



Report

Mass Transit Study

Edmonton's Future Mass Transit Network



Prepared for City of Edmonton
by IBI Group
February – 2020

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By IBI Group

BY



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Glossary and Abbreviations

AM	The early morning (7am to 8am) weekday time period,
BAP	Business As Planned (land use baseline used for this study for the future horizon)
BNR	Bus Network Redesign
BRT	Bus Rapid Transit
CBD	Central Business District (downtown Edmonton in this report)
EIA	Edmonton International Airport
ETS	Edmonton Transit System
HOV	High Occupancy Vehicles (can include carpools, transit and taxis)
LRT	Light Rail Transit
MD	The typical midday (9 am to 3:30pm) weekday time period. Statistics are usually for one hour.
MTN	Mass Transit Network
PM	The late afternoon (4:30pm to 5:30pm) weekday time period.
RTSC	Regional Transit Services Commission
ROW	Right-of-Way
WEM	West Edmonton Mall
Airport Connection	Airport service within the City-wide network with direct connection to the Centre City node with connections at key nodes along the way
Corridor	A place for movement, living and commerce that is anchored by key mobility networks and well connected to surrounding communities. There are two types:
District	A grouping of neighbourhoods with diverse amenities that support living more locally.
Edmonton Metropolitan Region	The geographical area that is home to more than one million people, has a diversified economy, and surrounds several municipalities and three first nations 24 municipalities and three First Nations. The City of Edmonton is continuously working with its regional partners to

help the Region thrive and prosper while also addressing the challenges of rapid growth.

Future Growth Area	Lands south of 41 st Avenue SW for which substantial completion of developing areas is required before authorizing the preparation of statutory plans.
Mobility Hub	A place for trip origins, destinations, and transfer points to allow people to seamlessly move from one travel option to another as needed. Mobility hubs are typically located in nodes and centred at cross sections of mass transit routes to create connections within Edmonton and the region.
Networks	Networks are spatial representation of physical or conceptual elements that link together or are related.
Nodes	Centres of activity of different shapes and sizes that feature a variety of housing types, gathering places, a mixture of land uses and varying tenures and affordability. There are three types:
Passenger Boardings	The number of passengers that get onto (board) transit vehicles. It is a measure of how many people use a transit route or transit system.
Passenger Volumes	The number of passengers on board a transit vehicle at a specific point on the route. At any given time, this is how many people boarded the vehicle since the start of the route, minus the number who have already left the vehicle at an earlier stop.
Peak Hour Passenger Volumes	The total number of passengers travelling in the peak direction on one or more transit routes, operating in the same direction, during a one-hour period. This value is the sum of the passenger loads on the individual vehicles during that hour. It indicates how busy the route (or corridor) is during the time period.
Critical/Maximum Load Point	This is the location or segment of a route where the highest passenger loads are experienced in one direction during the time period in question. It is also referred to as the maximum passenger load or volume. This number is often compared with the capacity of a transit route to assess if the right amount of service is being provided.
Passenger Loads	Synonymous for passenger volumes.
Directional Peak Load	This is the passenger load at the critical load point, only counting the peak (higher value) direction.
Peak Hour Capacity	This is the theoretical number of passengers that can be carried on a transit route or transit mode past a single point or location, in one hour. It is a function of vehicle space x number of vehicles per hour. The peak capacity assumes that vehicles arrive as scheduled and counts all passenger spaces (seated or standing) that are provided in the peak direction of a transit service. It is challenging to achieve peak capacity because passengers are not evenly distributed throughout transit vehicles, and when vehicles are fuller, slower passenger alighting and boarding can end up delaying service.
Productivity Index	This is a simplified measure of a route's relative attraction for

passengers. As used in this report, it is the AM + PM boardings per route-kilometre. This is calculated as the number of people in the AM and PM peak hours that board the route, divided by the length of a round trip. The higher the number, the more passengers are attracted to the service. This provides an indication of what hierarchy of service could be appropriate, with higher numbers indicating a need for more frequent service, and greater capacities.

Screenline	An imaginary line along streets or natural geographic features, used to measure how many people cross it in each direction during a time period. This line crosses multiple locations oriented in the same general direction and related to each other in some way (for example they may be alternative routes to each other).
Service Planning Capacity	This is a lower threshold for transit route capacity where the density of standing passengers is lower than the design load for that type of vehicle. It implies greater ease of passengers circulating on board, alighting and boarding the vehicle. This planning capacity is used to estimate how many vehicles a transit route should be allocated, with a safety margin built in for extra demand.
Transit River Crossing	Direct and convenient connection that traverses the river and provides connectivity between major activity centres via mass transit. May also accommodate active transportation options.
Transit Facilities	A location where residents can access public transit. Includes bus stops, train stations and transit centres.
Transit Vehicle Capacity	This is the number of passengers a transit vehicle can carry if full. It counts the seats on a transit vehicle plus an estimated number of people standing, assuming 'x' people per square metre of floor space in the vehicle. Since the 'x' value for number of people depends on operational needs and practices, there can be a range for this capacity value. (Please see Peak Hour Capacity and Service Planning Capacity)

Executive Summary

The City of Edmonton has developed an integrated and phased plan referred to as [The City Plan](#) to guide growth towards 2 million residents, double what it is today. As a component of this comprehensive work, this Mass Transit Study analyzes future mass transit needs to support the anticipated changes to land use and to increase options for how people get around the city. The focus of the study is mass transit and while local, regular or community based bus networks are included in the overall transit network, these other types of routes were not the focus of the evaluation. The recommendations in this report relate to those defined as mass transit in this study and not to the other service types.

Background research was conducted to establish the current transportation context in Edmonton and envision its future travel demand and transit network. An assessment of five peer agencies was completed to illustrate positive and negative experiences in creating a long-range transit strategy. The review identified several common success factors with regard to how service is operated and networks are laid out to serve and attract passengers.

With an established context, the Business As Planned scenario, three future growth scenarios were developed to explore how different policy levers could help shape future growth. These scenarios explored the implications of various land use patterns and densities and the requirements associated with servicing them. Collectively based on the same 2 million population estimate, each scenario differed in how and where the higher-density parts of the city would be distributed. In conjunction with this, transit options were defined and evaluated for each of the evaluation scenarios to explore how best to serve different travel markets.

To organize the envisioned transit services, categories of routes were applied to serve regional, rapid and urban oriented needs. Within these functional groupings, the types of service evaluated considered exclusive and semi-exclusive right of way, 'rapid' limited stop services, frequent services for denser urban areas, and a variety of regional connections in and out of the city. The evaluation allowed for different transit service types and configurations to be assessed and the most promising elements carried forward for further consideration.

A [Mass Transit Network](#) has been developed and is intended to enhance future transit system performance in addition to achieving several broader goals. These include supporting future land use plans and policies by serving existing ridership, shaping future travel demand, acting as a catalyst at development nodes and corridors, and helping the city to be more sustainable (financially, environmentally and socially). One strategy to support these goals is the implementation of Mobility Hubs. These are strategically located in nodes or can be centred on a mass transit station. They represent an important form of investment in transit infrastructure and help to support and incentivize large scale transit-oriented development. They tie important pieces of the proposed land use and transit strategies together.

The mass transit network broadly includes:

- Extension of LRT within the city along the Capital, Metro and Valley Lines, and introduction of a new exclusive ROW service between the centre of the city and airport;
- New semi-exclusive transit routes in five major travel corridors;
- A grid of limited-stop rapid services, including faster crosstown services;
- Enhancement of the frequent bus services to include additional routes; and
- Strategic modifications and additions to regional connections, which will require working with regional partners to design and implement.

- Mobility Hubs to facilitate integration with different modes of transportation as well as with surrounding expected land use development.

The mass transit network results in higher transit mode choice for nearly all quadrants of the city, which speaks to the structure of the proposed transit network, with added capacity in and out of central Edmonton and significant new crosstown and regional services. These improved connections serve and attract greater ridership, because every significant node and corridor in The City Plan would be served by at least one mass transit route. Further, the assumed speeds and directness of routes affect how fast and competitive the transit route is in serving travel markets.

In the AM peak period, for example, the mass transit network is projected to achieve 18% transit usage for trips starting in the city, compared to 12% in the 2015 travel survey. Similar results are achieved in the PM peak and off-peak periods. Overall, transit is forecast to make gains in all sectors of the city, with notable increases in the non-central employment areas that are currently more challenging to serve than the areas located closer to the centre of the city.

To advance the Mass Transit Study, next steps will include developing an implementation and phasing plan and the creation of design guidelines and standards for new transit services. Implementation is typically carried out under the guidance of shorter-term strategic and investment plans focusing on 4-year and 10-year time periods. This approach also creates opportunities to future proof the long-range plan by including incremental opportunities to adopt and adapt to new technologies.



1 Introduction

The City of Edmonton is developing a long-term plan for a city of 2 million residents, double what it is today. The City Plan contains policies and outlines the systems and networks including a set of planning and design, mobility, and growth management systems. This includes high level direction on the form that municipal infrastructure and services will take. As the city physically grows, this increases the needs for community connections, jobs, housing, amenities and services such as transit. The plan will broadly define built physical spaces, options for how to get around, new connections to support businesses, and more lifestyle choice.

The mass transit study is one of several studies looking ahead at the “2 million people” horizon, and working towards building a future vision. At several times in this report, a 2065 horizon is referred to, as this is the presumptive timing of the “2 million” horizon; however the exact timing is less important than the overall directions. The strategic outcomes of The City Plan and of this study were developed in parallel, and each of the land use plan and the mass transit network are intended to support the other.

The City Plan process has five phases, which include technical analysis, public consultation, synthesis and development of recommendations. The second phase of the plan, Foundations, aligned with the Mass Transit Background Report finalized in February 2019. The third phase, ‘Framing the Plan’, included the development and analysis of several hypothetical growth scenarios, and in parallel this study investigated several mass transit scenarios that would both serve and help to shape future land use patterns.

The fourth phase of City Plan, called **Building Up**, developed a land use City Plan Concept, described in the **The City Plan**. Both The City Plan land use concept and the proposed **Mass Transit Network** build on stakeholder input and the results of the technical analyses conducted in the third phase. The mass transit network described in this current report was defined in conjunction with The City Plan Concept. This concept is organized according to districts, nodes and corridors, and it includes growth in the developing, redeveloping and future growth areas of the city required to reach the 2 million population horizon. Likewise, the mass transit network includes expanded coverage, new types of mass transit routes, and increased frequency of services to meet and shape future demand.

The fifth phase of The City Plan process relates to public hearings on The City Plan and final approval of The City Plan.

What Is Mass Transit?

Mass Transit is a broad family of strategic public transit services that carry higher volumes of passengers within urbanized areas, such as the Edmonton Metropolitan Region.

Mass transit includes major regional connections for longer-distance trips, rapid and/or frequent transit for faster trips of varying lengths within the urban area that provide reliable local connections.

The remainder of this introductory section describes The City Plan evaluation scenarios developed by City of Edmonton staff for analysis purposes, and the associated Mass Transit scenarios defined within this study.

This study assessed the current state of Edmonton's mass transit network and provides a framework to **guide the development and expansion of mass transit** as the city grows to two million residents. Important learnings from this study are listed below:

- There is an opportunity for transit to gain market share for short trip lengths (<10 km) which are currently dominated by automobile use.
- The future distribution of people and jobs will be a critical determinant of where, when and how new mass transit lines will be built.
- The proposed mass transit network for The City Plan will include three key categories of transit in terms of their service characteristics (Regional, Rapid and Urban-Frequent).
- Demand is high for key parallel north-south and east-west mass transit lines.
- A mass transit option that serves the airport can also serve demand to the downtown and university area from the southern parts of the city, including future growth areas in the annexation lands.
- Rapid (semi-exclusive right-of-way) lines performed reasonably well and were found to be critical for crosstown movements to complement the LRT network.
- Rapid (limited stop) and Urban-Frequent lines connected a large part of the city beyond what the LRT and Rapid (Semi-Exclusive right-of-way) could cover.
- Success was observed in terms of carrying higher passenger volumes when lines were connected to employment areas.
- Travel demand from the region into Edmonton is dispersed. Different forms of mass transit may be more appropriate to serve intraregional travel markets over time.
- Two interdependent layers of transit route groupings, City-wide and District, will support different city building objectives and serve different mass transit needs but together encompass the mass transit network for Edmonton at two million people.

Further information and detail regarding these learnings that fed into the definition of the mass transit network are found in the "Mass Transit Backgrounder" report and the "City Plan Mass Transit Scenario Analysis" technical memo, prepared as part of this study. A link to these reports is provided in Appendix B.

The sections in this report will detail the development of the mass transit network and explain the components of network performance, the categories of mass transit service, and the collaborative approach of developing both City-wide and District Route Concepts. Together these routes (as well as local transit, first-km and last-km services, and mobility hubs) will provide high quality, reliable and efficient service allowing Edmonton residents to live and move within their community and connect to other communities thereby transforming Edmonton into a true community of communities.



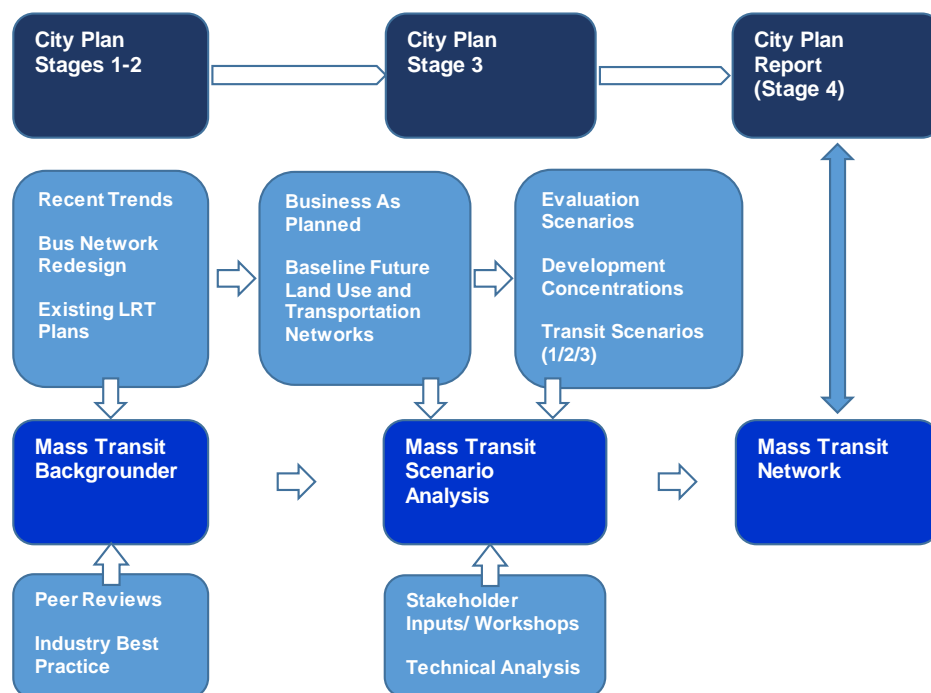
2 Mass Transit Network Development

The development of the mass transit network was carried out in parallel and in conjunction with The City Plan. The study process, major assumptions related to the transit networks, and the proposed network are described in the following sections. This includes maps and descriptions of the proposed routes forming the mass transit network.

2.1 Network Development Process

Exhibit 2.1 provides a visual summary of the twin processes in the development of The City Plan land use concept and the mass transit network component of the plan.

Exhibit 2.1: Process to Develop the Mass Transit Network



The mass transit scenarios were developed through an iterative and consultative process, with the following main steps in compiling and applying the relevant input:

- The **Mass Transit Backgrounder** (attached in Appendix B) provided background on the current context and some of the future (Bus Network Redesign, LRT Network Expansion) plans already in place for Edmonton's transit network. It also looked at how different travel markets respond to the transit service on offer, and reviewed several cities in Edmonton's peer group to draw out lessons about coordinated transit and land use planning.
- A future 'Business as Planned' (BAP) scenario was defined as the benchmark for modelling and other analysis purposes. This included population and employment projections for the 2 million population horizon, as well as build-up of the transportation network. This assumed that highway, street and transit service would include most planned or projected future projects and these would also extend into the city's future growth areas in the annexation lands.

- Three City Plan evaluation scenarios were defined in stage 3 of the overall process. These concepts were defined to help explore policy levers and the implications of different city structures for a broad range of criteria. The scenarios concentrated development in different ways:
 - **Strong Central Core (Referred to as City I)**. Development more concentrated in central Edmonton, around the University and a strategic set of surrounding nodes.
 - **Node City (Referred to as City II)**. Development throughout the city but with peaks at nodes, and intermediate density along certain connecting corridors.
 - **Corridor City (Referred to as City III)**. Development peaking along corridors criss-crossing the city with strategic nodes located across the city.
- Representative Mass Transit Scenarios were developed to align with these City Plan evaluation scenarios, and to allow for testing of different mass transit network elements. This drew upon the insights from the *Mass Transit Background*, and input from stakeholders and the consultant's expert panel to identify major elements for testing.
 - A workshop was held with stakeholders from City departments, to collect feedback on the challenges and opportunities perceived for each of the three cities. A group mapping task where each worked independently, resulted in a collection of transit network ideas for each of the three future city evaluation scenarios. The group concepts were defined using transit mode 'tiers' of regional, rapid, and frequent-urban (which are not technology-specific). These building blocks for mass transit are explained further in Section 2.2.
 - For each of the evaluation scenarios, there were elements that each group had identified in common, and other concepts that were either unique to one group or varied in the mode tier identified. It was recommended to retain as many different ideas as possible to evaluate the advantages of each. The City's Steering Committee and an independent expert panel retained by IBI recommended some additions and modifications to the draft mass transit scenarios, including additional transit elements.
- City I, II, and III land use assumptions and networks were defined and modelled, using the City's Regional Travel Model. After initial testing, refinements were made to some of the network and service frequency assumptions.
- The **City Plan Mass Transit Scenario Analysis** documented the transit-focused evaluation results for the refined versions of BAP and cities I, II and III. The intent of the evaluation was not to choose a scenario, but to identify which network elements worked together better than others, and the reasons why – such as how they connected and how they interfaced with the land use.
- A draft concept for a preferred network was generated based on the network elements that were 'most promising' from the technical assessment. This concept was included in The City Plan status updated provided to the City Council Urban Planning Committee in September 2019.
- Following The City Plan update to council, the mass transit network concept was developed in further detail and discussed with the Project Steering Committee. Modelling of an interim version of the mass transit network concept was carried out to inform the discussion of which elements would be part of the proposed mass transit network, which is presented in this report.

- Since the analysis results were driven more by the service assumptions rather than the technology used for modelling purposes for routes, the recommendations are mostly technology-neutral, except for approved and committed LRT extensions.

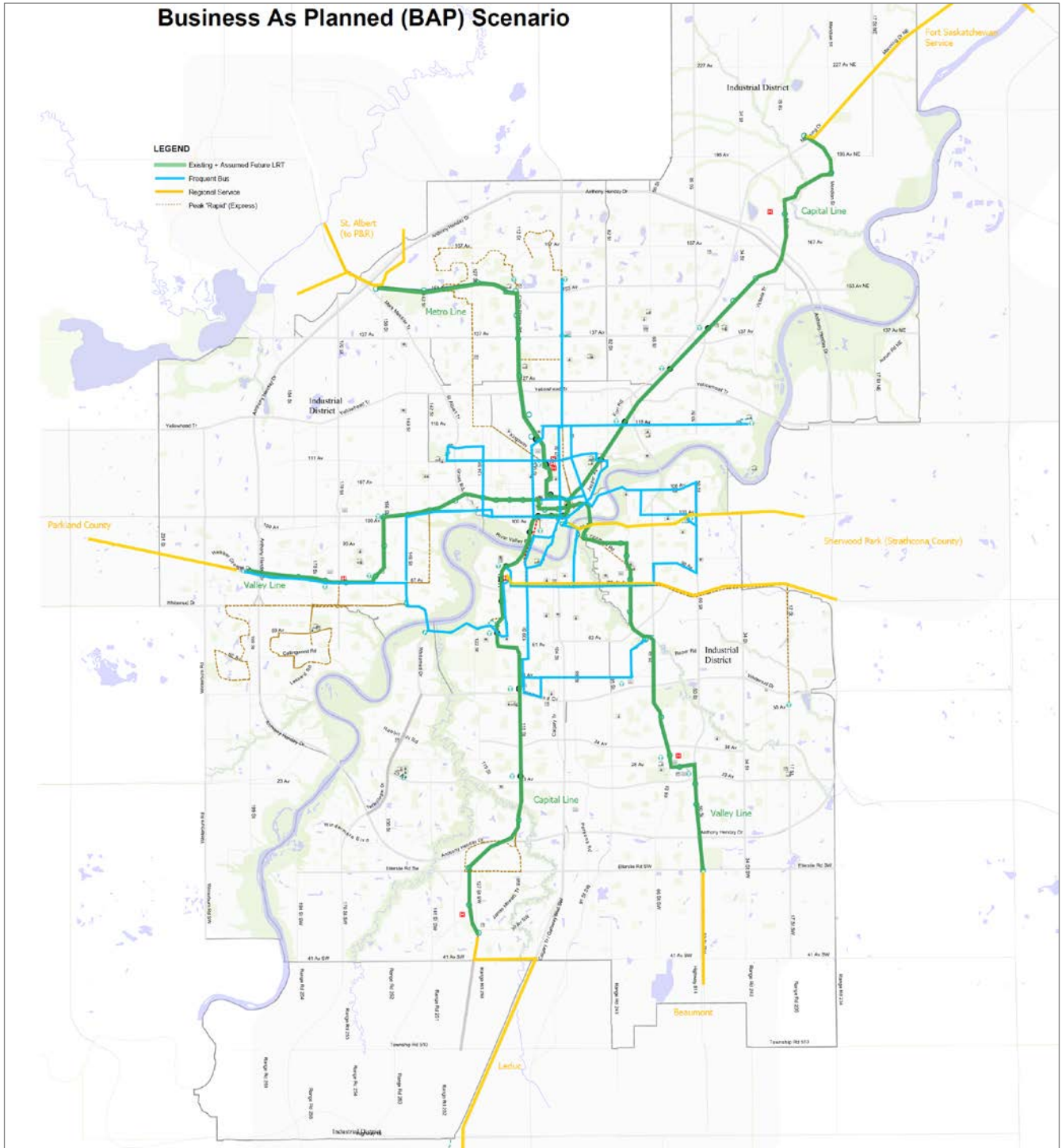
2.2 Business as Planned - BAP

The future BAP scenario transit network was the starting point for analysis, and includes the following major features:

- LRT network expansion: Routes assume provisional route structure incorporating approved LRT expansion and extending routes into developing and future growth areas. The following LRT line limits were assumed.
 - Capital Line LRT, from Heritage Valley to Energy Park;
 - Metro Line LRT, from Health Sciences to Campbell Road;
 - Valley Line LRT, from Lewis Farms to Ellerslie;
- Transit strategy **Bus Network Redesign**, using the assumptions and principles of the current (2018-19) initiative, which will go into service August 2020. This network is operated by ETS, and for the purpose of the BAP, it assumes a provisional route structure extending into future growth areas annexed in January 2019 and into parts of the developing areas.
- The transit service types embedded in the BAP and carried over to The City Plan mass transit scenarios testing are listed here. Some of the service characteristics would change for the proposed mass transit network, with levels of service adjusted to meet demand.
 - Light rail service that is similar to Capital and Metro lines would have frequencies of 10 minutes or less offering service from early morning to late night, or about 18-20 hours of the day.
 - Frequent Bus can run in major corridors in the inner areas near downtown with frequencies of 12 minutes or less, with similar 18-20 hours of daily service offering.
 - Crosstown Bus can operate along arterial roads to connect major destinations, however would not travel through downtown. The frequency and span of service would vary based on demand.
 - Local Bus can provide neighbourhood connectivity and coverage with frequent stops and connections to LRT and Frequent Bus routes. The frequency and span of service would vary based on demand.
 - Community Bus can provide more specific service connections to local destinations, with services targeted to serve seniors for example. The frequency and span of service would vary based on demand.
- Regional services based in the surrounding municipalities, including St. Albert, Fort Saskatchewan, Sherwood Park, Beaumont, Leduc County (Nisku), Devon, Leduc, Parkland County, Stony Plain and Spruce Grove.

Exhibit 2.2 shows the assumed LRT (dark green), regional routes (yellow), frequent bus (turquoise), and peak rapid express routes (brown) that form the backbone of the BAP transit network. In addition, the entire built-up area of Edmonton and the surrounding municipalities is served by local routes and regional connections. These routes were considered as part of the modelling analysis but are not shown in detail by the exhibit.

Exhibit 2.2: Map of Edmonton, Business as Planned (BAP) Scenario



2.3 Categories of Mass Transit Modes

In addition to building on the BAP network, the mass transit network provides as opportunity to bring together and categorize different mass transit modes. Exhibit 2.3 outlines the types of services that are included in the mass transit network, and explains their role or the primary market that they cater too as well as some examples of each type of service. Most of the services can be provided by more than one technology option (primarily rail and bus variations).

The exhibit also identifies:

- The range of typical operations usually seen with the different modes of transit operation for the regional, rapid and urban forms of mass transit. These are expressed in terms of stop spacing and frequency;
- The lengths of typical trips supported by the different forms of mass transit;
- The typical densities served and connected by the different forms of transit. This provides some guidance as to where the different forms of transit would usually find success in attracting enough passengers;
- Typical benefits and challenges associated with implementation and operation of each type of service. These are based on general practice in North America.

Exhibit 2.3: Mass Transit Modes, Technology Examples and Service Characteristics

Mode	Primary Trip Markets	Technology Examples	Typical Services	Trip Length (km)	Density (people + jobs/ha)	Benefits	Challenges
Regional Transit (Link Cities Together)							
All Day	<ul style="list-style-type: none"> Long commuter trips Long off-peak discretionary trips 	<ul style="list-style-type: none"> Passenger train Highway coach (Bus) 	<ul style="list-style-type: none"> Peak headway, 5 to 15 minutes 800 m to 4 km spacing 	>15	Varies by context	<ul style="list-style-type: none"> Competitive with auto for long trips Better mitigates peak hour congestion 	<ul style="list-style-type: none"> ROW can be costly given long distances Costly station parking & road improvements
Peak Only	<ul style="list-style-type: none"> Long commuter trips 	<ul style="list-style-type: none"> As above, but only commuter services 	<ul style="list-style-type: none"> Peak headway, 10 to 20 minutes 800 m to 4 km spacing 	>15	Varies	<ul style="list-style-type: none"> Better mitigates peak hour congestion Restricted service times lowers operating costs 	<ul style="list-style-type: none"> Does not serve non-work based trips well Costly station parking & road improvements
Rapid Transit (Support Cross-City Travel and Higher Density Development)							
Exclusive ROW	<ul style="list-style-type: none"> Long and intermediate distance trips, all times of day 	<ul style="list-style-type: none"> Subway Automated Train or Bus LRT or BRT in tunnel, trench or on structure Signal Pre-emption or Priority System at intersections 	<ul style="list-style-type: none"> Peak headway, 3 to 6 minutes 400 m to 2 km spacing 	5-15	>200	<ul style="list-style-type: none"> Very high capacity Can encourage densification 	<ul style="list-style-type: none"> High capital costs Space requirements
Semi-Exclusive ROW	<ul style="list-style-type: none"> Long and intermediate distance trips, all times of day 	<ul style="list-style-type: none"> LRT or BRT in exclusive path, but with intersections Integrated Transit Priority Measures (queue jumping, dedicated lanes, etc.) 	<ul style="list-style-type: none"> Peak headway, 3 to 10 minutes 400-800 m stop spacing 	5-15	100-200	<ul style="list-style-type: none"> High capacity at lower costs than exclusive ROW Can encourage densification 	<ul style="list-style-type: none"> Less reliable and potentially slower than exclusive ROW Space requirements
Limited Stop	<ul style="list-style-type: none"> Long and intermediate distance commuter trips 	<ul style="list-style-type: none"> Limited stop 'rapid' bus in bus lanes and mixed traffic Optional Transit Priority Measures (queue jumping, dedicated lanes, etc.) 	<ul style="list-style-type: none"> Peak headway, 5 to 12 minutes 400-800 m stop spacing. 	5-15	50-100	<ul style="list-style-type: none"> Reduced travel times attracts new riders Low cost, flexible route designs 	<ul style="list-style-type: none"> Reliability concerns due to mixed traffic Less impact on densification
Urban Mass Transit– (Convenient Access to Local Destinations)							
Frequent	<ul style="list-style-type: none"> Long and intermediate distance commuter Off-peak discretionary trips in major nodes and corridors 	<ul style="list-style-type: none"> Bus or streetcar/ tram in frequent/primary transit network 	<ul style="list-style-type: none"> Peak headway, 5 to 10 minutes Spacing same as currently done, 100-200m. 	<10	50-100	<ul style="list-style-type: none"> Extend reach of rapid services 	<ul style="list-style-type: none"> Operating costs need to be justified by demand Need many intersecting routes to work well

2.4 Mass Transit Network

The mass transit network builds on the BAP network, mentioned previously, by adding mass transit elements (identified in Section 2.3) and refining the service assumptions for the underlying local transit network. For the purposes of this study, some assumptions regarding technology type and specific route alignment on corridors were made in order to carry out the technical analysis. **It is critical to recognize that these assumptions should not be interpreted as final decisions on technology, alignment or station locations.** Furthermore, the network was not aligned with preliminary discussions around a proposed RTSC network although similar desire lines have been identified by both studies. Therefore, future planning and engineering work, along with discussions with the

Exhibit 2.4 shows the structure of the network, including the rail elements (LRT in green), semi-exclusive transit (shown in red), Airport Connection (in purple) and routes operating in mixed traffic (rapid bus in dark blue, frequent bus in light blue, and major regional routes in yellow). The following are the main highlights of the network:

- **Frequent.** These include 'F' routes from the BAP, with some refinements to service levels. Buses in these routes operate in mixed traffic, make all local stops, and operate at least once every ten minutes in the AM and PM peak and 15 minutes in the midday and early evening. The mass transit network includes more emphasis on denser areas, and several brand-new routes were added to intensify central area service. This approach was based on peer examples in other cities where the spacing of the frequent network was as close as 400 metres in denser areas. The routes encompassed mainly the central areas of the city.
- **Limited Stops.** These are limited stop routes, serving transit facilities, mass transit stations, activity nodes and other transfer points. They function as feeder routes but also support corridors. Buses on these routes are often larger and while they may operate in mixed traffic they run faster than typical buses because of the stop spacing. They are also sometimes sped up by allowing all-door boarding and providing transit priority measures (including HOV lanes, dedicated transit lanes, queue jumping) in busy corridors where these routes operate.
- **Semi-exclusive** - The network includes five semi-exclusive transit routes (red on the map). The transit vehicles on these routes are able to operate at the full posted speed of the corridor between traffic signals, as they run in dedicated/segregated lanes (or on tracks), and are not in mixed traffic. They do cross other traffic at intersections; however, these services are often sped along by transit priority measures and by having off-vehicle fare payment at the platform, to reduce dwell times. The mass transit network includes the following semi-exclusive routes:
 - A north-south route running between Castle Downs and Century Park District Nodes. This would use dedicated ROW (except for strategic segments where Bus/HOV lanes could be more appropriate) and would include a new direct connection (bridge) across the river between Downtown and Whyte Avenue.
 - An east-west route operating between West Edmonton Mall/Misericordia Major Node and Bonnie Doon District Node. This would include a new direct connection (bridge) across the river west of the University.
 - Three routes using a mix of dedicated and shared lanes in the north and west (B4), south (B5), and southwest (B6) parts of the city. Each of these connects to the other mass transit lines (such as the LRT lines) in at least two places. Where these operate in shared lanes, the design would be context-sensitive, and transit priority measures would be applied to produce fast travel speeds.

