

Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



# Green Line LRT

Beltline to Inglewood/Ramsay Station  
Alignment Options Evaluation



## 1 Introduction

Since early 2016, Administration has been evaluating how best to connect the Beltline communities to the future Inglewood/Ramsay station. In December, 2016, City Council approved 12 Avenue S as the preferred corridor for the Green Line. Administration then turned their attention to the short but complex stretch in Victoria Park that would complete the connection of the north and southeast segments of the Green Line.

Administration has evaluated several alignment options that would connect the Green Line in the Beltline to Inglewood/Ramsay station.

No single option serves all stakeholders and meets all program objectives without trade-offs, but the recommended option presents the best balance in achieving The City's long-term goals.

The Transition to 10 Avenue S.E. addresses technical and stakeholder constraints, supports the vision for the redevelopment of Victoria Park, minimizes impacts to single family residential communities, and provides an opportunity for a multimodal station at 4 Street SE.

### 1.1 Connecting the Beltline to Inglewood/Ramsay station

In 2016 April, Council approved the underground alignment on 12 Ave S west of Macleod Trail SE. Administration was directed to investigate alignment options east of Macleod Trail SE to connect the Beltline to Inglewood/Ramsay station.

One of the key considerations for the Beltline to Inglewood/Ramsay alignment recommendation is coordination with the various planning initiatives in these communities. Coordination includes working closely with ongoing projects in the area, such as, Calgary Municipal Land Corporation's (CMLC) Rivers District Masterplan, the potential entertainment complex in Victoria Park, 17 Ave SE connection to Stampede, Stampede's long term vision, the 9 Avenue SE bridge replacement project, the 25 Avenue S LRT Grade Separation Study, and the Inglewood and Ramsay Area Redevelopment Plans (ARP).

Administration developed an alignment option to connect from 12 Ave S, around the north side of Victoria Park Transit Centre (Option 1 below). During evaluation of this option it was revealed there were technical constraints that would have led to very slow LRT speeds, and additional wear and tear on equipment. Slower LRT speeds and increased maintenance requirements results in higher operating costs. Societal costs in terms of lost productivity due to additional travel time for commuters adds significant costs over time. More detail on the economic analysis is provided below. Additionally, trains and buses would share space at the main access to the Victoria Park Transit Centre, increasing the potential for conflicts, and slowing the dispatch of buses. Stakeholders also voiced concerns with this option due to the configuration of 12 Ave S, impacts to traffic access and circulation in the area, and the location of the tunnel portal.

Due to the constraints identified with Option 1, an additional option was developed that travelled along MacDonald Avenue S in the community of Ramsay. Option 2 – MacDonald Avenue, resolved some of

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



### Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

the technical constraints with option 1, but introduced new challenges in the community of Ramsay. This option was not supported by the community, and a number of properties would be required, including a heritage home. This option also didn't resolve concerns regarding impacts to traffic access and circulation in the area, and the location of the tunnel portal on 12 Avenue S.

Through discussion with all stakeholders, Administration developed two additional alignment options to connect the Beltline to Inglewood/Ramsay station. They were shared at public engagement events in-person, and online, in early 2017 May. The new alignment options addressed some of the technical constraints and stakeholder sentiment shared with the previous alignment options. The four alignment options reviewed are (Figure 1):

Option 1 – North of the Victoria Park Transit Centre

Option 2 – MacDonald Avenue SE

Option 3 – Staged around the Victoria Park Transit Centre

Option 4 – Transition to 10 Avenue SE

The attached table provides a summary of the options evaluation.

