,399	197,278	91%
Richmond	159,230	174,466	91%
North Shore	157,519	179,023	88%
North Surrey/North Delta	322,820	385,028	84%
Maple Ridge/Pitt Meadows	67,212	84,818	79%
Southern Region/Langleys	177,613	244,212	73%
Total Metro Vancouver	1,888,630	2,116,416	89%

Created using BC Statistics Population Data and TransLink Transit GIS

In Vancouver and Burnaby/New Westminster more than 95% of the population are located within 400 metres of a bus route. The general trend visible throughout the Metro Vancouver region is that the further the region is located from the Vancouver Metro Core, the lower the percentage of population located within 400 metres of a bus route. Unsurprisingly, in the Southern Region/Langleys this is as low as 73%, as geographically it is more difficult to serve the population with transit services. Overall in the region, nearly 1.9 million people live within an approximately 5-minute walk of a bus route. However, this performance target does not account for the quality or service frequency of the route or for stop locations. Data were not immediately available to measure the service quality in addition to stop location.

7.5 Supply of Rapid Transit

The T2021 MRP provides performance targets related to the supply of rapid transit with an expected 83 kilometres of length in place by 2006. By 1993, there was 23 kilometres of bi-directional SkyTrain guideway in in the Metro Vancouver region either in operation or under construction, which consisted of the original Expo Line to New Westminster, the 1989-1990 extension to Scott Road Station, and the 1994 extension to King George Station. Figure 21 below summarizes the length of bi-directional SkyTrain guideway constructed and opened to the public between 1991 and 2011.

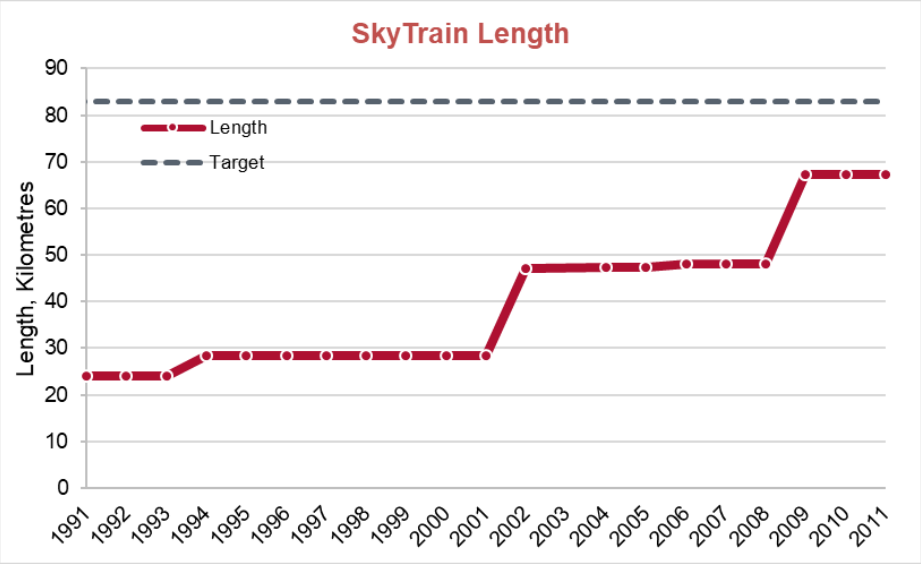


Figure 21: SkyTrain Length
Created from TransLink GIS data

Although the length of SkyTrain track more than doubled by 2006, the outcome fell well short of its target of 83 kilometres with approximately 48 kilometres built. This represents around 58% of the target length. As of August 2017, there is slightly less than 80 kilometres of SkyTrain track in operation. Significantly more track opened during the TransLink era (39 klometres versus 4 kilometres). However, the Millennium Line had already been planned and designed and was under construction when TransLink opened its doors in 1999. The 19 km Canada Line was planned, designed, and implemented during the TransLink era.

Sub-regional differences were noted. Table 16 below summarizes the state of the SkyTrain track length in 2006 and 2009. By 2006, only three regions contained any SkyTrain track: Vancouver, Burnaby/New Westminster and North Surrey/North Delta. Notably, Burnaby/New Westminster, located centrally in the region, had nearly 27 km of SkyTrain track, or more than half of the total track length.

Table 16: SkyTrack Track Length (Regional Differences)

Region	Length (by 2006)	Length (by 2009)
Burnaby/New Westminster	26.93	26.93
Vancouver	15.09	26.07
North Surrey/North Delta	6.01	6.01
Maple Ridge/Pitt Meadows	0.00	0.00
Richmond	0.00	8.19
North Shore	0.00	0.00
Southern Region/Langleys	0.00	0.00
Northeast Sector	0.00	0.00
Total	48.04	67.2

Created from TransLink GIS data

7.6 Atmospheric Pollutants

The performance target for atmospheric pollutants emissions was not met by 2006 or 2011. However, atmospheric pollutant emissions from mobile sources decreased significantly over 1991 base levels, according to Metro Vancouver Air Quality monitoring reports (Metro Vancouver, 2007, 2013). The AirCare program ran, which from 1992 until 2014, was tasked with testing the emissions of vehicles registered in the lower mainland to ensure that they were within the acceptable standards. AirCare was an effective program, claimed to be responsible for removing around 6,500 tonnes of emissions per year, or a reduction of 31% (Griffin, 2014) . The AirCare program was

cancelled in part because fewer and fewer vehicles were failing the test as newer vehicles became more efficient (Griffin, 2014). This is consistent with Canada-wide trends. Data from the Government of Canada show that “emissions [from the] 5 key air pollutants were 66% to 18% lower [in 2015] than in 1990“ (Government of Canada, 2015).

7.7 Highway Construction in Protected Areas

No highways were constructed in environmentally protected areas during the study period. However, the South Fraser Perimeter Road (completed in 2013) was built directly adjacent to the protected Burns Bog located in Delta (R. Taylor, 2014). The highway project was constructed as part of the BC Liberals Gateway Program, first announced in 2006 (Government of British Columbia, 2006). Numerous environmental mitigations were implemented by MoTI during construction (Ministry of Transportation, 2008); those mitigations have been described as successful (R. Taylor, 2014).

7.8 Summary of Findings

This research showed that nearly all the performance targets of the T2021 MRP were met, or nearly met, by 2006. By 2011, all but two of the targets (for which data were available) were met nor nearly met. A summary of the outcomes assigned to a continuous degree of conformity scale is presented below (Table 17). As in the literature, a degree of conformity of less than 50% should certainly be considered not achieved. For this evaluation, targets that came within 90% of their target were considered fully achieved, except in special circumstances.

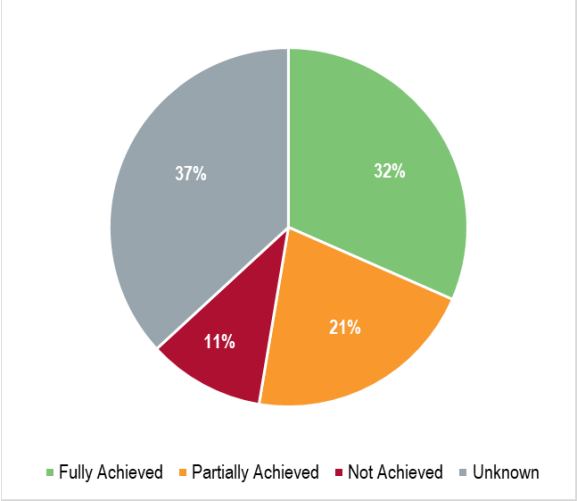
Table 17: Summary of Performance Target Achievement

Target	1991	2006	2011	Target	Degree of Conformity (2006)	Degree of Conformity (2011)
Transit Share in AM Peak Hour	13%	15%	17%	17%	88%	100%
Non-driver Share in AM Peak Hour	41%	46%	48%	47%	98%	102%
Driver Share in AM Peak Hour	59%	53%	52%	54%	102%	104%
Transit Share in AM Peak Hour (To CBD)	37%	50%	55%	45%	111%	122%
Rapid Transit Length (kilometres)	24	47	67	83	57%	81%
Total Population <1km from Rapid Transit	8%	16%	21%	25%	64%	84%
Total Population <400 m from Bus Route	87%	89%	89%	90%	99%	99%
Cyclists to Work in AM Peak Hour	4,000	7,200	8,000	12,000	60%	67%
Auto Occupancy in AM Peak Hour	1.28	1.37	1.35	1.35	101%	100%
Auto Occupancy in AM Peak Hour (to CBD)	1.29	1.22	1.25	1.35	90% **	93% **
Transit Share in AM Peak Hour (To RTCs)	13%	N/A	20%	17%	N/A	118%
Atmospheric Emissions (tonnes/year)	380,000	202,000	123,000	107,000	189%	115%
New Roads in Protected Areas (lane-km)	N/A	0	0	0	100%	100%
AM Peak Hour Auto Ave. Speed (km/hr)	38	N/A	N/A	40	N/A	N/A
24-Hour Truck Ave. Speed (km/hr)	53	N/A	N/A	53	N/A	N/A
Cost of Truck Congestion Delays ($m/yr)	$110	N/A	N/A	$162	N/A	N/A
Total Truck Running Costs ($m/yr)	$525	N/A	N/A	$775	N/A	N/A
Percentage of Roads Badly Congested (LOS E or F)	9%	N/A	N/A	8%	N/A	N/A
Annual VKT (billions of km)[34]	11.1	N/A	N/A	13.4	N/A	N/A

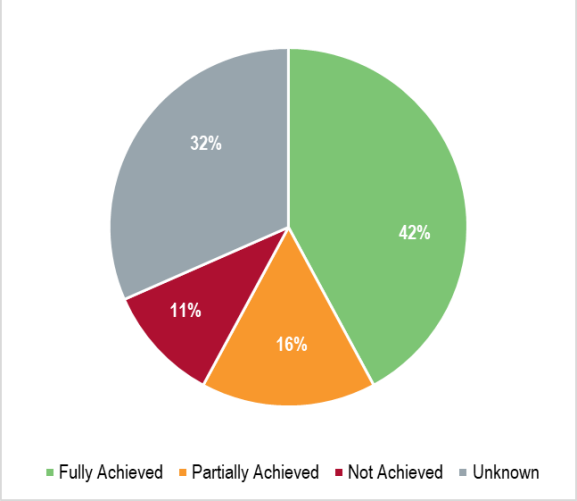
** Although the outcome is close to the target, the value is lower than the 1991 value.

Figure 22 below shows portions of performance targets achieved or partially achieved by 2006 and 2011 (for those performance targets for which data were available), including the results of the alternative analysis.

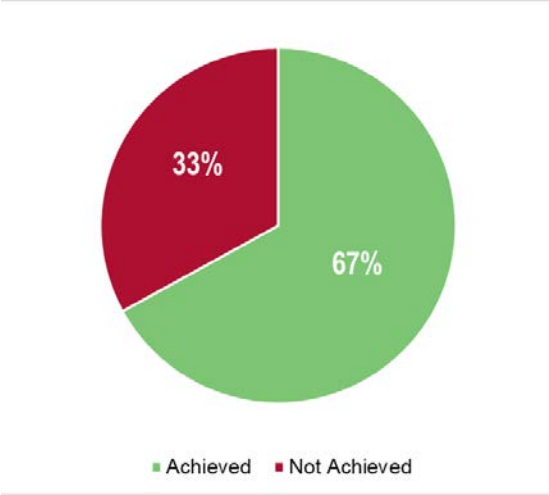
[34] Daily VKT data is available from the 2008 and 2011 Trip Diary Surveys. However, the 1991 value is based on the AM Peak only Trip Diary Survey which was expanded to an annual value. This annual expansion value is not known, therefore comparisons cannot be made. In 2008 and 2011 the daily per capita VKT was about 14.5 km (Halcrow Consulting, 2010; TransLink, 2013).



2006 (Farmer, 2017)



2011 (Farmer, 2017)



2011 (PSN, 2013)

Figure 22: Summary of Performance Targets

By 2006 the AM Peak mode share performance targets were achieved apart from transit trips to the Vancouver CBD; by 2011 they had all been achieved. By examining, the rates of change of the mode shares, we can see that, for transit usage in the AM peak hour, the steepest change rate occurred between 2006 and 2011. The change in the rate of change likely occurred earlier than 2006 but due to the 2004 Trip Diary Survey occurring in Spring as opposed to the Fall, it is not possible to confirm this. The transit mode share to the Vancouver CBD is very high, and the performance target

for 2006 was likely reached by 1998. By 2011, around 55% of all trips to the Vancouver CBD in the AM Peak hour were by transit. Additional analysis by DeMarco (2013) has shown that the mode shares to the RTCs in the AM Peak hour have not been quite so successful; the mode shares to RTCs was 17% in 1991 and by 2011 had reached 20% versus a target for 2006 of 23%.

A different story emerges when the 24-hour Trip Diary Survey data is examined, which has been available since 1994. Between 1994 and 2011, while the transit mode share has also increased (to 14% in 2011 from 10% in 1994), the driver mode share has remained constant at 57% of all trips. The increases in transit trips have come from a reduction in automobile passenger and active mode trips. By 2006 and 2011 (DeMarco, 2013) the rapid transit-related supply objectives were not met, but the bus-related target was met sometime by 2006. Despite not meeting the target, the portion of population living within 1 kilometre of rapid transit doubled from just 8% in 1993 to 16% in 2006 and to 21% in 2011. Bus coverage increased to serve 89% of the population by 2006 and 2011. The target for the number of cyclists to work in the AM Peak hour was not met by 2006 or 2011. TDM policies were the main tool for which the T2021 MRP expected this target to be met. Implementation of these policies was weak. Additionally, little in the way of cycling-specific infrastructure was built outside of the City of Vancouver in this time period. The targets for auto occupancy in the AM Peak hour were met by 1994, when the average auto occupancy was 1.42. Since that time, the average auto occupancy has steadily decreased, but was still above the target of 1.35 for 2006. Auto occupancy to the Vancouver CBD has proven to be the complete opposite trend – initially the auto occupancy rate decreased to a low of 1.19 in 1994, but has continued to slow increase up to 1.25 in 2011. These performance targets were used, in part, to inform whether the following general goals of the T2021 MRP were achieved. The summary of the outcome goals is shown below, in Table 18, with descriptions.

Table 18: Summary of Goal Achievement

Goal	Achieved by 2006	Achieved by 2011	Results
An increase in population in the inner suburbs (prevent future sprawl and reduce).	Partially	Partially	Portions of the population growth were generally more concentrated in the inner suburbs than the BAU scenario, however population growth did not increase in certain sub-regions, such as the Tri-Cities area, as much as was anticipated. Employment growth was also not evenly dispersed to the RTCs as significant job growth was concentrated in Vancouver.
A decrease in automobile trips with a corresponding shift to transit and active modes (especially for trips with destinations to the Vancouver CBD and Regional Town Centres).	No	No	Most AM Peak performance targets were met, but 24-hour auto driver mode shares have barely changed since 1994. The AM Peak and 24-hour transit mode share has increased, but with corresponding reduction in active and carpooling mode shares.
An increase in carpooling.	No	No	The AM Peak regional auto occupancy rate has increased, and met its target, but the regional 24-hour auto occupancy has decreased since 1994.
A decrease in atmospheric pollutants from vehicles.	Partially	Partially	Due in part to the AirCare program, but also because of technology advancements, emissions decreased significantly over 1991 levels. However, the performance targets were not met.
An increase in the portion of residents living close to transit.	Partially	Partially	The total regional population living close to transit increased to within 99% of the target for bus, but just 80% for rapid transit.
An efficient road network for cars and trucks with a decrease in “congestion”.	Unknown*	Unknown*	Data were not available to determine if this goal was achieved.
A decrease in total driving (VKT).	Unknown*	Unknown*	Data were not consistently available, so it was not possible to determine if this goal was achieved.