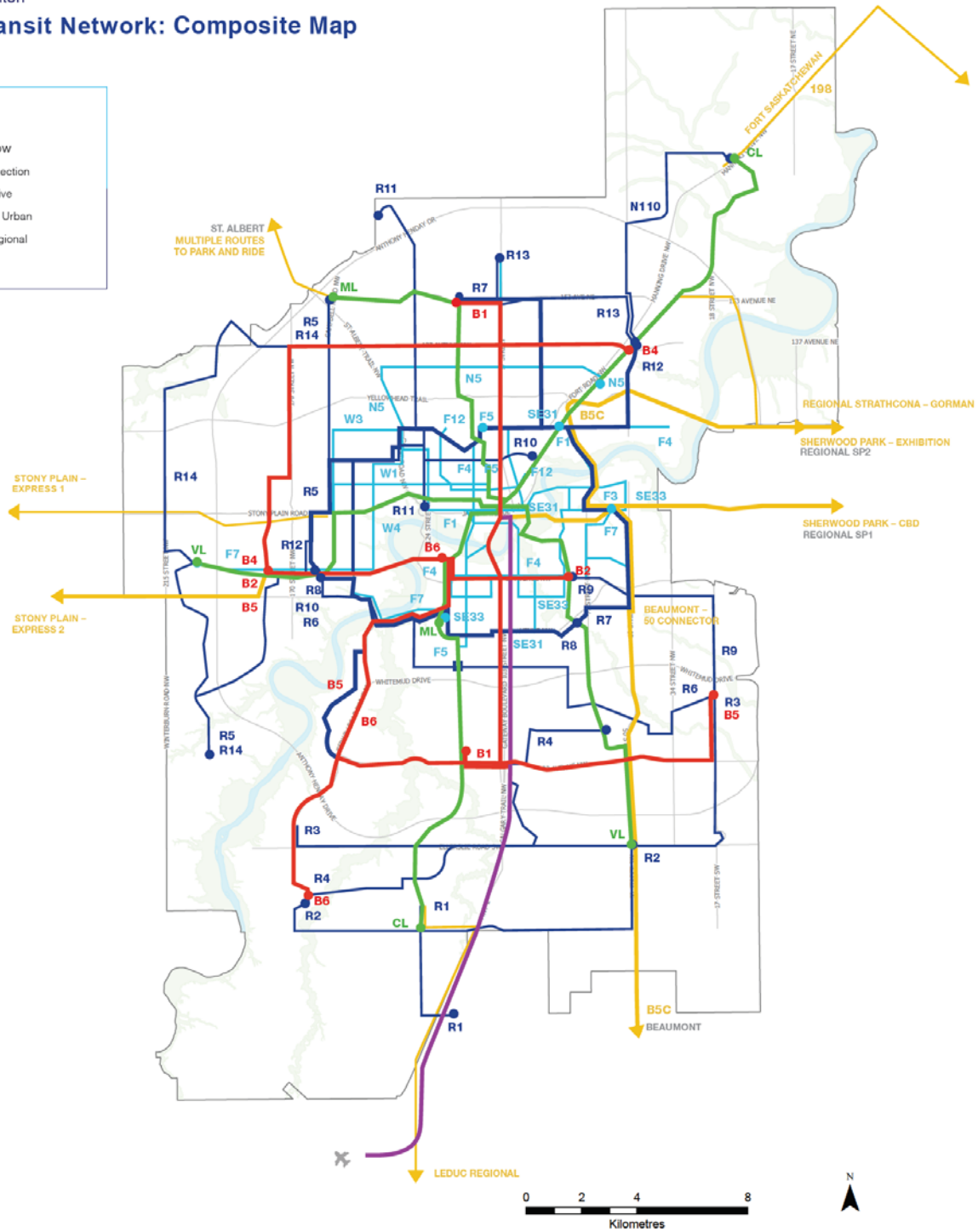
Exhibit 2.4: Map of Edmonton Mass Transit Network (MTN)

City of Edmonton

Mass Transit Network: Composite Map

Legend

- Exclusive ROW
- Airport Connection
- Semi-Exclusive
- Limited Stop Urban
- Frequent Regional
- Service



- **Exclusive ROW** – The network includes four exclusive transit routes encompassing mainly current and proposed LRT alignments and extensions (green) and a proposed airport connector (purple). Transit vehicles are able to operate at the full posted speed of the corridor between traffic signals, as they run in dedicated on tracks and are not in mixed traffic. A combination of infrastructure upgrades (grade separation) and technology (pre-emptive and priority signalling) are used to cross at traffic intersections. These services have off-vehicle fare payment at the platform, to reduce dwell times. The mass transit network includes the following exclusive ROW (as defined in this report) routes:
 - Capital Line LRT operating from Heritage Valley to Energy Park.
 - Valley Line LRT operating from Lewis Farms to Ellerslie.
 - Metro Line LRT operating between Campbell Road (St. Albert Park and Ride) and South Campus. The mass transit network assumes measures such as grade separation are in place to permit 24 trains per hour, per direction, to cross University Avenue. (This extension adds service capacity at the busiest point in the LRT system and is discussed later in the report)
 - The **Airport Connection** is assumed to operate between a grade-separated station downtown – with walk connections to mass transit lines nearby – and an elevated station at the airport terminal entrance. This line is proposed to ultimately follow the CP railway corridor and remain east of Calgary Trail/Gateway Boulevard until near the Airport. Intermediate stations would allow for connections to other bus routes. Of special note, stations would be included at 23 Avenue and Whyte Avenue.
- **Regional bus services** were carried over from BAP, representing future versions of existing services. Three new express services have also been defined. Two connect the Sherwood Park and Bremner areas to Exhibition District Node and Gorman; and a third running on 50 Street, connecting Exhibition District Node and Beaumont. Several other regional connections to Stony Plain/Spruce Grove, Fort Saskatchewan, St. Albert and Leduc have also been identified.

In addition to the services identified in the mass transit network, local and other regional transit services within Edmonton and in the surrounding municipalities were considered as part of this study. These were carried over from the BAP scenario, with some adjustments to service levels to meet projected future demands. Routes in this group would provide first-last mile and connective functions to local destinations that are not situated in the major nodes and corridors and therefore not part of the mass transit network

To help organize these families of services, they have been split into two functional groups. They are described in this fashion and in further detail in the next sub-sections, and Section 4 reports on some of their characteristics using the same groupings. Most of the higher-demand or longer routes are included in the City-wide Routes, while the rest are referred to as District Routes. Nevertheless, they all work together, along with the underlying transit services, to provide mobility to residents of Edmonton and the rest of the Metropolitan Region.

2.5 City Plan Land Use – Nodes and Corridors

The City Plan includes a land use concept that envisions development to occur through intensification of existing communities (infill and redevelopment) and through greenfield development in future communities. As a result, the population and employment in The City Plan land use concept is strategically allocated around a network of nodes and corridors.

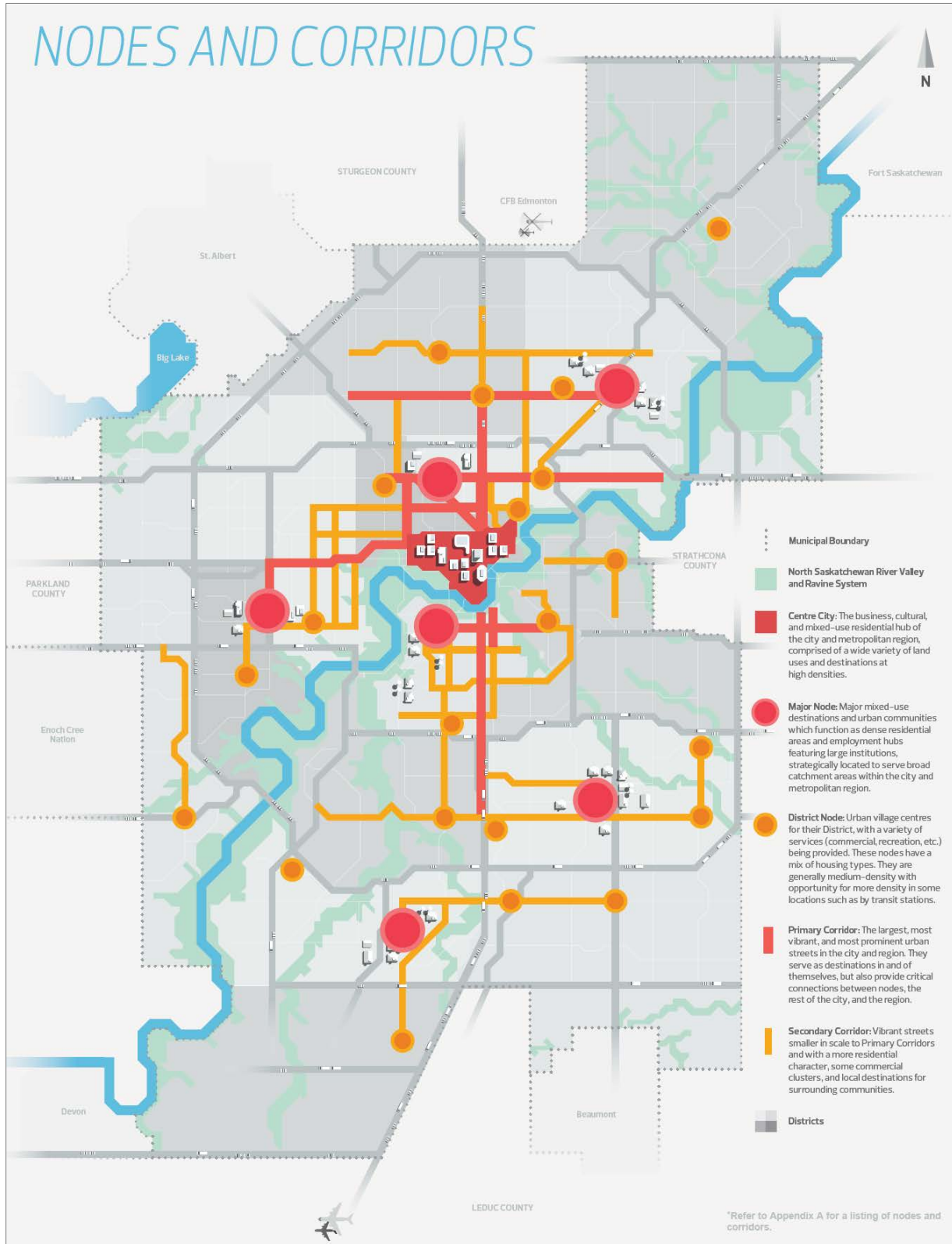
The node and corridors network was developed concurrently with the exploration of mass transit options during this study resulting in the mass transit network and the network of nodes and corridors being integrated with one another. Many of the more promising routes in the mass transit network correspond to the nodes and corridors that would benefit the most from enhanced transit connectivity. It is important to note that each node and each corridor in The City Plan has some form of mass transit serving it.

Exhibit 2.5 illustrates the nodes and corridors network included in ***The City Plan***. As shown by the map, there are different hierarchies to the nodes and corridors:

- Centre City Node.
- Major Node.
- District Node.
- Primary Corridor.
- Secondary Corridors.

In the following sections, the names of the nodes and corridors are referred to in the descriptions of the future transit routes serving them. The names are consistent with those used in The City Plan and can be found Appendix A. Appendices A.1 and A.2 form an inventory of the conceptual transit routes and identify the nodes and corridors each route would connect, accompanied by reference maps in A.3 (districts) and A.4 (nodes and corridors).

Exhibit 2.5: City Plan Nodes and Corridors



Source: City of Edmonton.

2.6 City-wide Routes Concept

City-wide Routes – Defining Characteristics

These routes provide mass transit service that is fast and reliable facilitating city-wide mobility for Edmonton. These routes encompass the “backbone” of public transit for the city. Building on the LRT network, these routes create city-wide mass transit circuitry connecting all quadrants of the city and major nodes using rapid and frequent service. Within the city-wide network are all the exclusive and semi-exclusive routes along with strategic limited stop and regional routes that provide key cross town travel. Additionally there are transit river crossings that provide priority access for mass transit to connect areas of the city across the North Saskatchewan River.

This network will ultimately be characterized by high quality stops and stations, wide stop spacing, segregated right of way -- or at a minimum transit priority measures-- for transit vehicles, with efficient transfers between services, and all-day service every 10 minutes or better (5 or better in the peaks) creating a reliable journey for travellers. Service levels on the regional routes and airport connection are less frequent than the city-focused elements, but represent a fairly high level of service for longer-distance routes.

A description of the individual routes and some of their important characteristics follows the map and is again summarized in a table format in Appendix A.1.

2.6.1 Exclusive ROW Routes

This routes categories includes services that are proposed to operate at very high frequencies during the peak periods, with headways between vehicles as low as 3 to 5 minutes in each direction. This level of service tends to be provided for only a handful of transit services, based on passenger demands in busy corridors. Vehicles are typically multiple units joined together, with higher passenger carrying capacities. The exclusive ROW for these routes allows them to operate with no to minimal interference from cross traffic, and achieve similar or higher speeds than parallel traffic. These routes encompass mainly the proposed LRT network build out with recommended end points that were determined through this study.

Metro Line (LRT): Campbell Road –South Campus

The Metro Line (ML) connects north-south from Campbell Road to South Campus connecting the following nodes and corridors: Castle Downs, 137 Avenue, Blatchford-NAIT-Kingsway, Centre City and University/Garneau utilizing an exclusive ROW (as defined in this study).

Within city limits, the Metro Line terminates at Campbell Road. The potential for extension of the LRT into St. Albert should be subject to regional discussion; however analysis shows that demand can be accommodated by other categories of mass transit. Peak demand of combined bus routes inbound/outbound to Campbell Road LRT was <1500 passengers. To the south the proposed terminus to the Metro Line is South Campus. Analysis showed that extending it this far south provides capacity relief for the Capital Line. This is further discussed in section 4.4.2.

Capital Line (LRT): Energy Park – Heritage Valley District Node

The Capital Line (CL) connects North-South from Energy Park to Heritage Valley district node connecting the following nodes: Horse Hill, Clareview, Exhibition, Stadium, Centre City, University/Garneau, Southgate, Century Park, Heritage Valley and several important corridors.

This line currently has the highest peak passenger volumes and is expected to grow. One of the issues identified with the BAP scenario was a lack of parallel capacity, which meant that many transit passengers from the south and southwest parts of the city were relying on this route. The mass transit network provides alternatives, including the B1, B6 routes (described in the next section) and an Airport Connection which shows positive results in ridership uptake and relief for the Capital Line. The benefits of this are illustrated in more detail in Section 4 in particular.

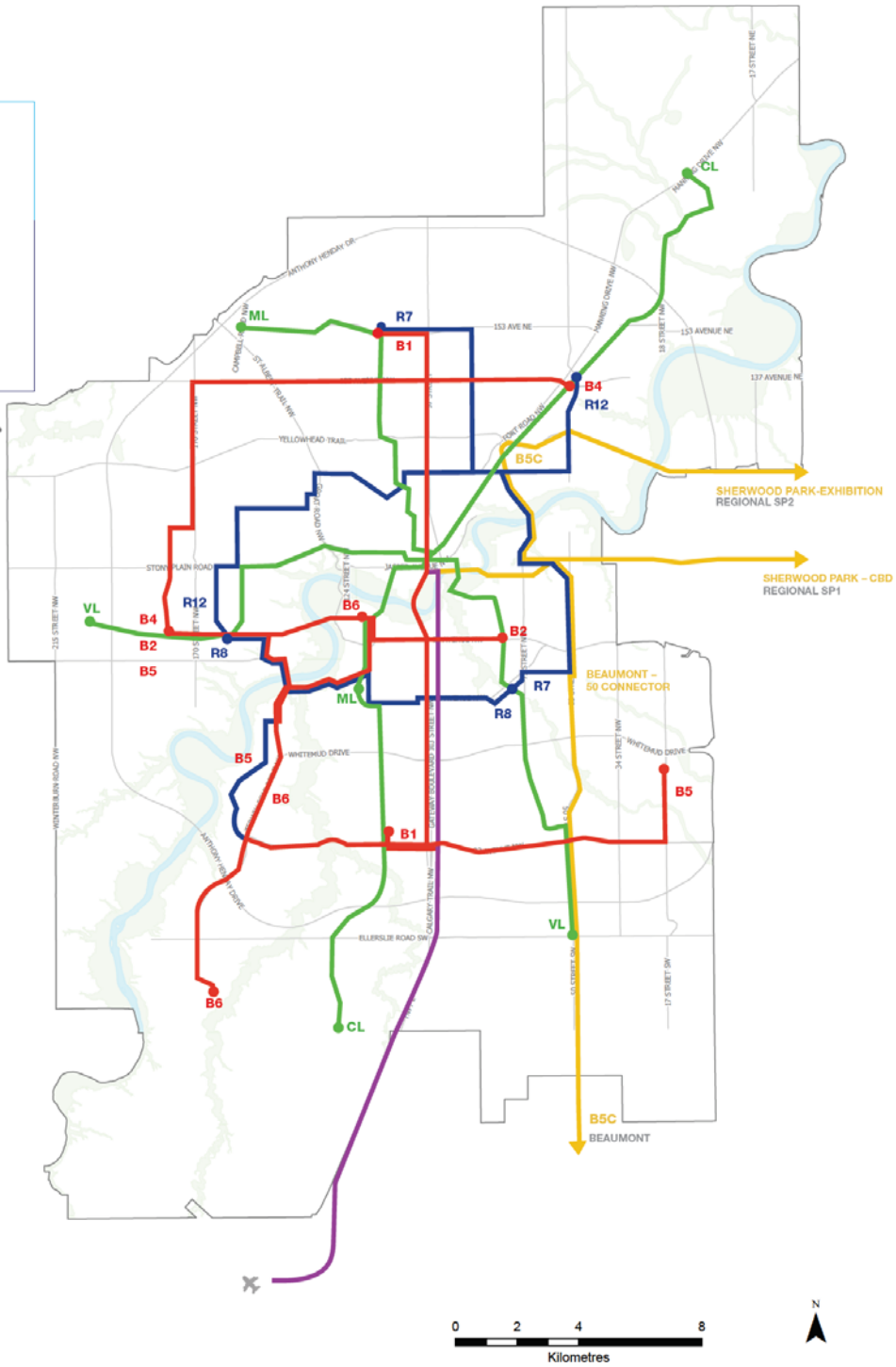
Exhibit 2.6: Map of Edmonton Mass Transit Network (MTN) – City-wide Routes

City-wide Routes

Legend

- Exclusive ROW (i.e. LRT)
- Airport Connector (i.e. Bus or Rail)
- Semi-Exclusive ROW (i.e. BRT)
- Limited Stop (i.e. Bus)
- Regional Service (i.e. Coaches)
- Terminus for Transit Route
- CL Capital Line
- ML Metro Line
- VL Valley Line

Note: Routes are representative and reflect initial results of demand modelling, in response to future population (city of 2 million) and employment projections. Refinement would take place as a step in project planning.



Valley Line (LRT): Lewis Farms – Charlesworth District Node

The Valley Line (VL) connects West to Southeast from Lewis Farms to Ellerslie Road (Charlesworth District Node) connecting the following nodes and corridors: Charlesworth, Mill Woods, Bonnie Doon, Centre City, Stony Plain Road, Meadowlark, West Edmonton Mall/Misericordia.

This LRT line will be using low-floor technology and will be more integrated into the urban fabric of the areas it serves, in particular the portions on 102 and 104 Avenue in the Centre City. While much of the LRT line can easily be characterized as 'rapid transit' due to higher speeds, the street-running portion of this line will generally be subject to speeds more like typical traffic (in the 40-50 km/hour range between stations). This is still a significant step up from typical street-running transit, because it will feature a dedicated running way and will make use of traffic signal priorities to balance demand by different modes at high volume intersection crossings. This higher level of service is what categorizes the in-street and grade-separated portions of this line as 'rapid transit'.

The portion of the line between the initial southeast terminus at Mill Woods and the provisional end of the line at Ellerslie Road is the assumed alignment and set of stations but this has not been fully committed.

When operational, it is expected that some of the existing inter-municipal transit operations would shift from their current configurations to connect with the Valley Line (i.e. Beaumont, Spruce Grove, and Parkland County) at key stations in the southeast and western extents of this line.

Airport Connector: Centre City (Downtown) – Edmonton International Airport

This proposed route would provide regional and intercity travel to the Airport, connecting with other services including the Metro Line, Capital Line, Valley Line and other City-wide routes (B1, B2, R8, B5, and R3 (described in the next section). Stops would be every 3-4 km in general (with possible shorter spacing within dense urban areas), to allow for higher speeds, and stations farther out from the centre could include bus transit loops and park and ride facilities. Additionally, an airport connector would provide a connection north from the continued growth of the southeast and southwest. Therefore, a connection to the Centre City node (including an exclusive river crossing) will provide an additional option for travel north to Centre City. While the service considers use of the CP rail corridor, or operations adjacent to it, that concept may not be immediately feasible given other uses of the freight corridor and objectives of the railway company. Partnership with the Province would be required for the development of the Airport Connector. Feasibility of the route would be improved if the Airport Connector were to be incorporated as part of a potential intercity transit corridor between Edmonton and Calgary.

An interim solution may be available to provide coverage by extending bus services using the B1 (described in next section). However, the Airport Connector is proposed to stop less often, and operate less frequently due to lower demand to and from the airport. Therefore, a service plan would likely need to be developed for the B1 to only serve the airport on certain trips. Because this route extends well beyond the city to EIA, there may arise challenges with operational reliability. In addition, operating bus service with stops along the Queen Elizabeth Highway Highway 2 may also require a provincial partnership.

2.6.2 Semi-Exclusive ROW Routes

This family of mass transit routes includes services that are proposed to operate at very high frequencies during the peak periods, with headways as low as 3 to 4 minutes in each direction. This level of service tends to be provided for only a handful of transit services, based on passenger demands in busy corridors.

There is precedent for this level of service in other Canadian cities on certain high-demand surface routes, such as the King Streetcar in Toronto, and the 99 B-Line bus in Vancouver. These are operated as close as 2 minutes apart. This level of service tends to require transit priority measures and/or sufficient space at busier stops and stations for more than one vehicle, since the close spacing of service means that delays tend to cause the vehicles to bunch together periodically. One of the major benefits of this level of service is that passengers come to count on it without the need to consult a schedule, as the next vehicle is almost always within sight. In Edmonton, similar tactics would be required to support these routes.

B1 Route (BRT): Castle Downs District Node – Century Park District Node

B1 is a proposed semi-exclusive transit route operating north-south from the Castle Downs district node to the Century Park district node connecting the following nodes and corridors: Northgate/Northtown, 97 Street, Centre City, Whyte Avenue, Gateway/Calgary Trail. The route would primarily utilize 97 St/101 Street and Gateway Boulevard/Calgary Trail and will require an exclusive river crossing from the Centre City to Whyte Avenue.

The B1 service would stop every 1 to 1.5 km along its route and provide connections to numerous other elements of the mass transit network as well as the underlying network of other bus transit services. This adds significant north-south high-capacity frequent service to denser parts of the urban area. In its early stages of implementation, this route could potentially feature a branch of service where a subset of the buses (due to less demand) continues south to Edmonton International Airport.

The downtown section of this route was assumed to use bus or HOV lanes given that the streets it follows are physically constrained and spot widening, even to create medians without adding more lanes, could compromise sidewalk widths and affect access to this route. The northern section of this route, on 97 Street, is consistent with previous City (*High Speed Transit, 2004*) and Regional studies (*Capital Region High Occupancy Vehicle/Transit Priority Study, 2016*) indicating a desire for this corridor.

The dedicated river crossing included in this route proposal may be a new facility (bridge) or the future expansion (or repurposing) of existing bridges to create dedicated transit-only space.

As documented in Section 4 of this report, B1 is high-demand route with peak passenger volumes approaching those of the LRT lines.

B2 Route (BRT): WEM/Misericordia Major Node – Bonnie Doon District Node

B2 is a proposed route crossing east-west from WEM/Misericordia Major Node to Bonnie Doon District node connecting the following nodes and corridors: Meadowlark, University/Garneau, Whyte Ave/99 Street and Gateway/Calgary Trail in a semi-exclusive ROW (including an exclusive bridge crossing west of the University).

Long-term demand warrants further exploration of the river crossing connection, not only determining potential financial costs but also social and environmental costs associated with this option. Alternative improvements to support less direct routes via Whitemud Drive and possibly Fox Drive should be considered as part of a possible interim service for this route.

Similar to the B1 route, the B2 route is a high-demand route with peak passenger volumes approaching those of the LRT lines.

B4 Route (BRT): Clareview Major Node – WEM/Misericordia Major Node

B4 is a proposed route operating crosstown from WEM/Misericordia Major Node to Clareview Major Node connecting the following nodes and corridors: Londonderry, Northgate/Northtown, 137 Avenue travelling through northern and western Edmonton, primarily on 137 Avenue (east-west) and a combination of 170 and 178 Street (north-south). Depending on the nature of travel delay hot spots on this corridor, then this route might operate in a combination of semi-exclusive

lanes in more congested portions, and in mixed traffic with strategically located transit priority features for the remainder.

Before implementing this route, the north-south portion in particular will warrant further investigation of options along with the proposed R5 (described in next section). As currently defined in the plan, R5 includes north-south service on 156 Street and 163 Street, with similar demand as the parallel service offered by B4. The ultimate configuration of these two routes may follow the defined routes, switch route segments between 137 and 87 Avenue, or other refinements that may be identified during project implementation.

B5 Route (BRT): WEM/Misericordia Major Node – Meadows North District Node

B5 is a proposed route making limited stops, operating in a primarily east-west orientation across the southern part of Edmonton primarily serving along Riverbend Road, Terwillegar Drive and 23 Avenue. The route termini are WEM/Misericordia Major Node and Meadows District Node connecting the following nodes and corridors: Meadowlark, Century Park, South Common - Research Park, Mill woods, and Meadows South.

It is expected that this route will evolve over time to operate mostly in semi-exclusive ROW, such as bus-only lanes crossed by other traffic at intersections. Portions of the route where traffic delays are a lesser concern, or dedicated lanes might not fit the context, could operate as rapid bus in regular lanes with some strategic use of transit priority measures where warranted. In exhibit 2.4 and 2.5, this is shown as a combination of these two alignment types (red and blue), and it is anticipated that Riverbend Road (blue) is a more likely rapid bus segment.

B6 Route (BRT): University/Garneau Major Node – Rabbit Hill

B6 is a proposed route servicing south-west Edmonton, using dedicated lanes on the Terwillegar Expressway to serve stations at major cross streets. The map shows an assumed route via Fox Drive, which allows for the route to serve a shared station (with B5) at 53 Avenue. Based on the analysis carried out for this study, this is the higher-demand variation of this route. This route was found to perform well provided that service to either the University/Garneau area or Whyte Avenue was provided directly without the need for an additional transfer to these areas.

However, as indicated in public presentations for the Terwillegar Project, a final busway routing north of Whitemud Drive has not been selected and an alternative using 122 Street will also be under consideration. While initial results suggest this other routing may have lower demand, there will be other considerations in selecting a preferred alternative.