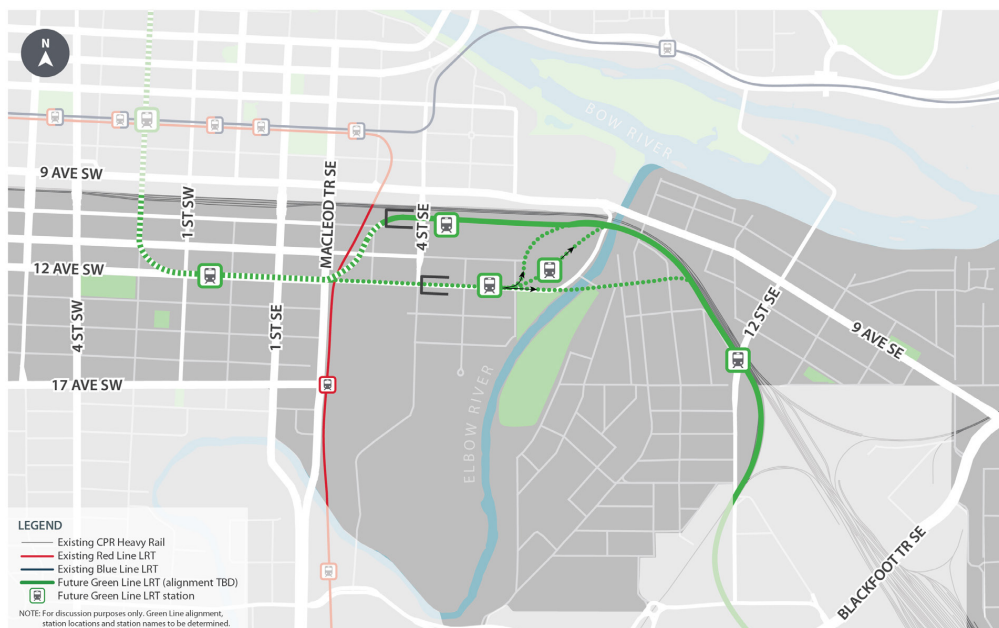


Figure 1: Beltline to Inglewood/Ramsay Alignment Study Area Showing Four Alignment Options



## 1.2 Tunnel Portal

Options 1, 2, and 3 all have the LRT coming to surface in a portal in the block between 4 Street SE and 5 Street SE. Options to shift the portal further to the west were considered however several challenges were found. Other locations considered were:

- Portal between Macleod Trail and 3 Street SE:  
The Green Line tunnel has to go under the Red Line tunnel east of Macleod Trail SE. It is not feasible to surface so quickly from underneath the Red Line tunnel to place the portal between Macleod Trail and 3 Street SE.
- Portal between 3 Street SE and 4 Street SE:  
This option is feasible however is constrained by access and connectivity requirements of the existing buildings and developments including the Arriva building and the current Cowboys Casino. This portal location introduce an at-grade crossing for the LRT at 4 Street SE which is a key north-south corridor to connect Victoria Park and East Village, reducing LRT operating efficiency and introducing an additional location for potential conflict.
- Portal on private property:  
Several options have been investigated to place the portal on private property in the Beltline area in order to preserve functionality of the road network for all modes. Although feasible this would result in additional land costs and complicate redevelopment of lands adjacent to the portal.

As a result, the earliest the LRT may surface is between 4 Street SE to 5 Street SE. This allows for grade separation of 4 Street SE and the LRT, which is planned as one of the major future retail access points to the Stampede site. The portal trench could be placed on the south side of 12 Avenue S, off the road right of way, in order to allow sufficient space for road lanes, sidewalks and future extension of the cycle track. This portal placement has received significant negative stakeholder feedback due to the placement of the portal in the vicinity of redevelopment sites, and the challenges of integrating the portal.

Option 4 is the only option that locates the portal away from 12 Avenue S. In this option, the portal is located adjacent to heavy rail and an electrical substation.





## 2 Options Evaluation

### 2.1 Option 1: North Side of Victoria Park Transit Centre

In order to connect from 12 Avenue S to the previously approved Green Line alignment next to the CPR corridor, the LRT would turn north onto 6 Street SE and then turn east onto the north side of the Victoria Park Transit Centre (VPTC). Assuming 4 Street SE station to be located between 5 Street SE and 6 Street SE and space proofing for the 6 Street SE underpass, this shifts the LRT onto the east side of 6 Street SE which conflicts with the bus fueling and fare collection stations at the VPTC. This alignment also results in several tight curves which impacts LRT run times, operations and maintenance.