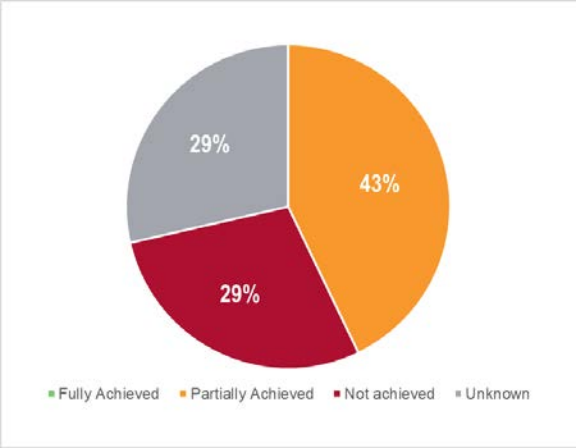


Figure 23: Summary of Goal Achievement

Although we have an unfortunate lack of data, we can see that some of the goals of the T2021 MRP were not fully met. Of the seven major goals that were checked as part of this evaluation, only one can be considered met. One was partially met and two were not met. Three out of the seven goals were not possible to evaluate as data were not available. In the future, attention should be payed to choosing performance targets that can easily be checked by TransLink and non-TransLink staff, or more data should be publicly available. Methods for better measuring congestion, automobile and truck travel speeds, and vehicle-kilometres travelled are available for commercial use and should be employed in the future by TransLink.

Chapter 8. Factors

The purpose of this analytical step is to show which plan and non-plan factors affected both the implementation and the outcomes (Laurian *et al.,* 2010). Data collection for this portion of the analysis consisted of qualitative interviews.

8.1 Examination for Biases

There is some evidence of either confirmation bias[35] or the so-called IKEA effect[36] in the responses of the experts. Some aspects of the interviewees' behaviour may be explained by these biases. To test this hypothesis, the experts were requested to share their thoughts on whether they believed that the plan was successful, with no definition of the term given. All the experts interviewed believed that, although not all the plan's outputs were implemented and not all the performance targets were achieved, it was successful in helping to guide the overall direction of transportation network development and mode shares, and "re-affirmed" the commitments to creating a sustainable region and to integrating land-use and transportation. For example, Mr. Clive Rock said that it's "been successful, and remains successful, in terms that it has gotten people to think about things systematically and thinking about the transportation system as a whole" (Rock, 2017a Personal Communication). While, Mr. Gordon Price said:

> […] particularly the land-use/transportation connection was really well laid out. That connection has to be made… It affirmed the direction which we wanted to go [as a region] (Price, 2017a Personal Communication).

Their opinions did not change when shown the results of the implementation and outcomes analyses[37], which showed that the implementation was not complete and not

[35] . Confirmation bias, a ubiquitous problem in social research, is possibly present in their testimony; Confirmation bias can be defined as "interpreting evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand" (Nickerson, 1998).

[36] The IKEA effect, first described by Norton *et al.* (2012) based on "effort justification" - the more effort people put into some pursuit, the more they come to value it (Festinger, 1957). Since all experts were involved, in some way, with the creation of the plan, they may over-value its significance and success.

[37] Most were already aware of the state of these outcomes and implementation, as they are individuals concerned and interested in transportation systems.

all the performance targets were fully met. This is potential evidence of confirmation bias as they were still convinced that the plan was successful. There is an alternative explanation however, which is that the experts subscribed to the performance principle for plan evaluation. Normally associated with longer-range strategic plans without specific goals (Mastop & Faludi, 1997; Laurian *et al.*, 2010; Ranasinghe & De Silva, 2013), the performance principle holds that success in planning occurs when plans are actually used, rather than if the outcomes were achieved. These biases likely do not exist or are inconsequential as the experts were more than happy to point out issues, factors, and lay blame to issues and agencies they believed contributed to the only partial implementation of the T2021 MRP.

Other, more specific instances of biases may have also occurred. Martin Crilly's responses regarding the modelling process and the performance targets, which he believed were not accurate[38], even going so far as to state that he believed if they did become true, it would be "sheer luck" (Crilly, 2017a Personal Communication). He may be suffering from the corollary of the Dunning-Kruger effect – a tendency for highly skilled individuals to underestimate their relative competence (Kruger & Dunning, 1999). It's entirely plausible that the original forecasted performance targets were correct, especially given that the T2021 MRP states that "the target values for the years 2006 and 2021 stem from extensive numerical analysis […they] are internally consistent with each other and draw on surveys of past traffic patterns and behaviours in the B.C. Lower Mainland". (GVRD, 1993, p. 52).

8.2 Summary of Findings

The interviewees, first individually and later confirmed by the other interviewees through second round of interviewees (using the pseudo-delphi approach), supplied a listing of the factors that affected the implementation, both positively and negatively (Cameron, 2017 Personal Communication; Crilly, 2017b Personal Communication; Price, 2017b Personal Communication; Rock, 2017b Personal Communication). These factors are:

- politics/political pressure/funding pressure from senior governments;

[38] Refer to Section 5.2.

- a lack of an implementation plan/plan not fully implemented;
- the review and update process was not followed;
- the establishment of TransLink;
- land-use patterns not developing as expected;
- priority treatment for transit vehicles not being adequate;
- construction of unplanned highway infrastructure; and
- the U-Pass program.

In this section I discuss in detail how each of these factors affected either implementation, outcomes, or both. This information will later allow me to inform conclusions and provide recommendations to build plans that are more implementable with outcomes that more closely match the plan.

Politics and Planning

The T2021 MRP gives recommendations to governments which are 'rational' and based on technical and logical guidance – not politics. In the case of the T2021 MRP, all experts agreed that political pressure played a significant role in determining which transportation projects and policies were implemented. In all cases, the experts discussing political pressure were referring to political pressure from senior governments on the region. Multiple examples of extreme political influence by both major BC political parties on particular projects were cited, including the Millennium Line (by the NDP) and the Gateway project (by the BC Liberals).

Metro Vancouver is by no means unique in this regard, examples of politics and its influence on transit projects can be found in Los Angeles (B. D. Taylor *et al.*, 2009), Bogota (Ardila, 2002), and more or less everywhere in the USA that accepts federal funding for transport projects (Sciara, 2012). In Los Angeles, Taylor *et al.* (2009) found that the Wilshire subway, although technically a sensible transit project which would probably have significant ridership potential, was continuously postponed or re-aligned for purely political reasons. None more obviously than by Congressman Henry Waxman, who managed to ban the use of already-approved federal funding for the subway project in his own district (Taylor *et al.* p. 176). Although a case study, the authors believe that their example shows that politics influence all steps of the planning process including

technical analyses. Others have also shown that technical analyses can be easily manipulated, to the extent that “lying with numbers” is common in planning and business case development (Flyvbjerg, 2009). Further, Sciara (2012) shows that this type of behaviour occurs everywhere where federal funding is involved and that “for planners and planning bodies operating in politically charged environments, politics not only matters; it’s essential” (Sciara, 2012 p. 253). Mr. Ken Cameron also believed that in Metro Vancouver “every decision is going to be political because it involves the allocation of someone else’s money” (Cameron, 2017a Personal Communication).

The T2021 MRP’s provincially-apolitical assumption was not realistic and almost certainly contributed to the failure of the plan. Local municipal politicians had the advantage of being the politicians to eventually sign of the T2021 MRP, but this was due to their positions as board members for the various agencies (including the GVRD, the VRTC, and later TransLink). Due to this, the T2021 MRP itself is a politically-shaped document, but for local politicians only. As Ardila (2002) found in Bogota, a successful plan is one that is implementable and politically feasible, for all who are involved politically. He argues that planners should strive to make plans that are politically feasible and therefore implementable

Notably, the Millennium Line was entirely funded by the provincial government. It was the first line built after the release of the T2021 MRP, despite it being the lowest priority of the three possible lines. When asked why they believed this happened, the experts were unanimous with their opinion that the reason that line was built was purely because it was politically advantageous for the NDP who were in control of the BC legislature at the time. After the 1996 provincial election, the North Burnaby, Burnaby-Willingdon, Burnaby-Edmonds, and New Westminster ridings in the legislature were held by the NDP, a new electoral district, shared with Coquitlam and to be called Burquitlam, was also forthcoming for the 2001 election (BC Elections, 1999). The experts believed the Millennium Line was chosen by the provincial government simply because it was geographically located in or near these electoral districts. As Mr. Gordon Price simply stated: “the NDP built [the Millennium Line] for servicing their constituents; there is not much more to it than that!” (Price, 2017a Personal Communication). The GVRD politicians, through the T2021 process, recommended which rapid transit route was to be built, using the province’s revenue, with no regard to what might be politically advantageous to whichever party was in control of the legislature. T2021 MRP was

therefore breaking the so-called ‘golden rule’: whoever holds the gold, also makes the rules. The provincial government held the ‘gold’, so to speak, so similarly to what LA Congressman Waxman did when he effectively cancelled the Wilshire subway *(*B. D. Taylor *et al.*, 2009), the province made the rules and built the Millennium Line.

The other major BC political party, the BC Liberals, have made use of the assets that they control likely for political reasons– namely the provincial highway system. After the BC Liberals were elected to power in 2001, highway infrastructure programs were quickly announced and later built, including notably the Gateway Program which aimed to “reduce congestion” by make commuting easier (Government of British Columbia, 2006). These highway expansions were aimed in the eastern suburbs, home to many BC Liberal supporters (Walks, 2004, 2006).

The potential influence of the provincial government on transportation projects was curtailed when, in part due to the establishment of TransLink in 1999, funding for major projects was split between the region, and provincial and federal governments. This was the case with the Canada Line. No longer did the province have all the ‘gold’, so they could not simply choose which line to build themselves. The decision to fund the Canada Line came down to the TransLink board, comprised of local politicians. The board voted to cancel the Canada Line in favour of the Evergreen Extension to Coquitlam a total of three times. This was despite the knowledge that the funding to be provided by senior governments would be gone if the project were to be cancelled. However, gradually, enough of the board members changed their votes to yes, and the line was built and open by 2009. Mr. Ken Cameron had previously asked George Puil, one of the TransLink board members at the time, why he “caved”. According to them, his response was “I just can’t as a politician turn my back on that amount of federal funding”. Which they believed to be “an example of the kind of distortion that the federal and provincial funding pressures have put on [the region]” (Cameron, 2017a Personal Communication). TransLink’s establishment and hopes of giving an equal say to the local governments was not to be, in this case, the ‘golden rule’ still remained squarely in the favour of more senior governments.

Lack of an Implementation Strategy

After the plan was released, there was no obvious leader who was supposed to undertake the implementation of the plan. The plan itself simply charges “governments”

with performing the work. The GVRD and the Transport 2021 steering committee, who released the plan, had no capacity to enact the recommendations and policies. The plan only gives vague instructions to 'who' is supposed to do what, there were "no consequences to not following the plan" (Crilly, 2017b Personal Communication), and that "nobody was charged with doing the work" (Rock, 2017a Personal Communication). This factor likely contributed to the non-implementation of the plan, which consequently affected the outcomes. As was found in the implementation analysis, the plan was not fully implemented.

Review and Update Process was not Followed

The T2021 MRP performance targets were meant to be regularly checked, and the plan updated every one-to-two years, so the "uncertainties of the future can be dealt with and the transport system can respond to changing and unforeseen events" (GVRD, 1993, p. 50). Additionally, the cycle of regular reviews was also intended to "ensure that region is developing according to plan" (GVRD, 1993, p. 14). Mr. Martin Crilly, director of the T2021 steering committee, questioned whether "the institutions of the day [had] the capacity to sustain a well-organized planning cycle?" (Crilly, 2017a Personal Communication). The T2021 steering committee, who developed the plan, was disbanded shortly after the plan was released. While later plans did refer to the T2021 MRP and T2021 LRP, reviews and updates to T2021 MRP were not completed. As Mr. Clive Rock pointed out, there was no comprehensive T2021 implementation strategy – including for the regular reviews and follow through. Likely since no agency was initially identified to take responsibility of this task, none did so. While informal reflection and evaluation likely did occur at TransLink, it was not done in a formal, systematic, and public way. Because of this, there is no way to know how, or if, TransLink planners learned from reflection and evaluation and whether informal, internally completed evaluations are effective learning tools.

TransLink and its Influence

The experts all agreed that the establishment of TransLink did play a role in affecting the implementation and subsequently the outcomes. Mr. Ken Cameron and Mr. Clive Rock were both instrumental in the establishment of the agency. They were clear that the TransLink of today was not the authority that they initially visualized to take Transport 2021 to completion. As Mr. Ken Cameron stated:

> The concept that we were working on was that there was one urban transportation system with many different parts […] Transport 2021 more or less encompassed that view of the transportation system. Our concept for TransLink was that it would be the strategic planning agency for that system, which is quite different [from] that [reality] (Cameron, 2017a Personal Communication).

The CAGRs of the performance targets were examined as part of the Outcomes Analysis. Where the full range of years of data was available, I was able to determine the pre-TransLink era and TransLink era CAGRs. By examining the differences between these CAGRs, I can observe whether TransLink potentially had a positive influence on certain, but I cannot conclude with statistically absolute certainty as the sample size is very small. The CAGRS are summarized in Table 19 below. The sample size is very small, and proper statistically conclusions cannot be drawn

Table 19: Summary of CAGRs

Unit	CAGR pre-TransLink era	CAGR TransLink era	Type	Improved?
Transit Mode Share (AM Peak)	0.4%	2.2%	Transit	Yes
Transit Mode Share (24-Hour)	0.0%	2.8%	Transit	Yes
Non-Driver Mode Share (AM Peak)	1.5%	0.4%	Automobile	No
Non-Driver Mode Share (24-Hour)	0.5%	0.0%	Automobile	No
Transit Mode Share to CBD	1.6%	2.7%	Transit	Yes
Cycle Trips to Work (per Capita)	1.2%	2.2%	Active	Yes
Active Mode Share (24-Hour)	0.0%	0.0%	Active	-
Rapid Transit Length	2.1%	7.5%	Transit	Yes
Auto Occupancy (AM Peak)	-0.8%	0.3%	Automobile	Yes
Auto Occupancy (24-Hour)	-0.6%	-0.7%	Automobile	No

As previously observed, transit's share increased (including AM Peak regionally, all-day regionally, and to CBD) markedly during the TransLink era compared to before its establishment. However, the rate of change in the non-driver mode share was somewhat higher during the pre-TransLink era. The rate of change of cycling trips, to work, is higher during the TransLink era compared to before its establishment in 1999. However, the all-day active mode share CAGRs have consistently remained nil between 1991 and 2011. Auto occupancy rate changes are less than 1%/year in both eras. Differences were noted between the AM Peak Occupancy rate, which had a positive rate of change during the TransLink era, and the all-day rate, which has had a consistently negative rate of change since 1994. The data confirms the experts' opinions, that TransLink likely had little influence on the transportation network outside of public transit, in terms of affecting the goal achievement.

Where TransLink did succeed, with transit, the rate of change in the supply of transit (in terms of capacity-hours) generally matched or exceeded population growth, as well as the rate of increase in transit demand, as can be seen in Figure 24. Generally, until 2002, demand does not exceed the increase in population, but after 2002 it has expanded rapidly. Since 2009, however, the rate of increase of transit demand has declined, with a negative slope starting from 2012-2013. During this period, there was also a reduction in the supply of transit, in terms of capacity-hour and service hours. In Metro Vancouver, transit supply and demand appear to be highly correlated. Indeed, the transportation literature confirms that, transportation supply is correlated to transit use in North American cities[39] (Alam *et al*., 2015; B. Taylor & Fink, 2003).

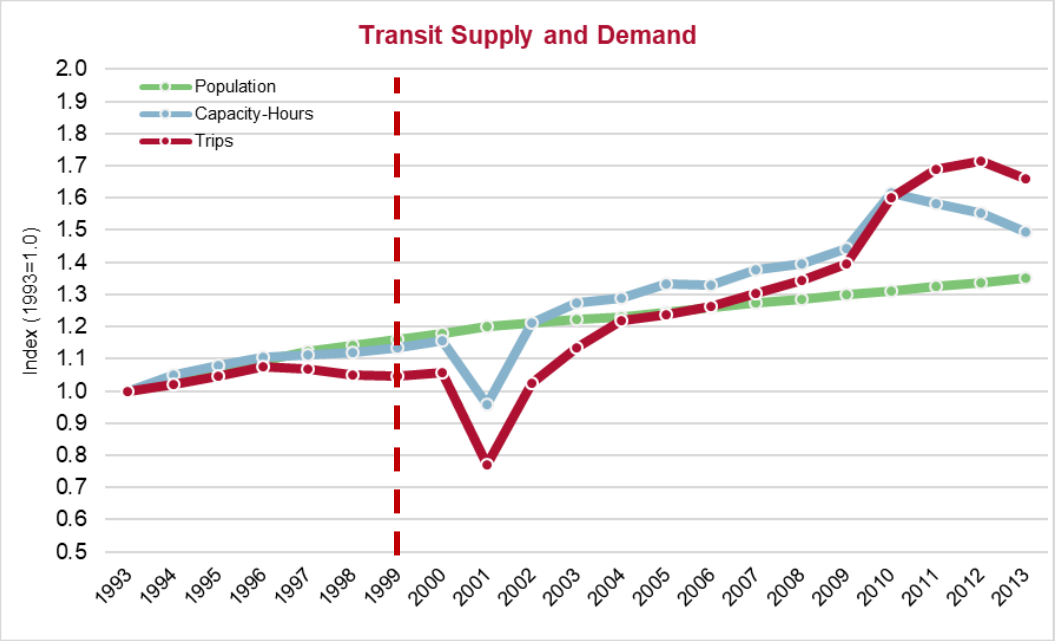


Figure 24: Indexed Transit Supply and Demand (Per Capita)
Created using Metro Vancouver Transit Ridership Data BC Statistics Population Data.