2.6.3 Rapid Limited Stop (Buses) and Regional Services (Buses)

RapidBus12 (R12): Meadowlark District Node – Clareview Major Node

R12 is a proposed rapid transit route operating east-west with limited stops between Meadowlark district node and Clareview major node. The route travels primarily along 118 Avenue, with a north-south section on 163 Street. This route had strong ties to land use, with ten nodes and corridors along its proposed route including the following: 124 Street, Blatchford-NAIT-Kingsway, 97 Street, 118 Street, and Exhibition.

RapidBus7 (R7): Castle Downs District – Davies Mass Transit Station

R7 is a north-south cross town rapid route connecting multiple development nodes and corridors, and linking them to a variety of mass transit routes. This route is proposed to follow 153 Avenue, 82 Street, Wayne Gretzky Drive and 50 Street and would include limited stop spacing. This route was assumed to operate paired with R8, which would also terminate at Davies LRT station on the Southeast Valley Line.

RapidBus8 (R8): Meadowlark District Node – Davies Mass Transit Station

This service would form part of a ring around the central part of the city, along with the B4 and R7 routes. This segment is proposed to serve as an east-west connection from Meadowlark District Node through 63 Avenue corridor and have limited stop spacing.

Beaumont-50Street-Exhibition (B5C): Beaumont – Exhibition District Node

This route is identified as a regional connection due to the southern portion operating in the City of Beaumont. Trips from Beaumont are partially oriented towards the southern end of the Valley Line, but many also continue north along 50 Street. The primary markets served by this route are crosstown travel to and from the Exhibition district node and trips to and from employment areas along 50 Street and in Capilano. The B5C route concept may represent two future routes, one that serves the regional trips, and another that focuses on the crosstown service, operating as a rapid route.

Sherwood Park (Reg. SP 1/1A): – Sherwood Park – Centre City Node

This proposed route will connect Sherwood Park to Downtown with limited stop service via Capilano or Bonnie Doon. Further connections can be made to proposed services such as the R8, B5C, Valley Line, Metro Line, Capital Line, B1, and Airport Connector. It will require planning and coordination with Strathcona County and the Regional Transit Services Commission (RTSC) in order to incorporate regional travel into the mass transit network. This route is a future version of existing Strathcona County services, based on review of the potential transit demand into central Edmonton.

Sherwood Park (Reg SP 2): Sherwood Park – Exhibition District Node

Planning for this route will require coordination with Strathcona County and the Regional Transit Services Commission (RTSC). This is a proposed future service that provides a more direct option for parts of Strathcona County to connect to the mass transit network. Exhibition District node was chosen due to its relative proximity to the Yellowhead Highway, and it allows for connections in several directions (not just to the Centre City) on the transit network. Additional development in Bremner is assumed to be required to support this line.

2.7 District Routes Concept

District Routes - Defining Characteristics:

These routes provide mass transit service that enables frequent and rapid mobility between and within districts. Additionally, this network will play a critical role in supporting the City-wide routes by providing direct connections thereby further enabling cross-city travel through public transit. Ultimately, this network provides all-day 10-15 minute frequent service and creates seamless connectivity to the City-wide routes. Stop spacing will vary within this network, with higher-speed routes having stops 1km or more apart, and routes in denser corridors stopping every 400-500 metres.

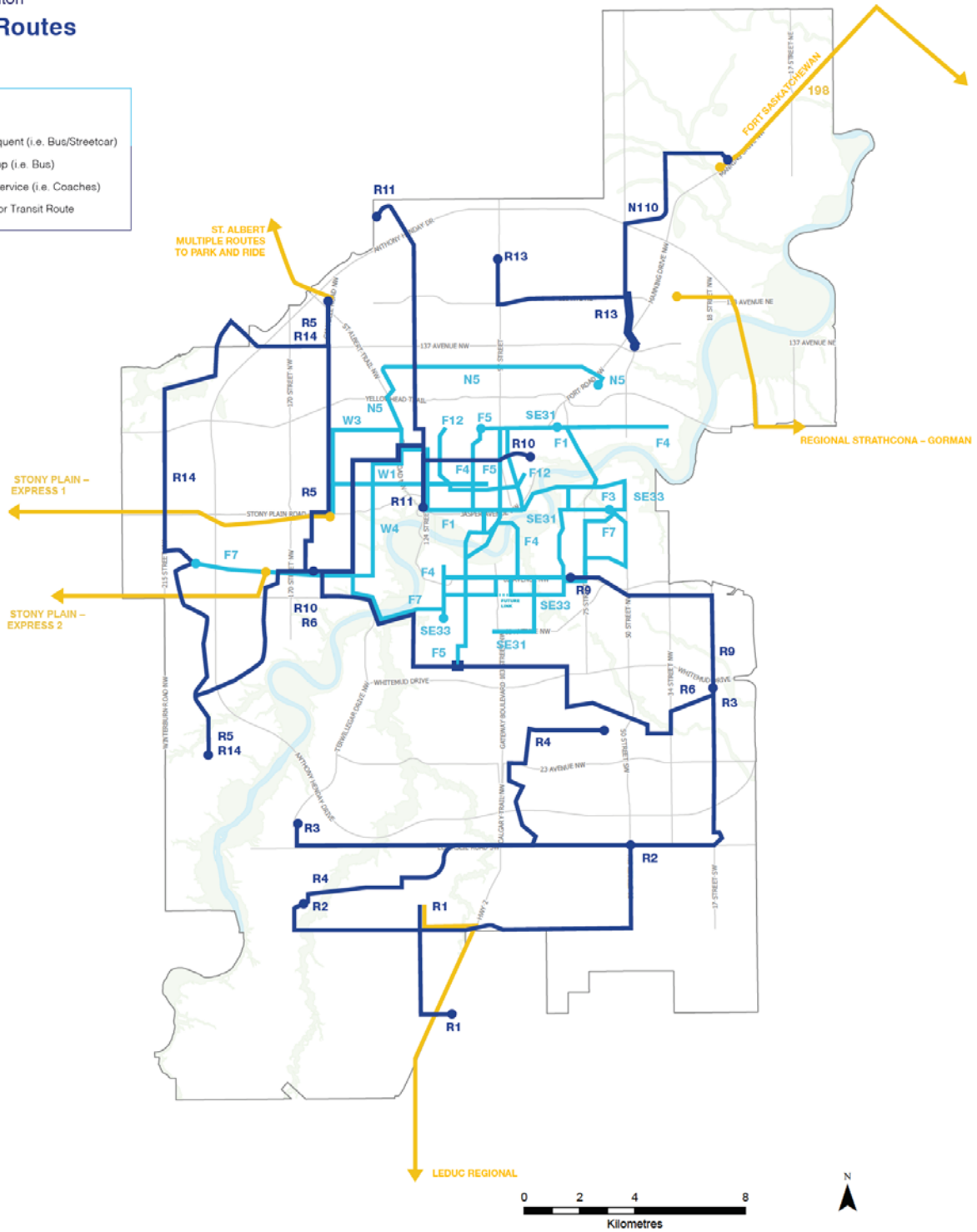
Exhibit 2.7 provides a visual guide to this family of services. A description of the individual routes and some of their important characteristics follows the map and is again summarized in a table format in Appendix A.2.

Exhibit 2.7: Map of Edmonton Mass Transit Network (MTN) – District Routes

City of Edmonton
District Routes

Legend

- Urban Frequent (i.e. Bus/Streetcar)
- Limited Stop (i.e. Bus)
- Regional Service (i.e. Coaches)
- Terminus for Transit Route



2.7.1 Rapid Limited Stops (Buses)

RapidBus1 (R1): Heritage Valley Major Node – Airport Connector

The purpose of R1 is to provide a linkage from the proposed Airport Connector. R1 would have one terminus at a rail or bus station along the Airport Connector, serve the New Southwest district node, and connect to the end station of the Capital Line at Heritage Valley. This line helps to connect trips between southwest Edmonton and the Airport without further extension of the LRT past Heritage Valley. The overall number of boardings is relatively low due to the short length of this route, however; the average number of boardings per km served is above average for this group of routes.

RapidBus2 (R2): Rabbit Hill – Charlesworth District Node

R2 is a proposed rapid service supporting the newer parts of southern Edmonton between Rabbit Hill and Charlesworth District Node with connections to several undeveloped nodes and corridors. Its good ridership is a result of providing key linkages to the planned B6, Capital Line, R3, Valley Line, and B5C routes.

RapidBus3 (R3): Windermere District Node – Meadows North District Node

R3 is a proposed rapid route operating west-east between Windermere and Meadows district nodes. It will connect several development nodes as well as the Ellerslie Road corridor in the southern part of the city. Further into the future, there could be potential for this route to be extended via mixed traffic to the Riverview area west of the river, depending on how travel patterns evolve in the future.

RapidBus4 (R4): Rabbit Hill – Mill Woods Major Node

The R4 is a proposed rapid service following east-west primarily along 28 Avenue SW, Ellerslie Road, Parsons Road, and 34 Avenue connecting Rabbit Hill with Mill Woods major node. It supports connections between some key nodes and corridors that are not otherwise connected or connected well, such as South Common and 34 Avenue.

RapidBus5 (R5): Campbell Road – Riverview Centre District Node

The R5 is a north-south route connection from Campbell Road to Riverview Centre district node going mainly along 156 Street, Lessard Road, and 199 Street. It serves key linkages to the Metro Line, B4, R12, Valley Line, B2, and B5. This route appears to serve two travel markets, one from Riverview to WEM/Misericordia major node, and the other along 156 Street to Campbell Road. As noted in the description for B4, this route should likely be evaluated in conjunction with it to determine an optimal joint configuration for the two.

RapidBus6 (R6): Meadowlark District Node – Meadows North District Node

The R6 is a proposed rapid route going east-west between Meadowlark District Node and Meadows North District Node primarily along Whitemud Drive, 51 Avenue, and 38 Avenue. Design for this service will consider its potential relationship with crosstown service on Whitemud Drive and with local services in the eastern part of Mill Woods.

RapidBus9 (R9): Bonnie Doon District Node – Meadows North District Node

R9 is a proposed east-west rapid route between Bonnie Doon district node and Meadows North district node primarily along 82 Avenue, 76 Avenue, and 17 Street. It would provide key linkages to the B2, Valley Line, B5C, R3, and B5 routes. There may be sufficient demand for this route to connect to downtown in the future, possibly in combination with part of another District route, particularly in the peak periods.

RapidBus10 (R10): Meadowlark District Node – Stadium District Node

The R10 is a proposed rapid route running east-west between Meadowlark district node and Stadium district node primarily along 149 Street and 111 Avenue. It provides linkages to R12, R8, Valley Line, B2, Metro Line, B1, and the Capital Line. It also provides a core connection to nodes and corridors immediately north of Centre City including several of the first horizon land use priorities. As such, it is one of the better performing peak and off-peak rapid limited stop routes.

RapidBus11 (R11): Goodridge Corners – 124 Street Primary Corridor

This North-South rapid route connects Goodridge Corners and 124 Street Primary Corridor with linkages to Metro Line and Valley Line. An initial version of this route might consider the southern segment of the route first.

A future version of this route may include extension across the river to provide a direct (perhaps non-stop) connection to University-Garneau Node; however, this was not assumed as initial testing of routes over the Groat Road bridge suggested only modest demand.

RapidBus13 (R13): 97 Street Secondary Corridor – Clareview Major Node

The R13 is a proposed rapid route between the north section of 97 Street corridor and Clareview major node travelling along 153 Avenue. This transit service can provide linkages to the B1, B8, R12, Capital Line, and B4 routes.

RapidBus14 (R14): Campbell Road – Riverview Centre District Node

The R14 is a proposed north-south rapid route connecting Campbell Road to Riverview travelling mainly along 137 Avenue, Winterburn Road/199 Street. Key transit connections include B4 and the Valley Line. Due to its length, this concept might include one route north of Lewis Farms and another to the south.

Rapid Bus N110 (R110): Energy Park – Clareview Major Node

Route R110 is a proposed future rapid bus connection into the northeast employment district, with termini proposed at the Clareview major node and the Energy Park. It would also provide service to residential areas along 50 Street north of Clareview major node. There may be opportunity to interline this with regional service between Energy Park and Fort Saskatchewan; given the likely difference in service frequency this might be achieved by having some buses 'short turn' at Energy Park while other buses are through-routed.

2.7.2 Regional Services

Leduc Regional: Leduc – Heritage Valley Major Node

This proposed regional service is meant to provide key connections to the Airport Connector and Capital Line, and is the assumed future version of an existing route between Leduc and Century Park. The future route is expected to follow 41 Avenue SW and Queen Elizabeth Highway 2; however, planning for this route will require coordination with the Regional Transit Services Commission (RTSC) for the final selection.

Regional Strathcona - Gorman: Sherwood Park – Gorman

This proposed north-south route will connect the Gorman area and Bethel Sherwood Park travelling along 153 Avenue-Anthony Henday Drive, Yellowhead Trail, and Sherwood Park Drive. This route will require coordination with Strathcona County and the Regional Transit Services Commission (RTSC) for the final selection.

Fort. Sask. 198: Fort Saskatchewan – Energy Park

This northeast proposed regional route connects Energy Park with the Fort Saskatchewan along Highway 15 and various corridors in Fort Saskatchewan. It represents a future version of existing service between Fort Saskatchewan and Clareview LRT station. This service is likely subject to coordination with the RTSC.

Depending on how this route is operated in the future, there is potential for it to have timed transfers with the N110 rapid service, or partial interlining.

Stony Plain Express 1: Stony Plain/Spruce Grove – Stony Plain Road Primary Corridor

This proposed regional route would serve east-west regional connections between Jasper Place and Stony Plain/Spruce Grove travelling along Highway 16A, Stony Plain Road, and 100 Avenue. This transit route would also connect to City-wide routes B4 and R12. The proposed routing via Stony Plain Road was forecast to produce higher demand than an option to connect at Lewis Farms.

Stony Plain Express 2: Stony Plain/Spruce Grove – WEM/Misericordia Major Node

Stony Plain/Spruce Grove Express #2 was evaluated as a regional express service with limited stops, mostly in the Town of Stony Plain, with a connection into Edmonton via Whitemud Drive to the WEM/Misericordia major node. Other possible endpoints of the route could include Lewis Farms LRT Station. The WEM option was selected to represent the concept because it was estimated to produce the highest transit ridership.

A similar route could be considered by the Regional Transit Service Commission (RTSC), and implementation would be coordinated through them and other regional stakeholders. This route has the potential to also make an interim stop or have a service branch to Enoch Cree Nation.

St. Albert (various routes) – Park and Ride: St. Albert – Campbell Road Park and Ride

The east-west regional service proposed for St. Albert would connect via St. Albert Trail and to Campbell Road Park and Ride. This concept is actually the combination of multiple routes circulating within St. Albert and then continuing to the future LRT station.

While the forecast demand is within the ability of the bus services to carry it, potential extensions of the Metro Line LRT beyond city limits would be a regional consideration. Extending the route beyond Campbell Road would have partnering implications.

2.7.3 Urban Frequent Routes

The names of the urban frequent are indication of where they are located within the city. Routes passing through the centre of the city have the 'F' designation carried over from the upcoming BNR, while N, SE, SW, and W routes extend into city quadrants.

F1 Route: Westmount District Node – Exhibition District Node

The proposed F1 east-west route connects the Westmount and Exhibition district nodes travelling mainly along 124 Street, Jasper Avenue, 97 Street, and 118 Avenue. Additional key linkages include the R12, Valley Line, Metro Line, Capital Line, Airport Connector, B1, B5C, R8 routes. This is a future variation of the F1 route identified in the BNR.

F3 Route: Centre City – Capilano District Node

The proposed F3 east-west route connects Centre City to Capilano district node travelling mainly along Jasper and 98 Avenue. Additional key linkages include the R8, B5C, B1, Airport

Connector, Metro Line, Capital Line, Valley Line routes. This is a future variation of the F3 route identified in the BNR.

F4 Route: University Major Node – 118 Avenue Primary Corridor

The proposed F4 is an S-shaped route to connect University Station and the east limit of 118 Avenue primary corridor travelling mainly along 82 Avenue, 99 Street, Jasper Avenue, 109 Street, and 118 Avenue and it expected to serve nodes and corridors well for urban service. It would provide further linkages to the B6, B2, Metro, Capital, Valley Line, B1, Airport Connection, R12, B5C, and R8 routes. This is a future variation of the F3 route identified in the BNR.

F5 Route: Blatchford-NAIT-Kingsway Major Node – Southgate District Node

The proposed F5 is a north-south route travelling mainly along 101 Street, 105 Street/109 Street. It will provide linkages to the Capital Line, B2, Metro, Valley, B1, R8, and R12. Since nearly all of the boardings on this route come from the southern end, a previous northern segment between 118 Avenue and Eaux Claires has been eliminated. That section of the previous F5 route did not compete well for riders once B1 and other local service were in place.

F7 Route: Lewis Farms – Capilano District Node

The proposed F7 east-west transit service between Lewis Farms and Capilano travels mainly along 87 Street, Whitemud, Fox Drive, 114 Street, and 82 Avenue. It provides linkages to the Valley Line, B4, B2, B5, R12, R8, B6, Capital Line, Metro Line, Airport Connector, R8, and B5C. Despite competing with other mass transit network services along much of its length, this route is fairly attractive to passengers. It serves several higher-density areas, and since its stop spacing is closer than B2, for example, it provides a complementary service.

F12 Route: Blatchford-NAIT-Kingsway Major Node – Stadium District Node

The proposed F12 east-west transit route would connect Blatchford-NAIT-Kingsway Major Node to Stadium district node travelling mainly along 119 Street, 106 Avenue, and along 107 Avenue through Westmount and Queen Mary Park. This transit line will work in tandem with the proposed W1 which is expected to provide urban service along 107 Avenue.

N5 Route: Westmount District Node – Fort Road Secondary Corridor

Route N5 serves residential areas along 132 Avenue, with an eastern terminus at Fort Road secondary corridor To enhance this route and provide more regional connectivity, it is proposed to extend this to Westmount district node via 128 Avenue and St. Albert Trail. It would provide linkages to Metro Line, R12, B1, R8, and Capital Line.

SE 31 Route: Exhibition District Node – Gateway Blvd/Calgary Trail Primary Corridor

The SE 31 is a proposed north-south line connecting Exhibition district node and Gateway Blvd/Calgary Trail Primary Corridor travelling mainly along 75 Street, 83/84 Street, 82 Avenue and 99 Street providing connections to several City-wide routes.

SE 33 Route: Capilano District Node – South Campus

The SE 33 is a proposed route travelling north-south along mainly 50 Street and 76 Avenue connecting Capilano District Node and the University of Alberta South Campus. The route was reviewed against the F7; however, it serves different connections and generates its own demand for service. As shown in Exhibit 2.7, this route could be further enhanced by a direct connection across the current rail yard lands along 76 Avenue. This will provide an opportunity for more direct connection that should be implemented in the future. This would also serve as an opportunity to provide other modes of transportation connections across these lands.

W1 Route: Stony Plain Road Primary Corridor – Centre City

The W1 proposed east-west line connects Jasper Place within the Stony Plain Road primary corridor and Centre City travelling mainly along 107 Avenue. It would provide linkages to the Valley Line, R12, Metro Line and B1. There is potential to review for combining with the F12 to improved cross-city connection along 107 Avenue.

W3 Route: Stony Plain Road Primary Corridor – Westmount District Node

The W3 is a proposed route running north-south between Jasper Place within the Stony Plain Road primary corridor and Westmount District Node mainly along 118 Avenue and 156 Street. It would provide linkages to the R12 and planned Valley Line. Since the F1 serves key inner nodes and corridors and Centre City; there is potential to consider combining these two routes together.

W4 Route: Westmount District Node – Meadowlark District Node

The W4 is a proposed transit route going north-south between Westmount District Node and Meadowlark district node running mainly along 142 Street and 87 Avenue. It serves linkages to the R12, R8, B2, B5, and Valley Line.

2.8 Success Factors

As a foundation to the definition of future transit network options for this study, a review of several peer agencies and background industry technical reports was conducted, with the results documented in the *Mass Transit Backgrounder* (Appendix B). The key lessons from this review were applied during this study, and many of the key elements of a successful mass transit network are demonstrated in the mass transit network for the City of Edmonton.

The following factors are common to other transit networks (or strong-performing portions of networks) across North America:

- Supportive urban form and densities (measured as number of people and jobs located near rapid transit stations);
- Length of exclusive right-of-way transit available, and the strongly related travel time competitiveness with the car; and
- Frequent Transit Network (FTN) coverage.

Exhibit 2.8 recaps the summary of key measures of success and major lessons learned identified through the peer review. Most of these measures relate directly to the mass transit and the land use around mass transit station locations. Measures such as these were applied to define network elements for the evaluation scenarios in the previous stage of the study, and have been used to select the representative alignments that form the mass transit network described in this study.

As identified in the following pages, the mass transit network addresses all the factors that were previously defined as key descriptors of a successful mass transit network. The success factors were an input to the definition of the network evaluation scenarios, and the factors were also a key consideration in selecting the elements carried forward from that evaluation. Sections 3 and 4 will speak to the qualitative results that further show the positive results attained through the mass transit network developed for Edmonton at 2 million people.

Exhibit 2.8: Key Measures of Success for Mass Transit

NUMBER OF RESIDENTS AND JOBS LOCATED NEAR MASS TRANSIT STATIONS

This promotes the network serving more passengers, and supporting land use objectives in The City Plan

Most City-wide and District routes, including the LRT, connect to major nodes and primary corridors in The City Plan land use concept



Images are examples illustrating the concepts.

LENGTH OF EXCLUSIVE AND SEMI-EXCLUSIVE RIGHT-OF-WAY TRANSIT AVAILABLE

Reflects speed and reliability for transit dependent and choice riders; *also supports travel time*

The proposed mass transit network includes proposed LRT extensions and semi-exclusive transit routes B1, B2, B4, B5 and B6 which increases the length of exclusive and semi exclusive ROW of Edmonton's mass transit network from 24 km now (37 km when Valley Line Southeast opens) to over 180 km in the mass transit network.

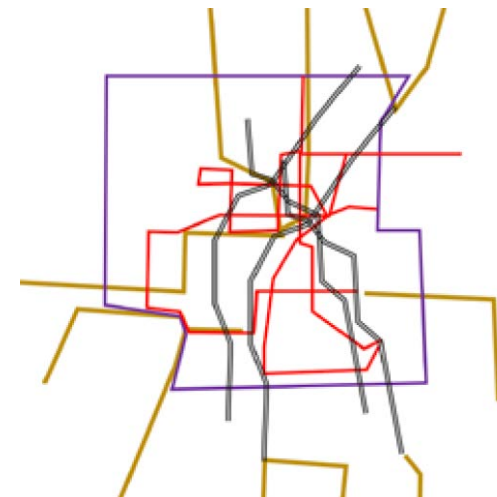


FREQUENT TRANSIT NETWORK (FTN) COVERAGE

Connectivity beyond basic rapid transit, integration of services

All parts of the city will have at least one transit route with frequent service, due to the grid structure of the mass transit network

Core areas of the city will be served by a variety of exclusive, semi-exclusive, rapid and frequent routes offering more localized service



TRAVEL TIME COMPETITIVENESS WITH THE CAR

Support mode share and sustainability objectives

Higher mode shares result in most parts of the city, including harder-to-serve employment areas, due to introduction of higher-speed semi-exclusive routes and a network of rapid and frequent routes.



MULTIPLE ANCHOR DESTINATIONS ALONG MASS TRANSIT

Increases ridership and spreads demand across more of the day

The mass transit network achieves this on most of the proposed City-wide routes and many of the District routes.

The anchor destinations include Centre City node, University/Garneau, Mill Woods, Heritage Valley, West Edmonton Mall /Misericordia, Blatchford-NAIT-Kingsway and Clareview Major Nodes and all of these are served by various mass transit routes.



PARKING COST/AVAILABILITY AT DESTINATION(S)

Higher parking prices are a stronger deterrent to drive-alone travel than fuel or the 'sunk costs' of auto ownership.

While general parking policy is not the subject of the mass transit strategy, new park and ride would be focused at ends of the rapid transit lines to create a catchment area feeding into transit. In other locations, parking would be tied in with development objectives, and transit options such as the District Routes will be on offer as a different way to access the City-wide transit routes (including LRT).



SPEED, RELIABILITY AND CAPACITY MEASURES

Operating transit in mixed traffic tends to reach a capacity limitation sooner, often due to platform (sidewalk) space at stations. In addition, the speed and reliability of mixed operations can reduce how many transit vehicles can operate along the route during peak hour. The impacts on travel speed therefore have a knock-on effect on capacity.

Implementing exclusive and semi-exclusive ROW with priority measures help to sustain higher-capacity service. The mass transit network includes extensions of the Capital, Metro and Valley Lines, and proposed new semi-exclusive routes B1, B2, B4, B5 and B6 (some of which may be BRT routes). In addition, priority measures for other routes, such as the 'R' series of limited stop Rapid routes, helps distribute this benefit around the city.



LIMITED STOP BUSES

A highly flexible form of mass transit, with some limitations due to operations in traffic; nevertheless, these routes can be highly productive, especially when linked to a major destination.

In addition to the 'B' series of routes that may be bus or rail, the 'R' rapid bus routes form a grid with services between major nodes and providing a two-way grid of crosstown connections.



OPERATIONS IN DIFFERENT PARALLEL CORRIDORS

This approach helps match the demand more effectively with capacity, with the added benefit of providing limited stop service to other passengers

Many of the major nodes and transit terminals are served by multiple routes in the mass transit network, in addition to local bus routes. A specific case where parallel services are critical is the north-south travel to areas between downtown and the airport. While the Capital Line is planned to be extended to Heritage Valley, new Airport Connector routes (making stops every 3-4 km) and B1 (stopping 1-1.5 km) help to serve the employment areas parallel to 111 Street and also offload some of the potential excess demand from the Capital Line. Similar offloading can be expected from the B6 route.





3 Network Performance

The mass transit network was been developed in conjunction with the Edmonton City Plan, and as such, it is intended to enhance future transit network performance in addition to several broader goals. These include supporting future land use plans and policies by serving and shaping travel demand, acting as a catalyst for development at nodes and corridors, and helping the city to be more sustainable (financially, environmentally and socially).

In this part of the report, the performance of the mass transit network is first compared with the BAP scenario to ensure that it represents an enhancement at a city-wide level. For ease of comparison, the future transit mode shares for different origins and destinations, and the characteristics of the proposed network, are then compared against the results of the 2015 Edmonton and Regional Household Travel Survey. The geographical location and boundaries of the destinations and origins referenced in this section are based on the travel survey, and can be seen in Appendix A, Exhibit A.5.

3.1 Mass Transit Network – Building on the Business as Planned Scenario

The mass transit network was built upon the Business as Planned (BAP) scenario with the objection of aligning with the land use patterns proposed by The City Plan land use concept thereby improving performance of the overall network. The City Plan land use density distribution is illustrated in Appendix A.10

It was important to improve performance of the overall network during the AM peak for work and school commute trips, in the midday for personal business, shopping and recreational travel, and in the PM peak for a broad combination of different trip purposes.

Exhibits 3.1, 3.2 and 3.3 summarize the mode choice results for the 2065 horizon (used as the approximate time horizon to reach 2 million people) for the BAP scenario and mass transit network developed together with The City Plan land use concept. The quadrants are indicated by geographic direction relative to the centre ('c') and a reference map of the boundaries is included in Appendix A.5. The overall average for the City of Edmonton is indicated at the top of the chart, and the result for the rest of the Edmonton Metropolitan Region (outside the city) at the bottom.

These results all reflect the mode choice at the origin. The proposed mass transit network results in higher transit mode choice for nearly all quadrants of the city, which speaks to the structure of the proposed transit network, with added capacity in and out of central Edmonton and significant new crosstown and regional services.

- In the AM peak, the mass transit network is able to build on the BAP scenario, increasing origin mode share for transit from 15.5% to 17.6%. This is the percentage of AM trips starting in the city that select transit as the primary mode. This includes people who access transit by walking, cycling, being dropped off by someone else, and parking at or near a transit station.
- In the PM peak, transit mode choice increases to 14.0%. This is marginally lower than in the AM due to the number and complexity of trips being higher in the PM. The reverse commute from the AM is part of the PM pattern, but there are additional discretionary trips such as personal business and shopping, and commute times in the afternoon and evening are more dispersed due to school ending at a generally different time from the end of the working day.

- In the MD typical hour, transit mode choice increases to 11.0% for trips starting in the city. This increase relative to BAP is supported by the increased speeds and frequencies associated with the new services in the network.

