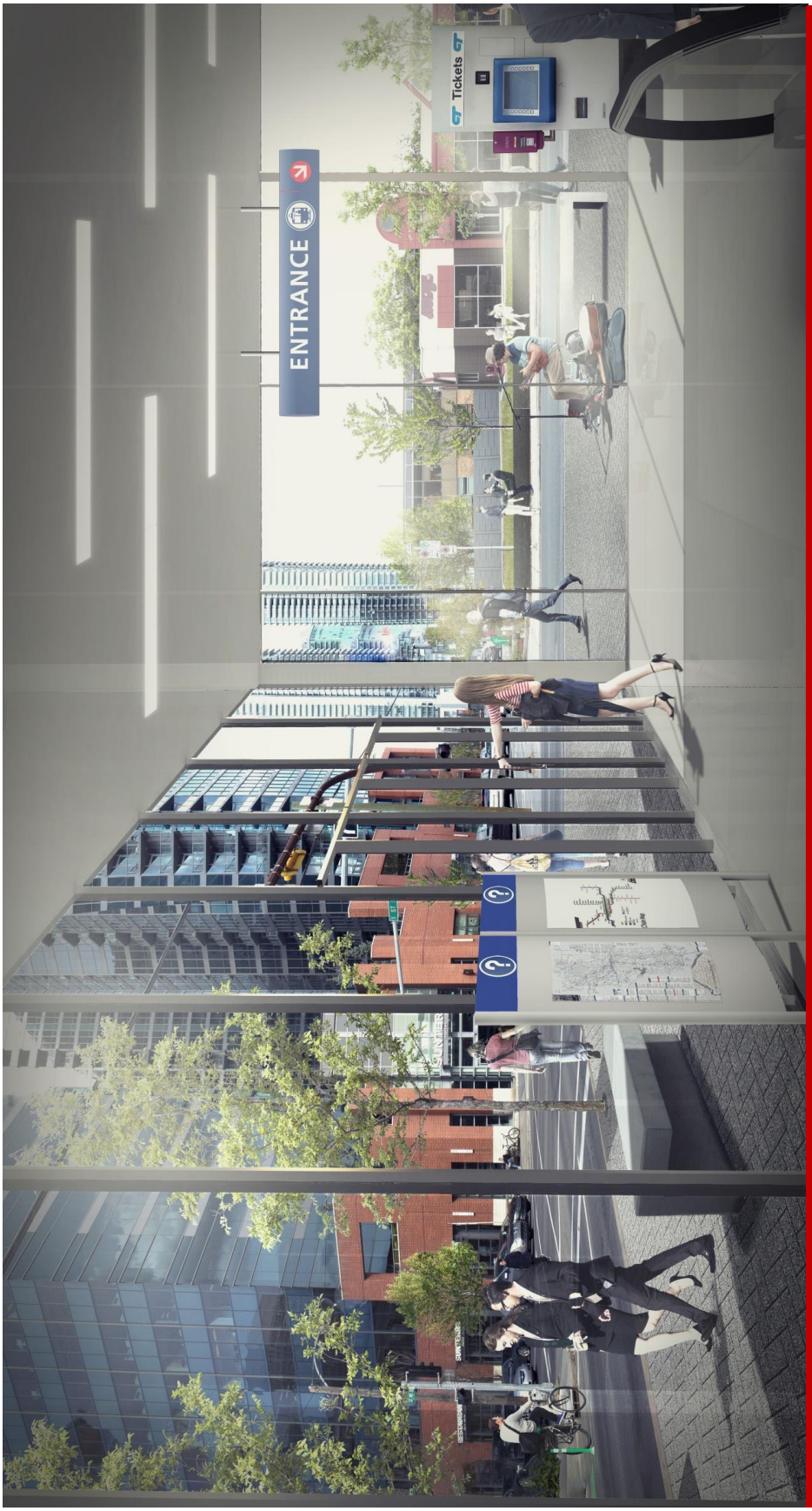
Calgary

Beltline Multiple Account Evaluation Summary Report



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Executive Summary

The Green Line is Calgary's next light rail transit (LRT) line. At more than 46 kilometres in length, the Green Line will nearly double the size of the current LRT network. The Green Line is more than just a transit project; it will improve the way Calgarians live, work, play and move in the city by helping to create sustainable, liveable, and vibrant communities.