Figure 2: Option 1

The opportunities and challenges are summarized below:

Option	Opportunities	Challenges
North side of the VPTC with the LRT on City-owned land	<ul style="list-style-type: none"> <li>Minimizes amount of privately-owned land required</li> <li>Ties in with the previously approved alignment at CPR</li> <li>Capital cost estimate is within the target for the Beltline section</li> </ul>	<ul style="list-style-type: none"> <li>Slowest LRT run times of the four options</li> <li>Impacts to bus operations</li> <li>Places portal on 12 Avenue S, adjacent to development site</li> <li>Reduces space for buses to turn on the northwest corner of the building requiring some building modification to maintain maintenance and storage bays</li> <li>Requires relocation of fueling station and fare collection from buses</li> <li>Tight turns and sightlines may trigger crossing arm protection at the entrance to the VPTC at 11 Avenue SE</li> <li>Tight turns and sightlines may trigger crossing arm protection at 6 Street SE and 12 Avenue</li> <li>No opportunity to accommodate special track work at the 4 Street SE station</li> </ul>

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



### Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

The below figure shows the impacts to the VPTC if the LRT was constructed on City-owned land. Specifically, functionality of five maintenance bays could potentially be impacted on the northwest corner of the building (shown in red). Some site modification may be done to maintain the northern maintenance bays however, due to the age of the site there may be environmental risks.

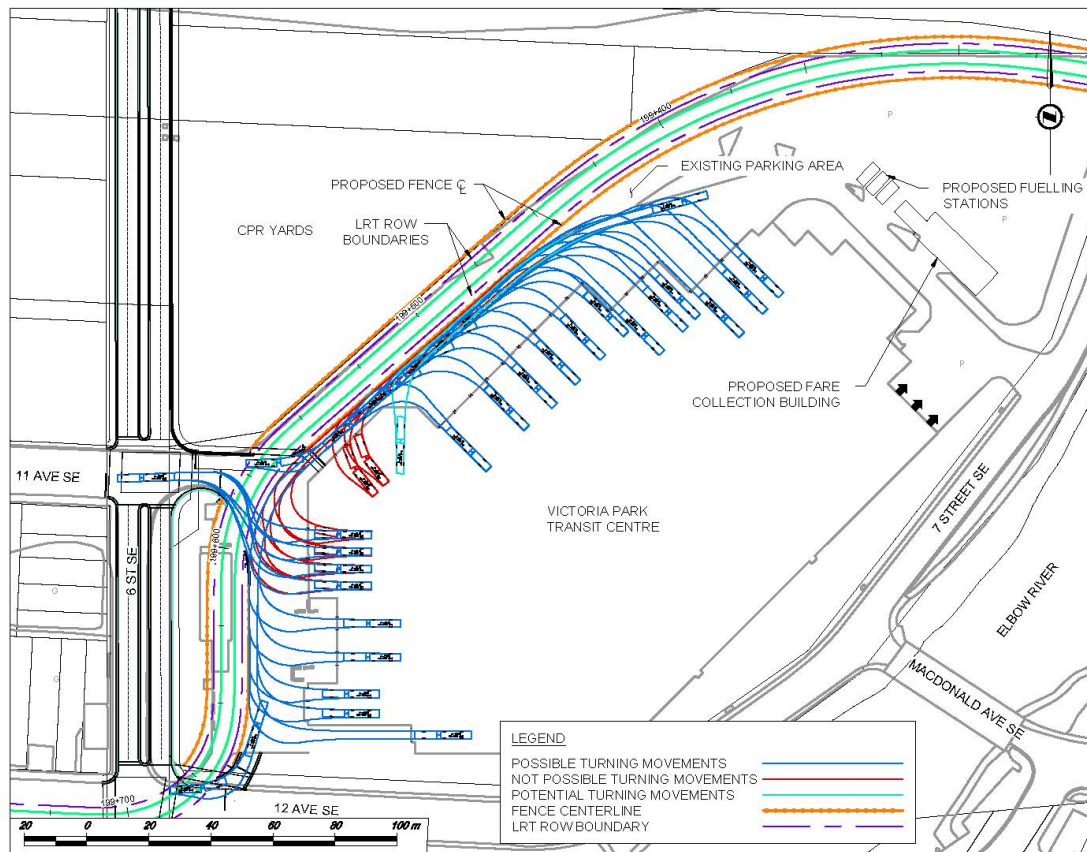


Figure 3: Bus turning conflicts and LRT boundary at Victoria Park Transit Centre with Option 1

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



### Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

The tight curves (track geometry) results in slower LRT run times and additional maintenance requirements. The alignment introduces a 500 metre section where the maximum operating speed will be restrained to 15km/h, adjacent to segments that will be grade-separated and have maximum operating speeds of 50-80 km/h. This creates a discontinuity in LRT operations for 500 metres resulting in approximately an additional two minutes of travel time for each train, impacting approximately 90,000 passengers per day at full build-out of Green Line.