Exhibit 3.1: 2065 AM Peak Mode Shares – MTN Building on BAP Scenario

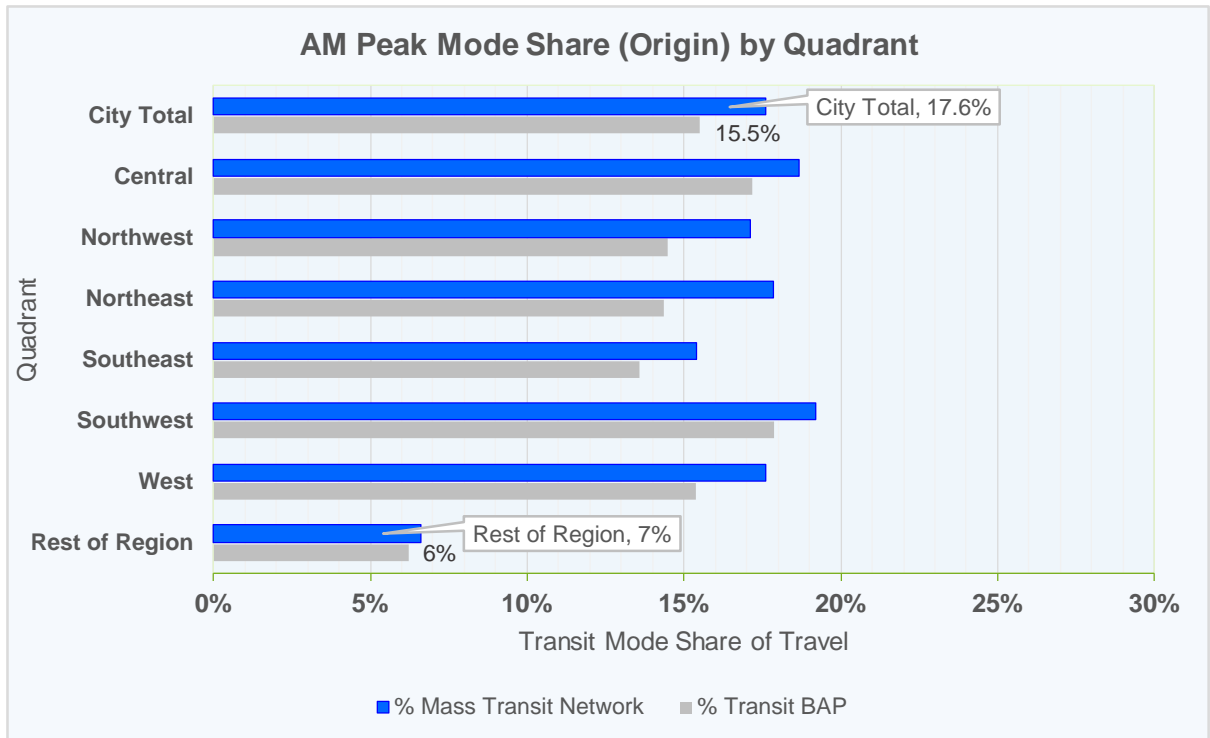


Exhibit 3.2: 2065 PM Peak Mode Shares – MTN Building on BAP Scenario

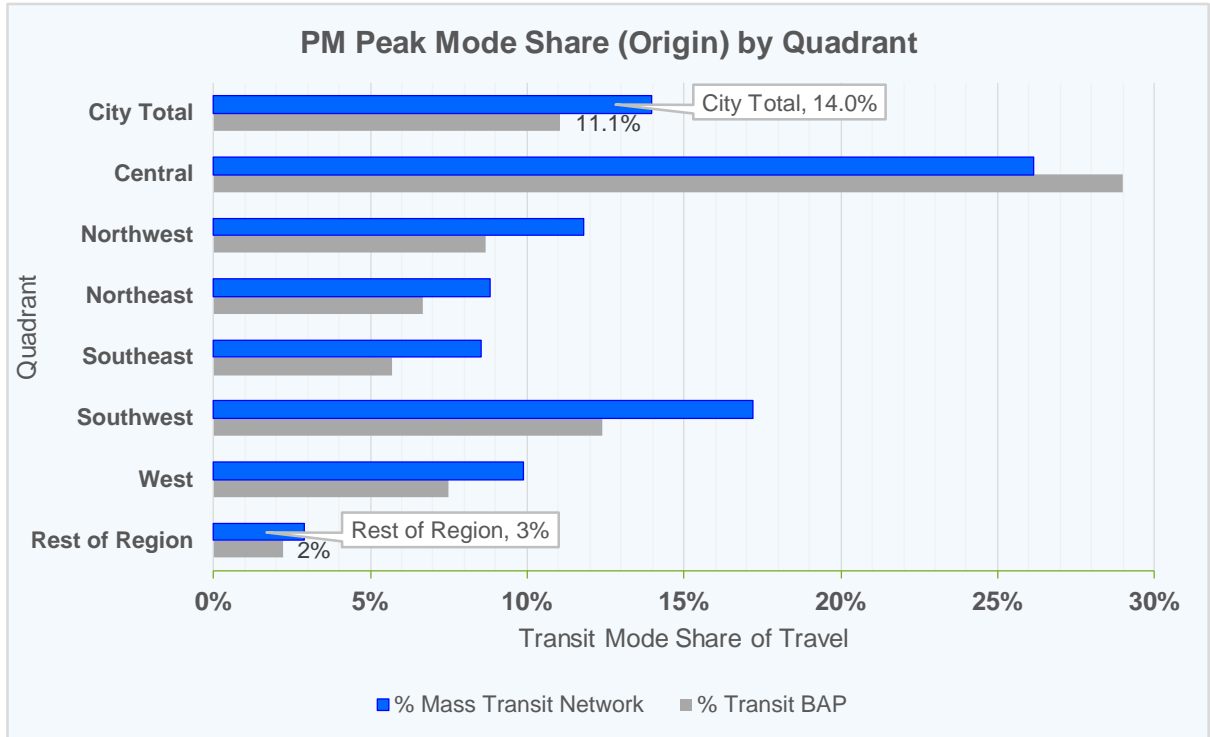
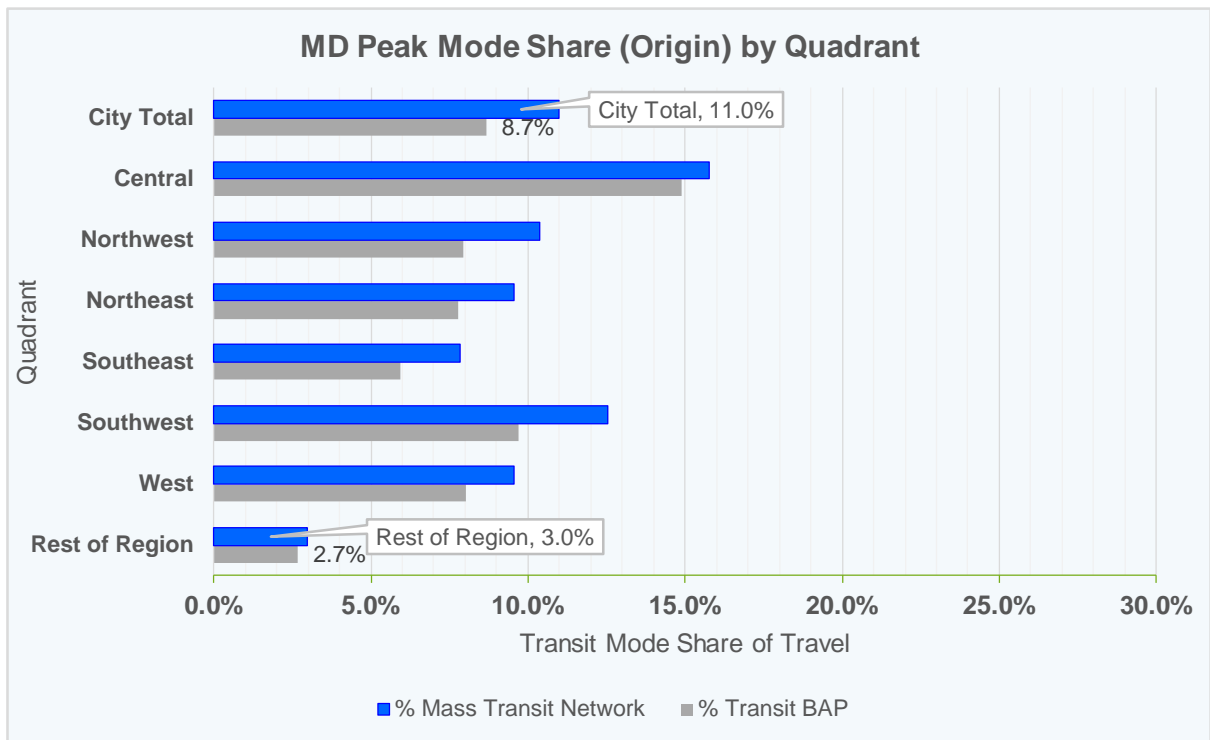


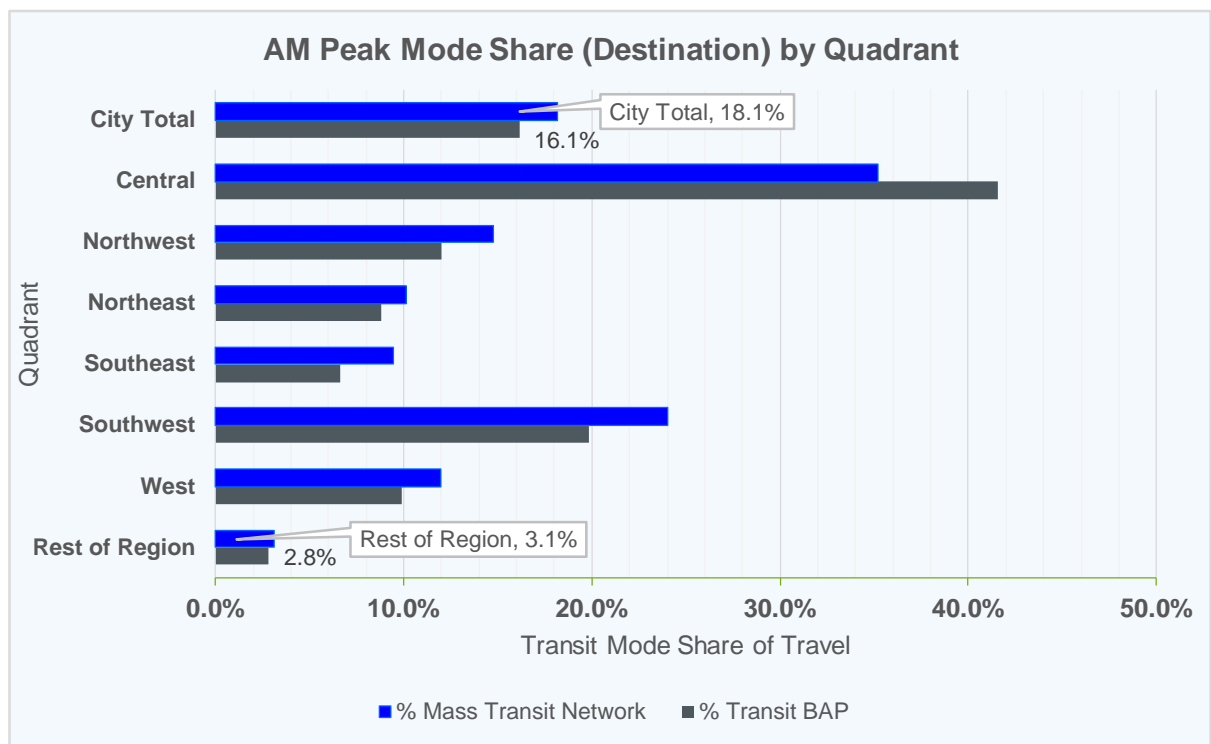
Exhibit 3.3: 2065 MD Peak Mode Shares – MTN Building on BAP Scenario



Part of the difference in mode choice between the scenarios is a reflection of the land use forecasts and how The City Plan land use concept strategically distributes population and employment differently than the BAP.

Exhibit 3.4 shows the same results for the AM peak, but with the percentages reflecting the number of trips destined to each area. One of the areas identified in the *Mass Transit Backgrounder* was to make services into non-central employment areas more attractive, and this is reflected in the higher destination percentages for each of the quadrants. The transit percentage is slightly lower for mass transit network in the central sector ('C'), and this is primarily related to more development being located in the downtown fringe, which lowers the resulting average to 36%, even though it contributes to an increase in transit usage overall for the city.

Exhibit 3.4: 2065 AM Peak Mode Shares, by Trip Destination – MTN Building on BAP Scenario



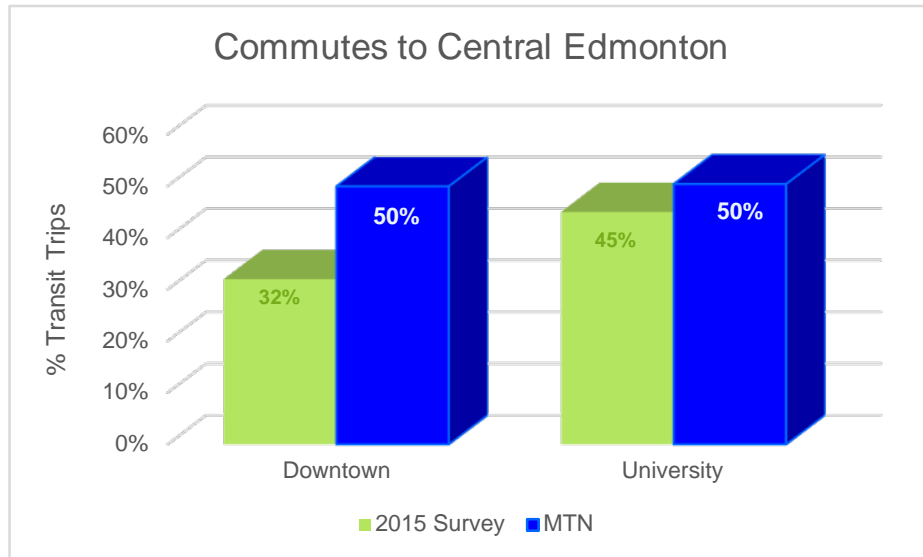
3.2 Serving a Variety of Travel Markets

The travel patterns and demographic-linked mode choices in the region are related to the major markets that have been considered while developing the mass transit strategy. These include travel markets that are already strong (or well used) and others where there was much more opportunity to make gains. The following section compares transit statistics from the 2015 Travel Survey with the projected mode choice percentages forecast for the mass transit network.

It is important to be mindful that transit mode choice has a tendency to slowly decrease as a large urban area grows, because the travel patterns tend to become more varied and complex, and more challenging to serve. This can be offset through strategic decisions related to the types and locations where development takes place, and in the investments made in transit infrastructure and services. The positive results resulting from this study and highlighted in this section reflect those factors.

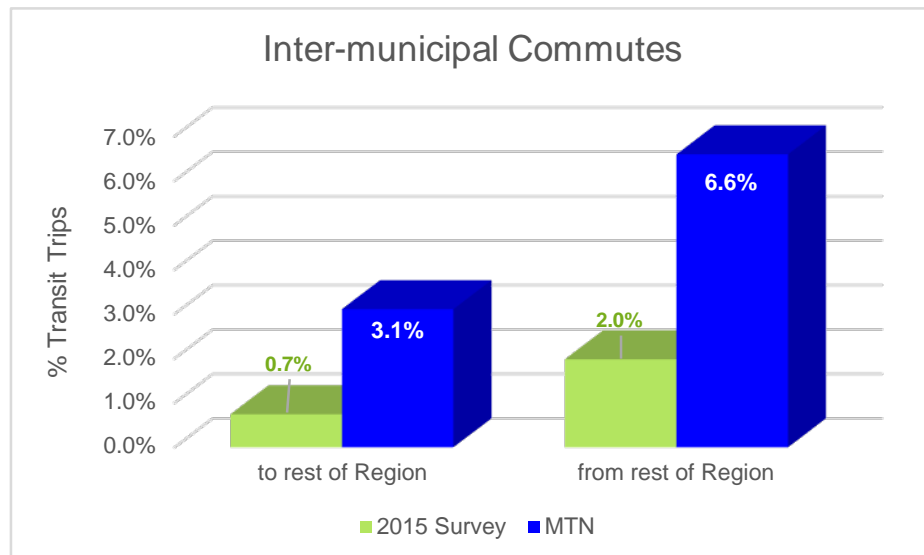
Commuters to the CBD and Post-Secondary Institutions. These are the strongest transit markets in Edmonton today and are expected to continue as such into the future.

Exhibit 3.5: AM Peak Mode Shares to Downtown and University, 2015 versus MTN



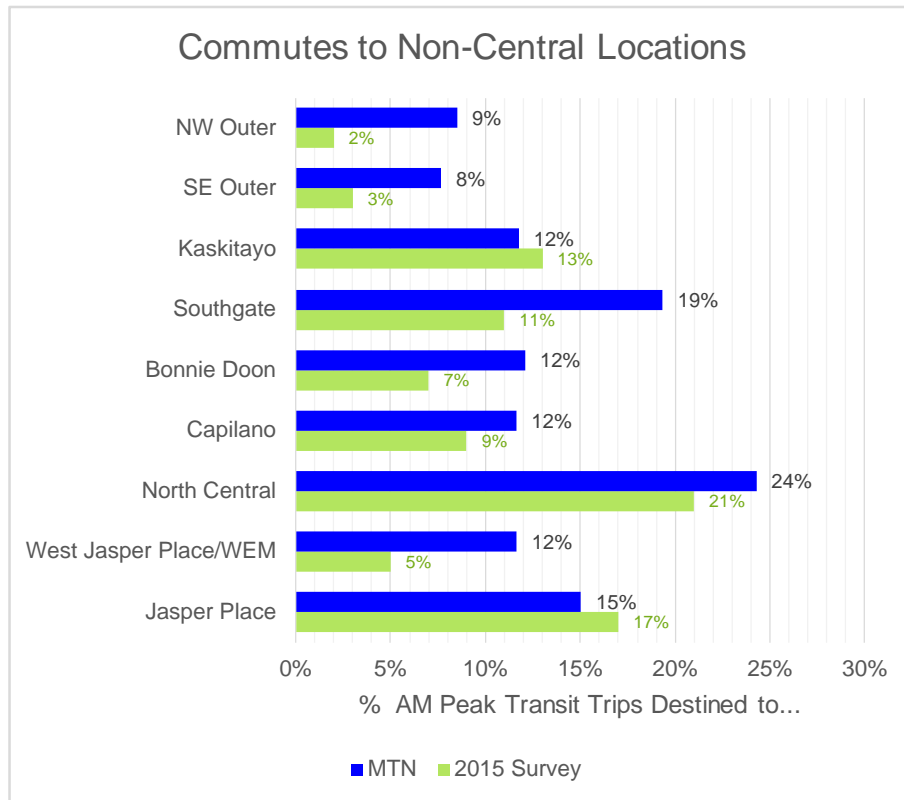
Inter-Municipal Commuter – Numerous morning peak period commute trips enter Edmonton from Sherwood Park, St. Albert and other municipalities. These trips are 15 – 20 km long, and while overall they make up only a small percentage of transit riders, certain origins and destinations benefit when high-quality service is provided to and from the region surrounding the city.

Exhibit 3.6: AM Peak Mode Shares to and from Municipalities outside Edmonton, 2015 versus MTN



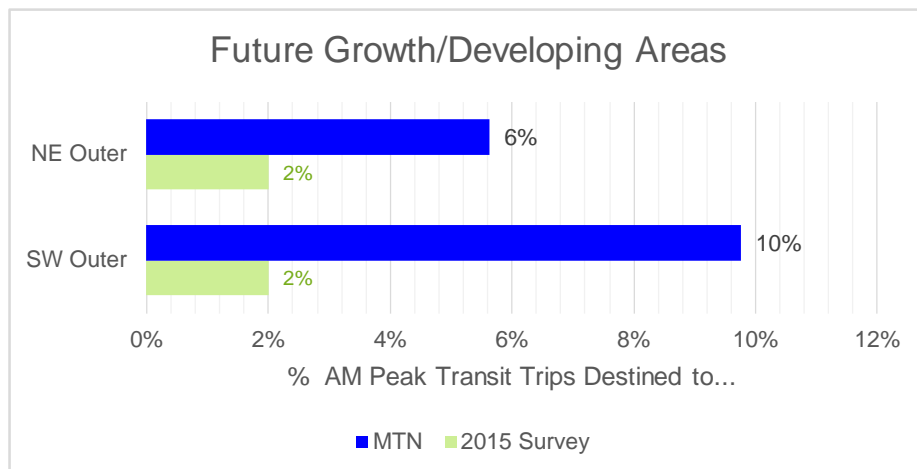
Suburban Worker – Residents in the growing Outer Edmonton area currently find it difficult to use transit for their daily commute, even though their destinations may be nearby. In particular, the SE and NW outer sectors of Edmonton are both large existing employment destinations, but with only 2-3% of workers using transit.

Exhibit 3.7: AM Peak Mode Shares to Non-Central Sectors of Edmonton, 2015 versus MTN



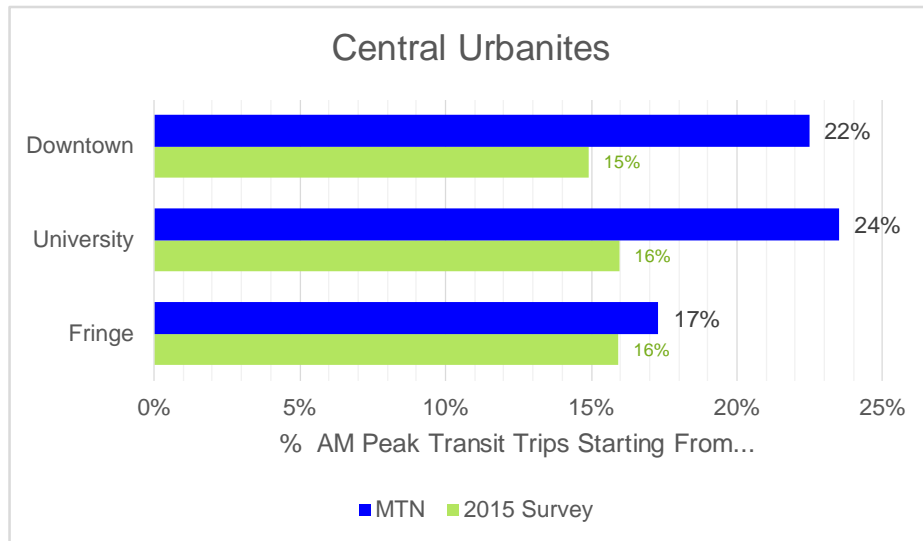
Future Growth Areas. As the city expands into new annexation lands and infill starts to take place, there was an opportunity to structure the overall transportation network in these areas to ensure that transit is a realistic and competitive option.

Exhibit 3.8: AM Peak Mode Shares to Future Developed Areas, 2015 versus MTN



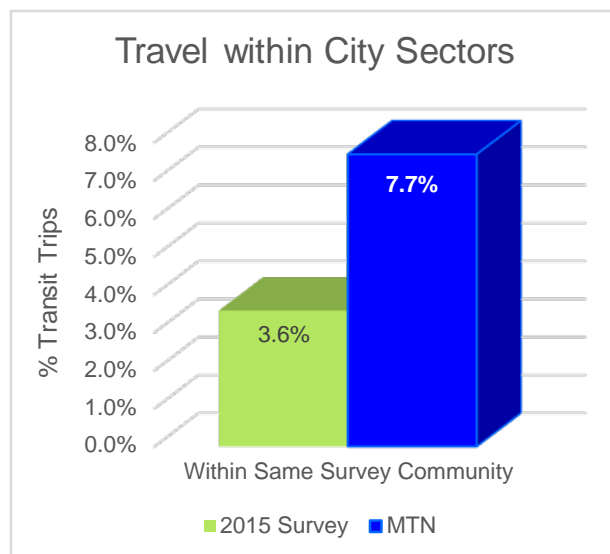
Central Urbanite – Central Edmonton remains a vibrant activity hub and ensuring that its residents have choices on how to travel is important to maintaining its attractiveness. Internal trips are quite short—just 1.5 km—and active modes dominate. The trips to nearby destinations averaged just 5.5 km in the 2015 survey, but only 15% were made on transit. There may be opportunities to improve transit service for these travellers who already live in transit-supportive neighbourhoods. The mass transit network achieved this feat in all three central sectors of the city, in particular trips originating from the University and Downtown sectors.

Exhibit 3.9: AM Peak Mode Shares for Trips starting in Central Edmonton, 2015 versus MTN



Neighbourhood Traveller – Short commute and non-commute trips, for example for shopping or entertainment, are important since having fast, reliable access to neighbourhood amenities is key to keeping neighbourhoods vibrant. Every day in neighbourhoods outside of Central Edmonton, only 3.6% of shorter trips (within the travel survey sectors) used transit in 2015. The new services included in the mass transit network increased this to 7.7%.

Exhibit 3.10: AM Peak Mode Shares for Shorter-Distance Trips (Outside the Centre)

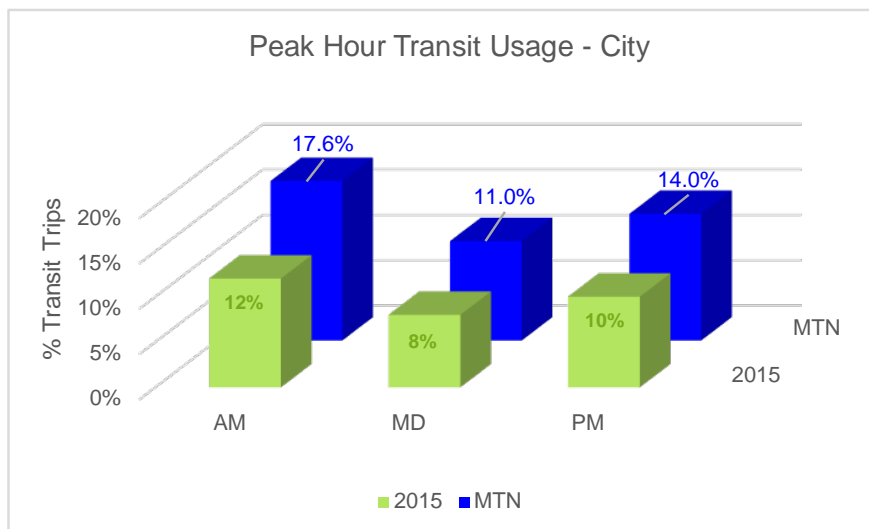


Overall Travel in the City

Exhibit 3.11 shows how the mass transit network improves the percentages of transit usage relative to the 2015 travel survey, for each of the time periods. These percentages are based on trips starting within Edmonton during each of the time periods. As such, they include Edmonton residents and also non-residents who make up part of the city's 'daytime population'.

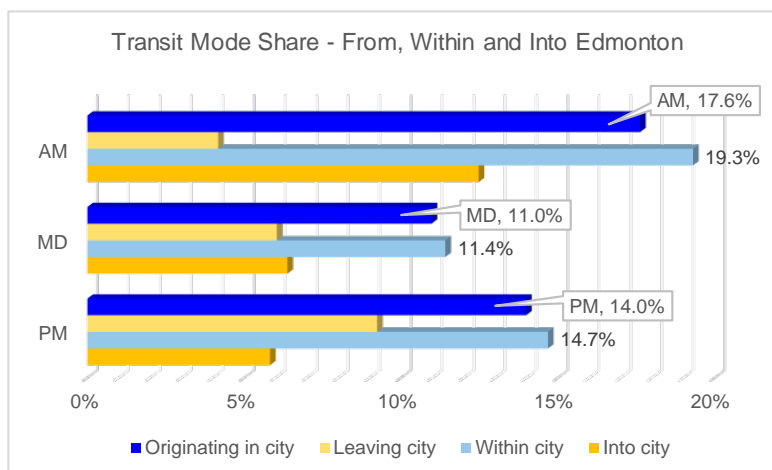
The percentages are highest in the AM peak because work and school commute trips dominate the travel patterns, and these purposes lend themselves more easily to being served by mass transit. Transit volumes can be as high or higher on many routes in the PM peak, but the transit percentage in the PM is lower due to a higher number of overall trips. The midday is typically lowest in North American cities, as is the case here, but the mass transit network demonstrates success in increasing the off-peak transit share.

Exhibit 3.11: Peak Mode Shares for Trips From or Within Edmonton, 2015 versus MTN



When considering the percentages of transit trips made to, from and within Edmonton, it is important to distinguish between trips entirely within the city versus those leaving for or entering from other municipalities, as those percentages are typically lower. Exhibit 3.12 shows how these values compare for the different time periods in the mass transit network. The 'originating in city' value is the same one from the exhibit above.

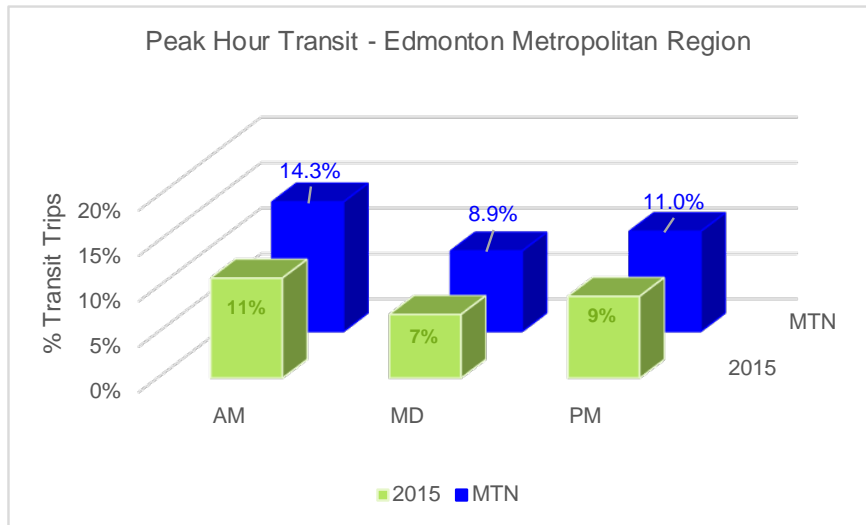
Exhibit 3.12: Peak Mode Shares for Trips within, entering or leaving Edmonton, MTN



Travel Region-wide

Exhibit 3.13 illustrates the progression of transit mode shares for the whole Edmonton Metropolitan Region. These percentages include trips within Edmonton, entering or leaving the city, and within or between other municipalities. Consequently, the percentages are lower than those focused on the city, but they show the same relative pattern of transit shares.