MULTIPLE ACCOUNT EVALUATION

Following City Council approval, in principle, of the underground alignment (Option D) for the Bow River crossing, an LRT tunnel will connect the Centre City from 24 Avenue N to 10 Avenue S (TT2016-0705). City council still has one section of alignment to finalize: the section in the Beltline from 2 Street SW at 10 Avenue S to the Elbow River. The Centre City and Beltline is a critical anchor to a successful LRT line and requires many factors to be considered when determining how to integrate the LRT and shape the future vision for the Beltline communities. After careful consideration, four options were selected to be evaluated: (1) a surface option on 10 Avenue S, (2) a tunnel + surface option on 10 Avenue S, (3) a surface option on 12 Avenue S and (4) a tunnel + surface option on 12 Avenue S.

The options that connect the Green Line LRT to the Beltline communities were evaluated using a set of technical, financial, economic, environmental, and community-focused criteria based on city policies. A multiple account evaluation (MAE) process was developed to understand, evaluate, and compare the relative benefits, opportunities, challenges, and trade-offs between the options. The list of accounts and criteria used in this evaluation was reviewed and approved by Council prior to undertaking the evaluation, with all criteria weighted equally against the next.

PUBLIC ENGAGEMENT

Through 2016, the project team met with community and business leaders, property owners, developers and the public to identify the opportunities, challenges and trade-offs that needed to be considered in the evaluation of the four options. Participants had an opportunity to learn about each option and to provide input on what needed to be considered.

In November 2016, the project team reported back to stakeholders on the results of the comparative evaluation of the Beltline options and obtained additional input for further consideration and evaluation. Participants were presented with the evaluation process, with examples of the look and feel, benefits, opportunities, and challenges of each option.

Feedback from these events closely mirrored what was heard in earlier engagement, with support for the 12 avenue corridor. Participants generally agreed with the results of the option evaluation, noting that the 12 avenue corridor will better serve the larger population centers in the beltline. However, participants also wanted the project team to remember to consider the importance and value of the cycle-track, the need to minimize traffic flow issues, and concern about noise and vibration impacts on current residents. Several participants also noted potential opportunities to integrate surface or underground stations into future development in the area.

CORRIDOR RECOMMENDATION

The multiple account evaluation results found that 10 Avenue S tunnel + surface, 12 Avenue S surface, and 12 Avenue S tunnel + surface were highly ranked options. There also was a clear indication of 12 Avenue S as the preferred corridor due to several factors including:

- Better opportunities for near term redevelopment and place making largely due to more diversity in the current land use along the corridor
- Better connects the communities in the Beltline
- Established road network grid on 12 Avenue S east of Olympic Way also provides better integration and accessibility to the 4 Street SE station

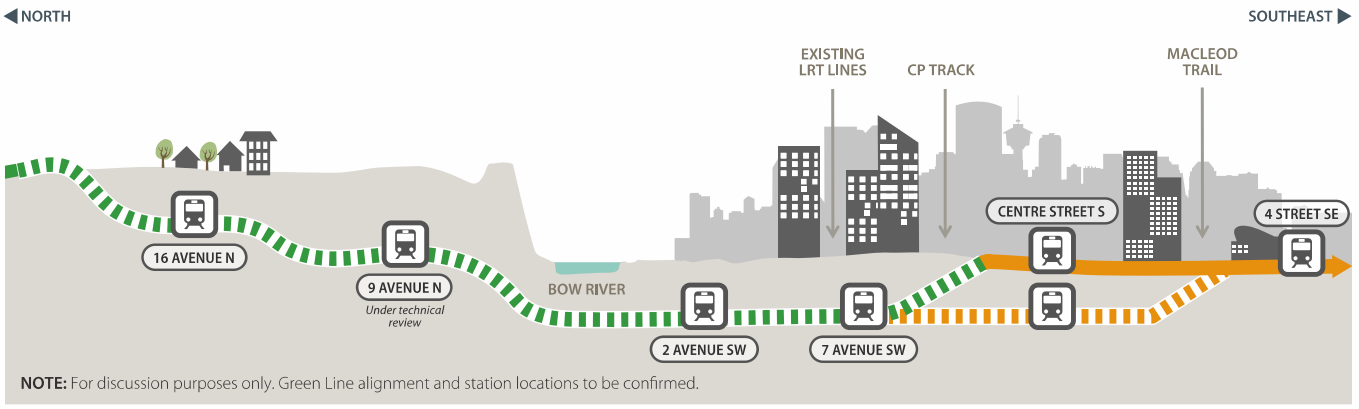
There are trade-offs between the surface and tunnel + surface options on 12 Avenue S. The surface option is the lowest cost option in the Beltline but would introduce LRT and traffic delays and could require substantial changes to the road network. In turn, the tunnel + surface option is better for traffic operations, and provides LRT run times and reliability that benefits the overall Green Line. The tunnel + surface option is a higher cost option and introduces challenges to area stakeholders where the LRT surfaces from the tunnel on 12 Avenue S near 4 Street SE. A recommendation for an alignment will be based on maximizing the total return on investment for Calgarians.