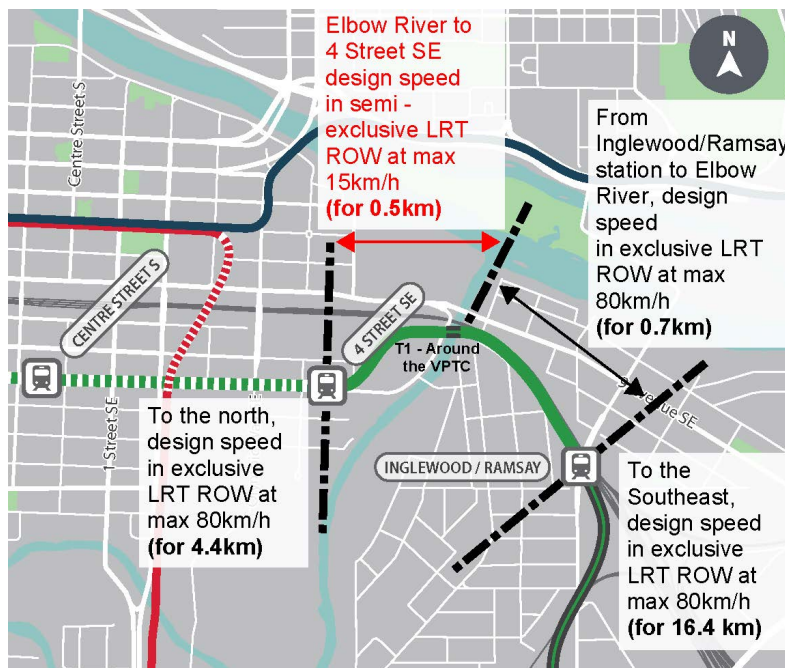


Figure 4: Maximum design speeds for LRT based on curves (track geometry).

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



### Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

## 2.2 Option 2: MacDonald Avenue SE

The option to continue the LRT over the Elbow River and connect at surface along MacDonald Avenue SE had the most direct connection from 12 Avenue S to the Inglewood/Ramsay station. This option was shared with the Ramsay Community Association in September 2016, and the community identified numerous challenges. At that time Administration was still investigating constraints and opportunities in Victoria Park to better understand alignment options. In early 2017, this option was brought forward again,



Figure 5: Option 2

and the Ramsay community did not support this option. The portal location, and surface-running LRT in Victoria Park also poses technical and operational challenges. The opportunities and challenges are summarized below:

Option	Opportunities	Challenges
LRT surface on MacDonald Avenue	<ul style="list-style-type: none"> <li>Improved LRT geometry (compared to option 1) allows for better operations and improved run times</li> <li>Allows for future redevelopment of the VPTC site</li> <li>New bridge could provide a gateway feature to Ramsay, would include improved pedestrian and cycle connections</li> <li>Capital cost estimate is within the target for the Beltline section</li> </ul>	<ul style="list-style-type: none"> <li>Requires deviation from the previously approved alignment adjacent to the CPR in Ramsay</li> <li>Requires additional land within the Ramsay community</li> <li>Geometric constraints within the Ramsay community will require intersections to be relocated and localised regrading within the Ramsay community</li> <li>Vehicular traffic circulation will require roadways and alleyways to be revised in Ramsay</li> <li>Portal location on 12 Avenue S</li> <li>Traffic access and circulation on 12 Avenue S</li> </ul>

Although the community impacts of this option are considered as significant, this option has the highest benefit to the LRT operations. However, this option would still carry the stakeholder challenges with the portal placement between 4 Street SE and 5 Street SE. This option would introduce 1.5 minutes of LRT run time savings compared to the option on the north side of the VPTC as the LRT would be able to travel up to 45km/h going straight through the area. This still does create a short operational inconsistency for 500 metres, but not as significant as the other at-grade options.





## Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

### 2.3 Option 3: Staged Around Victoria Park Transit Centre

In order to connect from 12 Avenue S to the previously approved Green Line alignment next to CPR, a staged option was developed that had a near-term configuration that would be optimized once the VPTC facility was relocated in the long-term. This option aims to keep the VPTC operational during the interim. However, there would not be a Green Line station in Victoria Park until the relocation and remediation of the VPTC site in the long-term.