Exhibit 3.13: Peak Mode Shares for Trips in the Edmonton Metropolitan Region (Including City), 2015 versus MTN



As this section has shown, the mass transit network includes successful additions to the city's future transit network, building on the BAP and going beyond in capturing a larger share of the travel market. This is highlighted by the specific jumps in transit usage for several of the travel markets investigated in this section. The next part of the report now focuses on specific transit routes that contributed to this success.



4 Performance of Network Elements

In this section, the performance of the individual network elements is presented in order to identify key areas of interest within the network. This section, builds upon the broader network considerations discussed in Section 3. The first three sub-sections focus on the routes as a whole, applying several metrics to help compare them. In the final sub-section, several important service issues are reviewed to show the benefits of several routes working in combination to address mobility for Edmonton at 2 million people.

4.1 Measures/Definitions

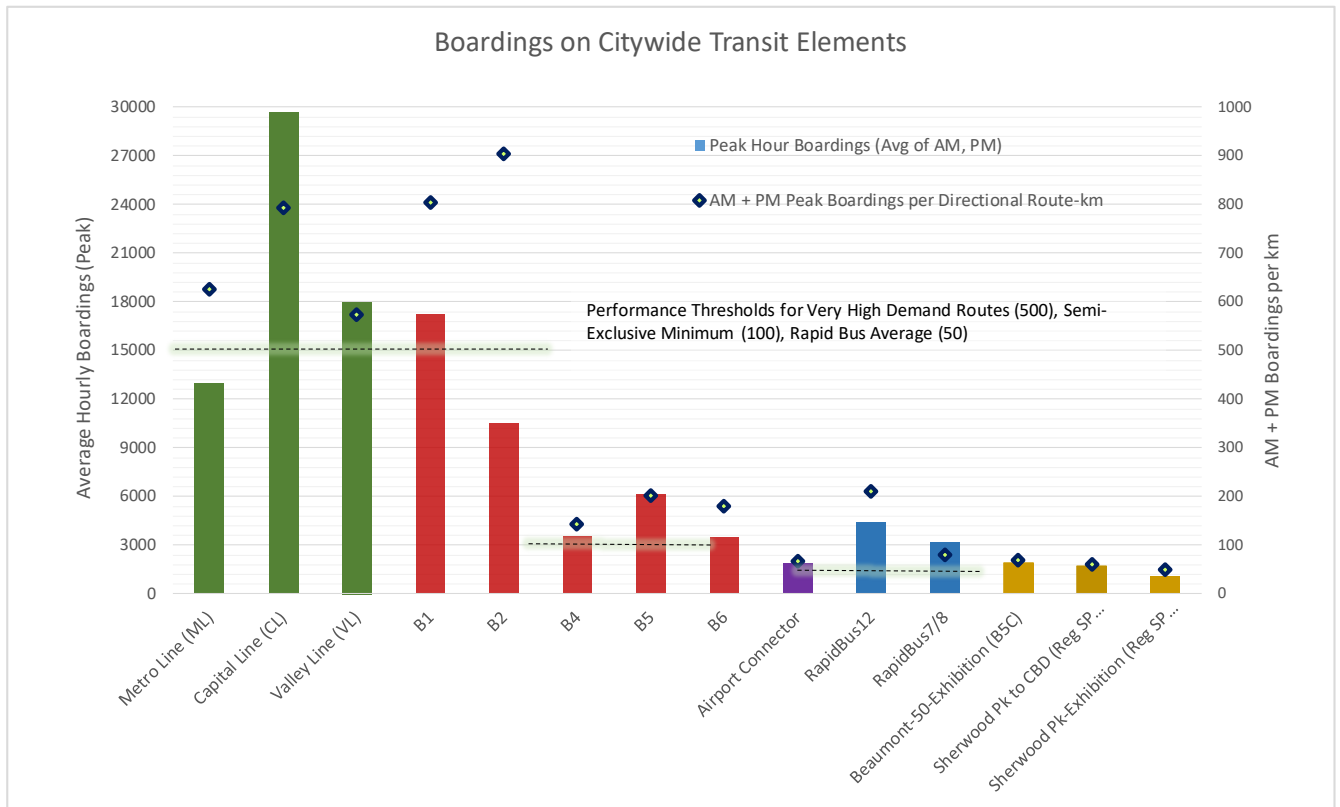
The following measures are used in this section to better articulate the performance of individual routes, and normalize them against each other.

- Average Hourly Boardings – AM and PM peak hour passengers getting onto a route, added in both directions, expressed as a per-hour average. It is a measure of how many people **use** (demand) a transit route or transit system.
- AM + PM Boardings per km – Total passengers boarding a route in the AM and PM peak hours, divided by the length of a round trip on that route (this distance is also known as the total directional route-km). This measures the **attractiveness** of a route and its assumed stops, and is divided by distance to allow us to compare routes with different lengths.
- Hourly Volume – Number of passengers on board transit vehicles, passing a location in a one-hour period, in one direction, on one or more routes. Maximum volume is the highest of these values along a route or corridor. This measures how **full** the service gets, which is both a measure of its attraction and also an indicator how much service is needed to meet the maximum demand.

4.2 City-wide Routes

Exhibit 4.1 summarizes the resulting average hourly boardings for the AM and PM peaks (coloured bars) and the AM + PM boardings per-km number (as described previously) for the City-wide transit routes in the mass transit network. The number of boardings has been colour-coded to roughly correspond with the map in Section 2.5. Elements of the City-wide routes include exclusive ROW rail services (LRT lines in green, Airport Connector in Purple), semi-exclusive ROW transit (shown in red-orange), and routes operating in mixed traffic (rapid bus in dark blue, and major regional routes in tan-yellow).

Exhibit 4.1: Boardings on City-wide Transit Elements

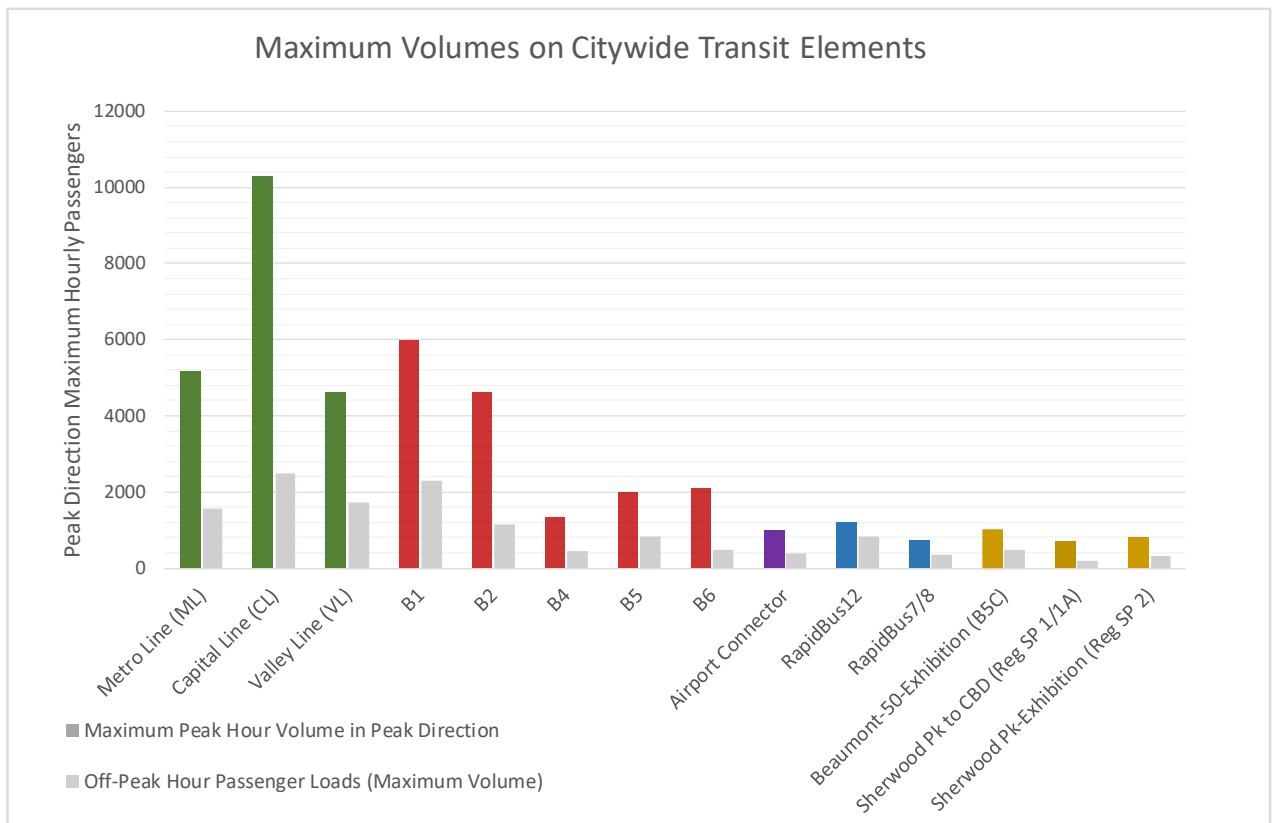


- The first five routes in the chart all stand out with high numbers of passenger boardings indicating that these lines are most responsive to the demand generated by the mass transit network. These lines serve major travel demands and connect several of the highest-density employment areas in the city, which explains the popularity of these routes.
- The Metro Line, Capital Line, and Valley Line all include exclusive river crossings, either existing or under construction. B1, and B2 also propose new river crossings. The number of peak boardings and the per directional route-km index both indicate that direct river crossings assist with attractiveness of these routes, by allowing for more direct travel between major origins and destinations.
- For comparison purposes, the per-km threshold of 500 passengers is shown against these 5 routes. This threshold is comparable to the busiest surface route in Greater Vancouver, the 99 B-Line, a frequent limited bus between the SkyTrain rapid transit system and the University of British Columbia. This line represents a high level of passenger activity and requires substantial capacity to meet the demand which is similar to how these first five lines would be operating by the time the city reaches the 2 million population threshold.
- Routes B4, B5 and B6 are the next three routes and are a step down in the level of demand they attract. However, these are still fairly busy transit routes.

- The second per-km threshold of 100 passenger boardings is the suggested minimum to meet bus rapid transit service levels. This was established through comparison with peer services. For example, two of the Metro Vancouver rapid bus routes (95 and 96 B-Lines) currently achieve 130-170 peak boardings (two peak hours) per directional kilometre of route. The other services are not expected to attract as many passengers since they serve less dense corridors and do not align with as many major activity nodes. For comparison purposes, the suggested threshold shown in the chart is 50 passengers per km.
- The Airport Connection and the regional routes are longer and with fewer stops. This type of service is usually evaluated as to how full the individual vehicles are, and how long the average passenger trips are on the service. Because the number of stops is usually fewer, the number of boardings per km will naturally be lower.

Exhibit 4.2 illustrates the maximum passenger volumes at the peak demand location on each route. It also shows the typical one-hour midday demand for each route in grey. For most of the routes, this value is less than half the peak hour which is due to service frequency being consequently much lower than in the peak. The two rapid bus pairings show the most similarity between peak and off-peak demand, potentially due to the nature of the corridors the routes serve.

Exhibit 4.2: Maximum Volumes on City-wide Transit Elements



One thing to note with the maximum passenger volumes is that they provide some of the guidance to how much service would be needed on each route, in terms of frequency and vehicle capacity. Values of 2000 passengers or fewer could be accommodate by

articulated transit buses (or standard size buses) operating at a sufficiently high frequency and with support from transit priority measures. Carrying the higher peak loads on the first five services, where peak volumes are all in excess of 4000 passengers, will require a high level of priority, and significant vehicle capacity, either through larger vehicles or very close headways, to meet that demand threshold.

The other aspect in defining these services is that some routes, especially in the off-peak, would not be expected to be as full, and would be operating at a policy headway to maintain convenience and make the service competitive in terms of overall trip times.

4.3 District Routes

Due to the larger number of routes in this category, the charts have been split into the different transit categories for ease of understanding.

Exhibit 4.3 summarizes the average number of hourly boardings for the AM and PM peaks (coloured bars) and the per-km number of peak boardings for the rapid bus elements in the District route grouping.

Routes R5 and R10 are the standouts here, with fairly high numbers of passengers in total and per km of route. This relates to the travel demand in the nodes and corridors being served by these routes. R5 operates north-south in the western part of the city, and feeds into the Valley Line and the Metro Line as well as many other mass transit routes. R10 operates east west and while it parallels R12, there appears to be substantial east-west demand along the corridors it serves – the northern edge of the centre of the city and southern fringe of the Blatchford area would be in the catchment for this route,

Routes R1, R9 and R11 are shorter but achieve above-average numbers of boardings per km. This is due to the direct connections each of them provides between City-wide transit routes and the nodes and corridors the routes serve. The least popular of these routes, R3, would be offered at lower frequencies than the other services, to match its lower demand better. It is being retained as an element of the mass transit network because its stopping pattern would still be that of a rapid bus.

Exhibit 4.4 compares peak and off-peak passenger volumes, and consistent with the number of boardings, it is routes R5 and R10 that perform the best for this measure. As a result, these two routes would be operated more frequently than the others in the District routes, given the higher demands and resulting capacity requirements. Accommodating the peak volume on R5 is likely to require vehicles with capacity similar to an articulated bus, operating at a peak frequency below 5 minutes. This demand is expected to emerge as development intensifies in the areas (such as Riverview) that the route is proposed to serve.

Exhibit 4.3: Boardings on District Routes – Rapid Bus Elements

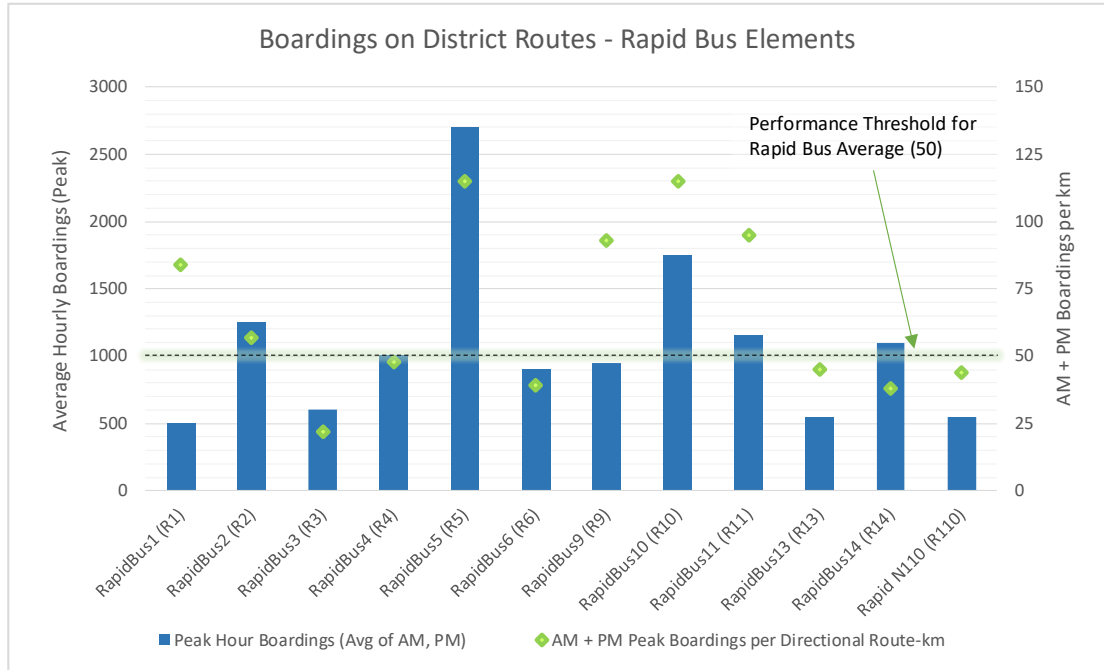


Exhibit 4.4: Maximum Volumes on District Routes - Rapid Bus Elements

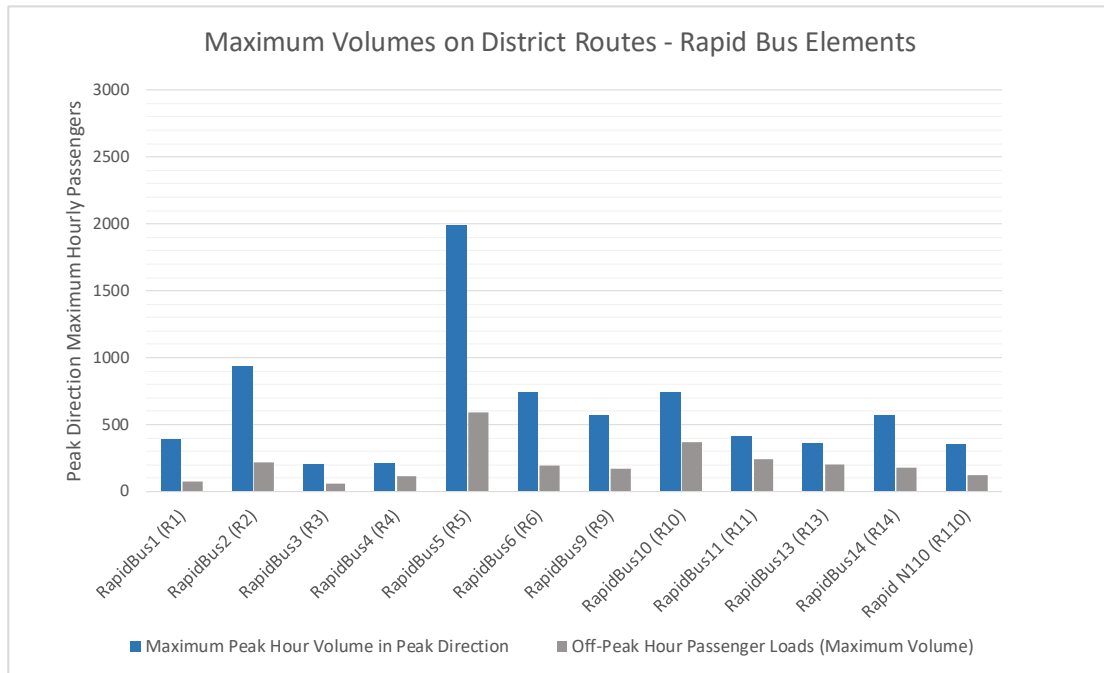


Exhibit 4.5 shows boardings for the regional District routes. In this exhibit, the Leduc, Strathcona-Gorman and Fort Saskatchewan services perform very well. Each of these routes provides a direct connection into City-wide routes on the mass transit network. The combination of bus services into St. Albert produces the highest number of boardings. However, this is a result of numerous bus routes to and from St. Albert and does not reflect one single popular bus route.

Exhibit 4.5: Boardings on District Routes - Regional Elements

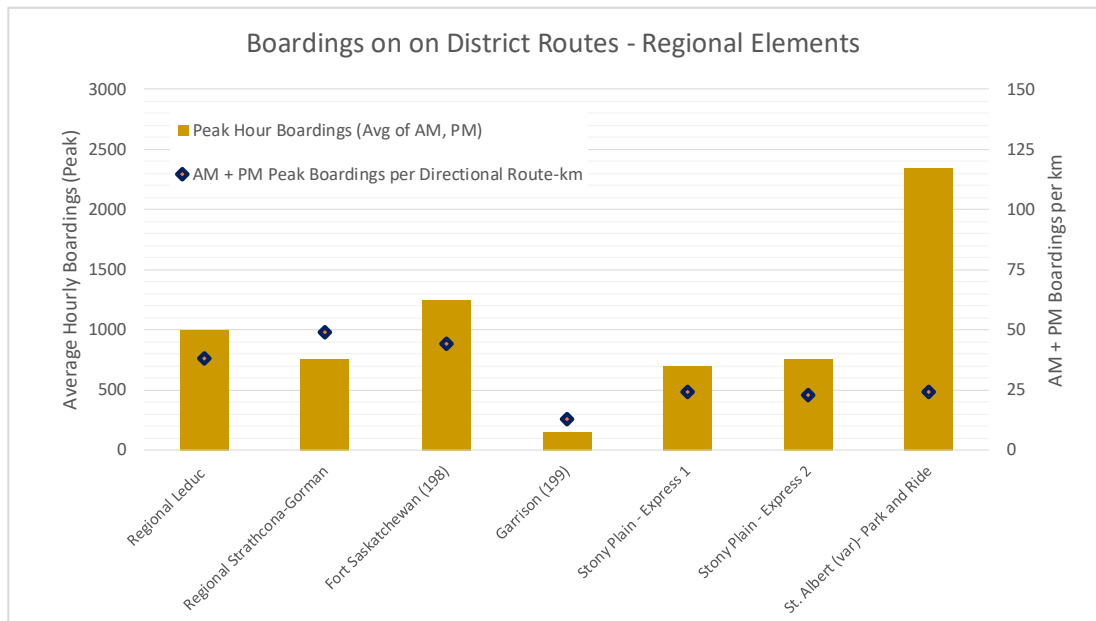
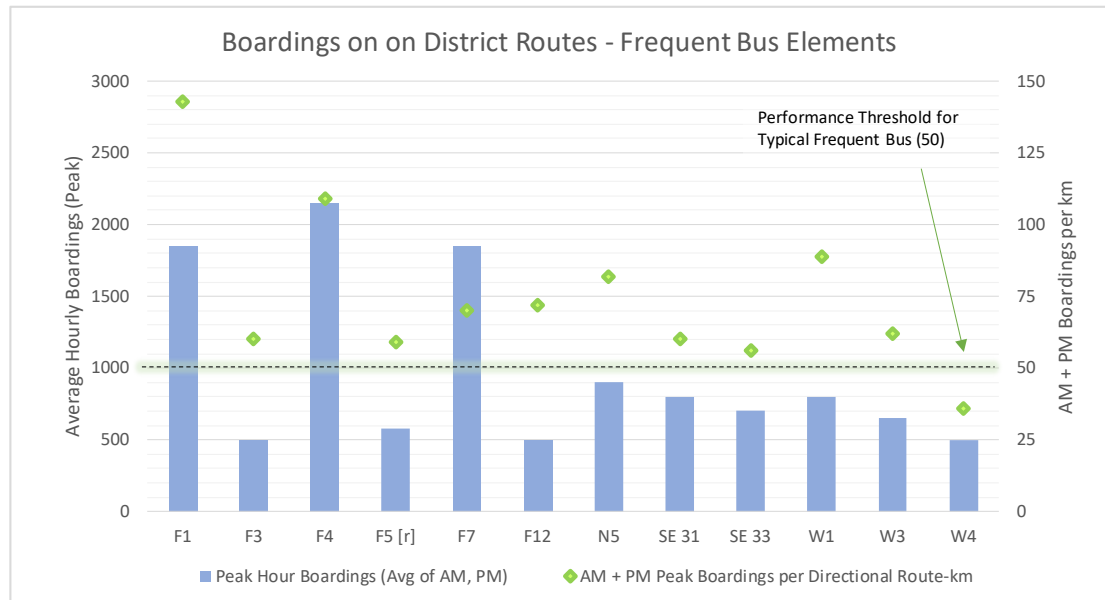


Exhibit 4.6 provides a comparison of frequent routes against the same threshold from the rapid bus plot. Nearly all frequent routes meet this demand threshold, which speaks to their success as convenient services, albeit at a more conventional transit operating speed. These routes operate along primary and secondary corridors and within the Centre City node of The City Plan, which also explains their popularity.

Exhibit 4.6: Boardings on District Routes - Frequent Bus Elements



4.4 Building Capacity and Attracting Passengers

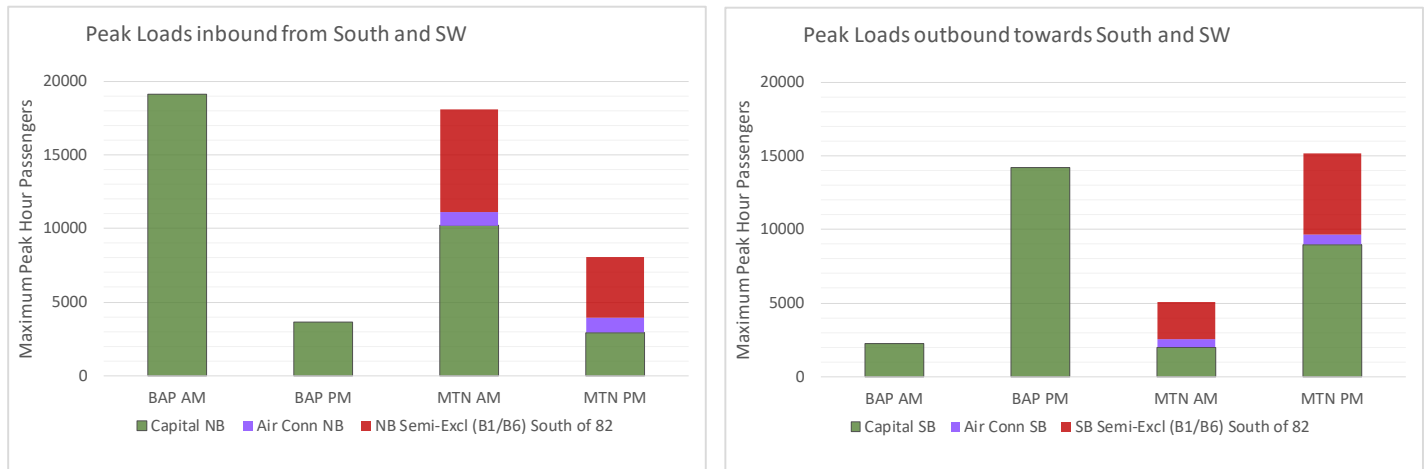
The benefits of the mass transit network can further be illustrated by looking at how capacity is provided and additional passengers attracted in several key locations around the city. These locations helped to inform the outcomes from the evaluation of different options, and this section acts as a check to ensure that the intended outcomes occurred.

4.4.1 North-South between Downtown & Airport

Exhibit 4.7 demonstrates two of the benefits of the mass transit network by comparing how transit passengers are forecast to travel north-south across the North Saskatchewan River, towards (inbound) or away (outbound) from the University Campus/Whyte Avenue area and Centre City.

- In the peak directions (AM inbound and PM outbound), the introduction of new transit lines offers passengers different options for how to travel across the river, and passengers shift from the Capital Line LRT to a combination of LRT plus the proposed semi-exclusive routes (B1 and B6) and the Airport Connector.
- The introduction of the new services also increases transit demand in the non-peak direction (AM outbound and PM inbound) – this represents a capture of new passengers and signals a mode shift from other modes of travel

Exhibit 4.7: Peak AM and PM Passengers North-South approaching Whyte Avenue



4.4.2 Peak Loads on the Capital Line plus the Metro Line

The Capital Line already experiences heavy passenger loads during part of the AM and PM peak hours, with the highest volume of passengers observed just south of Health Sciences station. This is expected to increase in the future as growth occurs in the south and southwest corners of the city, and the Capital Line is extended beyond Century Park to Heritage Valley.

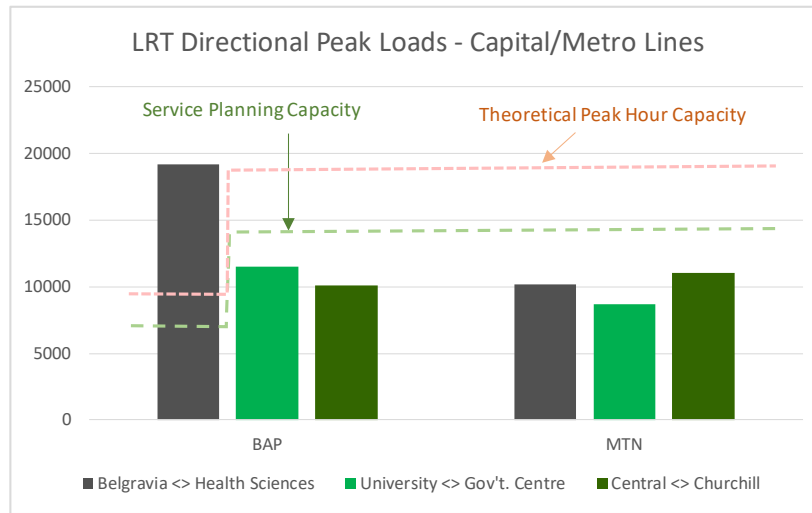
The BAP scenario forecasts suggest that the peak hourly volumes would be in the order of 19,000 passengers. This would pose a serious challenge to the existing LRT operation, as the grade crossing at University Avenue effectively restricts the number of trains that can operate south of Health Sciences, the peak load point of the transit system. As modelled in the future, twelve trains per direction pass this point. The theoretical capacity in each direction is 9,600 passengers (5 cars x 160 passengers each x 12 trains per direction per hour). The capacity range indicated on the chart depends on the assumed density of standing passengers

Exhibit 4.8 shows the projected number of passengers at several locations in the central part of the system, by combining the volumes of the Capital and Metro Line trains. It also shows the theoretical capacity. Based on the proposed mass transit network, north of the grade crossing, the LRT infrastructure and systems are expected to be able to handle up to 24 trains per direction per hour, so the potential capacity is higher and the passenger loads are not as critical.

The mass transit network proposes to address this in two ways:

- Increased LRT capacity across University Avenue, likely in the form of grade separation or reconfiguration of the streets, would allow up to 24 trains per hour to operate through this segment by facilitating the extension of the Metro Line terminus point to south campus.
- The peak loading “crunch” south of Health Sciences is alleviated through shifts in passenger demand to other routes, as indicated previously. If the new services are implemented sooner, then this may delay the need for grade separation at University Avenue until the total loads of these lines begin to reach planned or theoretical capacity of the Capital Line.