Land-Use Patterns Not Developing as Expected (LRSP Goals)

Land use patterns as they relate to the transportation/land-use connection were mentioned many times as one of the most important, if not *the* most important, factor that affected the outcomes. Some experts made a special point to say that the land-use factor is the most overriding and significant factor. While land-use is discussed in the

[39] Of course, other factors matter as well. According to Alam, Nixon, & Zhang (2015) gas price, transit fare, revenue hours, average headway, safety, transit coverage, service intensity are also statistically significant factors in addition to transit supply.

plan, it is largely covered by a different plan (the LRSP). Planning literature confirms that this connection is important, and that it is possible to shape transportation with investments in light rail transit (Handy, 2005). The experts identified that, importantly, even in outer suburban municipalities, such as Port Moody, denser urban developments were made with elements that de-emphasize the car. Specific examples of positive examples of developments were provided, such as the Newport Village development in Port Moody (Price, 2017a Personal Communication).

Indeed, Handy (2005) explains that this is not simply a Metro Vancouver phenomenon, as where light rail systems, exist "expansion to the [light rail rapid transit] system can begin to have an impact on station-area development as early as the planning stages" (p. 159). However, as we saw in the outcomes analysis, the regional land-use goals were not met. Despite specific examples of "fine urban design", the population growth in the Tri-Cities was around the same as the BAU scenario. Mr. Martin Crilly noted the following regarding the greater regional land-use patterns:

> Land-use didn't concentrate as quickly as the plan had assumed. With that dawning reality, that it was not following the LRSP as quickly, then you would expect the planning and the implementation system to adapt to the new reality. You would hope that you wouldn't stick to the Transport 2021 plan, and accommodate to a new land-use plan (Crilly, 2017a Personal Communication).

As previously discussed, this review and update did not happen during the implementation period – this was certainly a factor that affected the outcomes.

While employment growth was not covered by the T2021 MRP 2006 targets were provided in a different document [it was assumed that employment growth would take longer to change and therefore covered by the T2021 LRP (GVRD, 1993, p. 52)]. The outcomes analysis showed that employment growth had also drifted from the intended targets. As Mr. Clive Rock pointed out:

> Institutional development has gone well. Private employment didn't go well. The real private employment generators have not gone to [urban centers]. As an example, Hudson's Bay built their warehouse on No. 6 Road [in Richmond]. […] They didn't have a bus to get their workers to work (Rock, 2017a Personal Communication).

Confirming the anecdotal information supplied the interviewees regarding business-park style employment centres, DeMarco's (2013) analysis described how

"burgeoning office parks and big box retailing locating away the [*sic*] frequent transit network resulted in fewer jobs concentrated in Urban Centres." Additionally, her analysis determined that employment growth by 2006 was largely concentrated in Vancouver and other core municipalities as opposed to being more evenly distributed among the urban centres – requiring workers to continue to commute long distances. Locating jobs in close proximity to housing can help to reduce driving (Cervero & Duncan, 2006; Ewing, 1996), but there are few examples of success stories in the literature of policies that have successfully increased the jobs-housing balance. These land-use related issues are potentially stem from the ineffectiveness of the LRSP[40].

Inadequate TPM

The experts mentioned that inadequate TPM were a factor that did affect the regions ability to achieve its mode shift targets, but also to indicate to road users that these lanes are reserved for transit vehicles. In Seoul, for example, bus lanes are painted a red, which was found to reduce lane infractions. Seoul's bus lanes are extremely effective, as transit vehicle speeds were found to have increased by 100% after they were implemented (Agrawal *et al.*, 2012). As Mr. Clive Rock stated:

> Bus priority measures have not been extensively done [in Metro Vancouver] at all. The City of Vancouver has been particularly backward with regards to bus priority measures. You should have signals that go green when buses come around, different coloured pavement; we don't have different coloured pavement. A lot of what is portrayed as bus lanes is actually 2-person carpool lanes by the province (Rock, 2017a Personal Communication).

While TPM were a minor part of the plan, they are a good example of how transportation planning did not evolve 'rationally'. Confirmed by the implementation analysis, little in the way of TPM were implemented, and significantly less than what was planned for. But TPM are a cost-effective way to increase transit ridership (Agrawal *et al.*, 2012; Chada & Newland, 2002), so why weren't they implemented? Mr. Clive Rock speculated that this occurred again due to politics, since there was too much of a focus on "big and expensive projects" as "our political masters … get their jollies off on cutting ribbons on things ... the idea of a bus running 5% quicker isn't particularly sexy, so its

[40] Correspondingly, the LRSP should also be evaluated for its effectiveness.

distorted to spending bigger amounts of money" (Rock, 2017a Personal Communication).

Additional Highway Infrastructure Implemented

All experts agreed that unplanned highway infrastructure played a role in affecting the outcomes. Mr. Gordon Price was particularly adamant that this factor was very important, and squarely blamed the province under the BC Liberals; as he put it:

> MoTI. What are they doing? […] They're ignoring everything that came before it and they're building single-purpose road-dominant infrastructure, out of context that will nonetheless [*sic*] make the land-use plans irrelevant (Price, 2017a Personal Communication).

Additionally, Mr. Ken Cameron stated: "we […] invested heavily in road infrastructure to the detriment of economically viable transit and land development that supported our transportation policies" (Cameron, 2017b Personal Communication). The literature agrees with the notion that building additional highway infrastructure can increase sprawl (Handy, 2005) which was contrary to the goals of all of Metro Vancouver's regional plans.

The U-Pass Program

Not originally planned for by the T2021 MRP, the U-Pass TDM program was introduced by TransLink in 2003. As previously discussed, this program led to a significant increase in transit use at post-secondary institutions. Simultaneously, there were large decreases in the auto passenger, walking, and cycling mode shares. The interviewees believed that the overall effect of this TDM program was negative on the goal achievement due to its cost, with dubious results. As Mr. Clive Rock said:

> It led to a reduction in biking trips, carpooling trips, and walking trips. It resulted in a further dispersion of where students live. It wasn't thought about in terms of its transportation impact […] I don't know what the rationale is. I think it was a misguided program (Rock, 2017a Personal Communication).

As previously discussed, there is evidence to show that it has positively influenced individuals to continue to use transit long after graduation. While expensive, the U-Pass program is likely significantly contributing to the increases in transit use and decrease in automobile use (Cooper, 2009) and therefore in line with the plan's goals.

In the following final chapter, I summarize the finding of the four analytical evaluative steps and make conclusions relating to the plan's effectiveness and the other research sub-questions. Finally, I provide the reader with a series of recommendations to improve implementation in future regional transportation plans.

Chapter 9. Conclusions

In this thesis I evaluated the T2021 MRP to determine its effectiveness using a conformance-based approach. With its relatively short, 15-year time frame, and specific goals in the form of performance targets, the T2021 MRP meets the criteria of a medium-range projects plan as defined in the literature (Mastop & Faludi, 1997). Therefore, to evaluate it, a pragmatic, conformance-based, evaluative approach was used (Laurian *et al.*, 2010; Ranasinghe & De Silva, 2013). Using this approach, to be deemed effective, a plan should:

- be logically *capable* of achieving its goals (Day *et al.*, 2009; Laurian, Day, Berke, *et al.*, 2004; Ranasinghe & De Silva, 2013);
- be at least 50% implemented (Alfasi *et al.*, 2012; Bulti & Sori, 2017; Talen, 1997; Tian & Shen, 2011); and
- have achieved its goals (Day *et al.*, 2009; Laurian *et al.*, 2010).

9.1 Research Questions Revisited

In the table below, I summarize the answers to the research sub-question as determined by this evaluation (Table 20).

Table 20: Overview of Findings

Question	Answer
Were the T2021 MRP's goals achievable?	Technically yes, but there is reason to believe that some aspects of the plan were politically or financially infeasible.
To what degree was the T2021 MRP implemented by the horizon date (2006)? Beyond the horizon date, were any delayed goals implemented?	By 2006: 38% fully and 38% partially By 2013: 44% fully and 38% partially
To what degree were the expected outcomes listed in the T2021 MRP achieved by the horizon date (2006)?	None of the 7 goal categories were confirmed to be fully achieved. Three goal categories were partially achieved, two were not achieved, and two were unknown.
Beyond the horizon date, were the expected outcomes ever achieved?	By 2011, the goal achievement remained the same as 2006.
What factors affected the implementation and the outcomes?	Most importantly politics and a failure to achieve the goals of the LRSP, but also a lack of an implementation plan, lack of review and update to the plan, the establishment of TransLink, TPM being inadequate, unplanned highway infrastructure being constructed, and the U-Pass program.
Did the establishment of TransLink in 1999 aid in achieving the expected outcomes of the plan?	For transit-related goals, yes, but for non-transit related goals, probably not.

9.2 Overview of Findings

The evaluation has shown that, the four "levers" if "pulled" as the plan recommended would have pushed the land use targets, mode shares, carpooling, reductions in driving, and other goals in the desired directions – as review of literature has confirmed (Agrawal *et al.*, 2012; Alam *et al.*, 2015; Chada & Newland, 2002; Handy, 2005; Kwon & Varaiya, 2008; Litman, 2017; Litman & Burwell, 2006). However, the T2021 MRP was likely infeasible for non-technical reason related to politics, construction timelines, and financial feasibility. Projects in the T2021 MRP were primarily focused on the "inner core" of the region, was which not politically advantageous for the BC Liberal party; other crucial transportation policies, such as road pricing (which have been shown to be universally disliked by drivers (Jaensirisak *et al.*, 2005; Verhoef *et al.*, 1997)) were not well-thought-out so as to be politically interesting for any provincial political part. Additionally, the T2021 MRP would have required impractical and unprecedented project construction timelines. This evaluation concludes that **the T2021 MRP was not an**

effective plan as less than half of its outputs were fully implemented and consequently most of the goals were not achieved.

The literature tells us that, in other localities, the capacity of the planning agency, the quality of the plan itself (Berke *et al.*, 2006; Laurian, Day, Berke, *et al.*, 2004), and the political and financial feasibility of the plan (Ardila, 2002) are all factors that affect successful implementation. In addition, interviews with local transportation experts have provided multiple locally-specific factors which they believed were of particular importance. These factors include political influence; a lack of a comprehensive implementation strategy; a lack of follow-through with the review cycle; the establishment of TransLink in 1999; land-use patterns (from the LRSP) not developing as anticipated; inadequate TPM; construction of additional highway infrastructure; and the U-Pass program. These factors all played a role in goal achievement, but politics the failure of the LRSP to achieve its goals especially so.

For political interference in transportation, I provided three examples. Firstly, the Millennium Line was chosen by the NDP because it served their Burnaby and New Westminster constituents. Second, the suburban highway-capacity-heavy Gateway program was not part of the plan and was implemented as it served the suburban constituents who tend to vote for the BC Liberals (Elections BC, 2002, 2014, Walks, 2004, 2006). And finally, despite being the most effective TDM policy tool available to decision-makers, neither party seriously considered road pricing at any point because it is universally unpopular (Jaensirisak *et al.*, 2005; Verhoef *et al.*, 1997). In Metro Vancouver, and other localities too (Ardila, 2002; Sciara, 2012; B. D. Taylor *et al.*, 2009), political preferences have trumped good policy.

Equally important, the land-use goals of the LRSP did not develop as anticipated, which did affect regional transportation goals (Handy, 2005). There was, for example, more population growth within the more suburban eastern regions, and less employment growth outside Vancouver. A detailed look at the implementation of land-use policies (generally covered by the LRSP and local plans from municipalities) to influence where population growth occurred was not the focus of this evaluation; however, based on interviews with local experts, the data, and additional analysis (DeMarco, 2013), implementation of the land-use policies were only partially successful for population and employment growth. Importantly, there was a little too much employment growth in the

central core (Vancouver) and too much population growth in the more suburban Southern Region and Langleys. Despite this, land-use did develop in a manner which was more sustainable than the projected trend. The T2021 MRP recognized that transportation infrastructure could be used to shape land-use development, and there is much other research to support this notion (Handy, 2005). Physical evidence in Metro Vancouver can be seen in the transit-oriented developments that were built around SkyTrain stations such as Edmonds (Ohnemus, 2016).

The GVRD is a planning body with little capacity to directly implement its land-use plans or transportation plans itself. Since the GVRD released the T2021 MRP, the responsibility for transportation planning has been taken over by TransLink, which unlike the GVRD, does have the capacity to directly implement some transportation-related projects and policies, especially for the transit network. However, TransLink is hampered by its inability to significantly increase its funding or implement major rapid transit or road infrastructure projects. Its current governance structure, implemented by the BC Liberals, ensures that local politicians have limited say over what projects are implemented: for major decisions, the provincial government 'has the gold' and therefore 'makes the rules'. Consequently, this evaluation found that the establishment of TransLink enabled increased success in achieving some goals of the T2021 MRP, but only for those goals that were transit-related. Although TransLink is often touted as a multi-modal transportation authority, they have only limited opportunity to create change in the non-transit markets.

TransLink is committed to increasing the transit mode share and, since its inception, has had success in doing so. My analysis of Trip Diary Survey data has shown that more people than ever people in Metro Vancouver, are using transit (especially for trips to the Vancouver CBD); regionally cycling trips to work per capita have increased; the supply and quality of transit has increased (especially in the core regions) and in the inner and core municipalities (Burnaby, New Westminster, and Vancouver), automobile mode shares have decreased, with gains seen in the transit and active mode shares. Unfortunately, this is contrasted by an increasing automobile mode share in the outer suburbs, with the automobile-based mode shares as high as 89% in the Langleys. Between 1994 and 2011, the transit mode share has increased from 10% to 14% in, but the driver mode share has remained constant at 57% of all trips. The increases in the transit mode share have, in part, come from a reduction from the

automobile passenger and active mode trips**.** In addition, fewer people than ever are carpooling and in the suburbs, automobile mode shares are higher than they've ever been.

Despite these challenges, the implementation of certain aspects of the plan were relatively successful. Eventually, most of the rapid transit trunk-lines were built, the latest opening in late 2016 – about 10 years later than expected. It is likely not a coincidence that they more-or-less match the lines on the map drawn by the T2021 planners, and some of the experts certainly believed this to be true (Crilly, 2017a Personal Communication). While not all the policies and projects described in the plan were implemented, political buy-in for transit from local politicians and bureaucrats at TransLink was and continues to be high (Cameron, 2017a Personal Communication; Rock, 2017a Personal Communication). This was almost certainly due to the influence of the T2021 series of plans and the LRSP.

9.2.1 Caveats

This evaluation is high-level and conformance-based by design, and as such it does not provide a detailed analysis of each of the factors identified by the experts. It also does not provide detailed reasons for why certain outputs were implemented over others. The benefit of this approach is that the evaluation is not overly time-consuming and provides the right amount of information to answer whether the plan was effective, further providing some insights into what factors affected the implementation and outcomes. This information, once understood, is enough to provide correspondingly high-level recommendations to improve future plans. While this evaluation was able to determine the answers to the research questions, there are some caveats based on the data collected, and additional questions for future research consideration.

Data were not available to check whether all the performance targets were achieved. Performance targets without data were mostly related to the performance of the road network including truck speeds and other congestion measures which were not well-defined. It should also be noted that other available data the Trip Diary Survey data had other issues including that they are relatively small samples taken over short periods of time, usually around 5 years apart. Over the years, research methodology for the Trip Diary Surveys has changed; notably the 1991 Trip Diary Survey, and basis for the

performance targets, was AM Peak-only versus 24-hour for all subsequent Trip Diary Surveys. Some substantial changes in mode shares and auto occupancy were noted between the 1991 and 1994 Trip Diary Surveys which could possibly be attributable to survey methodological differences rather than true differences. For privacy reasons, TransLink was only able to supply data aggregated to the municipal/sub-regional level, so correspondingly some potentially important levels of detail were not available.