The near-term alignment is similar to Option 1 (discussed above), in terms of portal location on 12 Avenue S between 4 Street SE and 5 Street SE, but without a station on 12 Ave SE. This alignment assumes that 6 Street SE is closed between 11 Avenue S and 12 Avenue S. This allows the alignment to navigate this block while avoiding conflicts with the bus fueling and fare collection stations at the VPTC. This alignment does include tighter LRT track curves which impact LRT run times, operations and maintenance.



Figures 6 and 7: Option 3

The long-term condition allows for improved LRT geometry with wider track curves as compared to the interim condition. It also locates 4 Street SE station a block away from the Stampede grounds and close to the future Elbow River pathway. Given the potential redevelopment of the VPTC site, this option was preferred to provide an opportunity to integrate the LRT and station with future redevelopment if the VPTC is potentially being relocated in the near term, however, there would still be issues with the portal between 4 Street SE and 5 Street SE. The opportunities and challenges are summarized below:

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



### Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

Option	Opportunities	Challenges
<b>Staged</b> <i>Near-term – North side of VPTC</i> <i>Long-term - Through the VPTC site after relocation of the facility</i>	<ul style="list-style-type: none"> <li>Improved LRT geometry (compared to Option 1) allows for better operations and improved run times in the ultimate condition</li> <li>Allows for redevelopment on the balance of the VPTC site</li> <li>Ties in with the previously approved alignment at CPR</li> <li>Allows for the City to organize the funds and timeline for relocation of the VPTC site including environmental remediation without adding complexity to Green Line</li> <li>Capital cost estimate is within the target for the Beltline section</li> </ul>	<ul style="list-style-type: none"> <li>No Green Line station in Victoria Park in the interim configuration for an undetermined timeframe</li> <li>Redevelopment of VPTC site (and addition of station) challenged by unknown timeline for relocation of facility</li> <li>Additional cost associated with realigning portion of the tracks</li> <li>Portal location on 12 Ave S</li> <li>Traffic access and circulation on 12 Ave S</li> </ul>

### 2.4 Option 4: Transition to 10 Avenue S

To connect from 12 Avenue S to the previously approved Green Line alignment next to the CPR corridor, the LRT tunnel would continue under MacLeod Trail SE along 12 Avenue SE, and at a point east of Macleod Trail SE, turn north proceeding in a north-easterly direction coming to surface on the north side of 10 Avenue SE adjacent to the CPR right of way. It would then proceed eastward over 4 Street SE underpass with a station adjacent to the underpass.



Figure 8: Option 4

The alignment then continues eastward along the previously-approved Green Line alignment on the south side of the CPR in Ramsay to connect with the Inglewood/Ramsay station.

The opportunities and challenges are summarized on the next page.

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation



### Beltline to Inglewood/Ramsay Station Alignment Options Evaluation

Option	Opportunities	Challenges
Transition to 10 Ave SE	<ul style="list-style-type: none"> <li>Minimizes community impacts, particularly in Ramsay. Connecting to the previously approved alignment in Ramsay minimizes community impacts and land acquisition in the community</li> <li>Provides improved LRT operations and fastest travel times</li> <li>Coordinates with the long-term vision for Victoria Park and the Rivers District Masterplan</li> <li>Provides rapid transit service closer to East Village</li> <li>Capital cost estimate is within the target for the Beltline section</li> <li>Addresses many of the technical and stakeholder challenges associated with the other options</li> <li>Does not impact operations at the Victoria Park Transit Centre</li> <li>Provides a large, contiguous site for future redevelopment south of CPR.</li> <li>Provides an opportunity for a multimodal station (LRT, regional passenger rail, and high speed rail)</li> <li>No impact to traffic access and circulation in Victoria Park allowing for more flexibility to plan redevelopment in the area</li> <li>Locates tunnel portal away from 12 Avenue S</li> <li>Economic analysis indicates societal benefits (primarily cost savings based on time) with improved LRT and traffic operations</li> </ul>	<ul style="list-style-type: none"> <li>Land acquisition</li> <li>Tunnel will be constructed under developable land parcels</li> <li>A number of buildings may be required to be demolished</li> <li>Station location two blocks north of main retail/commercial and residential corridor in Victoria Park (12 Ave S)</li> </ul>



### **3 Economic Analysis**

Administration performed an economic analysis for the overall Beltline section to provide data comparing the surface and underground options. The analysis revealed significant societal benefits (in terms of time savings) for Calgarians using the Green Line, and Calgarians driving cars, with the underground option.