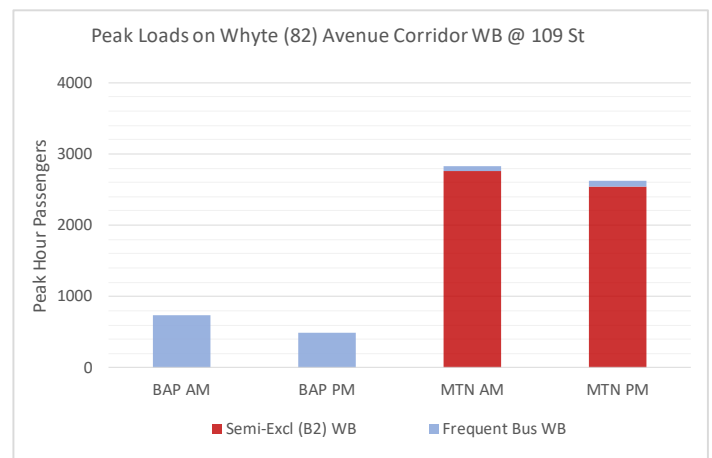
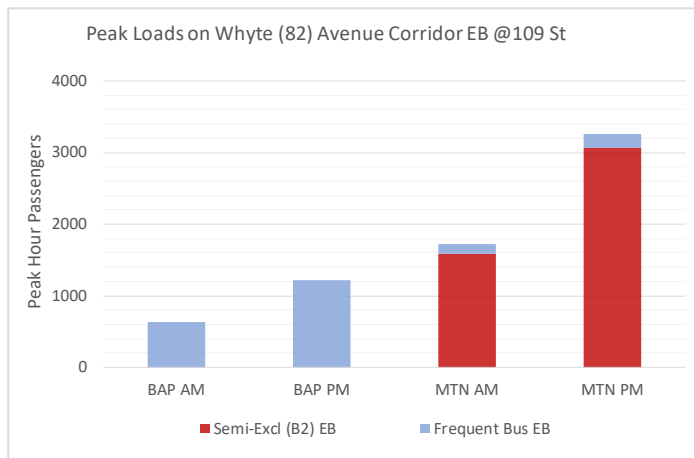
Exhibit 4.8: Peak AM Passengers on Combined Capital and Metro Lines



4.4.3 Whyte (82) Avenue

Shifting our attention to the east-west direction, one of the busiest travel corridor outside Centre City is the Whyte (82) Avenue corridor. Options for this corridor have been reviewed in past studies and several different transit service options were considered in the scenario evaluation of this study. A semi-exclusive transit service complemented by frequent transit with closer stop spacing was identified as the best option to represent this corridor. A semi-exclusive transit service would allow for some flexibility and context sensitivity in the design and operation of higher-capacity transit. Exhibit 4.9 illustrates a stark difference between the BAP scenario and the mass transit network.

Exhibit 4.9: Peak AM and PM Passengers on Whyte Avenue



- BAP relies on frequent bus services (F4 and F7 primarily) to serve passenger demands. On their own, the conventional buses would be at their limit in the east bound PM peak when demands spike.
- With the mass transit network, much of the demand is projected to shift from the conventional bus routes to the semi-exclusive, and more significantly, the volumes would be double or better. This indicates that the B2 service addresses a strong travel desire line. In addition to serving this corridor and the development of nodes and

corridors along it, the route also adds high-capacity transit alternative between the Capital Line and Valley Line that does not require passengers to first go to the Centre City.

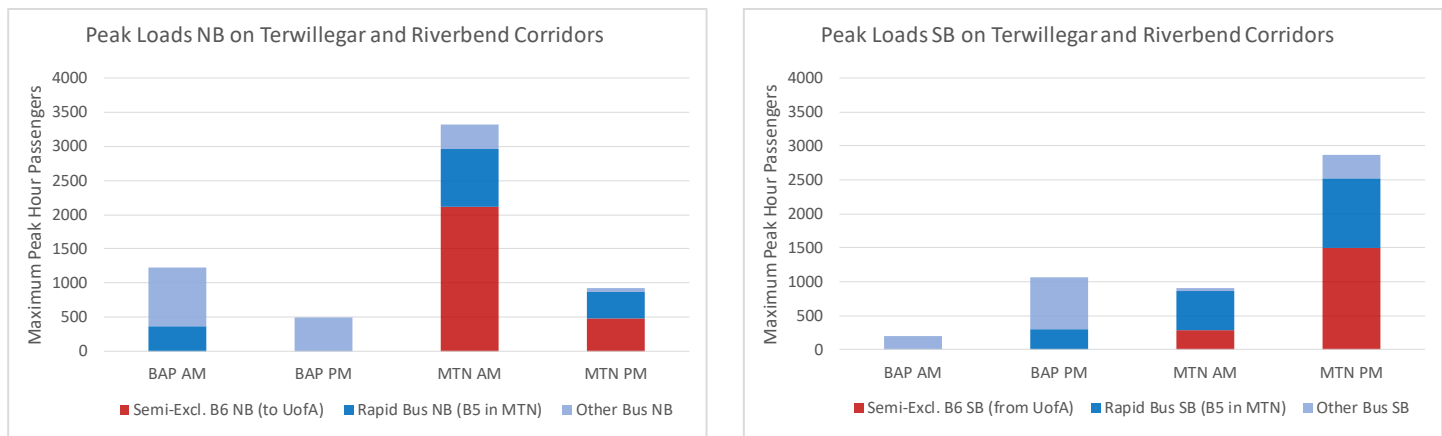
4.4.4 Terwillegar

The Terwillegar corridor connects to developed and developing communities in the southwest part of the city. The analysis of transit scenarios demonstrated that transit demand in this corridor is fairly sensitive to travel time including transfers.

Exhibit 4.10 shows what the mass transit network does to re-shape transit demand in this part of the city:

- Within these corridors, the mass transit network attracts significantly more transit demand, with better connections to the University (using B6) and West Edmonton (using B5). This is partly new demand drawn in by the higher quality connections. It also reflects some passengers taking advantage of the more direct route on Terwillegar, instead of travelling by transit or car to the Capital Line at Century Park (and eventually Ellerslie Road).
- Demand is also projected to shift away from the conventional bus routes to the semi-exclusive and the rapid bus routes.

Exhibit 4.10: Peak AM and PM Passengers on Terwillegar and Riverbend



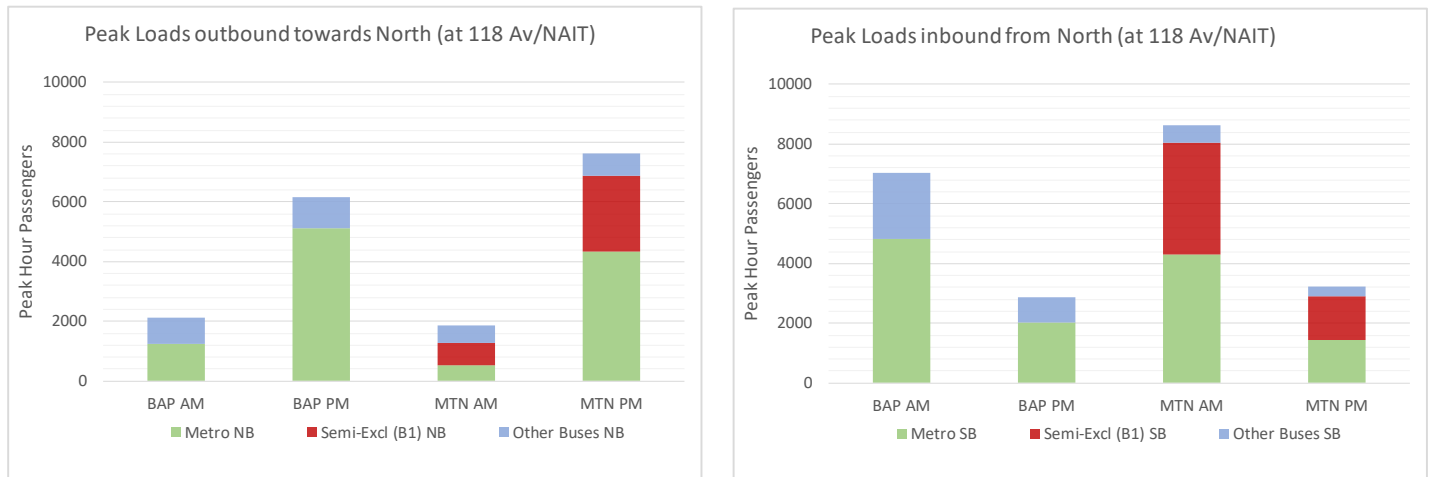
4.4.5 North of Downtown

Travel north of the downtown core also benefits from the new routes introduced by the mass transit network, as shown in Exhibit 4.11.

- The mass transit network attracts significantly more transit demand in the peak direction.
- Off-peak demand is neutral overall (a little lower in the AM and higher in the PM). The shifts relative to BAP from one transit mode to another reflects passengers opting for faster services where they are provided.

Future demand is reduced marginally on the Metro Line due to the new B1 service offering more direct connections to other destinations. This helps to take pressure off the LRT lines as they approach the Centre City from the north.

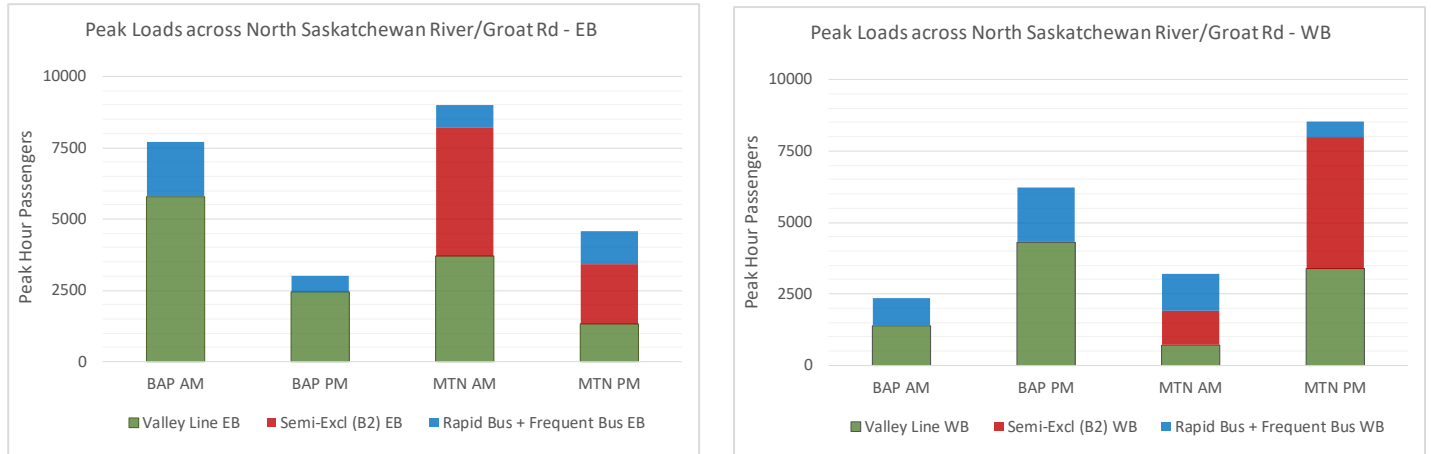
Exhibit 4.11: Peak Passengers to and from the North



4.4.6 East/West to Downtown/University

Exhibit 4.12 demonstrates the effect of the mass transit network on east-west travel into the downtown and University areas from communities to the west. If a screenline were drawn along Groat Road and down the Saskatchewan River, then travel options across that line would include the Valley Line LRT, semi-exclusive route B2, and several frequent bus routes.

Exhibit 4.12: Peak Passengers east/west across the North Saskatchewan River/Groat Road



The mass transit network attracts significantly more transit demand in both the peak and non-peak directions, and in fact the B2 route represents such a strong desire line that its peak loads exceed those of the Valley Line at a similar point in the alignment. It should be recognized that this service assumes a dedicated transit crossing of the river, west of the University which will require further study and planning to determine the economic, social and environmental costs.

4.4.7 Summary

The examples included here have demonstrated several common themes:

- The mass transit network adds capacity in both directions of travel, and new routes often provide more direct and faster options.

- New services included in the mass transit network cause demand to shift from services already assumed in the BAP scenario. This provides capacity relief by adding service and shifting demand through different lines in the mass transit network.
- Transit demand in the off-peak direction usually increases due to the new connections provided by the mass transit network which results in new ridership being added.
- Certain new connections provided by the mass transit network are highly attractive because they propose to tackle capacity limitations or add new river crossings. However, implementing these improvements will pose challenges and carry costs that will need to be considered when developing these concepts in the future.



5 Mobility Hubs

The mass transit network strategy can be further refined by identifying intermodal transit hub locations, based on transportation and land use considerations. These are referred to as mobility hubs, and are an important form of investment in transit infrastructure and help to support and incentivize large scale transit-oriented development. They tie important pieces of the proposed land use and transit strategies together.

Mobility Hubs are strategically located in nodes or can be centred on a mass transit station. They serve as critical places for trip origins, destinations and transfer points. Furthermore, they create connectivity to different modes, supporting a mobility system that allows people to seamlessly move from one travel option to another and to conveniently fulfill their daily needs. This is where different modes of transportation come together including walking, biking, transit and shared mobility options to create connections within Edmonton and to the region. Existing examples of possible emerging mobility hubs where key connections between routes are made could include Century Park and West Edmonton Mall.

Selection of these functional types of mobility hubs was made based on identifying key City Plan nodes and key transportation intersection points that were candidates to fit the primary function for each of these types of mobility hubs:

- **Entry hubs:** Typically situated at or near the end of the high-capacity mass transit lines;
- **Transfer hubs:** Areas of significant network transfer points that combine higher volumes of passengers with a proposed land use node or location along a designated development corridor.
- **Destination hubs:** Identified as the Major Nodes from The City Plan Concept, since these are planned to act as both employment centres (destinations) and as origins and transfer points for people movement.

To focus investment on a strategic set of locations and reinforce The City Plan's idea of "15 minute districts" and Community of Communities outcomes, it was proposed to identify no more than one hub of each type, and a maximum of two hubs in each Planning District. Exhibit 5.1 displays a map illustrating the proposed mobility hubs corresponding to the mass transit network. The map shows the three types of mobility hubs and recommended locations.

Exhibit 5.2 describes the characteristics of the mobility hub locations and provides high-level guidance as to the typical features of each hub. The locations of the hubs in each category are also listed for reference.

It should be recognized that each mobility hub location may serve more than one function. Therefore, the typologies assigned to each location serve as preliminary identification of each mobility hub's primary function. It is expected that further study and planning will identify and incorporate other secondary functions of each mobility hub.

Exhibit 5.1: Proposed Mobility Hubs – Edmonton Mass Transit Study

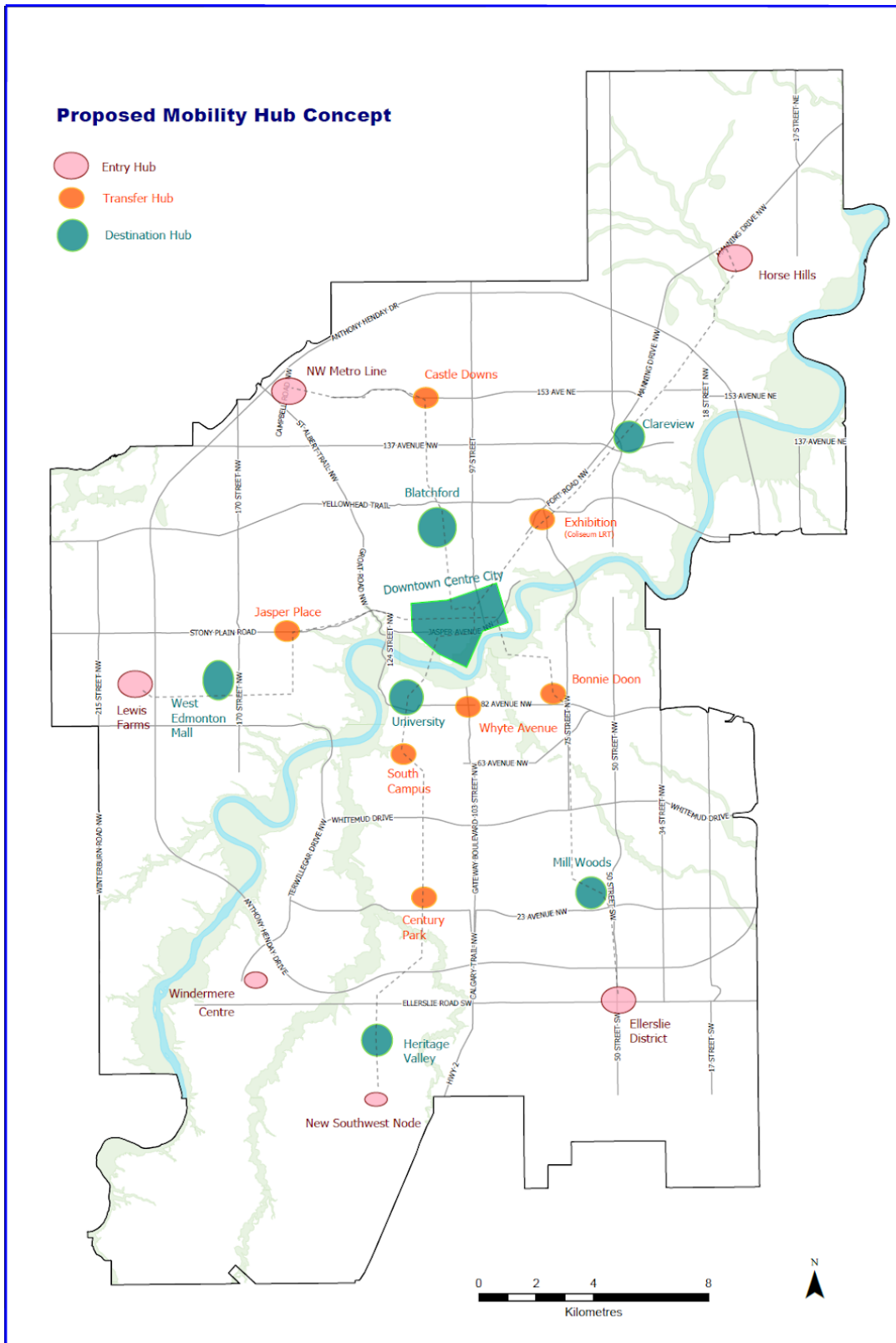


Exhibit 5.2: Proposed Mobility Hub Typologies and Design Guidance – for the Edmonton Mass Transit Study

TYOLOGY	ENTRY HUBS
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Description

- High proportion of outbound trips in the morning peak
- Often a major connecting point to regional services

Design Guidance

- Typical amenities include bus transit terminals, commuter parking, and bicycle parking and related facilities. Integration with surrounding development (such as retail, mix-used amenities, civic facilities and other uses) should be required.
- Design should address station access requirements and large activity peaks during rush hour. Design should also be mindful of sustained all-day transfers, albeit at lower intensity than peaks
- Design for parking and pickup/drop-off facilities should evolve towards higher use of shared vehicles/ride sharing/ride hailing
- Bicycle network routes geared towards commuters as well as other users should connect to these hubs
- Integration with surrounding development (such as retail, mix-used amenities, civic facilities and others)



Examples for illustrative purposes only

PROPOSED LOCATIONS
<ul style="list-style-type: none"> • Horse Hill District Node • End of Metro Line NW (Campbell Rd) • End of West Valley Line in Lewis Farms • Southeast Valley Line (Charlesworth District Node) • New Southwest Node and Windermere Centre Node would be second-tier entry nodes because they split the demand from the SW corner of the city

TYOLOGY

TRANSFER HUBS

Description

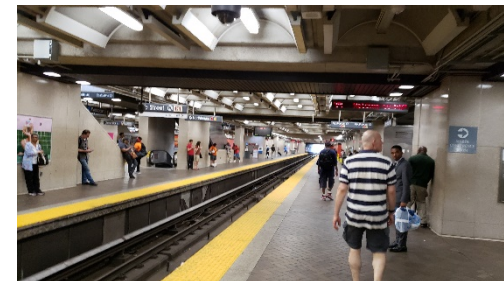
- Major transfer point in the mass transit network with transfer between one or more high-capacity lines and other transit services
- Large portion of traveller activity within this hub consists of traveller movements within the mass transit station

Design Guidance

- May connect multiple transit operators and/or multiple types of ETS services
- Design should focus on ensuring seamless transfer between lines
- Design may include elements of parking (mainly through underground or shared parking), pick-up and drop-off locations, shared mobility, and cycling, but these will be less prominent than at entry nodes

PROPOSED LOCATIONS

- Jasper Place (Stony Plain Primary Corridor)
- Whyte Avenue/ Gateway/Calgary Trail (Whyte Avenue/99 Street Primary Corridor)
- South Campus
- Century Park District Node
- Bonnie Doon District Node
- Exhibition District Node
- Castle Downs District Node
- There are other transfer nodes in addition to these, but with lower volumes would be less suitable as mobility hubs



Examples for illustrative purposes only

TYOLOGY

DESTINATION HUBS

Description

- Major destination in the mass transit network with concentration of employment, recreation, and institutional uses
- High proportion of inbound trips in the morning peak, with potential to achieve a greater inbound/outbound balance.

Design Guidance

- Typically served by a high number of mass transit lines
- Potential to include a future high speed train terminal, likely in one of the more central destination hubs
- Destination hubs may also incorporate a transfer hub function for some trips, due to the concentration of routes
- Design of these hubs should address the destinations served with a greater focus on walking connections to and from the hub
- Transfer hub functions at destination hubs may also be supported by cycling, shared mobility, but with a lower emphasis on parking supply
- Critical to physically integrate mobility functions with existing and future development



Examples for illustrative purposes only

PROPOSED LOCATIONS

- Centre City Node
- Clareview Major Node
- Blatchford-NAIT-Kingsway Major Node
- WEM-Misericordia Major Node
- University - Garneau Major Node
- Mill Woods Major Node
- Heritage Valley Major Node



6 Developing the Network

The mass transit network will require implementation that stages the network so it is developed in response to existing transit demand and capturing future ridership demand. It is also critical that the network be developed in manner the helps support components of The City Plan in particular the land use concept. Since the timing of the ultimate mass transit network is several decades into the future, a cautionary discussion of what future proofing of the network could entail is included. Finally, the next steps for this study and beyond are outlined to conclude this chapter.

6.1 Concept Staging

The mass transit network defined in this report represents the transit services available over a long-term horizon for a city with 2 million residents. This doubling in size will take several decades. As the city grows, the population increase will also mean that more public funding is available for transit operations. The extent of the transit system will gradually increase over time, through introduction of new types of service, new routes, and increased frequency. Staging is typically carried out under the guidance of shorter-term strategic and investment plans focusing on 4-year and 10-year time periods.

The mass transit network is expected to be deployed over time, with several opportunities and constraints factoring into the staging:

- Existing ridership demand and desired lines can provide a starting point for developing and expanding Edmonton's current mass transit network (mainly dominated by LRT). The result will be building the network logically through extensions or new mass transit lines (where the infrastructure/technology allows for exclusive or semi-exclusive ROW) connecting to current demand and to where already existing services exist (ideally coalescing around at least one mobility hub location). Additionally, the potential to capture future ridership (through future land development, or direct/fast connections) should be considered as the mass transit network is developed.
- The rationale for projects can and should be linked to city building opportunities. The City Plan land use concept proposes its own staging plan for different types of development, and the deployment of transit infrastructure and services can provide support and be a catalyst for the land use initiatives and transit oriented development.
- Financial resources available during a given time period mean that certain projects will be prioritized while others are deferred until more funding becomes available.
- Some forms of capital construction can be converted from one mode to another, but this will have significant capital cost and design implications. (I.e. new bridges or tunnels built for transit). Designing and building for multiple modes can introduce extra design features, requirements and costs which become 'throw away' after the transition. Furthermore, upgrading to new infrastructure requirements requires shut down or diversion to existing services causing disruption to mobility options.
- Some services may be introduced in a less capital-intensive form sooner (for example a rapid or limited stop bus) and then be converted in part or in full to semi-exclusive or exclusive transit as needs arise.

Relationship with The City Plan

Each of the nodes, corridors and new neighbourhoods in the plan has a designated activation approaches for each future time horizon. As noted in The City Plan, these include:

- *Strategize.* To help advance a priority growth area, work is undertaken to stimulate site/area readiness, build the necessary regulatory structure to support future action and build momentum in terms of buy-in and front-end preparation. This includes activities such as completing technical studies, preparing business cases, concept planning, developing geographic plans and/or other implementation planning activities.
- *Invest.* For sites/areas identified as ready for change from a strategy perspective, targeted investments respond to market demand, address infrastructure barriers or activate existing assets. This includes activities such as hard and soft infrastructure upgrades, **investing in mass transit** and using land assets to support key priorities in partnership with business and industry.
- *Nurture.* For sites/areas where development and change is underway, additional initiatives will support project momentum, fine tune roll-out and focus implementation efforts. This will include activities such as forming partnerships, piloting new ideas and deploying programming efforts to enhance area performance and viability.

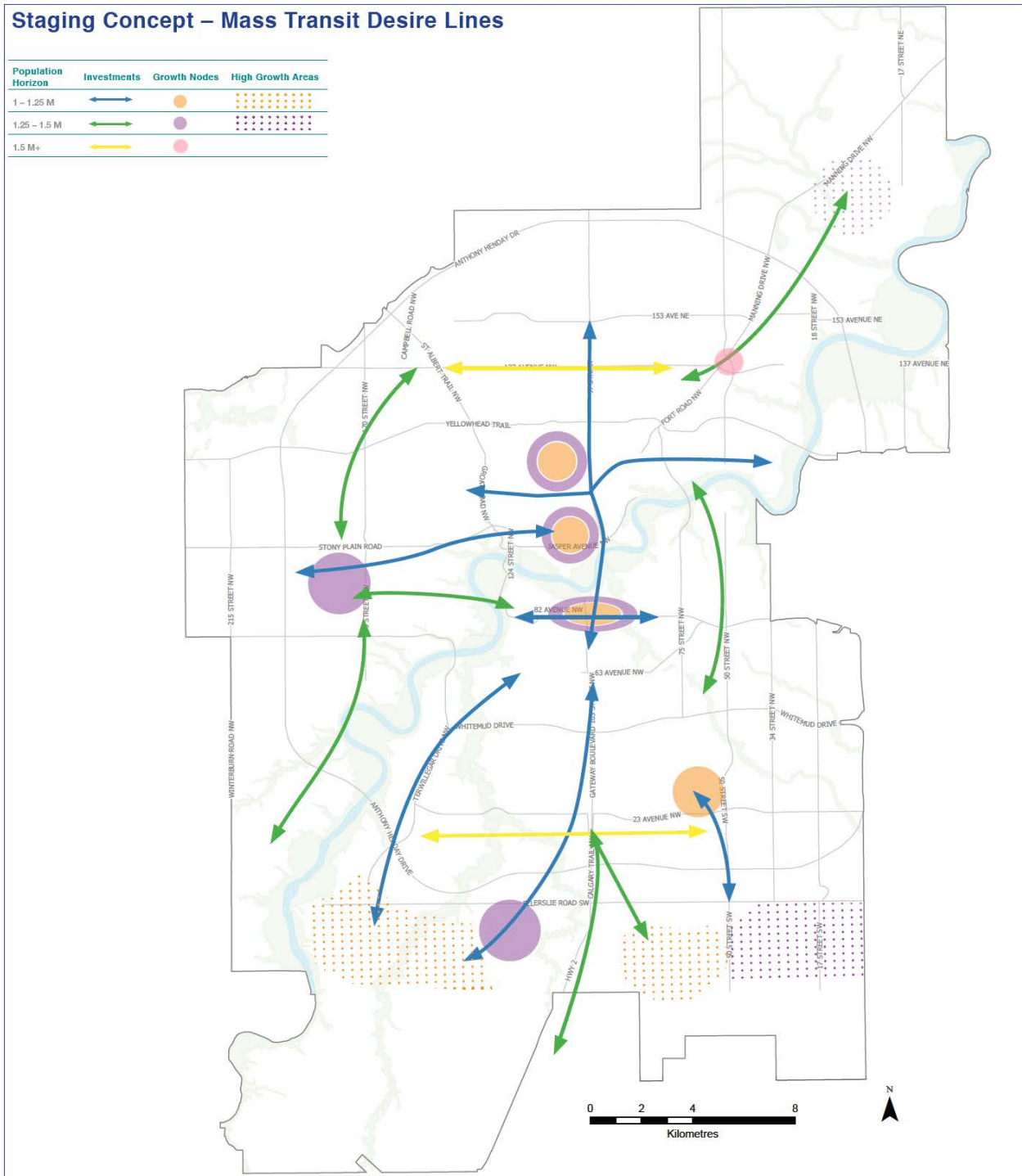
Areas that fall within the ‘invest’ category for a particular time-frame would be one of the focal points for mass transit implementation. Other investments in mass transit may also take place at the same time, to provide connections between the development/redevelopment areas and other parts of the existing mass transit network.