12 Avenue S Surface Option:

After leaving the downtown tunnel heading south, the LRT surfaces along 2 Street SW between 10 Avenue S and 11 Avenue S. It then turns east onto 12 Avenue S to proceed along the surface to Centre Street Station. Continuing east, it then proceeds to the 4 Street SE station, prior to turning north along side of the Victoria Park Transit Facility and connecting to the approved Green Line Southeast LRT alignment at the Elbow River.

12 Avenue S Tunnel + Surface Option:

After leaving the downtown tunnel heading south, the LRT continues in a tunnel under 2 Street SW, turning east under 12 Avenue S to an underground station at Centre Street. The LRT surfaces east of Macleod Trail, proceeding further east to a surface 4 Street SE station. The LRT continues on the surface, turning north alongside the Calgary Transit Victoria Park Transit Facility, and connecting to the approved Green Line Southeast LRT alignment at the Elbow River.



Evaluation Criteria	10 Avenue Surface	10 Avenue Surface + Tunnel	12 Avenue Surface	12 Avenue Surface + Tunnel
Financial Capacity An affordable and cost effective service. Costs are achievable, sustainable in the long term and provide good value for money.			✓	
Community Well-being A safe and socially inclusive service that improves access to key community destinations and provides transportation choices for Calgarians.			✓	
Transportation A high priority transit service that attracts transit use, walking & cycling as preferred mobility choices for Calgarians. An integrated service that improves customer experience, meets future demand and strengthens the regional & local transit networks.				✓
Urban + Neighbourhood Development A service that supports current and future land use, development along the corridor, and integrates with neighbouring communities.				✓
Sustainable Development A service that reduces greenhouse gases and minimizes impact to the existing natural environment.	✓	✓	✓	
Feasibility + Deliverability A service that can be constructed and operated without significant technical issues or constraints.		✓		
Stakeholders A service that reflects the values and priorities of communities.				✓
OVERALL All Criteria	✓	✓✓	✓✓✓	✓✓✓

✓ Highest Ranked Option

1 We Are Here

The Green Line is Calgary's next light rail transit (LRT) line. At more than 46 kilometres in length, the Green Line will nearly double the size of our current LRT network. This investment is more than just a transit project; it will improve the way we live, work, play and move in the city by helping to create sustainable, liveable, and vibrant communities.

End-to-end, the Green Line will connect Keystone in the north and Seton in the southeast to the Centre City and serve an estimated 90,000 to 140,000 passengers per weekday. The north leg of the Green Line will be 18 kilometres long running from 160 Avenue N to 4 Street SE through the Beltline, while the south leg will be 28 kilometres running from the Beltline to Seton. Overall the Green Line may have up to 30 stations (not including the Calgary International Airport) that will let Calgarians live, work, play and move in the city.

The Centre City will serve as the connection between the north and southeast communities along the Green Line. Integration of the Green Line in the Centre City will provide a new north-south LRT route along 2 Street SW in the Downtown Core, with a connection to the existing Red and Blue Lines at 7 Avenue S.

CENTRE CITY MULTIPLE ACCOUNT EVALUATION

City Council has approved , in principle, the underground alignment (Option D) for the Bow River crossing connecting downtown from 24 Avenue N to 10 Avenue S (TT2016-0705).This approval dictates the possible options for the Beltline.