Since implementation of the T2021 MRP was relatively poor, the experts were not able to say whether the plan was the major reason for the outcomes resulting as they did. Day *et al.* (2009) suggest that these types of evaluations do not provide the most ideal results when implementation is poor. Consequently, the responses of the experts (with some exceptions) focused heavily on reason for why the plan was not fully implemented. Multiple factors that help explain why the plan was not fully implemented, and also why it did not achieve its goals, were given. While this research benefited from the pseudo-delphi approach to increase the accuracy and breadth of answers, the data is still opinion-based and subject to potentially unaccounted-for biases. What's more, many of the events described in interviews took place decades ago and are thus potentially subject to memory failings. These issues are minor and accounted for through rigorous research standard using established methodology, however, further interpretations should be cognizant of these facts.

In the next section, I provide a series of recommendations that can be used to improve the implementation of transportation projects plans based on the results of this particular *ex post facto* evaluation. As this study was focussed on the Metro Vancouver region only, some of these recommendations may not be applicable elsewhere.

9.3 Recommendations to Improve Planning Outcomes

In this closing section, I recommend ways to improve implementation and therefore the outcome achievement of Metro Vancouver transportation plans. These recommendations are based on the results of this evaluation, which has partially suffered from a lack of data to check some of the outcomes, and a reliance on small sample of local experts who provided their opinions on events which took place years ago. The recommendations are untested and could potentially be quite difficult to implement.

The numerical targets provided in the plan give a useful and simple way to measure performance, but **care should be taken when selecting performance targets**. Targets and values selected for the T2021 MRP, based on AM Peak values, were not ideal. Instead, 24-hour values should be used. The AM Peak values can be misleading; for example, the AM peak transit mode share reached its target goal of 17%, but the 24-hour regional automobile driver mode share (not a target) stayed the same. In addition, data were not easily available to check some of these targets – targets should be selected for which there is data and eventually published, so the public and researchers can understand if the targets are being met. In future plans, **sub-regional mode shares should be listed as performance targets** and subsequently checked during evaluations. Analysis has shown that there are great differences in sub-regional trends which may give additional, crucial, information. When presented alone, sub-regional values are not useful (at best) and potentially misleading (at worst). For example, Vancouver mode shares are presented in any document, they look impressive indeed, but they can easily be confused for Metro Vancouver values which tend to be much less. A 45% active and transit mode share in Vancouver is less impressive when one knows that, just 30 minutes away in Langley, nearly 90% of people are using automobiles to get around.

Mostly importantly**, more, and new, efforts should be made to implement plans.** Major factors for the non-implementation of this plan was due to politics coming before 'good' policy, the failure of the LRSP to achieve its goals, and other unanticipated consequences. As planners cannot predict the future, static plans like the T2021 become increasingly irrelevant over time. To solve this 'problem', I provide five recommendations, some try to control the unanticipated consequences while one tries to react to the unanticipated consequences. The recommendations do not need to be mutually exclusive and all could potentially improve implementation.

1. **Provide the implementation agency (in this case, TransLink) with the capacity and funding tools, and a corresponding governance structure, to implement plans on its own**. While TransLink is now responsible for regional transportation planning, public transportation operation and management, maintenance and planning for the MRN, and three of the major crossings of the Fraser River, they have no authority over regional highways or other major bridges and tunnels. Importantly, TransLink requires the cooperation and permission of the provincial

government to implement most major projects or policies, such as tolls on all bridges, or new rapid transit projects. Since the organization was created by the provincial government, they potentially have full control over the agency and may pass legislation to alter the organization's structure, funding, or duties at any time. Without changes to the current regional transportation planning regime in Metro Vancouver, TransLink will have to rely on partnerships with the province that will change depending on what is political in the best interests of the party that controls the BC Legislature. If TransLink's mandate were expanded to include the whole of the regional highway and bridge system, then they would have greater success in implementing plans. In this case, the 'golden rule' would not be broken. Since TransLink would be the one supplying the majority of the 'gold', it could make the rules. Consequently, the governance structure would need to be put back into the hands of local politicians or re-thought completely. One possible example of a new paradigm could be the Portland Metro model, where the regional board members are neither from the state level nor municipalities, but directly elected (Oregon Metro, 2014).

2. **Recommended projects and policies should be fully considered, including implementation and funding.** Some of the recommendations from the T2021 MRP were not fully considered, or indeed implementable. For example, the plan recommends bridge tolls be implemented, but does not provide a solution to how this would be accomplished - especially with regard to the political challenges. With some extra thought put into the implementation of policies including perhaps additional studies and consultation with provincial leadership, a reasonable, pragmatic, politically-feasible implementation strategy could be created. The T2021 MRP weakly states that it is a high-level exercise and more guidance than prescription, but this evaluation shows that this will almost certainly result in a failure to be implemented if future plans follow the same extreme high-level approach.

3. **All modes should be considered.** The T2021 MRP has very few recommendations aimed at improving the active (pedestrian and bicycle) networks of Metro Vancouver and provided only one performance target relating to the active modes making it impossible to evaluate its impact on the active mode networks and any modal shifts to active. Future regional multi-modal projects plans should always include recommendations and performance targets related to all transportation modes.

4. **Individual agencies should be tasked with specific assignments and there should be consequences for not following the plan.** There was no specific agency tasked with completing the regular (one, two, or five year) reviews as described in the plan; these tasks could have been completed by the GVRD or TransLink, but neither agency did so. If the task of doing the reviews had been specifically assigned, then those agencies could be held to account. An implementation strategy, assigning tasks to different agencies, would go a long way to increasing accountability, but ideally, these tasks could be legislated through some Act and be enforceable. However, this concept faces a figurative uphill battle. A pair of 2014 court decisions by the BC Court of Appeal (Court of Appeal for British Columbia, 2014) found in favour of the Township of Langley's desire to allow a "University District" zoning within areas designated as "green zones" by the GVRD's regional growth strategy, Metro 2040. The court's decision implies that regional plans are not enforceable on other government's mandates (Metro Vancouver, 2014a).

5. **Transportation plans should be more adaptable to changes.** As Ardila (2002), Taylor *et al*. (2009), and Sciara (2012) found, politics are extremely important when considering planning and plans. Depending on which major political party oversaw the legislature, bits and pieces of the plan that suited them best were implemented or were ignored. However, since provincial elections happen every five years, and municipal elections every four, planners making medium or long-rage plans will have a tough time planning for the future. They simply cannot guess which political parties or individuals will come and go by the time their plans horizons come. Even in a medium-range time frame (15 years) at least two provincial elections will occur. How can planners anticipate the results of these elections, or more generally, a changing world?

   After performing a similar evaluation, Brody & Highfield (2005) found that the plan they were studying (an environmental plan in Florida) was not effective. They suggested that an "adaptable approach to long-term planning" with "micro-adjustments" could help to mitigate undesirable outcomes. Such solutions should be considered elsewhere. Adaptable planning solutions have also emerged in a different field: software development. So-called Agile Software Development was first proposed in 2001 by 17 programmers to promote innovative ideas that would help software developers avoid wasting time and energy building products with constantly

changing assumptions and goals. Their recommendations include involving end-users/customers in the planning process, empowering small teams to make decisions, being fast and light, developing small incremental releases, making quick changes in small batches, testing throughout the project lifecycle, and collaborating between all stakeholders (Agile Alliance, 2001). The application of these ideas to planning has not been widespread and there is little published literature or success stories of using agile urban planning. What would agile look like in a transportation plan? Perhaps, shorter timescales (such as 5 or 10 years maximum), pilot projects, easily measurable goals, more evaluations, and more stakeholder and public input. The T2021 MRP initially suggested agile-like planning techniques such as regular reviews and updates to the plan – these did not happen, instead the plans were either not updated at all, or entirely new plans were created, reminiscent of Calkin's (1979) long-established "new plan syndrome"[41]. Others *have* begun to see how the agile philosophy could be applicable to planning (Lapointe, 2014). Perhaps planners should learn from the fast-paced and iterative world of software development and perhaps the era of long-rage, and even medium-range, plans are over and 'agile' urban planning is next.

9.4 Areas for Further Research

As this evaluation was undertaken, numerous additional research questions emerged. While these questions were beyond the scope and of this thesis, they are important questions that are either directly related to the T2021 MRP and Metro Vancouver's regional plans, are more broadly tied to improving researching the outcomes of plans. Firstly, the two most crucial factors identified by this evaluation that affected the outcomes and implementation of the T2021 MRP were politics and the failure of the LRSP to achieve its goals. Both these major factors would benefit from additional research to more precisely understand why and how they affected the outcomes and implementation, in the Metro Vancouver context. Secondly, an evaluation of the related land-use plan, the LRSP, would be very beneficial to more fully understand the outcomes of the T2021 MRP, especially to know if the LRSP suffers from the same, or different, issues. Finally, more information about whether the plan had a direct impact on decisions to implement or not would be beneficial. Were the projects and policies that

[41] Where plans are simple redone without any attempt to measure progress of the old plan.

were implemented done because of, or even partially because of, the T2021 MRP? Although he was not entirely sure, Mr. Martin Crilly speculated that the plan probably did have an enduring influence, as he said "if you look at the highest profile investments… those lines that we drew on those maps had an enduring influence on how the major corridors evolved" (Crilly, 2017a Personal Communication). While the SkyTrain network eventually did come to look like those lines on the map (as I have previously discussed) the order and timing was different. To further confirm whether the T2021 MRP directly influenced decision-makers, the *performance*[42] of the T2021 MRP could be evaluated using a different methodology. Such an alternative evaluation would examine whether the plan was referred to by decision-makers when making choices and could be combined with studies on political influence. This type of evaluation would be most suitable for the T2021 MRP's companion T2021 LRP (Mastop & Faludi, 1997).

The five major recommendations to improve the outcomes of planning that I provide in this thesis are high-level and not fully defined. As high-level recommendations, they are each in turn an opportunity for potential future research. If each of the five, or all of them, were applied, how would the outcomes have fared differently? Of the five recommendations, the last one, that of making transportation plans more adaptable to changes, is currently the least understood. Correspondingly, this recommendation has the most promise for interesting future research, but also, I believe, for potentially improving the effectiveness of plans.

Finally, and most importantly, future transportation researchers should complete more evaluations on other plans. Planning agencies do not often do these evaluations themselves (Baer, 1997; Berke *et al.*, 2006; Laurian, Day, Backhurst, *et al.*, 2004; Laurian *et al.*, 2010; Talen, 1996b), so researchers are well-positioned to help these agencies out and make an impact with their results. I have shown that the PIE/POE methodology adapts easily and could be used for future studies on other regional plans. I have also shown that these types of evaluations are useful exercises that are well-worth the time to complete as they can provide additional insight into actual implementation, outcomes, and planning processes. Subsequent plans can be changed based on the knowledge learned, thus completing the planning cycle (Kaiser *et al.*, 1995). The more evaluations that are completed, then the more data is available for

[42] Refer to the Literature Review (Chapter 3) for more information.

further researchers to develop rigorous statistical models that could prove which factors have enabled certain agencies, or regions, to succeed while others have not.

If transportation researchers focus on answering these kinds of basic, practical, and applicable questions related to improving planning outcomes, then, I believe, there is a good chance that such research will be read, understood, and used by the planning agencies themselves therefore having an actual impact. To further enhance the probability of this occurring, those agencies should be, whenever possible, involved in the research process as stakeholders or sponsors.

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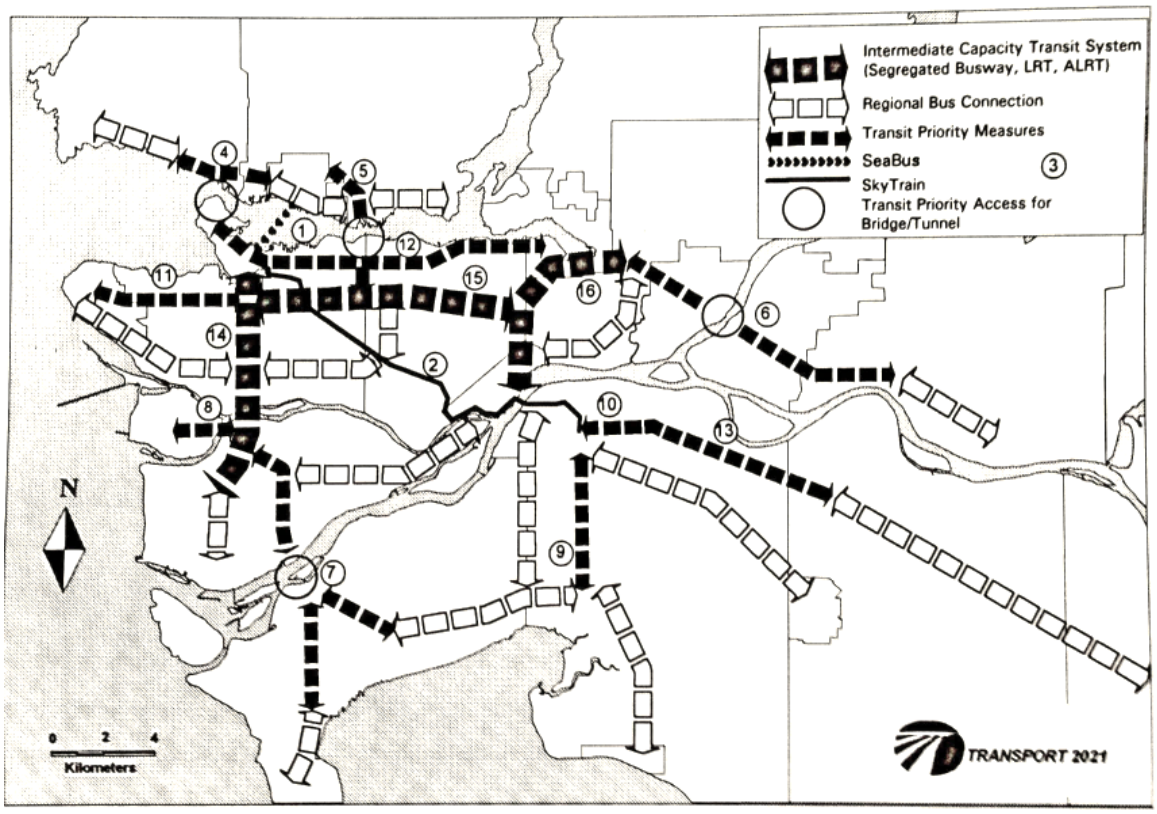
Appendix A – Summary of Improvements Listed

Transit Network Improvements



Provide basic transit improvements

1. Add SeaBus capacity across Burrard Inlet
2. Increase the existing SkyTrain capacity
3. Increase main-line and feeder bus coverage and service hours

Apply bus priority treatment across:

4. Burrard Inlet at or in the vicinity of First Narrows Bridge
5. Burrard Inlet at or in the vicinity of Second Narrows Bridge
6. the Pitt River in the vicinity of the Pitt River Bridge – Fraser North to Coquitlam Town Centre
7. the South Arm of the Fraser in the vicinity of the Highway 99 corridor – Ladner to Richmond

Provide bus lanes across the:

8. Middle Arm of the Fraser River – Vancouver International Airport to Richmond ICTS

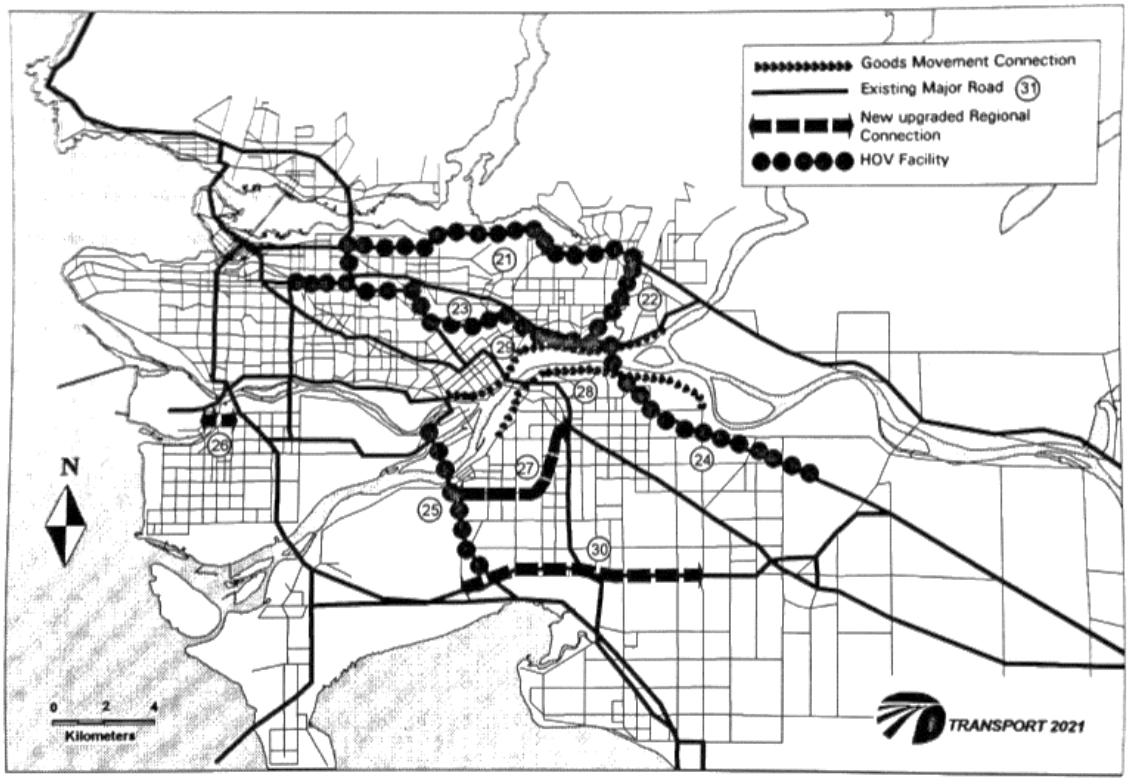
Provide transit priority measures:

9. from Surrey City Centre south to Newton and Surrey Municipal Hall
10. from Surrey City Centre east to Guildford Municipal Centre
11. along Broadway Corridor – UBC to the Vancouver – Richmond Rapid Transit
12. along Hastings corridor – North Burnaby to Vancouver Central Business District
13. along Trans Canada Highway corridor – 200 Street to Guildford Municipal Centre

Provide Intermediate Capacity Transit System (ICTS) from:

14. Richmond to Vancouver Central Business District
15. Lougheed Municipal Centre to the Vancouver Broadway business district
16. Existing SkyTrain Line to Coquitlam Town Centre

Road Network Improvements



Provide HOV lanes in the vicinity of the:

21. Barnet-Hastings corridor - Northeast Sector to Boundary Road

22. Lougheed corridor - Highway 7 to the Trans Canada Highway

23. Trans Canada Highway and Grandview Highway corridor - Cape Horn Interchange (North of the Port Mann Bridge) to Clark Drive

24. Trans Canada Highway corridor - 200 Street to the Cape Horn Interchange (North of the Port Mann Bridge)

Provide HOV lanes across the:

25. North Arm of the Fraser River at or in the vicinity of the Alex Fraser Bridge-Queensborough Bridge corridor

Provide other improved connections as follows:

26. Provide an improved Moray Channel Bridge and associated roadway improvements - Highway 99 to the Vancouver International Airport

27. Improve road access from Highway 91 at Nordel Way to the Surrey City Centre

28. Improve east-west connection from Highway 17/99 to Highway 15/Highway 1 (South Fraser Perimeter Road)

29. Improve east-west connection Southeast Port Road - Mary Hill Bypass/Highway 1 to Queensborough Bridge/Marine Way 30. (North Fraser Perimeter Road)

30. Improve Highway 10 from Highway 99 to Trans Canada Highway

31. Provide new arterials and widen existing arterials to serve development.

Appendix B – Summary of Implementation Analysis

Output			Implemented by 2006	Implemented by 2013
TDM Measures	2.1	TDM 'incentives'	Yes	Yes
	2.2	Raise fuel tax, to 25% Increase in real price of fuel	No (Market forces drove increases)	Yes
	2.3	Introduce bridge tolls on all bridges (road pricing)	No	No
Transit Network Supply	3.1	Increase SeaBus capacity	No	No
	3.2	Increase the existing SkyTrain (Expo Line) capacity	Yes	Yes
	3.3	Build ICTS on Richmond-Vancouver CBD corridor	No (Under Construction)	Yes
	3.4	Build ICTS on Lougheed Town Centre-Broadway BD corridor	Partially	Partially
	3.5	Build ICTS on New Westminster-Coquitlam Town Centre corridor	No	No (Under Construction
	3.6	Coquitlam-Vancouver Commuter Rail (West Coast Express)	Yes	Yes
	3.7	Increase main-line and feeder bus coverage and service hours	Partially	Partially
	3.8	Apply bus priority treatment/bus lanes/transit priority measures on major transit routes	Partially	Partially
	3.3a	Richmond-Vancouver CBD SuperBus (98 B-Line)	Yes	Yes
	3.4a	Lougheed Town Centre-Broadway Business District SuperBus (99 B-Line)	Yes	Yes

	3.5a	New Westminster-Coquitlam Town Centre SuperBus (97 B-Line)	No	No
Automobile Network supply	3.9	HOV Lanes on major Highways and Arterials	Partially	Partially
	3.10	Other road improvements	Partially	Partially

By 2006: 31% Fully implemented, 44% partially implemented, 25% not implemented.

By 2013: 44% fully implemented, 38% partially implemented, 19% not implemented.

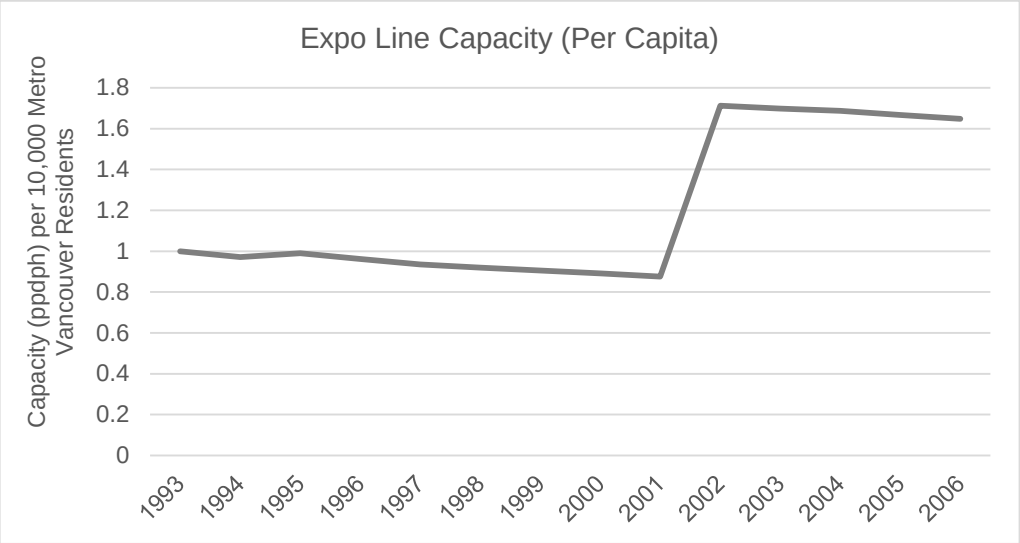
Appendix C – Information Provided to Experts

Outputs

Subcategory		Output		Implemented by 2006	Implemented by 2013
A	Provide basic transit improvements	A-1	Add SeaBus capacity.	No	No
		A-2	Increase the existing SkyTrain capacity	Yes	Yes
		A-3	Increase main-line and feeder bus coverage and service hours	Partially	Partially
BCD	Apply bus priority treatment/bus lanes/transit priority measures	BCD	Apply bus priority treatment/bus lanes/transit priority measures on major transit routes	Partially	Partially
E	Provide Intermediate Capacity Transit System (ICTS)	E-1	Build ICTS on Richmond-Vancouver CBD corridor	No (Under Construction)	Yes
		E-2	Build ICTS on Lougheed Town Centre-Broadway BD corridor	Partially	Partially
		E-3	Build ICTS on New Westminster-Coquitlam Town Centre corridor	No	No (Under Construction
	Provide "SuperBus"/Commuter Rail	E-4	Richmond-Vancouver CBD (98 B-Line)	Yes	Yes
		E-5	Lougheed Town Centre-Broadway Business District (99 B-Line)	Yes	Yes
		E-6	New Westminster-Coquitlam Town Centre (97 B-Line)	No	No
		E-7	Coquitlam-Vancouver (West Coast Express)	Yes	Yes
FG	Build HOV Lanes	FG	HOV Lanes on major Highways and Arterials	Partially	Partially
H	Improved Connections (Auto)	H	Improvements to Regional Highways	Partially	Partially
J	TDM Measures	J-1	Raise fuel tax, to 25% Increase in real price of fuel	Yes	Yes
		J-2	Introduce bridge tolls on all bridges	No	No
		J-3	Promote telecommuting	Yes	Yes
		J-4	Encourage medium-sized and large employers to help cut vehicle trips to their worksites	Yes	Yes

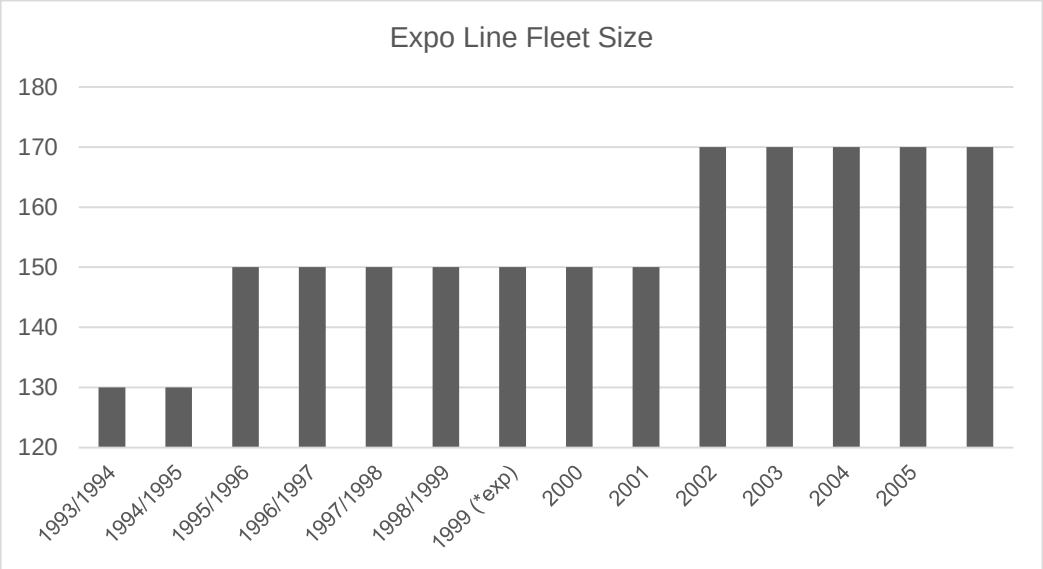
Output: A-2 (1)
Description: Increase the existing SkyTrain capacity
Implemented? Yes

Implementation
Expo Line capacity increased from an estimated 5,800 ppdph in 1993 to 12,100 ppdph in 2006
Nominal increase of 109%
Per capita increase of 66%



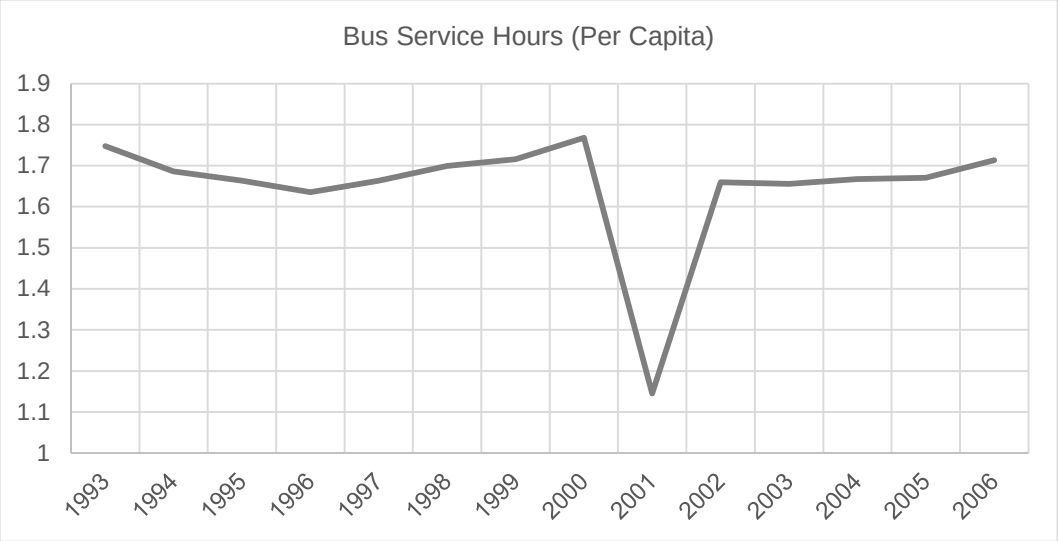
Source: BC Transit and TransLink transit schedules and BC Stats

Num of Vehicles



Output: A-3 (1)
Description: Increase main-line and feeder bus coverage and service hours
Implemented? Partially

Implementation
Total bus service hours increased from 3,049,523 to 5,117,217 hours (annually)
This is a nominal increase of 44.6%
This is a per capita change of -2.0%



Source: TransLink (public available on website) and BC Statistics
Noticeable drop in 2001 is due to transit strike

Total bus routes increased from 172 to 193
This is a nominal change of 12.2% or -10.9% per capita
The number of total departures during the AM Peak hour increased from 549 to 654
This is a per capita change of 19.1% or -5.3% per capita

Number of routes and route capacity (per capita)

	Change in Num. of Routes	Change in Departures per Hour
Vancouver	10%	7%
Burnaby/New West	-42%	-11%
Northeast	-16%	-16%
North Shore	-2%	11%
Surrey/Langleys	-32%	-20%
Richmond/South Delta	18%	17%
Maple Ridge/Pitt Meadows	0%	-22%

Output: BCD
Description: Bus priority treatment/bus lanes/transit priority
Implemented? Partially

Implementation
-Initially bus lanes were built on the South Delta/Richmond Hwy 17 and Hwy 99 corridor (completed in 1995)
-These bus-only lanes were converted to HOV lanes in 2000/2001 as part of the MoTH congestion relief program (for Auto)

-Bus lanes were built on the Barnet Hwy/Hastings corridor and completed in 1997
Pitt River and an HOV queue-jump lane for westbound travelers
-Finally, priority for buses was not implemented fully as expected by the plan

Output: E-2
Description: ICTS Lougheed Town Centre-Broadway BD
Implemented? Yes

Implementation
The Millennium Line opened in 2002 (with additional stations opening in 2003 and 2006)
It connects New Westminster to VCC-Clark and Broadway at Commercial via Lougheed and Brentwood Town Centres

Output: F-1
Description: 98 B-Line
Implemented? Yes

Implementation
The 98 B-Line was in service by September 2000.