Exhibit 6.1 is an illustrative concept for staging of the mass transit network based on potential future desire lines resulting from ridership demand. The selection of specific projects and routes would have to be evaluated as the opportunities are identified in order to define which project(s) move forward. The map indicates the growth nodes and high growth areas from three broad stages of growth: 1 to 1.25 million, 1.25 to 1.5 million, and 1.5 million to 2 million. The location of these growth areas provides an indication of where some of the mass transit investment would likely be focused, shown here as arrows.

- **1 to 1.25 Million Horizon.** This initial planning horizon builds on several key connections outward from the centre of the city, focusing on existing demand, and also emerging demand that will be driven by growth areas and nodes. In addition to the orange growth areas and node shown on the map, there are also numerous areas with “medium” growth and where these are clustered, there would also be priority in addressing these connections. Within this horizon, north-south and east-west connections through the Centre City and University/Whyte Avenue are identified, as well as initiatives towards the west, southwest, south and southeast, where communities are growing.
- **1.25 to 1.5 Million.** The areas of fastest growth include the northeast, near northwest, and again across the south. Priority connections identified by the green arrows connect to the growth areas for this horizon and start to enhance crosstown connections between residential and employment areas allowing for better city-wide travel through transit.
- **1.5+ Million Horizon.** Growth in the longer term is spread around much of the city, including new communities and redevelopment. The potential priorities at this time would be driven by where demand emerges, and would fill in remaining gaps in the long-term network.

As follow-up to this strategy, a more detailed review of implementation staging will be undertaken to refine this illustrative concept, based on estimated population and employment numbers for the city.

Exhibit 6.1: Implementation Staging Concept for Mass Transit Network



6.2 Future Proofing

In large part, advancements in mass transit technology over the past century have been largely incremental. Improvements to tunnelling, signalling, vehicles, intelligent transportation systems, and roadway design have made transit more comfortable, reliable, and convenient. However, the same technologies that were developed at the turn of the 20th century form the basis of most mass transit systems today.

Consider, for example, the London Underground. With very few exceptions, the rapid transit infrastructure constructed more than 100 years ago continues to form the backbone of the city's transportation network. This suggests that major infrastructure investments proposed as part of this plan will continue to have a life well beyond when Edmonton is a city of 2 million people.

Looking forward, however, there are two potentially disruptive technologies that should be taken into account during implementation of the future mass transit network for Edmonton:

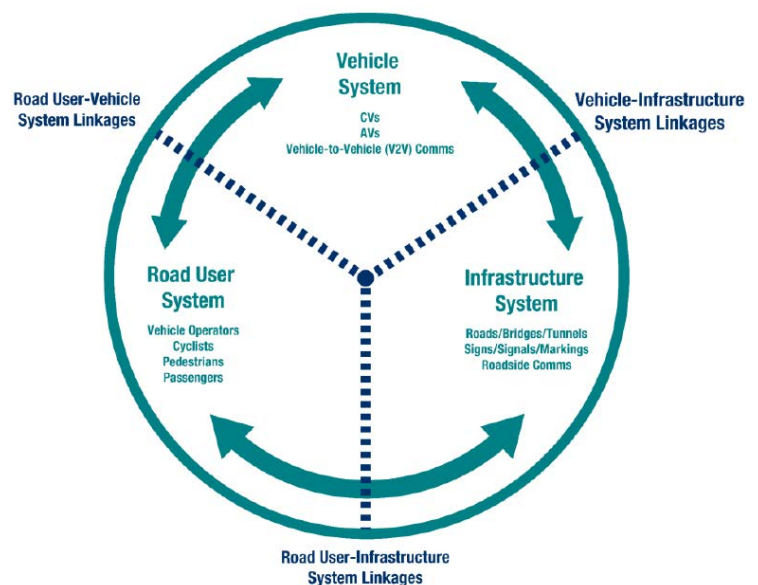
Vehicle Propulsion: With a growing focus on reducing greenhouse gas emissions and the environmental impact of vehicles, buses and trains have become key focal points for new propulsion technologies including battery-electric and hydrogen fuel cell systems.

Edmonton has already tested the feasibility of electric buses and will add 40 of these vehicles to its fleet by 2020, but it is important to consider the necessary infrastructure changes to support a fully-electric bus fleet in the long term. It is also critical that the challenges of adopting an electric fleet are considered, such as limits to electric grid infrastructure, retrofitting garages to accommodate vehicle types and timeline restrictions to the renewal of transit fleet.

Although they are currently less common than battery electric systems, hydrogen fuel cells can also be used to power transit vehicles including buses and trains. Since this propulsion system requires different infrastructure to supply hydrogen gas instead of electricity, its adoption requires careful planning and consideration of the benefits and drawbacks of fuel cell technology. For example, fuel-cell powered trains would not require overhead catenary lines to supply power, but may require two locomotives to provide useable range and an adequate supply of hydrogen.

Connected and Autonomous Vehicles (CAVs): There is a general consensus in industry and academia that fully-autonomous vehicles will enter the market at some point in the next decade. Although experts anticipate that the arrival of CAVs will have substantial impacts on the transit industry, this does not mean that transit will be completely replaced.

For one, the corridor capacity benefits of mass transit are not readily replaced by a different form of vehicle. It is more likely that the 'Connected' aspect will be used to complement transit services through increased operational efficiency and safety, rather than a model where passengers elect to switch to driverless single-occupant vehicles. One form of operational efficiency would be transit priority, which is already starting to migrate towards Connected Vehicle systems architecture.



While true that CAVs may take the form of smaller vehicles, such as sedans or mini-vans, they may also take the form of driverless buses, allowing traditional transit services to be provided at a lower cost. CAVs operated by a transit agency could also be used to provide demand-responsive or micro-transit services where traditional vehicles or routes are less feasible. In these cases, CAV technology may be used to supplement and support key transit corridors, which will continue to provide high-capacity service.

There is some broad uncertainty as to how these and other disruptors might influence travel in the future, and this depends in part on to what extent and how different services and technologies are regulated, and how people react to offerings.

The current consensus is that conventional transit is more likely to be affected by disruptors and that many of the elements of Mass Transit will continue to thrive well into the future, possibly with some evolution over time of what form it takes. A subtle example of this evolution of form is the recent shift from the heavy-rail style LRT approach used for the Capital and Metro Lines, to the urban style low-floor system being implemented for the Valley Line.

6.3 Next Steps

This report documents the mass transit network in its proposed state and is based on technical analysis and both internal and external stakeholder input. The immediate next stage is for public consultation to help inform the final version of The City Plan, for adoption later in 2020. However, this is simply the start of an ongoing process to develop the future transit network.

Implementation Phasing: The next technical step beyond the current study is for assumptions in community development, including population and employment, to be reviewed in greater detail and used to inform a phasing plan for the elements of the mass transit network. An initial concept for this is suggested in Section 5 and a Mobility Network Assessment will help define this in more detail, including the timing and in some cases the interim forms of service. These will be guided by community needs and opportunities, as well as the logistics of implementing transit infrastructure and services.

Another branch of technical analysis will be to assess the **operational feasibility** of elements of the mass transit network, to evaluate if and how they could be implemented. The increases in service frequency and new types of service point to several challenges that will need to be addressed through future study. These include:

- Increasing the capacity of certain parts of the LRT network to interline the Capital and Metro Lines at higher frequencies, and finding the best way to address the capacity constraint at University Avenue;
- Operating frequent and rapid buses at high frequencies, typically in mixed traffic and with constraints on 'platform' space in the public right of way. This will need to consider transit priority measures and curb management;

This type of work is usually collaborative and would draw upon the local knowledge base for the transit system, bring in lessons learned from applicable case studies, and evaluate potential solutions, potentially through modelling simulation.

Design Guidelines and Standards for the new and evolving types of transit service will need to be developed to inform planning and design of future services. This may take several forms but typically starts with confirming the ‘function and feel’ of transit infrastructure and services, with technical and stakeholder input informing this. Design standards can then be developed by merging best practice from existing standards, with emerging urban design principles, and the guidelines developed for transit infrastructure, vehicles and operations. It will also be important to align these guidelines and standards to City Policy (both short term and long term) and in particular land use development policy to ensure the integration with land use policies.

Bus Rapid Transit (with fully-segregated or dedicated lanes) types of service would be “new” to Edmonton and some elements would warrant development of guidelines and standards to support and inform future project development. This would also be applicable to mobility hubs and large scale mass transit stations not designed specifically for rail technology.

Early Implementation can take a number of forms. The Bus Network Redesign is already approved and many of the early versions of future routes included in the mass transit network will be in service in the city before the end of 2020.

The rapid bus and semi-exclusive services, including the look and application of Bus Rapid Transit (BRT), bus only or HOV lanes (painted and segregated) and transit priority measures, will be new to Edmontonians. Therefore, purposeful and coordinate efforts to define these concepts in the Edmonton setting will be critical for the success of implementing the mass transit network. It is common in the industry to select a priority corridor, work with stakeholders to develop, design and implement ‘quick wins’ improvements (for example, confirming and implementing bus stop locations for a rapid bus service) and deploying a demonstration/pilot version of the service. These are often carried out with the participation of senior levels of government to fund implementation, monitoring and reporting of results. These aspects are useful because they help to measure performance and inform local lessons learned that can be applied to the broader transit network.

Appendix A – Mass Transit Network Inventory and Additional Reference Exhibits

Inventories of Mass Transit Network Routes

Districts, Nodes and Corridors – Reference Maps

Additional Model Outputs (Volume Plots)

Future Population and Employment Density Map

Exhibit A.1 – Mass Transit Network Inventory – City-wide Routes

Appendix A.1 - Mass Transit Network Inventory - Citywide Routes

Line Name	Category	Direction	Origin-Destination (City Plan)	Key Nodes/Corridors Connections (Primary Corridors and Major/District Nodes Only)	Key Connections with Mass Transit Lines (City Wide Rapid Network Only)	Peak Hour Boardings (Avg of AM, PM)	AM + PM Peak Boardings per Directional Route-km	Maximum Peak Hour Volume in Peak Direction	Off-Peak Hour Passenger Loads (Maximum Volume)	Frequency - minutes between vehicles [Peak, Off-Peak]	Average stop distance (metres)
Metro Line (ML)	Exclusive ROW	North - South	Campbell Road - South Campus	Castle Downs, 137 Avenue, Blatchford, Centre City, University Garneau	R8, B1, B4, R12, Capital Line, Airport, B6, B2, R8	13000	626	5150	1560	5 / 5	1050
Capital Line (CL)	Exclusive ROW	North - South	Energy Park - Heritage Valley District Node	Horse Hill Centre, Clairview, Exhibition, Stadium, Centre City, University Garneau, Southgate, Century Park South Hospital - Heritage Valley	B4, R12, B5C, B1, Metro Line, Airport, B5, B6, B2, R8, B1, R3	29650	793	10300	2480	5 / 5	1350
Valley Line (VL)	Exclusive ROW	West - East	Lewis Farms - Charlesworth District Node (Ellerslie)	Charlesworth, Millwoods, Bonnie Doon, centre City, Stony Plain Road, Meadowlark, WEM	B5C, B1, R8, B2, B1, Metro Line, Airport, Capital Line, R12, B5, B4	18000	574	4600	1720	5 / 5	1050
Airport Connector	Exclusive ROW	North-South	Centre City - EIA	Centre City, WhyteAve-99 Street, Gateway Boulevard/Calgary Trail, South Common - Research Park, Airport	Metro Line, Capital Line, Valley Line, B1, B2, R8, B5, R3	1850	66	1000	390	20 / 30	3150
B1	Semi-Exclusive ROW	North - South	Castle Downs District Node - Century Park District Node	Castle Downs, Northgate/Northtown, 97 Street, Centre City, Whyte Ave, Gateway/Calgary Trail, Century Park	Metro Line, R8, B4, R12, Capital Line, Airport, Valley Line, B2, R8, B5	17200	805	6000	2310	3 / 5	700
B2	Semi-Exclusive ROW	West - East	West Edmonton Mall/Misericordia Major Node - Bonnie Doon District Node	WEM-Misericordia, Meadowlark, Unviersity Garneau, Whyte Ave, Gateway/Calgary Trail, Boonie Doon	B4, B5, Valley Line, R12, R8, B6, Metro Line, Capital Line, B1, Airport Connection	10500	904	4600	1160	3 / 5	1150
B4	Semi-Exclusive ROW (Partial)/Rapid Bus (Partial)	West - Northeast	Clairview Major Node - West Edmonton Mall/Misericordia Major Node	Clairview, Londonderry, Northgate/Northtown, 137 Avenue, WEM-Misericordia	R12, R8, B1, Metroline, B2, B5, Valley Line	3500	142	1350	440	4 / 10	1450
B5	Semi-Exclusive ROW (Partial)/Rapid Bus (Partial)	West - Southeast	West Edmonton Mall/Misericordia Major Node - Meadows North District Node	WEM-Misericordia, Meadowlark, Century Park, South Common - Research Park, Millwoods, Meadows South, Meadows North	B4, B2, Valley Line, R12, R8, B6, Capital Line, B1, Airport Connection, Valley Line, B5C, R3	6150	201	1950	820	4 / 6	1700
B6	Semi-Exclusive ROW	North South	University/Garneau Major Node - Rabbit Hill	University Garneau, Windermere Centre	B2, Metro Line, Capital Line, R8, B5, R3	3450	181	2100	470	4 / 10	1650
RapidBus12 (R12)	Rapid/Limited Stop	West-East	Meadowlark District Node - Clareview Major Node	Meadowlark, Westmount, 124 Street, Blatchford-NAIT-RAH-Kingsway, 97 Street, 118 Street, Exhibition	R8, B5, Valley Line, B2, Metro Line, B1, Capital Line, B5C, B4	4400	211	1200	840	3 / 6	1400

Appendix A.1 - Mass Transit Network Inventory - Citywide Routes

Line Name	Category	Direction	Origin-Destination (City Plan)	Key Nodes/Corridors Connections (Primary Corridors and Major/District Nodes Only)	Key Connections with Mass Transit Lines (City Wide Rapid Network Only)	Peak Hour Boardings (Avg of AM, PM)	AM + PM Peak Boardings per Directional Route-km	Maximum Peak Hour Volume in Peak Direction	Off-Peak Hour Passenger Loads (Maximum Volume)	Frequency - minutes between vehicles [Peak, Off-Peak]	Average stop distance (metres)
RapidBus7 (R7)	Rapid/Limited Stop	North-South	Castle Downs District Node - Davies Station	Capilano, Exhibition, Castledowns	Metro Line, B1, B4, R12, Capital Line, B5C, Valley Line	2650	98	750	350	4 / 8	1650
RapidBus8 (R8)	Rapid/Limited Stop	West-East	Meadowlark District Node - Davies Station	Meadowlark, University-Garneau, Gateway Blvd/Calgary Trail	R12, B2, B5, Valley Line, B6, Capital Line, Metro Line, B1, Airport Connection, B5C, B4,	550	45	350	150	7.5 / 15	1650
Regional Service											
Sherwood Park - CBD (Reg. SP 1/1A)	Regional Service	West-East	Sherwood Park - City Centre	Sherwood Park, Capilano, Centre City	R8, B5C, Valley Line, Metro Line, Capital Line, B1, Airport Connector	1700	61	700	180	5 / 15	850
Beaumont-50-Coliseum (B5C)	Regional Service	North-South	Sherwood Park - Exhibition District Node	Beaumont, Charlesworth, Millwoods, Capilano, Exhibition, 118 Ave	R3, B5, Valley Line, R8, Capital Line, R12	1900	70	1000	480	3 / 6	4550
Sherwood Park - Coliseum (Reg SP 2)	Regional Service	West-East	Beaumont - Exhibition District Node	Exhibition, 118 Ave	R12, Capital Line, B5, R8	1100	50	800	330	4 / 8	6150

Exhibit A.2 – Mass Transit Network Inventory – District Routes

Appendix A.2 - Mass Transit Network Inventory - District Routes

Line Name	Category	Direction	Origin-Destination (City Plan)	# of Districts Serving	# of Key Nodes/Corridors Connections (Primary/Secondary Corridors and Major/District Nodes Only)	Key Connections with Mass Transit Lines (City Wide Network Only)	Peak Hour Boardings (Avg of AM, PM)	AM + PM Peak Boardings per Directional Route-km	Maximum Peak Hour Volume in Peak Direction	Off-Peak Hour Passenger Loads (Maximum Volume)	Frequency (minutes) in Peak / Off-Peak	Average stop distance (metres)
Rapid/Limited Stop Routes												
RapidBus1 (R1)	Rapid/Limited Stop	North - South	Heritage Valley Major Node – Airport Connector	2	4	Capital Line, Airport Connector	500	84	400	80	8 / 15	1550
RapidBus2 (R2)	Rapid/Limited Stop	West - East	Rabbit Hill – Charlesworth District Node	2	4	B6, Capital Line, R3, Valley Line, B5C	1250	57	950	230	6 / 10	2800
RapidBus3 (R3)	Rapid/Limited Stop	West-East	Windermere District Node – Meadows North District Node	2		B6, Capital Line, Airport Connector, Valley Line, B5C, B5	600	22	200	60	10/15	2550
RapidBus4 (R4)	Rapid/Limited Stop	West - East	Rabbit Hill- Mill Woods Major Node	2	8	B6, Capital Line, R3, B5, Valley Line	1000	48	200	120	6 / 12	1751
RapidBus5 (R5)	Rapid/Limited Stop	North - South	Campbell Road – Riverview Centre District Node	3	12	Metro Line, B4 R12, Valley Line, B2, B6	2700	115	2000	620	4 / 5	1801
RapidBus6 (R6)	Rapid/Limited Stop	West - East	Meadowlark District Node - Meadows North District Node	3	11	R12, R8, Valley Line, B2, B5, Capital Line, B1, B5C, R4	900	39	750	200	6 / 10	2151
RapidBus9 (R9)	Rapid/Limited Stop	West - East	Bonnie Doon District Node- Meadows North District Node	2	6	B2, Valley Line, B5C, R3, B6	950	93	550	180	10 / 10	1951
RapidBus10 (R10)	Rapid/Limited Stop	West - East	Meadowlark Major Node- Stadium District Node	3	13	R12, R8, Valley Line, B2, Metro Line, B1, Capital Line	1750	115	750	380	5 / 8	1551
RapidBus11 (R11)	Rapid/Limited Stop	North - South	Goodbridge Corners - 124 Street Primary Corridor	2	6	Metro Line, B4, R12, Valley Line	1150	95	400	250	7.5 / 10	1500

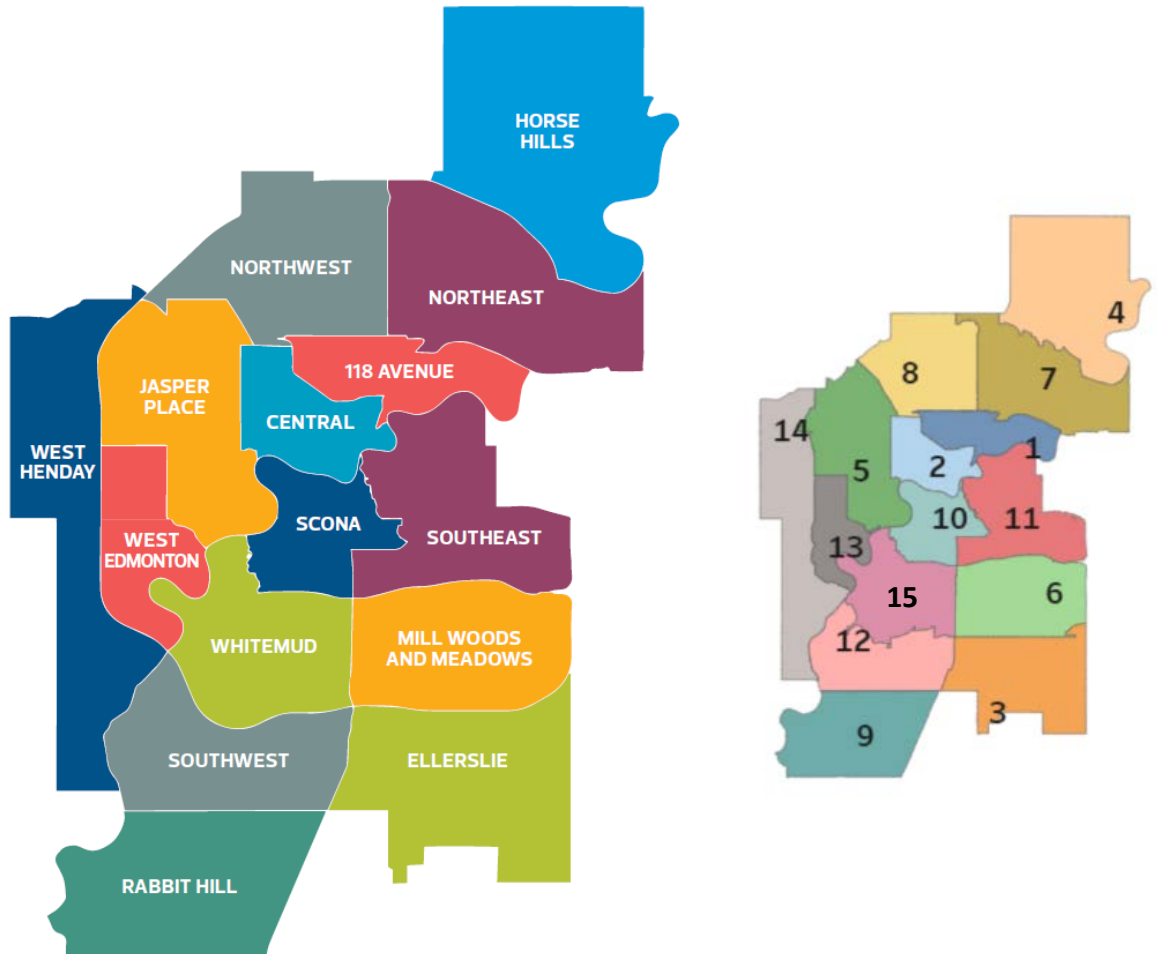
Appendix A.2 - Mass Transit Network Inventory - District Routes

Line Name	Category	Direction	Origin-Destination (City Plan)	# of Districts Serving	# of Key Nodes/Corridors Connections (Primary/Secondary Corridors and Major/District Nodes Only)	Key Connections with Mass Transit Lines (City Wide Network Only)	Peak Hour Boardings (Avg of AM, PM)	AM + PM Peak Boardings per Directional Route-km	Maximum Peak Hour Volume in Peak Direction	Off-Peak Hour Passenger Loads (Maximum Volume)	Frequency (minutes) in Peak / Off-Peak	Average stop distance (metres)
RapidBus13 (R13)	Rapid/Limited Stop	West- East	97 Street Secondary Corridor – Clareview Major Node	2	5	B1, B8, R12, Capital Line, B4	550	45	350	220	7.5 / 10	1950
RapidBus14 (R14)	Rapid/Limited Stop	North - South	Campbell Road – Riverview Centre District Node	2	2	B4, Valley Line	1100	38	550	190	5 / 10	2050
RapidBusN110 (R110)	Rapid/Limited Stop	North-South	Energy Park – Clareview Major Node	2	3	Capital Line, R12, B4	550	44	350	120	7.5 / 15	700
Regional Service												
Leduc Regional	Regional	North - South	Leduc - Heritage Valley Major Node	2	3	Airport Connector, Capital Line	1000	38	550	180	7.5 / 16	1001
Regional Strathcona - Gorman	Regional	North - South	Sherwood Park to Gorman	1	2	Capital Line	750	49	650	130	13 / 15	3701
Fort. Sask. 199	Regional	Northeast	Fort Saskatchewan - Energy Park	1	2	Capital Line	1250	44	750	200	5 / 15	1101
Stony Plain - Express 1	Regional	West- East	Stony Plain/Spruce Grove - Stony Plain Road Primary Corridor	3	4	B4, R12, Valley Line,	700	24	450	230	7.5 / 15	2051
Stony Plain - Express 2	Regional	West- East	Stony Plain/Spruce Grove – West Edmonton Mall/Misericordia Major Node	2	4	B4, B5, B2, Valley Line	750	23	550	150	6 / 15	2951
St. Albert (various)- Park and Ride	Regional	West-East	St. Albert - Campbell Rd Park and Ride	1		Valley Line	2350	varies by route	1250	620	10; Overall 30-4	951
Urban Frequent Routes, F = Frequent Services (Legacy Routes from BNR and similar central bus routes). N, SE, SW, W = existing and future local routes that evolve into future frequent services												
F1	Urban Frequent	West- East	Westmount Distric Node- Exhibition District Node	2	7	R12, Valley Line, Metro Line, Capital Line, Airport Connector, B1, B5C, R8	1850	143	650	340	5 / 8	450
F3	Urban Frequent	West- East	Centre City – Capilano District Node	2	3	R8, B5C, B1, Airport Connector, Metro Line, Capital Line, Valley Line	500	60	300	120	10 / 15	600
F4	Urban Frequent	S-Shaped	University Major Node – 118 Avenue Primary Corridor	3	10	B6, B2, Metro, Capital, Valley Line, B1, Airport Connection, R12, B5C, R8	2150	109	950	270	4 / 10	550
F5	Urban Frequent	North-South	Blatchford-NAIT-RAH-Kingsway Major Node - Southgate District Node	4	7	Capital, B2, Metro, Valley, B1, R8, R12, Airport Connector	575	58.97435897	250	170	10 / 15	650
F7	Urban Frequent	West- East	Lewis Farms – Capilano District Node	5	13	Valley Line, B4, B2, B5, R12, R8, B6, Capital Line, Metro Line, Airport Connector, R8, B5C	1850	70	550	230	6 / 12	700

Appendix A.2 - Mass Transit Network Inventory - District Routes

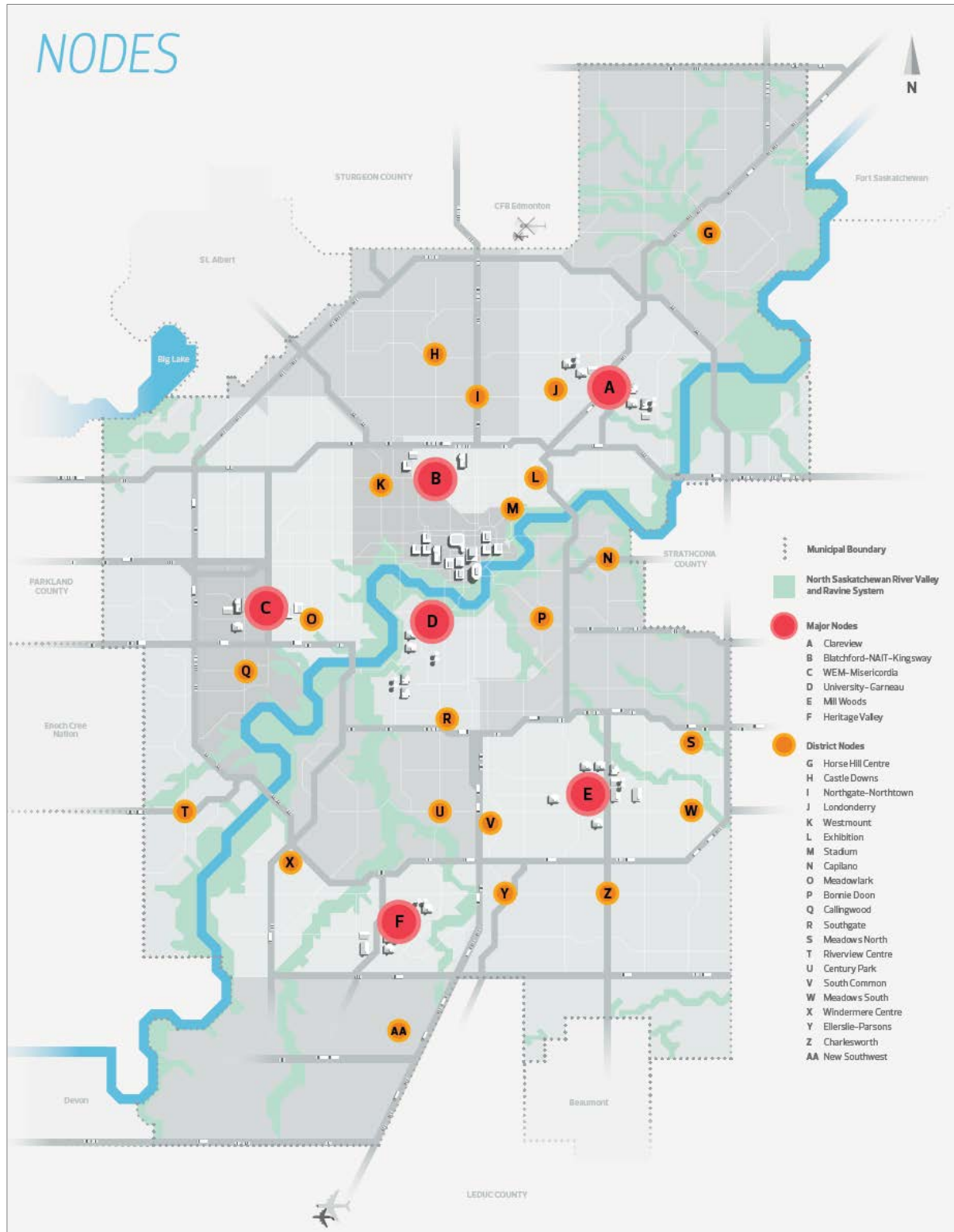
Line Name	Category	Direction	Origin-Destination (City Plan)	# of Districts Serving	# of Key Nodes/Corridors Connections (Primary/Secondary Corridors and Major/District Nodes Only)	Key Connections with Mass Transit Lines (City Wide Network Only)	Peak Hour Boardings (Avg of AM, PM)	AM + PM Peak Boardings per Directional Route-km	Maximum Peak Hour Volume in Peak Direction	Off-Peak Hour Passenger Loads (Maximum Volume)	Frequency (minutes) in Peak / Off-Peak	Average stop distance (metres)
F12	Urban Frequent	West-East	Blatchford-NAIT-RAH-Kingsway Major Node- Stadium District Node	1			500	72	300	140	10 / 15	450
N5	Urban Frequent	West- East	Westmount District Node – Fort Road Secondary Corridor	2	4	Metro Line, B1, R8, Capital Line	900	82	400	150	7.5 / 15	750
SE 31	Urban Frequent	North - South	Exhibition District Node – Gateway Blvd/Calgary Trail Primary Corridor	2			800	60	200	210	10 / 15	600
SE 33	Urban Frequent	North - South	Capilano District Node - South Campus	2			700	56	300	170	10 / 15	600
W1	Urban Frequent	West- East	Stony Plain Road Primary Corridor – Centre City	2	5	Valley Line, R12, Metro Line, B1	800	89	450	400	6 / 8	500
W3	Urban Frequent	West- East	Stony Plain Road Primary Corridor – Westmount Distric Node	2	5	R12, Valley Line,	650	62	250	60	10 / 30	550
W4	Urban Frequent	North-South	Westmount District Node – Meadowlark District Node	2	8	R12, R8, B2, B5, Valley Line	500	36	200	40	10 / 30	1050