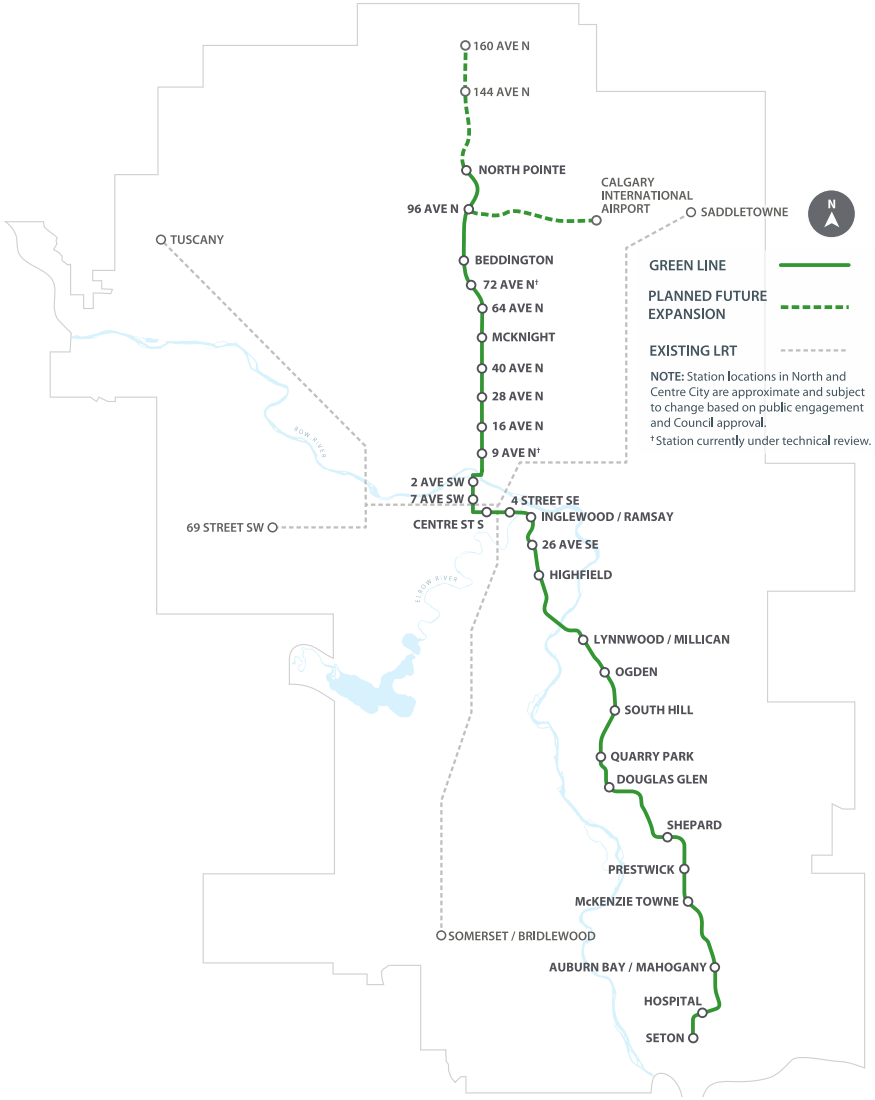


FIGURE 1 GREEN LINE LRT ALIGNMENT

OUR CHALLENGE

Our challenge is to find the best way to integrate the Green Line into the Beltline communities and future development in the area establishing the long term vision.

The Green Line will provide a new east–west LRT route on the eastern side of the Beltline communities connecting over the Elbow River to Inglewood and Ramsay. Assessing how to best integrate the LRT into the Beltline is critical in developing a vision for the future.

Options for the Green Line in the Beltline are complex and numerous. A multiple account evaluation (MAE) process, similar to the process developed for the Centre City options, was developed to understand, evaluate, and compare the relative benefits, opportunities, challenges, and trade-offs between the options. The list of accounts and criteria used in the evaluation was reviewed and approved by council prior to undertaking the evaluation, with each criterion weighted equally against the next. Due to the number of design variants, a pre-screening process that included the following factors was used to narrow the options:

+ Technical feasibility
+ Cost
+ Community / property impacts
+ Efficiency of operations
+ Public / stakeholder input

The options that passed the pre-screening process were then put through the detailed MAE using a set of technical, financial, economic, and community-focused criteria.

The evaluation of the Beltline options is just one part of a larger evaluation process. Key factors that will support a final recommendation include:

- Feedback from the public, downtown stakeholders and surrounding communities
- Assessment of economic impacts and opportunities
- Assessment of qualitative and quantitative risks
- Capital cost estimates

1.1 MILESTONES IN 2016

Presented on the following page is a summary of the timeline and milestones for the Green Line program. Listed below are some of the important milestones that the project team will have met by the end of 2016:

- Public engagement through a series of open houses and online engagement
- Developer working group with key land owners in the Beltline
- Recommendation for the underground option in the Centre City
- Ongoing geotechnical investigations through the Centre City and Beltline