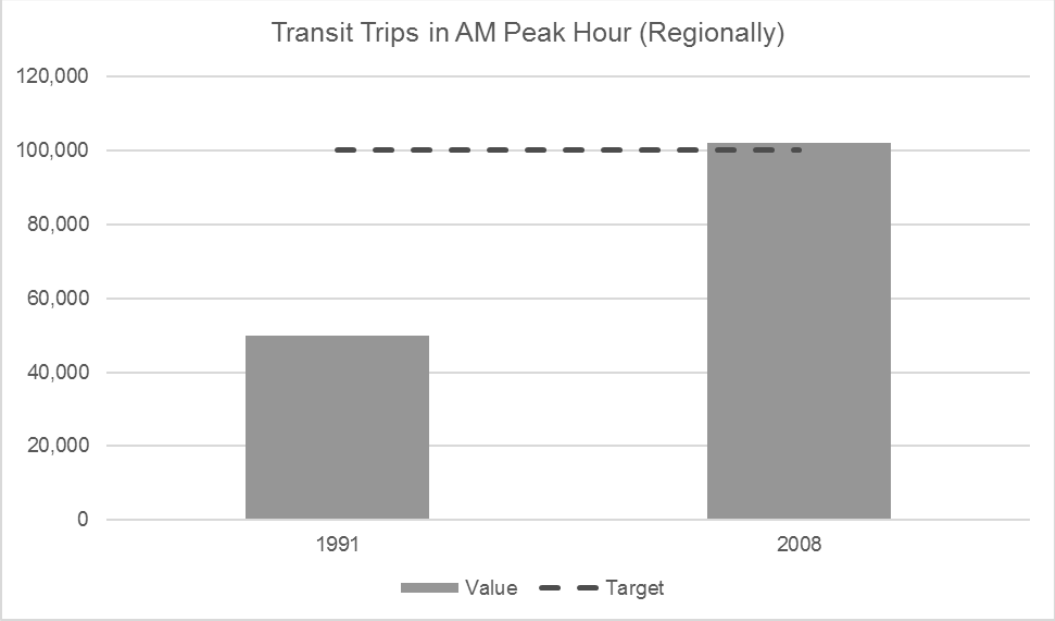
Output: F-2
Description: 99 B-Line
Implemented? Yes

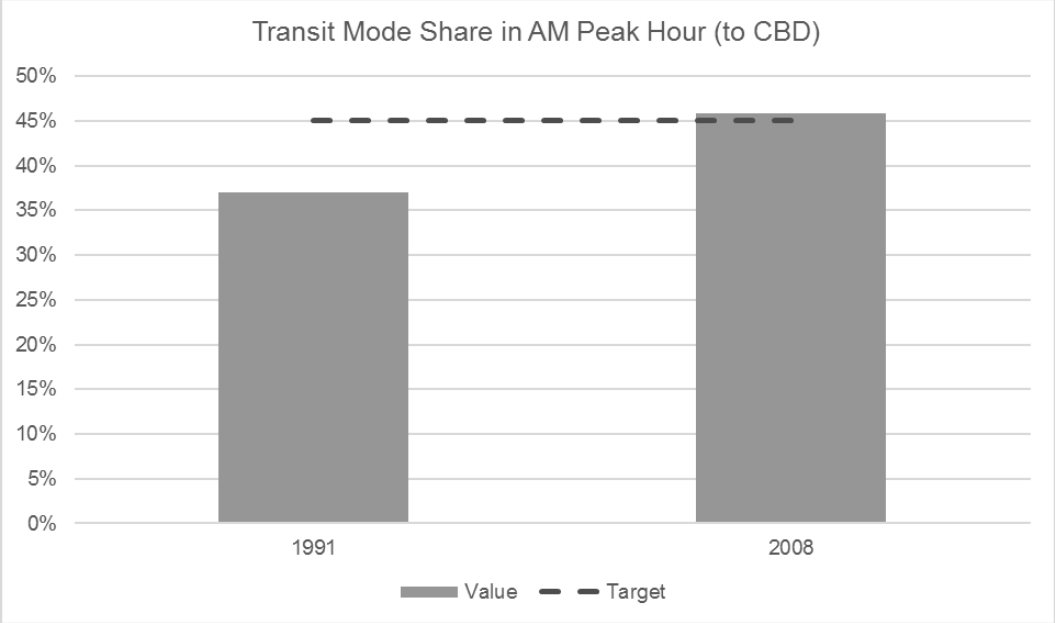
Implementation
The 99 B-Line was running by September 1996
Output: F-4
Description: Commuter rail on Coquitlam-Vancouver corridor (West Coast Express)
Implemented? Yes

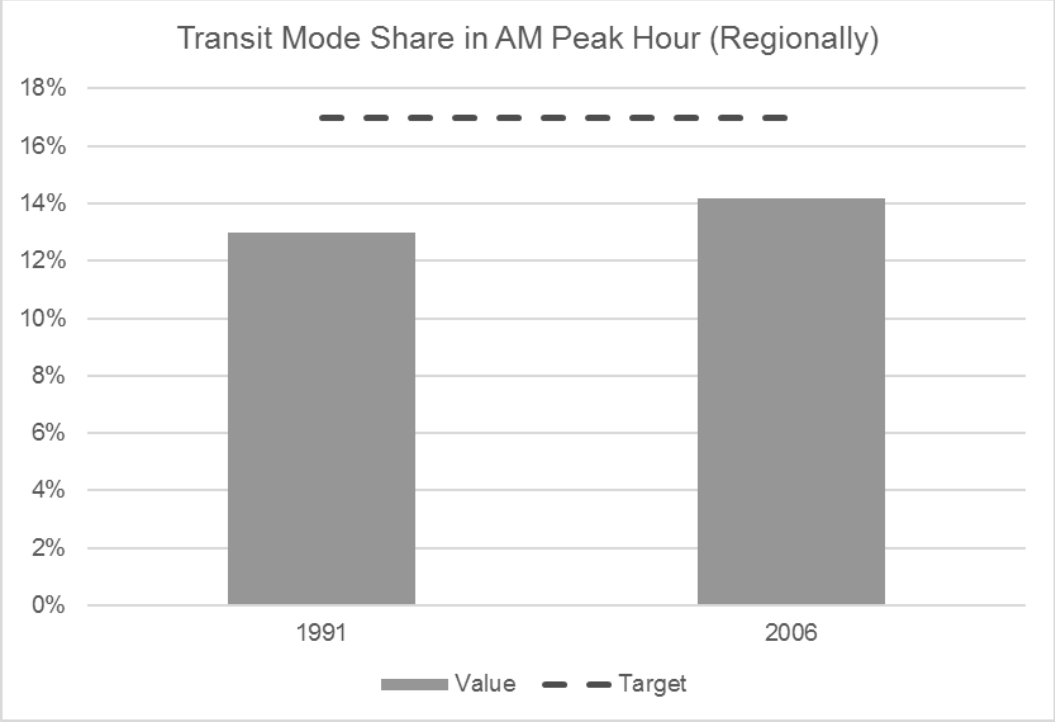
Implementation
The West Coast Express was running by November 1995

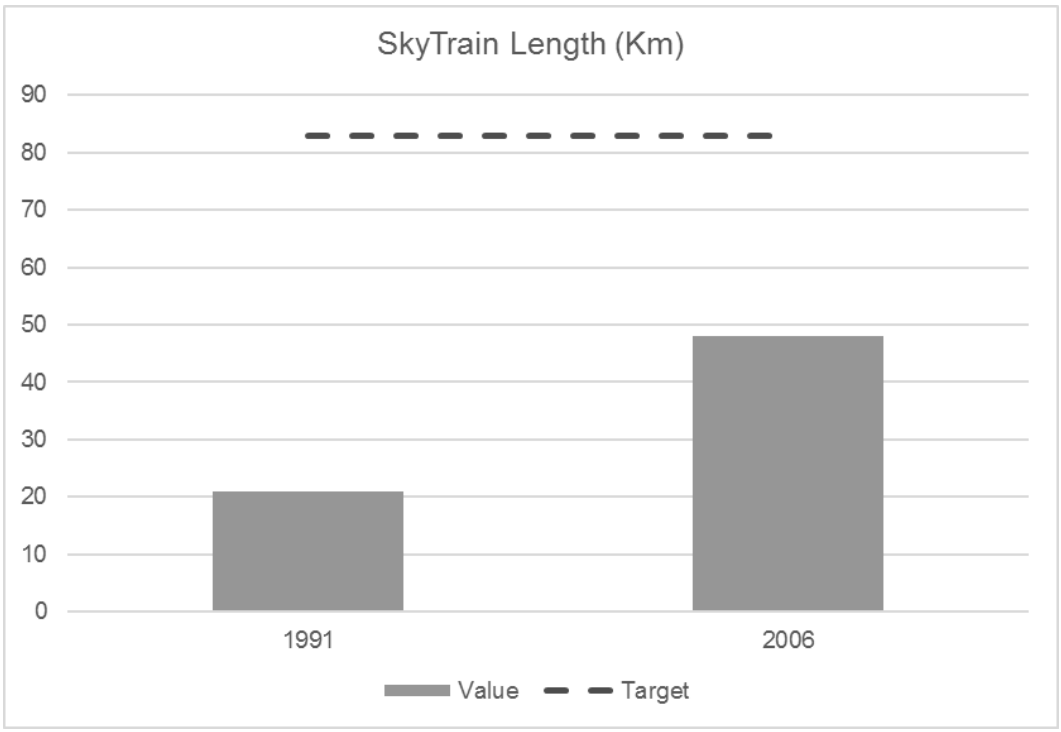
Outcomes

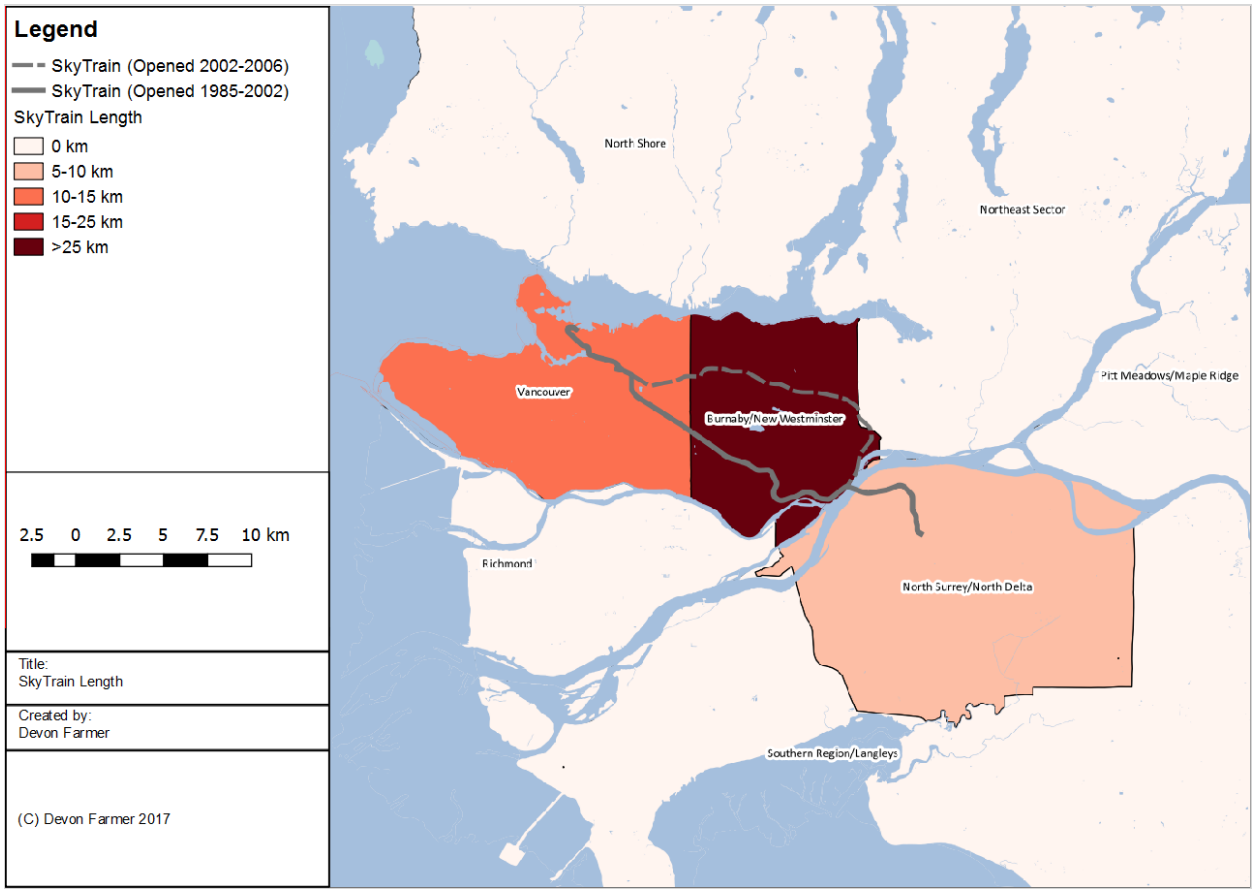
	Target	1991	2006	2011	Target	Achieved by 2006	Achieved by 2011
1	Transit share in AM Peak Hour	13%	15%	17%	17%	No	Yes
1a	Non-driver share in AM Peak Hour	41%	46%	48%	47%	No	Yes
2	Transit Share in AM Peak Hour (To CBD)	37%	50%	55%	45%	Yes	Yes
3	Rapid Transit Length (km)	24km	47km	67km	83km	No	No
4	Total Population (<1km from Rapid Transit)	8%	16%	21%	25%	No	No
5	Total Population (<400 m from Bus Route)	87%	89%	89%	90%	Yes (99%)	Yes (99%)
6	Cyclists to Work in AM Peak Hour	4,000	7,200	8,000	12,000	No	No
7	Auto Occupancy in AM Peak Hour	1.28	1.37	1.35	1.35	Yes	Yes
8	Auto Occupancy in AM Peak Hour (to CBD)	1.29	1.16	N/A	1.29	No	N/A