Exhibit A.3 – Reference Map – City Plan Districts

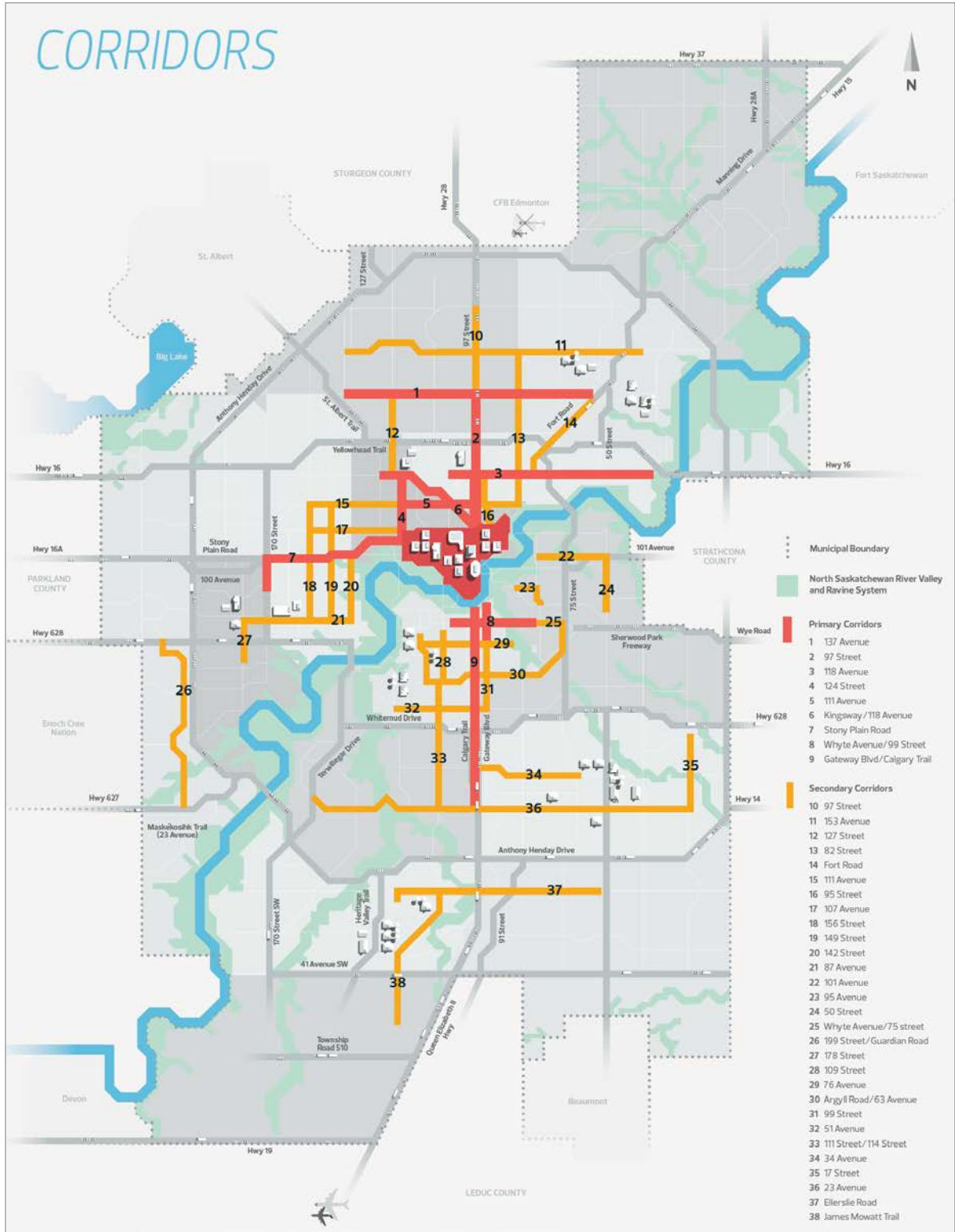


Source: Planning Districts Philosophy & Boundary Rationale. Numbering is used in the inventory of routes.

Exhibit A.4 – Reference Maps – City Plan Nodes and Corridors

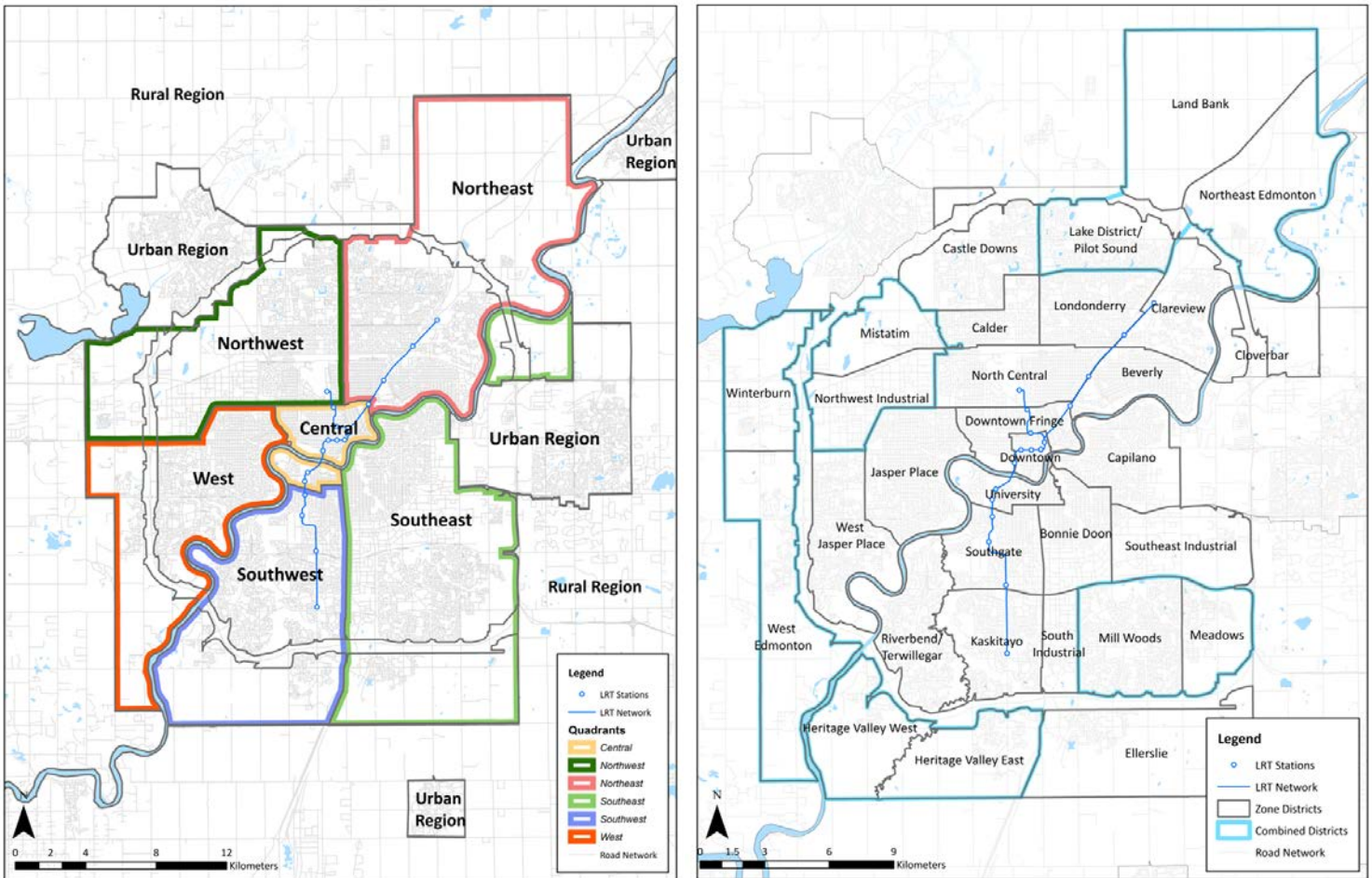


Source: City of Edmonton



Source: City of Edmonton.

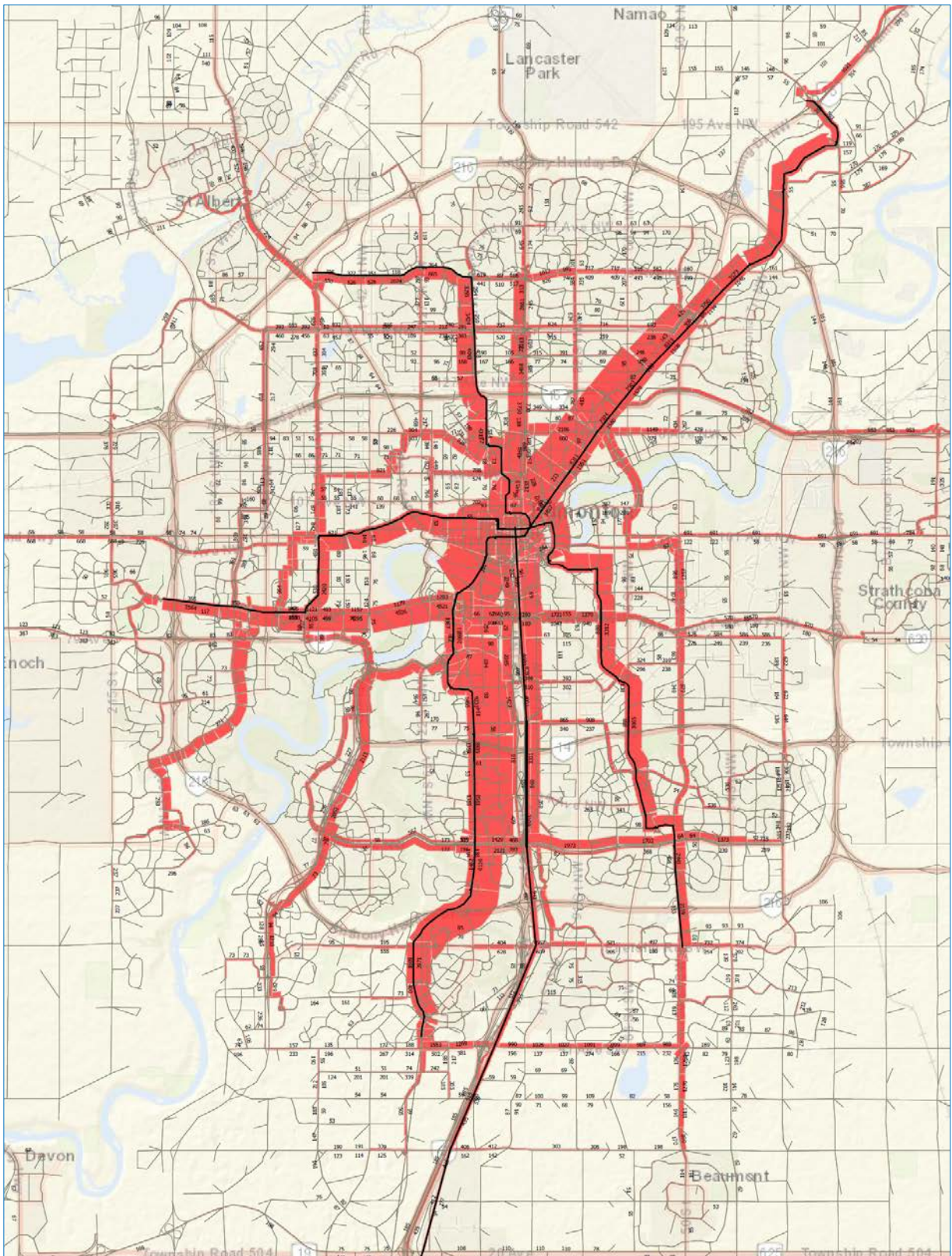
Exhibit A.5 – Maps of Travel Survey Quadrants and Sectors for Reporting of Mode Shares



Source: Making Tracks 2015 - Edmonton and Region Household Travel Survey. Prepared by R.A. Malatest & Associates Ltd. for City of Edmonton.

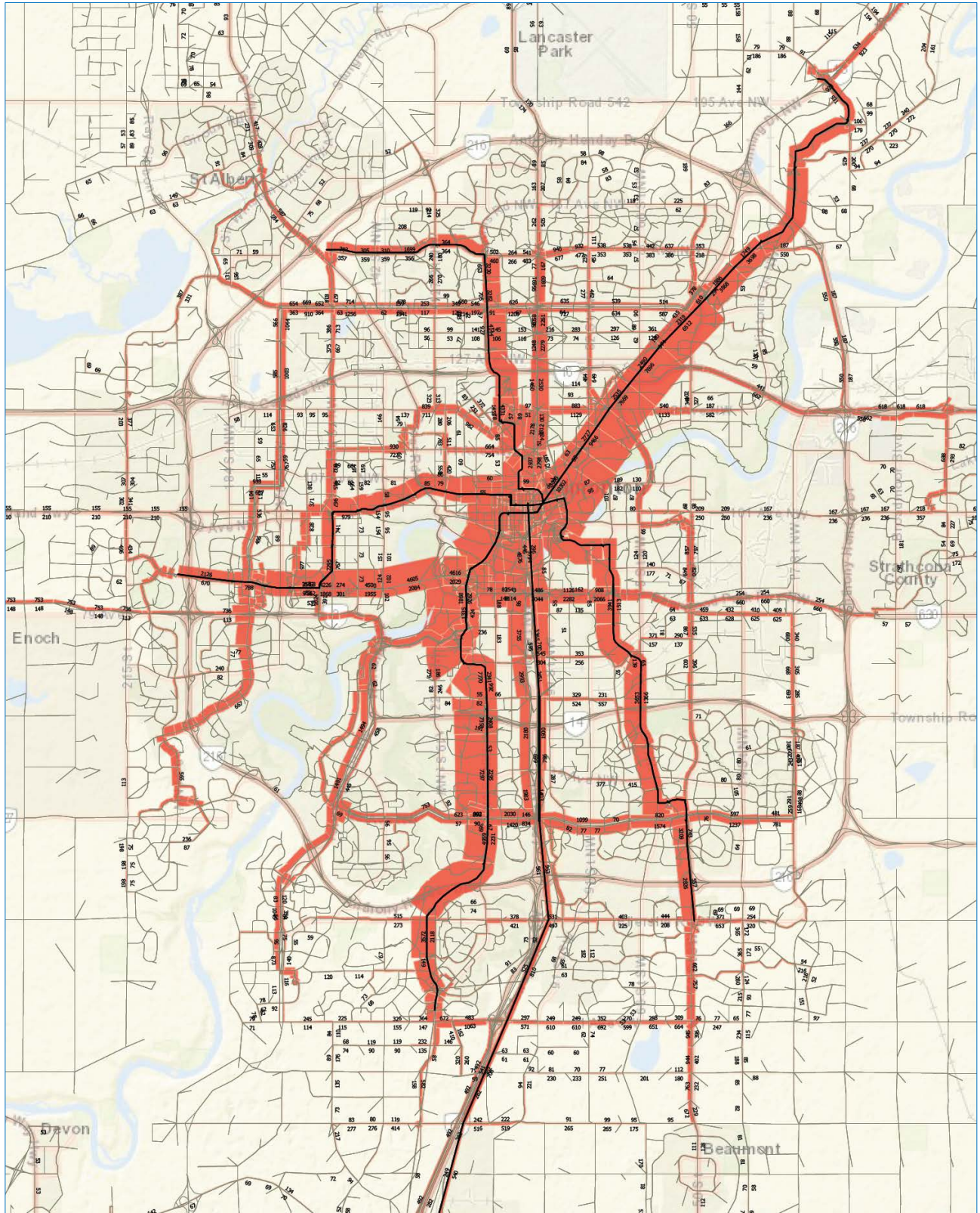
Note: These maps show the boundaries used to report results in Chapter 3 of this report.

Exhibit A.6 – AM Peak Transit Assignment Result – Mass Transit Network



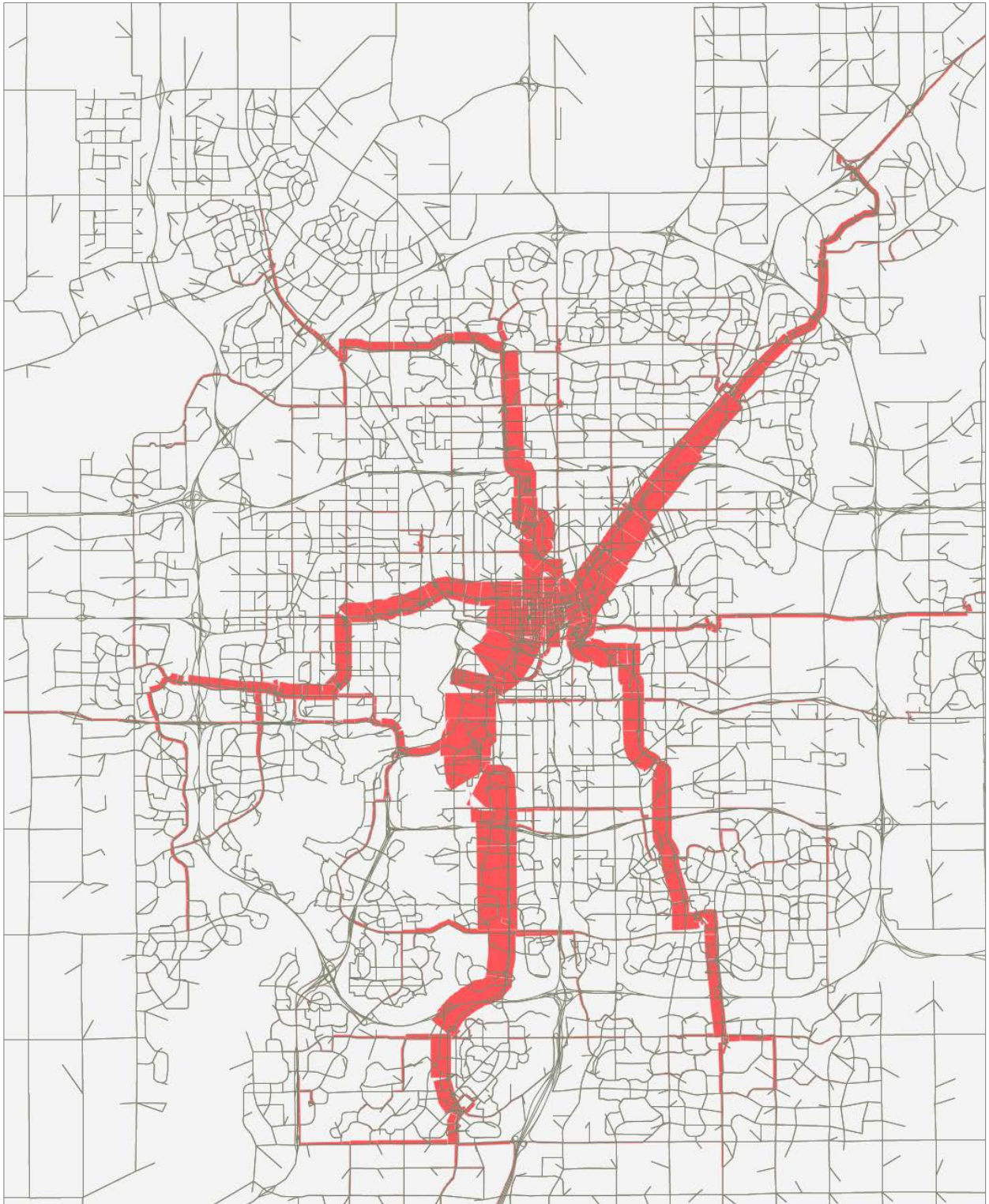
Source: IBI Group/City of Edmonton. EMME Transit Volume Plot.

Exhibit A.7 – PM Peak Transit Assignment Result – Mass Transit Network



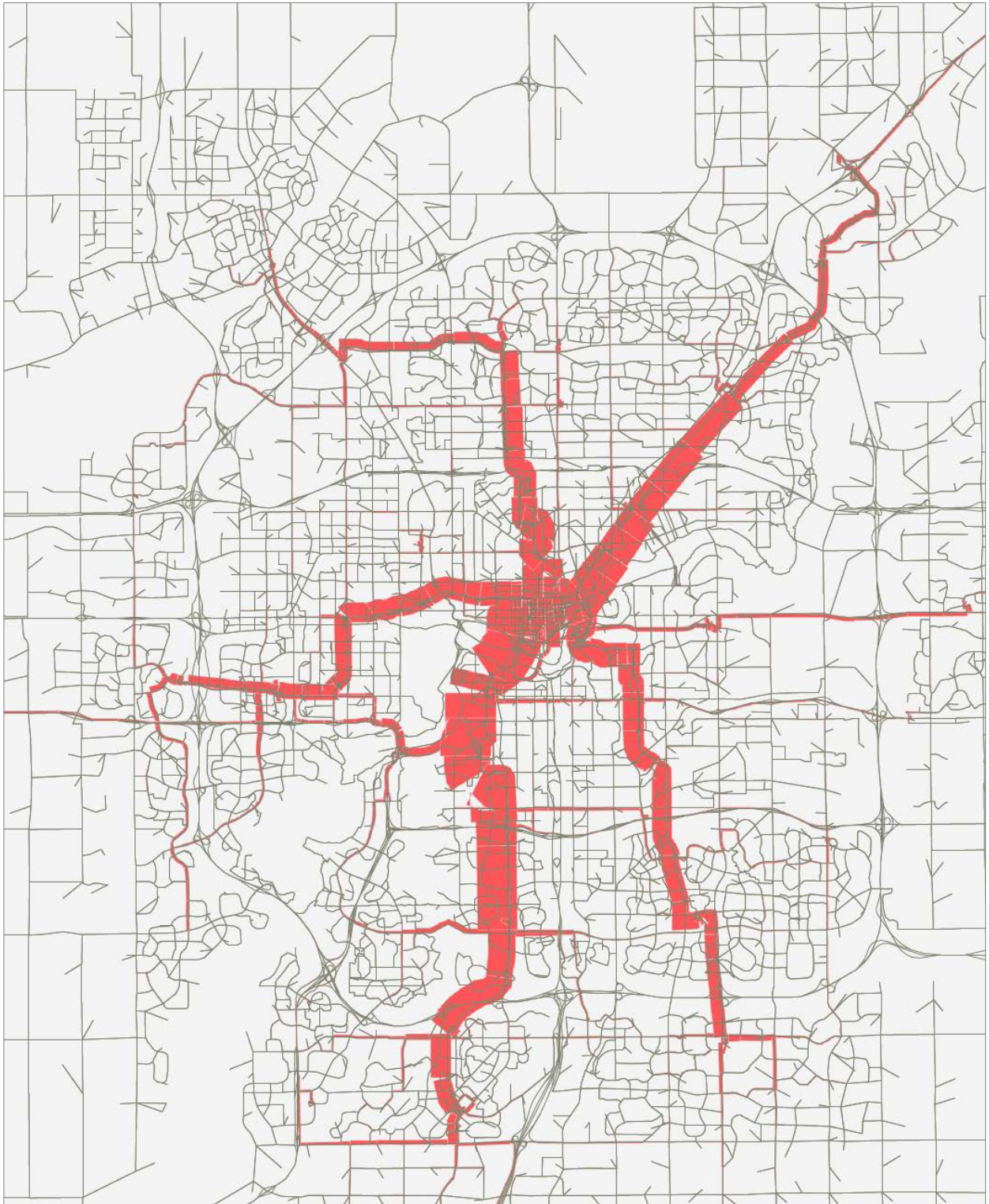
Source: IBI Group/City of Edmonton. EMME Transit Volume Plot.

Exhibit A.8 – AM Peak Transit Assignment Result – Business as Planned (BAP 2065)



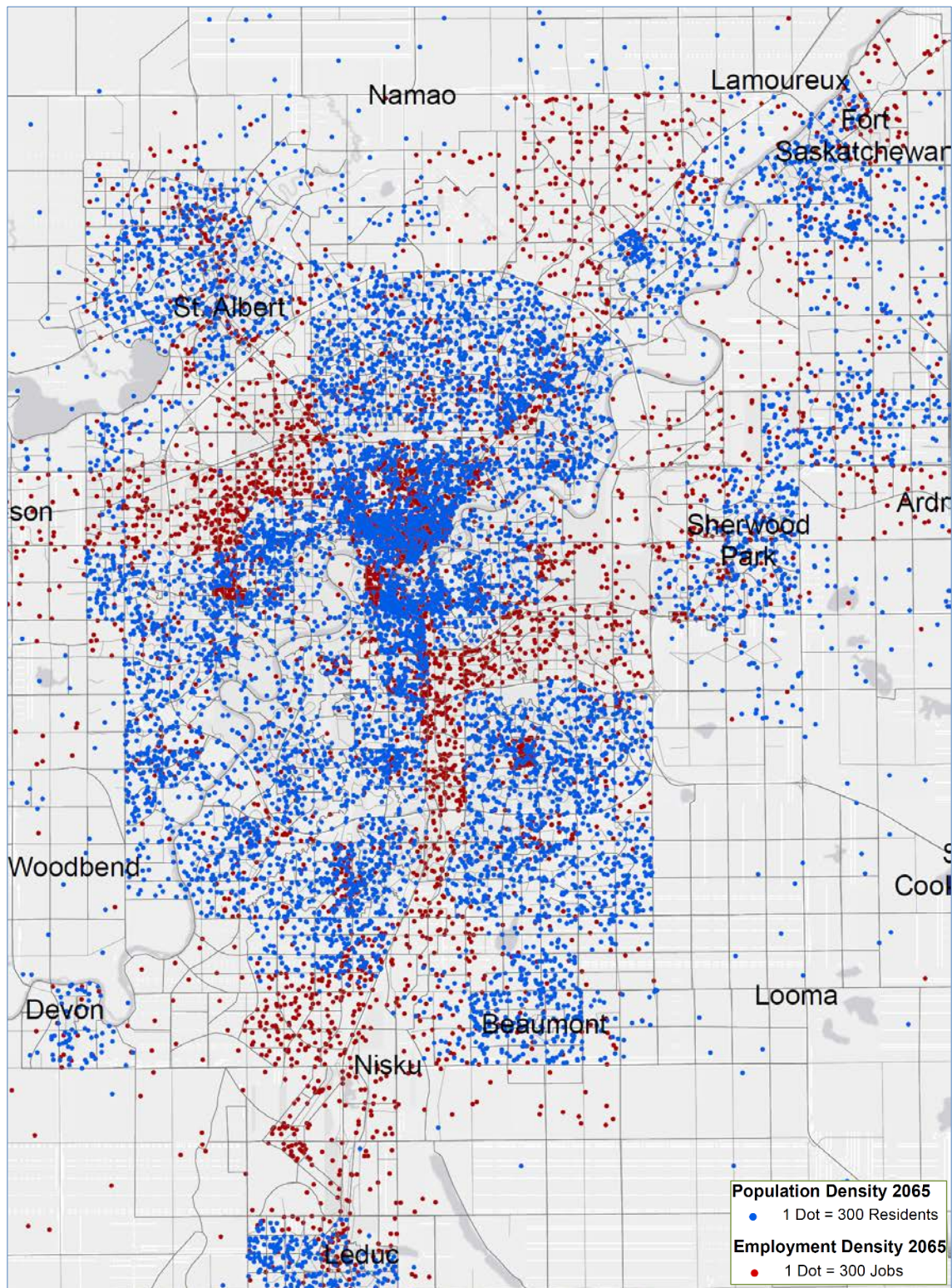
Source: IBI Group/City of Edmonton. EMME Transit Volume Plot

Exhibit A.9 – PM Peak Transit Assignment Result – Business as Planned (BAP 2065)



Source: City of Edmonton. EMME Transit Passenger Demand - Volume Plot.

Exhibit A.10 – Residential and Employment Density Map – Based on City Plan



Appendix B – Previous Mass Transit Study Reports

Mass Transit Backgrounder

https://www.edmonton.ca/city_government/documents/PDF/CityPlan_MassTransitBackgrounder.pdf

City Plan Mass Transit Scenario Analysis

https://www.edmonton.ca/city_government/documents/PDF/CityPlan-MassTransit_ScenarioAnalysis.pdf