Green Line LRT: Project Timeline
2011
City applies for Provincial GreenTRIP grant for the Green Line preliminary design and transit oriented development (TOD) study.
2013
Council allocates $52 million/year from 2015-2024 for the Green Line.
2013 - 2014
Extensive public engagement & technical studies identify route for the north leg of the Green Line. Centre Street alignment is approved by Council.
Jan to Sept 2015
Public engagement & design work confirms alignment, station locations and TOD plans for the southeast leg of Green Line.
Jul 2015
The Government of Canada announces up to $1.53 billion to the Green Line LRT project.
Nov 2015
Council approves route alignment, station locations and TOD plans for the southeast leg of Green Line.
Jan 2016
The project team begins public engagement to develop land use plans in the southeast.
Dec 2015
Green Line brought under one program and planned for an initial phase of LRT. Engagement on station locations, TOD, and alignment for Centre City and north leg of the line begins.
Apr to May 2016
Report-back on Downtown & Bow River Crossing options. Start of public engagement for Beltline. TOD design charrettes begin.
WE ARE HERE
Q2 2017
Present final recommendations to Council for full alignment, station locations, cost estimates, contracting strategy, TOD plans, and city-shaping framework.
Q1/Q2 2017
Present recommended Beltline alignment to Council's Transportation & Transit Committee.
Q1 2017
Report back on the recommended alignment for the north, Centre City, Beltline, and southeast Green Line segments.
Dec 2016
Present outcomes of Beltline corridor evaluation to Council's Transportation & Transit Committee.
Sept to Dec 2016
Evaluate and confirm the Beltline corridor options. Continue public engagement and design work along the Green Line.
Sept 2016
Council approves the fully tunneled LRT route in Calgary's Downtown Core, in principle.
May to Jun 2016
Report-back with an update on the Downtown & Bow River Crossing results. Introduce and gather feedback on preliminary Beltline alignment options.

Pedestrian's view from a station on 10 Avenue S at Centre Street 7

2 STUDY AREA

The study area for the Beltline evaluation extends from the CPR tracks at 2 Street SW to the Elbow River as shown in figure 2. All options in the Beltline will connect to the tunnel, approved in principle by Council. The option selected in the Beltline will affect the depth of the tunnel on 2 Street SW. Similarly, all options will connect to the approved southeast alignment at the proposed Elbow River LRT bridge.

Figure 3 shows the communities that are included within the Centre City boundary. The Green Line will connect the Beltline communities of Victoria Crossing Centre, East Victoria Crossing, and Stampede Park which are all located within the Victoria Park Area.

FIGURE 2 STUDY AREA FOR THE BELTLINE EVALUATION

FIGURE 3 CENTRE CITY COMMUNITIES

Pedestrian's view from a station on 12 Avenue S at Centre Street

3 BELTLINE OPTIONS

Integrating the Green Line into the Beltline has the potential to shape the vision for these communities in the future. With ten million square feet of redevelopment anticipated for East Victoria Park, the urban fabric is evolving.

To extend LRT service into the heart of the Beltline, three corridor options were originally explored with a combination of surface, elevated, and underground options. The corridors that were assessed included 10, 11 and 12 Avenues S.

In all, eight corridor options, illustrated on the following page, were developed for the Beltline:

- 10 Avenue S surface
- 10 Avenue S tunnel + surface
- 10 Avenue S elevated
- 11 Avenue S surface
- 11 Avenue S tunnel + surface
- 12 Avenue S surface
- 12 Avenue S tunnel + surface
- 11 & 12 Avenues S surface couplet

These options were pre-screened based on several factors including

- Technical feasibility due to constrained LRT geometry
- Capital cost estimates
- Community and property impacts particularly impacts to heritage / historic buildings in the community
- Efficiency of operations for the LRT with slow turns results in longer ride times through the Beltline
- Public and stakeholder input gathered on the various options

Four options were dropped from consideration, as illustrated on the following page. The following four options were carried forward into the detailed MAE:

- 10 Avenue S surface
- 10 Avenue S tunnel + surface
- 12 Avenue S surface
- 12 Avenue S tunnel + surface

3.1 PRE – SCREENED OPTIONS

10 Avenue S Surface

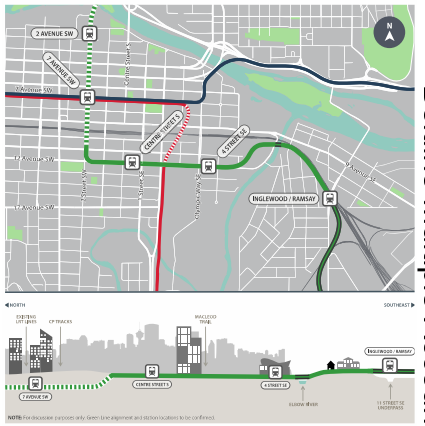
10 Avenue S Tunnel

11 Avenue S Tunnel

Eliminated due to:

- Loss of heritage building
- Portal placement may restrict development east of 4 Street SE

12 Avenue S Surface



10 Avenue S Elevated

Eliminated due to:

- Elevated guideway did not fit into urban context
- Numerous grade changes

11 Avenue S Surface

Eliminated due to:

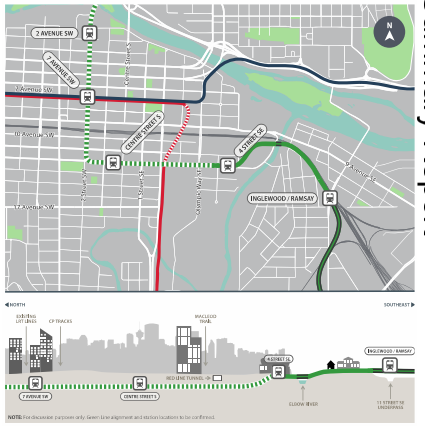
- Loss of heritage building
- Constructability issues with portal on 2 Street SW

11 and 12 Avenue S Surface Couplet

Eliminated due to:

- Loss of heritage building
- Traffic circulation most restricted due to turn restrictions

12 Avenue S Tunnel



3.1.1 10 Avenue S Elevated

On 10 Avenue S the elevated option was not carried forward for further consideration. When the elevated guideway was assessed as part of the Centre City MAE, it received poor feedback from the public and key stakeholders. The elevated guideway would introduce concrete piers in the middle of the road that would make it more challenging to create a positive public realm.

In addition to public realm challenges, this option would result in the loss of Centre Street Station. To tie to the Centre City tunnelled alignment the LRT would need to surface on 10 Avenue S between 2 Street SW and 1 Street SW and then quickly begin to transition to an elevated guideway before 1 Street SE. The short distance for a transition would not provide sufficient space for a station at Centre Street.

3.1.2 11 Avenue S Surface

The 11 Avenue S surface option was not carried forward for further consideration. For this option to function, it was assumed that traffic would be transferred to 10 Avenue S which would require four lanes of traffic on 10 Avenue S. However, the placement of the portal on 2 Street SW may encroach onto 10 Avenue S not allowing for 10 Avenue S to function for through traffic.

Additionally, the turn for the LRT from 2 Street SW onto 11 Avenue S would require a tight radius that would conflict with the heritage building on the northeast corner of the intersection. This building conflict was considered high risk as it may require this heritage building to be relocated and would impact several owners in the building.

3.1.3 11 Avenue S Tunnel + Surface

Similar to the surface option on 11 Avenue S, this option was also not carried forward for further consideration due to the tight turn from 2 Street SW onto 11 Avenue S. Although in a tunnel, it is anticipated that there could be high risk to the heritage building.

Additionally, this tunnel option would surface on 11 Avenue S east of 4 Street SE. The placement of this portal may be seen as restricting development as main access at 5 Street would be constrained.

3.1.4 11 and 12 Avenue S Couplet

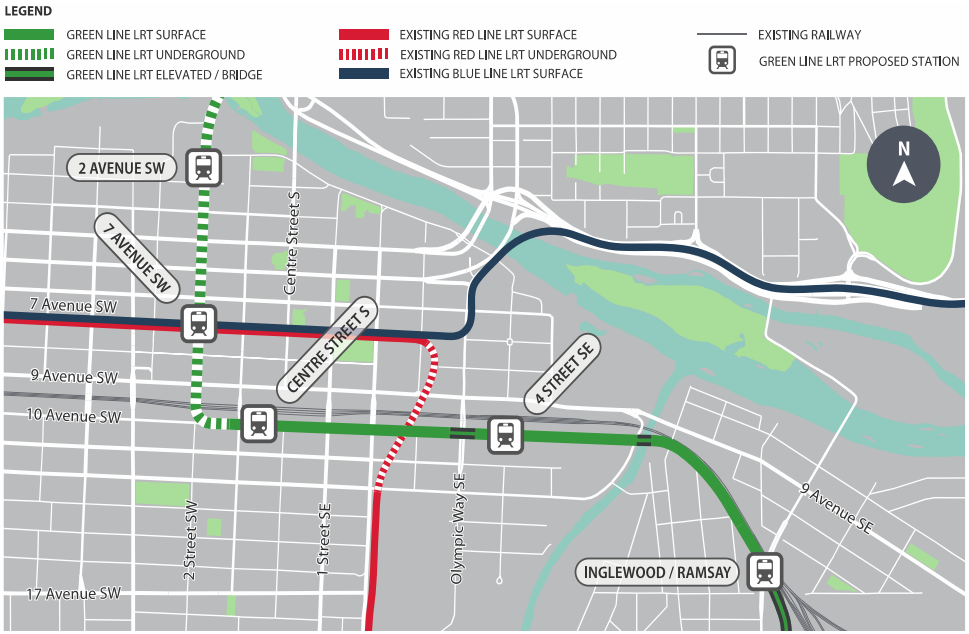
This option was not carried forward for further evaluation for similar reasons as the 11 Avenue S surface option. For this option the portal would be in the same location and would impact traffic operations on 10 Avenue S. It would also impact the heritage building on the northeast corner of 2 Street SW and 11 Avenue S.