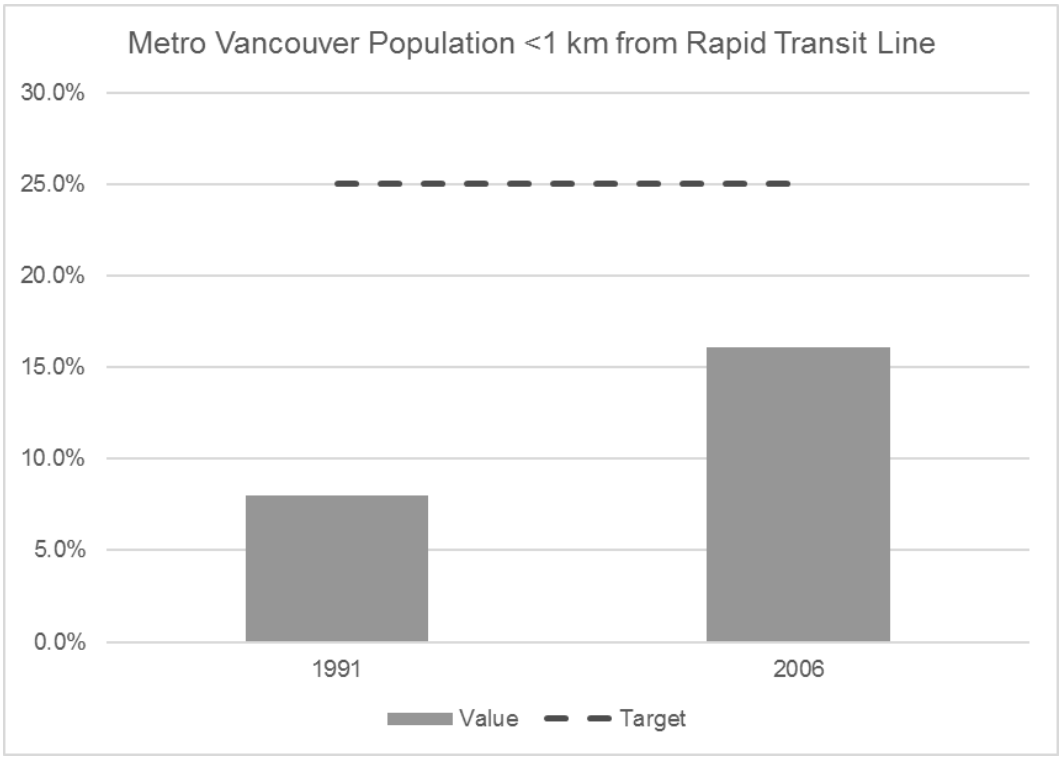


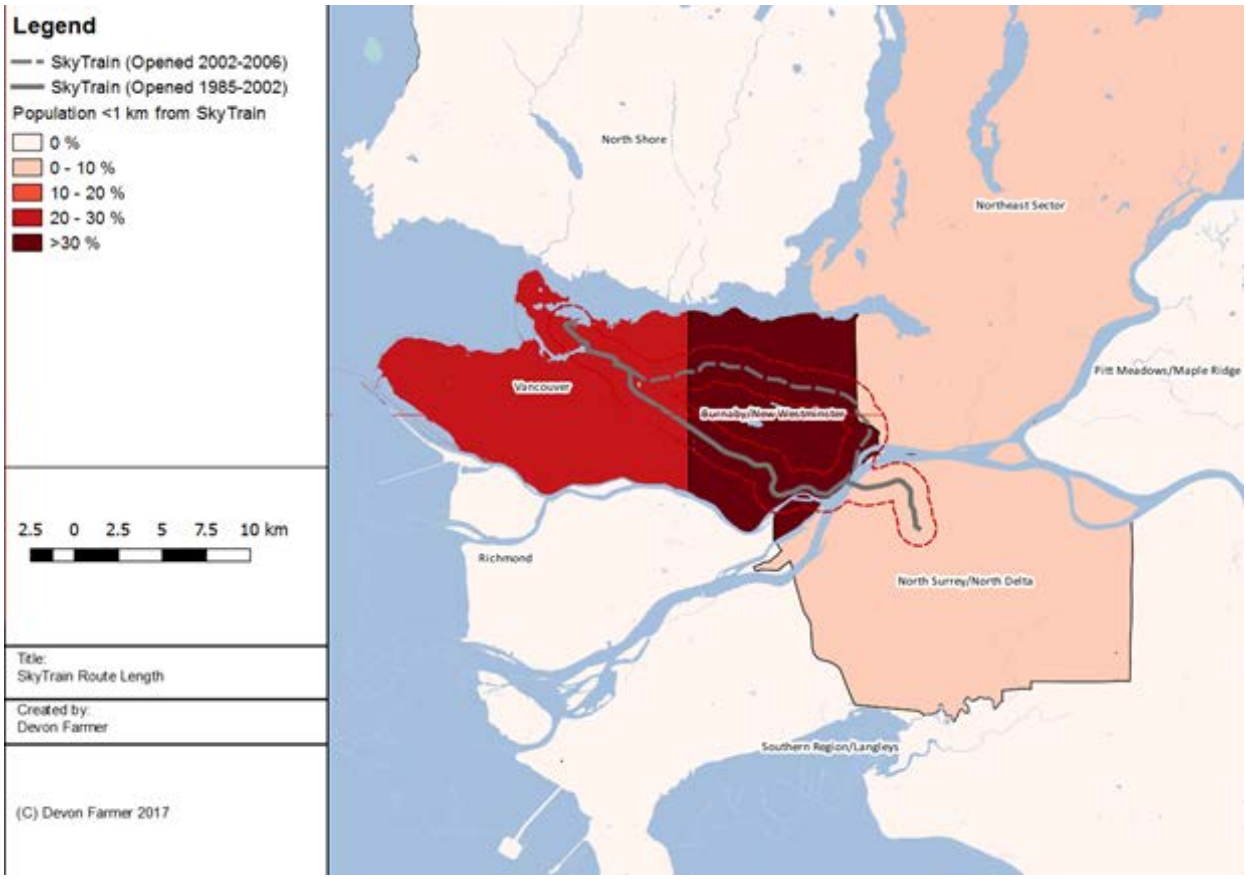

Transit Mode Share in AM Peak Hour (to CBD)
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
1991
2008
Value
Target

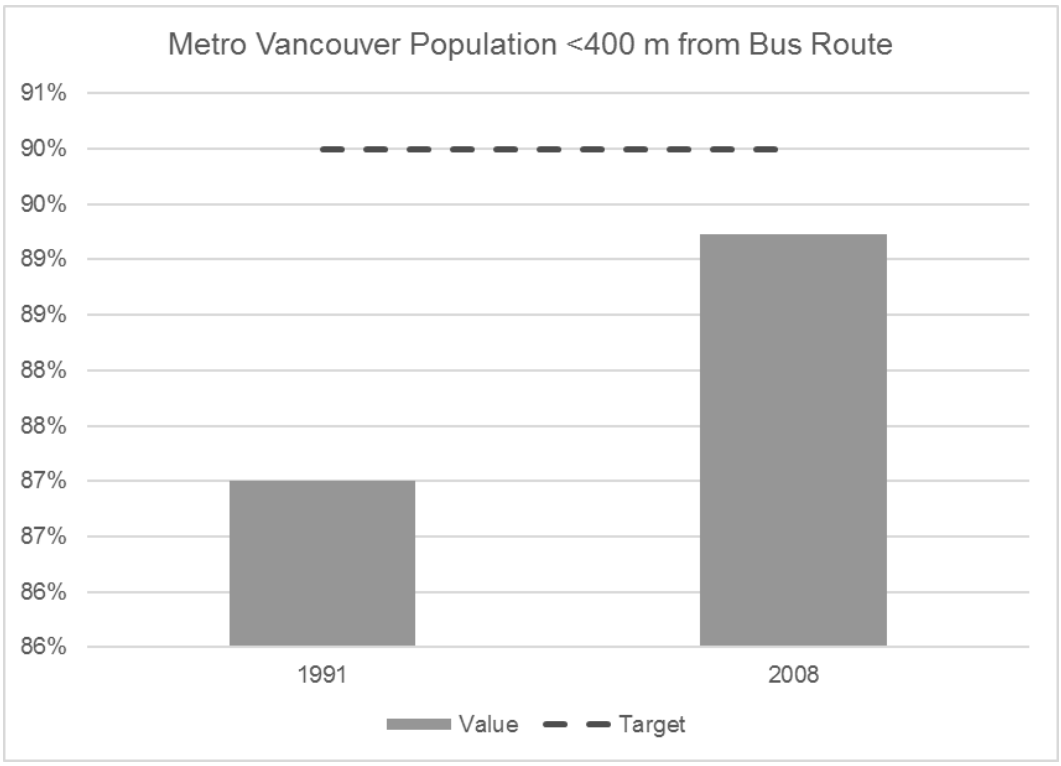

Transit Mode Share in AM Peak Hour (Regionally)
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
1991
2006
Value
Target

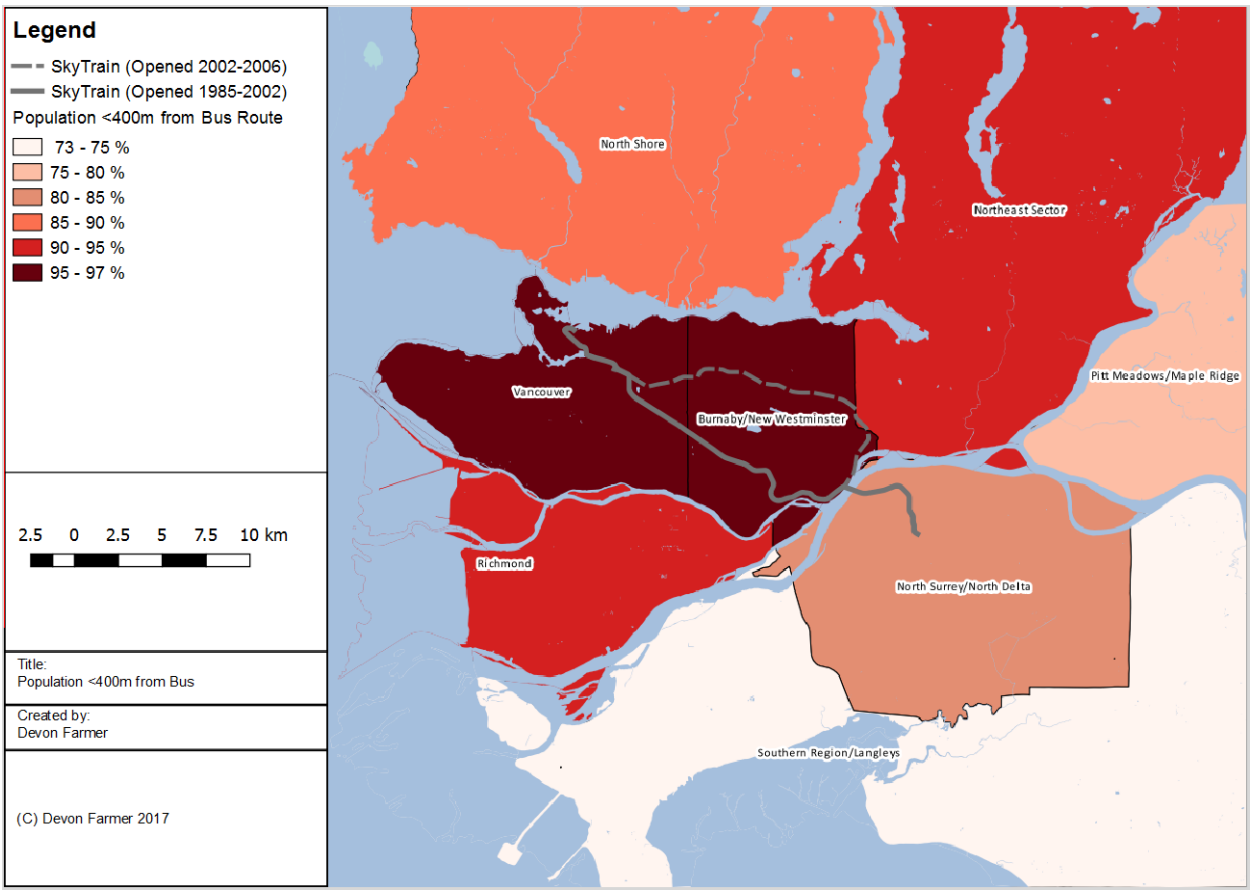

SkyTrain Length (Km)
90
80
70
60
50
40
30
20
10
0
1991
2006
Value
Target


Legend
SkyTrain (Opened 2002-2006)
SkyTrain (Opened 1985-2002)
SkyTrain Length
0 km
5-10 km
10-15 km
15-25 km
>25 km
2.5 0 2.5 5 7.5 10 km
Title:
SkyTrain Length
Created by:
Devon Farmer
(C) Devon Farmer 2017
North Shore
Northeast Sector
Vancouver
Burnaby/New Westminster
Pit Meadows/Maple Ridge
Richmond
North Surrey/North Delta
Southern Region/Langleys

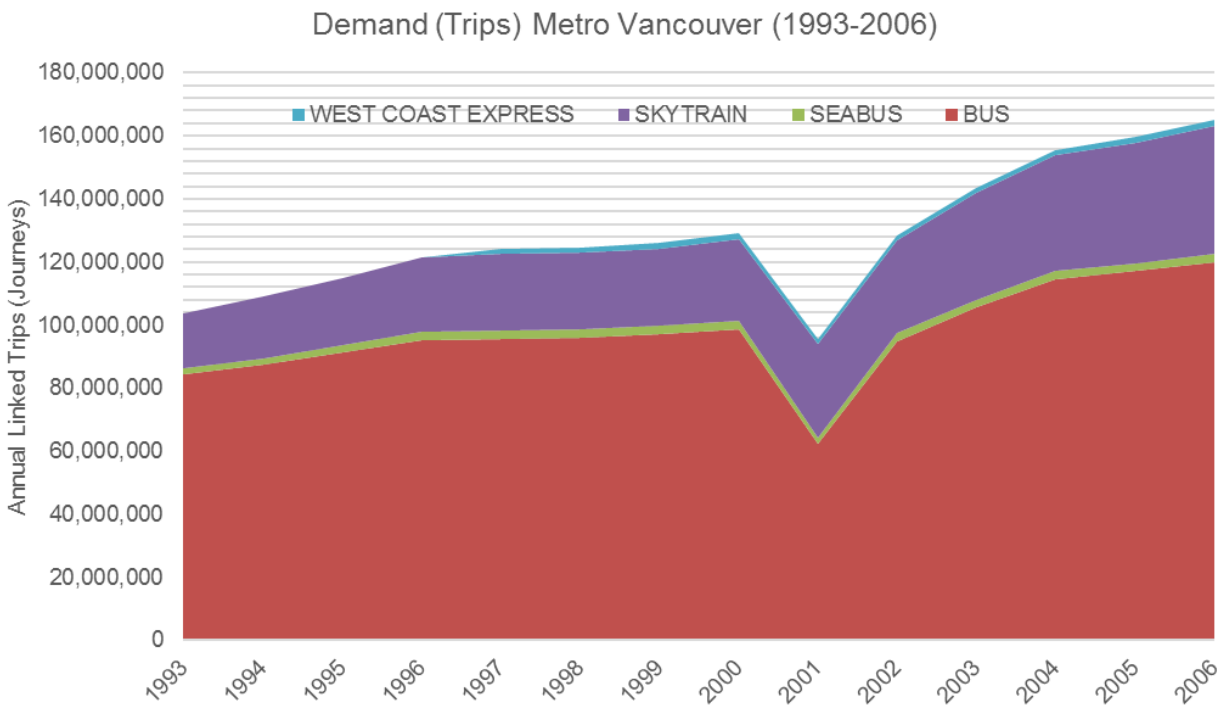

Metro Vancouver Population <1 km from Rapid Transit Line
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
1991
2006
Value
Target


Legend
SkyTrain (Opened 2002-2006)
SkyTrain (Opened 1985-2002)
Population <1 km from SkyTrain
0 %
0 - 10 %
10 - 20 %
20 - 30 %
>30 %
2.5 0 2.5 5 7.5 10 km
Title:
SkyTrain Route Length
Created by:
Devon Farmer
(C) Devon Farmer 2017
North Shore
Northeast Sector
Vancouver
Burnaby/New Westminster
Pitt Meadows/Maple Ridge
Richmond
North Surrey/North Delta
Southern Region/Langleys

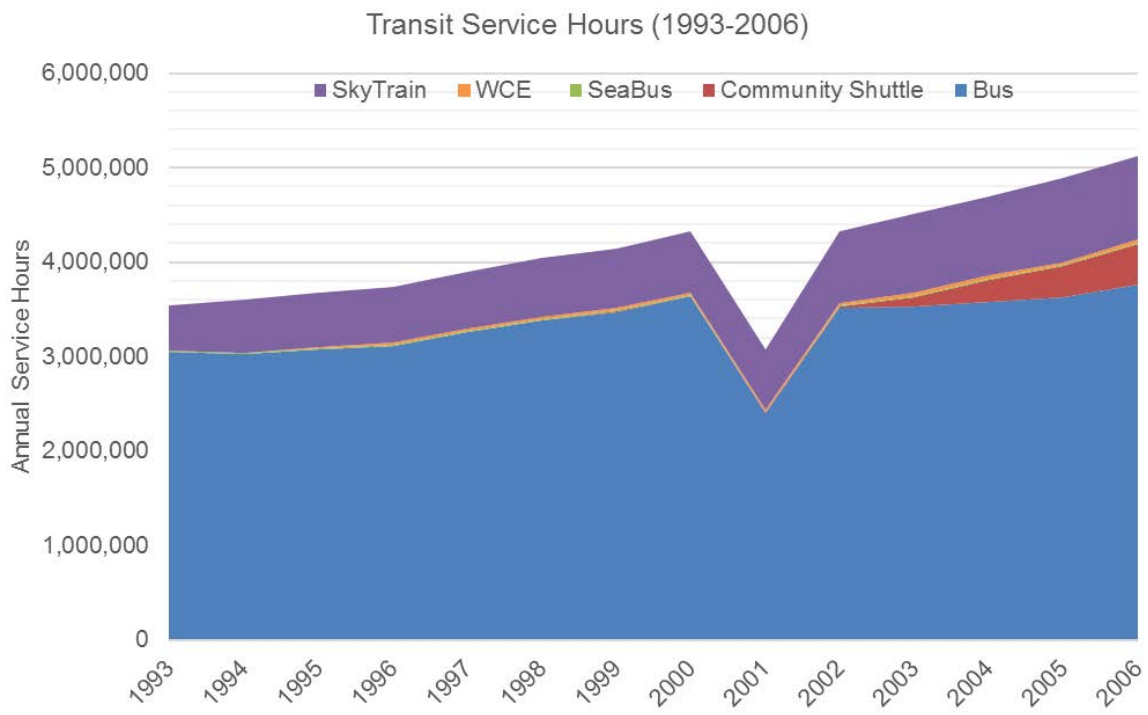

Metro Vancouver Population <400 m from Bus Route
91%
90%
90%
89%
89%
88%
88%
87%
87%
86%
86%
1991
2008
Value
Target


Legend
SkyTrain (Opened 2002-2006)
SkyTrain (Opened 1985-2002)
Population <400m from Bus Route
73 - 75 %
75 - 80 %
80 - 85 %
85 - 90 %
90 - 95 %
95 - 97 %
2.5 0 2.5 5 7.5 10 km
Title:
Population <400m from Bus
Created by:
Devon Farmer
(C) Devon Farmer 2017
North Shore
Northeast Sector
Vancouver
Burnaby/New Westminster
Pitt Meadows/Maple Ridge
Richmond
North Surrey/North Delta
Southern Region/Langleys