The recommended alignment is not completely underground in the Beltline, however it provides the same operational benefits as an underground alignment, at a reduced construction cost. The alignment is grade-separated, meaning there is no interaction between the LRT and traffic. This provides improved LRT operations, improved traffic operations, and reduces potential for conflict.

The economic analysis is based on the Alberta Ministry of Transportation's Benefit Cost Analysis (BCA) Model (2015). The methodology used in the BCA is an industry standard method of assigning a monetary value to future benefits associated with new infrastructure projects. The following metrics were included in the analysis:

- Capital construction costs
- Travel time of commuters (on LRT and in cars)
- Carbon emissions
- Property value uplift
- Effects on retail

The improved travel time of commuters on LRT associated with the underground (grade-separated-option) provided a significant societal benefit in terms of time savings (represented by the cost of time). This is a consideration due to the estimated high passenger volumes in this area entering downtown. This metric was the biggest differentiator between the underground and surface options, highlighting the long-term economic benefits of an alignment that provides efficient travel times. The recommended alignment provides the best travel times of the four options evaluated.





## 4 Conclusion

Administration recommends Option 4 – Transition to 10 Ave S, to connect the Beltline to Inglewood/Ramsay station. No single option serves all stakeholders and meets all program objectives without trade-offs, but the recommended option presents the best balance in achieving The City's long-term goals.

The Transition to 10 Avenue S.E. addresses technical and stakeholder constraints, supports the vision for the redevelopment of Victoria Park, minimizes impacts to single family residential communities, and provides an opportunity for a multimodal station at 4 Street SE.

Administration continues to work with stakeholders in Victoria Park and Ramsay to acquire land, identify station connections, coordinate ongoing planning projects, and support the vision for the future of the area.

## Beltline to Inglewood/Ramsay Station - Alignment Options Evaluation

Metric	Option 1: North of the Victoria Park Transit Centre	Option 2: MacDonald Avenue SE	Option 3: Staged Around the Victoria Park Transit Centre		Option 4: Transition to 10 Avenue SE	Full Tunnel (removed from consideration)
Estimated LRT Run Time	<b>Slowest (8.5 minutes)</b>	<b>Medium (7.0 minutes)</b>	<b>Near-term</b>	<b>Long-term</b>	<b>Fast (6.0 minutes)</b>	<b>Fastest (5.5 minutes)</b>
Community Impacts	Minimal impacts to existing communities	<b>Highest impacts to existing communities</b>	Minimal impacts to existing communities	Minimal impact to existing communities	Minimal impact to existing communities	<b>Some impact to Ramsay community (for tunnel portal)</b>
Development Impacts	Places portal adjacent to development site	Places portal adjacent to development site	<b>No station in Victoria Park</b>	Complicates future development of Transit Centre lands	Complicates future development above tunnel	<b>Low impact on future development</b>
Capital Cost Consideration	\$550 million	\$600 million	\$540 million	Additional \$20 million for track reconstruction and station.	\$600 million	<b>\$900 million</b>
Property Cost Consideration	Property costs will be a major differentiator between individual options. Costs are determined through negotiated land agreements. Property acquisition remains a high risk for the project.					Costs are determined through negotiated land agreements.
Stakeholder Sentiment	Concern about portal location & 12 Ave S traffic access and circulation impacts	Concern about community impact, portal location & 12 Ave S traffic access and circulation impacts	Concern about portal location & 12 Ave S traffic access and circulation impacts	Concern about portal location & 12 Ave S traffic access and circulation impacts	Minimizes impacts to community, traffic access and circulation	Favoured by many stakeholders
Transit Operational Considerations	Significant impacts to bus & LRT operations	Minimal operational impacts	Impacts to Transit Centre operations & LRT operations	Minimal impact [Transit Centre is relocated]	No impact to Transit Centre & LRT operations	No impact to Transit Centre & LRT operations
Traffic Operational Considerations	Impacts to traffic access and circulation on 12 Ave S	Impacts to traffic access and circulation on 12 Ave S	Some impacts to traffic access and circulation	Some impacts to traffic access and circulation	No impact to traffic access and circulation	No impact to traffic access and circulation