This option would also introduce the most constraints on traffic circulation. With one set of LRT tracks on each of 11 Avenue S and 12 Avenue S it would result in both avenues being reduced to two traffic lanes due to the placement of the LRT tracks and the stations.

3.2 Options for Evaluation

3.2.1 10 Avenue S Surface

This option begins at the Inglewood/Ramsay station and continues on the surface to a new Elbow River LRT bridge. From the bridge, the alignment continues west on the surface, paralleling the existing CP tracks to the surface 4 Street SE station. West of this station, the alignment crosses Olympic Way on a new LRT bridge and ties back to 10 Avenue SE on the surface to the Centre Street S station. West of this station, the alignment descends into a tunnel with a portal located between 2 Street SW and 1 Street SW. In the tunnel, the alignment turns north under the CPR tracks to connect to the Centre City tunnel alignment.

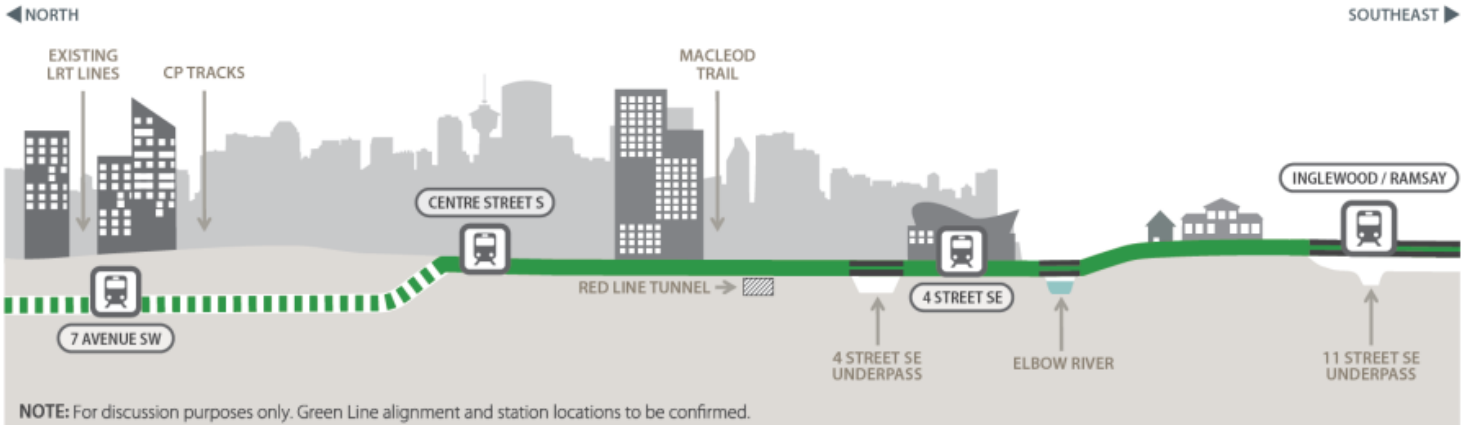


Challenges

- Higher risk due to a high number of utility conflicts along 10 Avenue S
- Challenging integration of LRT into existing public realm
- Traffic and parking disruption
- No direct connection to Beltline communities
- Portal location near historical buildings