Additional Information



Data source: TransLink



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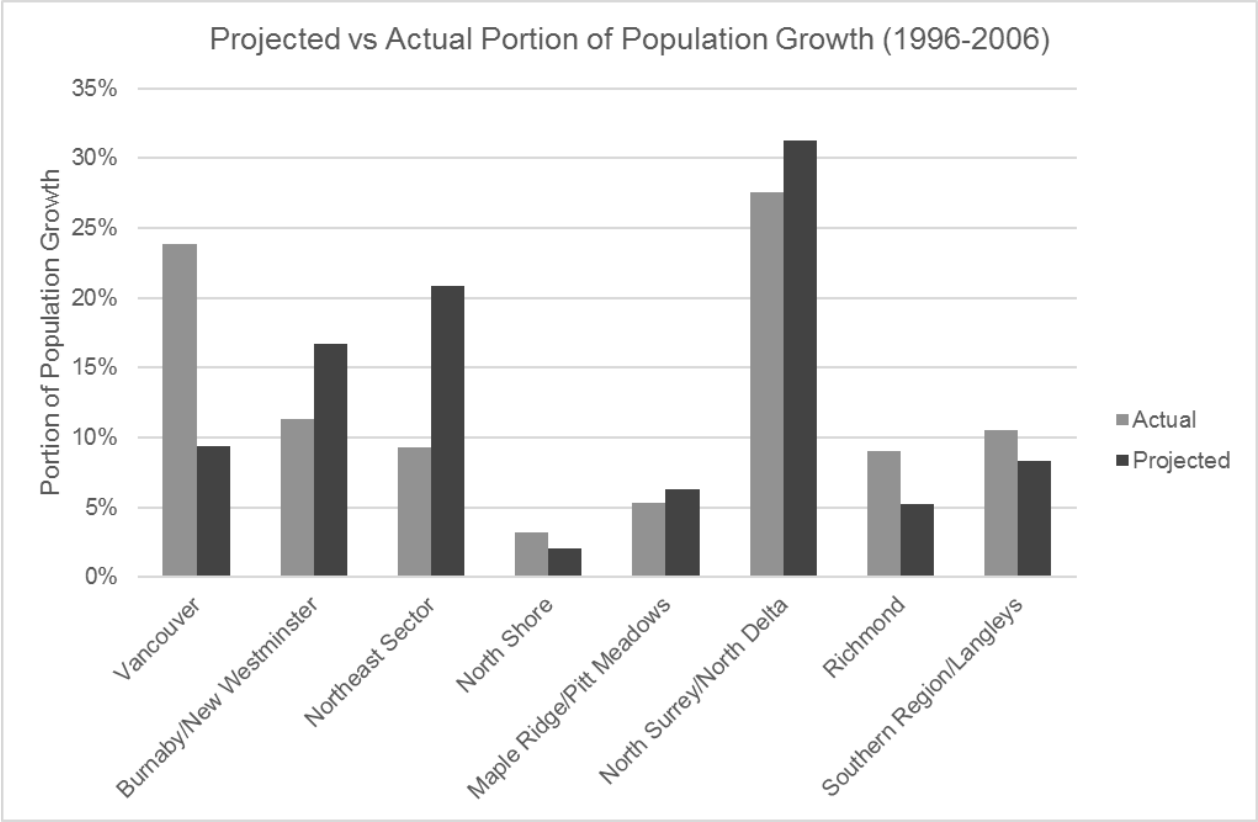
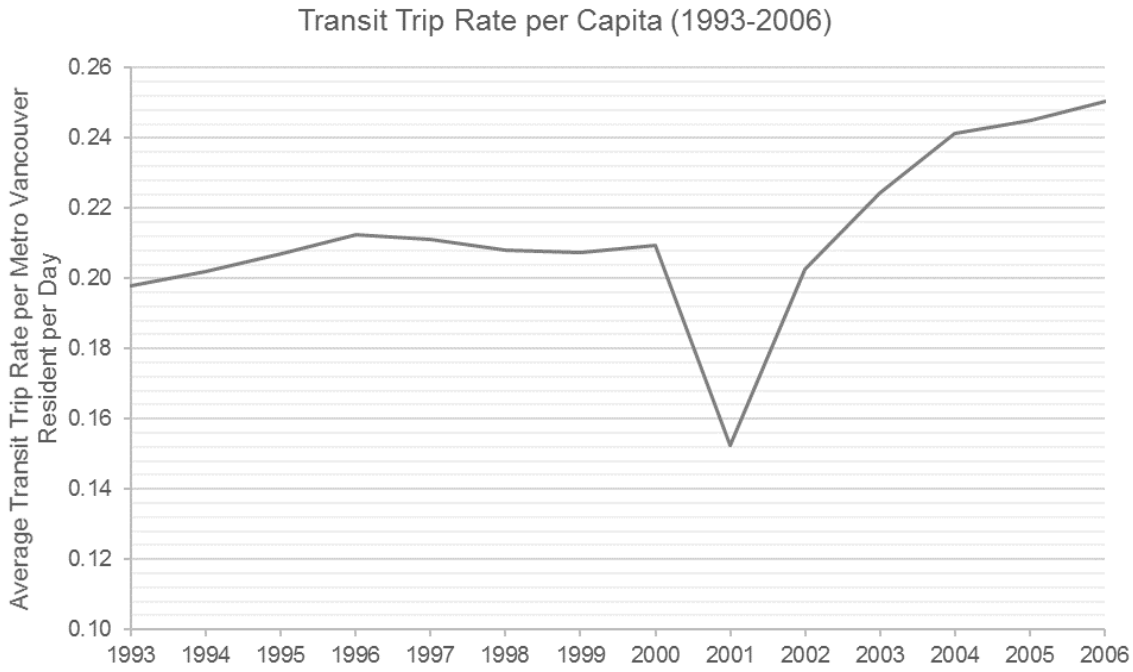


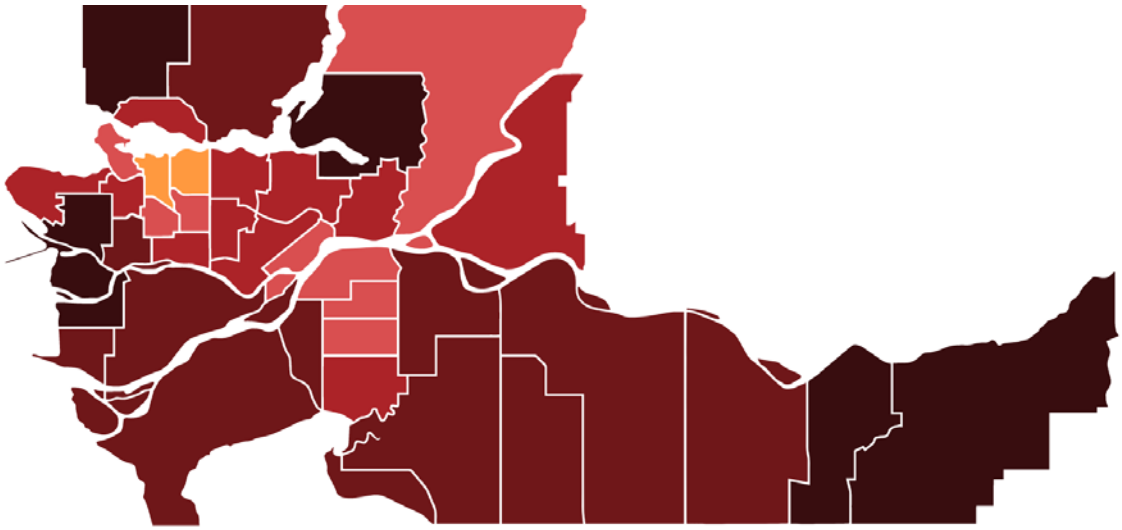
Data source: Statistics Canada 1996 and 2006 Census of Population



Data source: TransLink and BC Statistics

Appendix D – Provincial Election Results Maps

2001 Election



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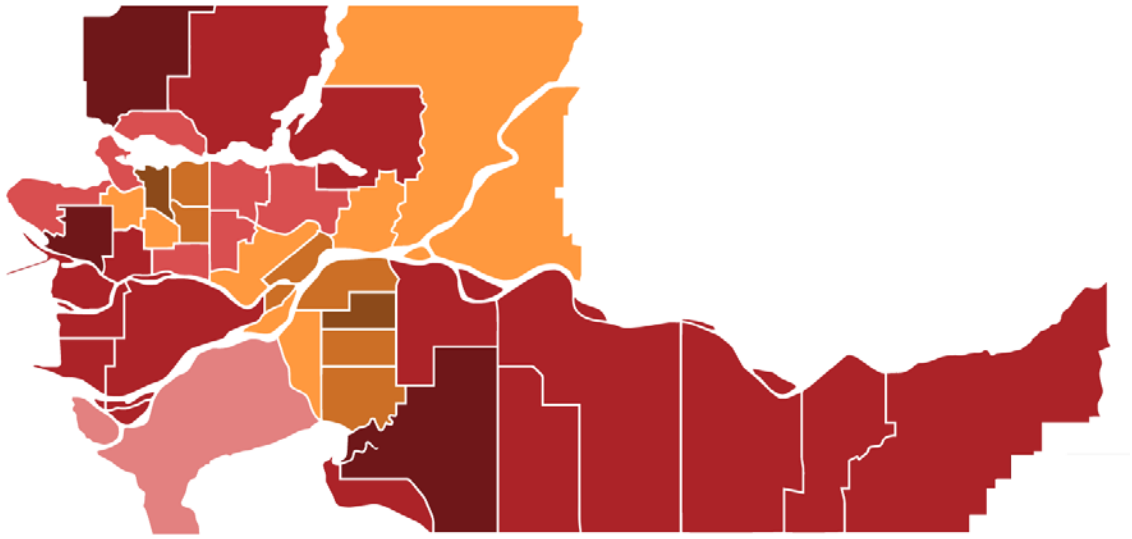
2005 Election



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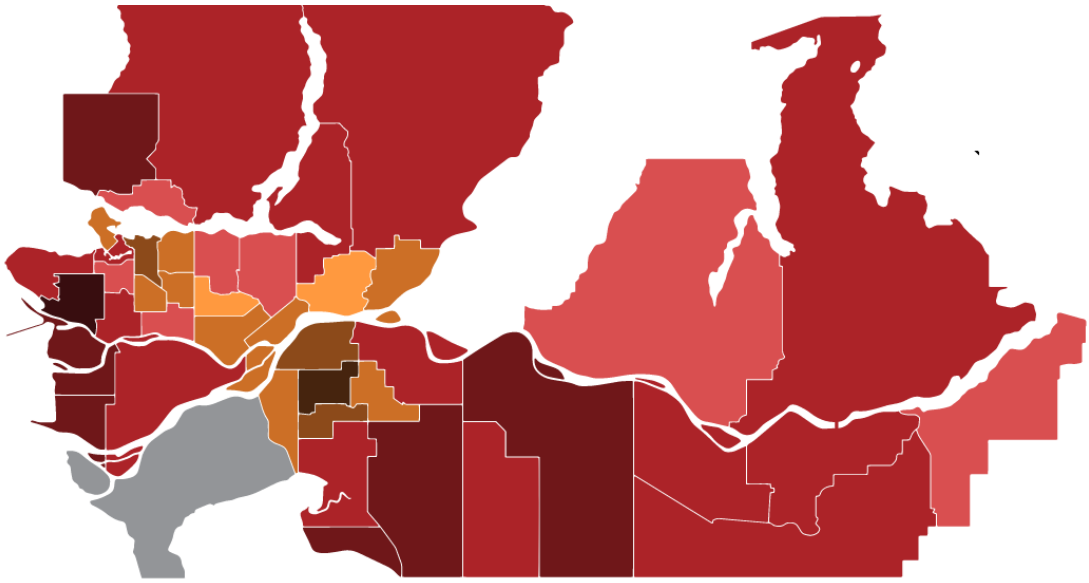
2009 Election



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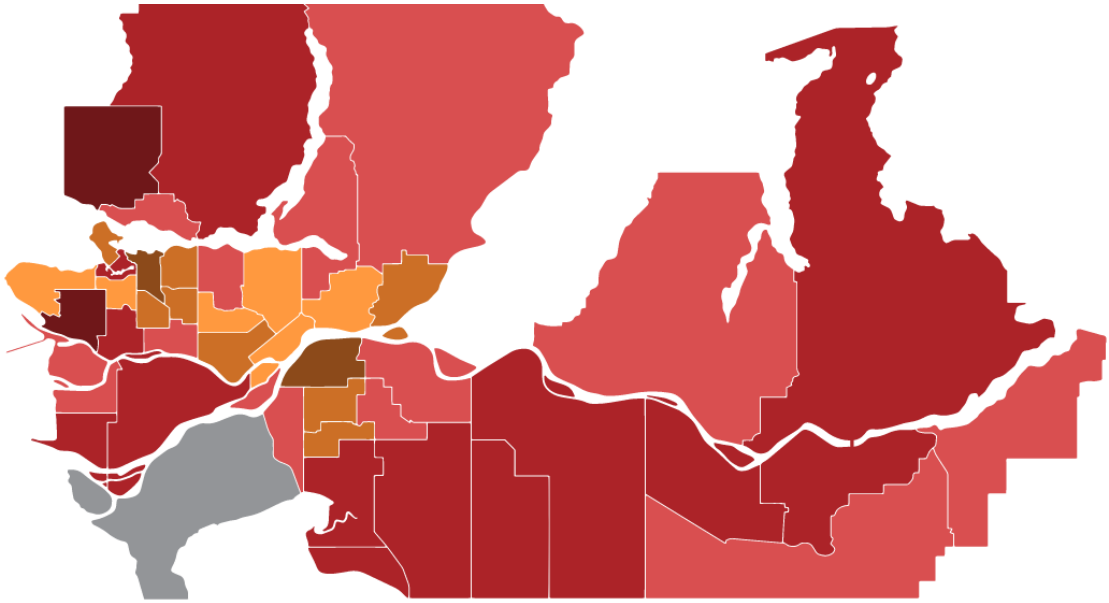
2013 Election



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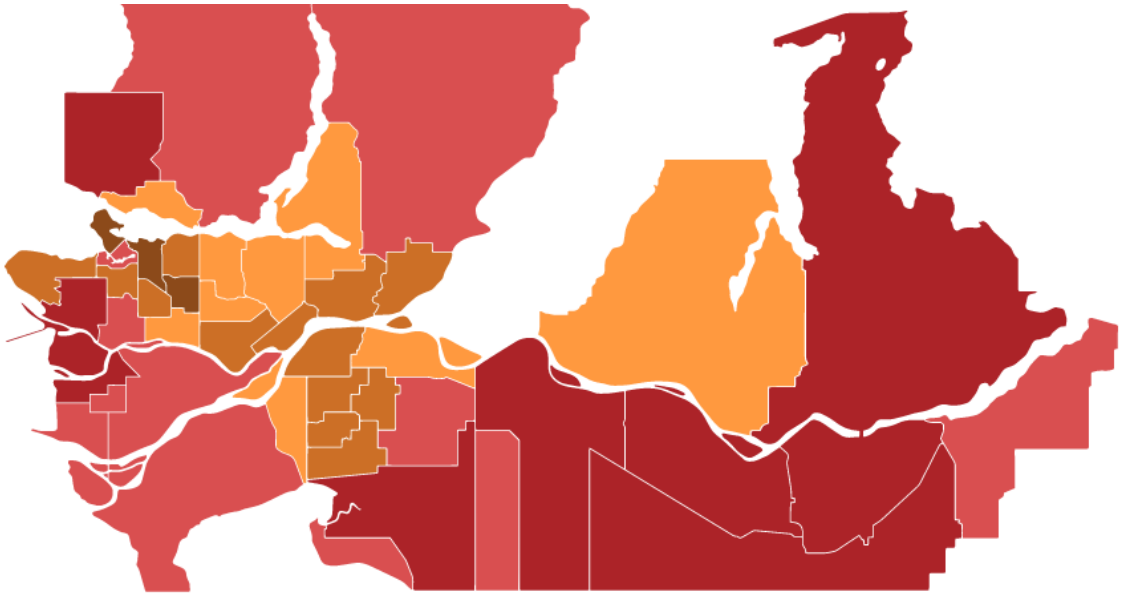
2017 Election



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