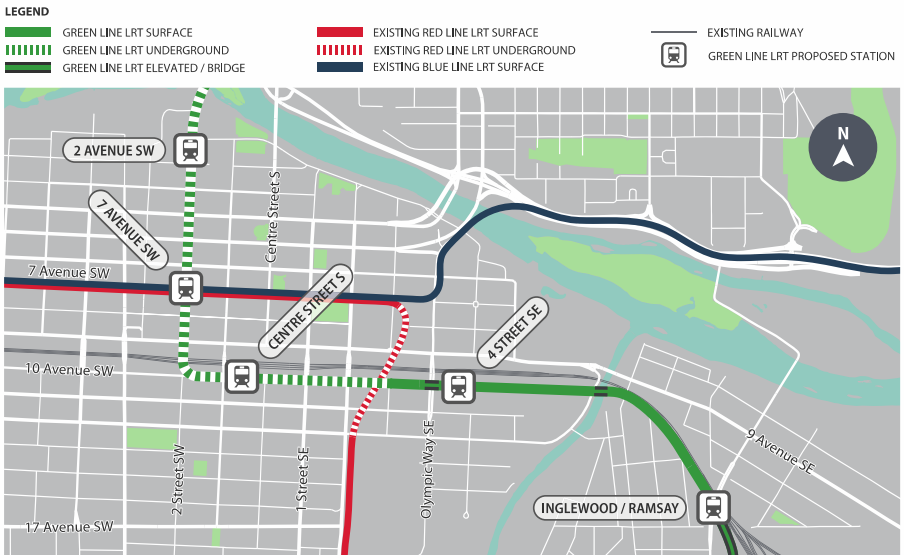
Opportunities

- Lower relative cost
- Long-term redevelopment potential



3.2.2 10 Avenue S Tunnel + Surface

This option begins at the Inglewood/Ramsay station and continues on the surface to a new Elbow River LRT bridge. From the bridge, the alignment continues west on the surface, paralleling the existing CP tracks. The LRT then descends into a tunnel with a portal on 10 Avenue S between 3 Street SE and Macleod Trail, above the existing Red Line tunnel. The alignment continues in the tunnel to an underground station at Centre Street S. From the station, the alignment continues west, underground to the CPR tracks and then turns north to connect to the Centre City tunnel alignment.

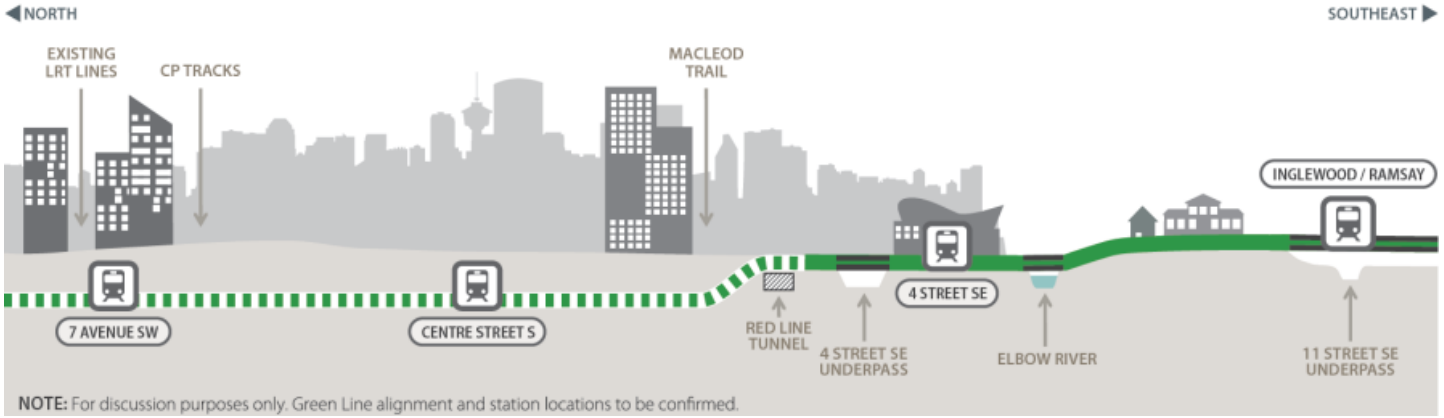


Challenges

- Higher risk due to a high number of utility conflicts along 10 Avenue S
- Challenging integration of LRT into existing public realm
- No direct connection to Beltline communities
- Higher relative cost

Opportunities

- Preserves current transportation network in Beltline for all modes
- Long term redevelopment potential



3.2.3 12 Avenue S Surface

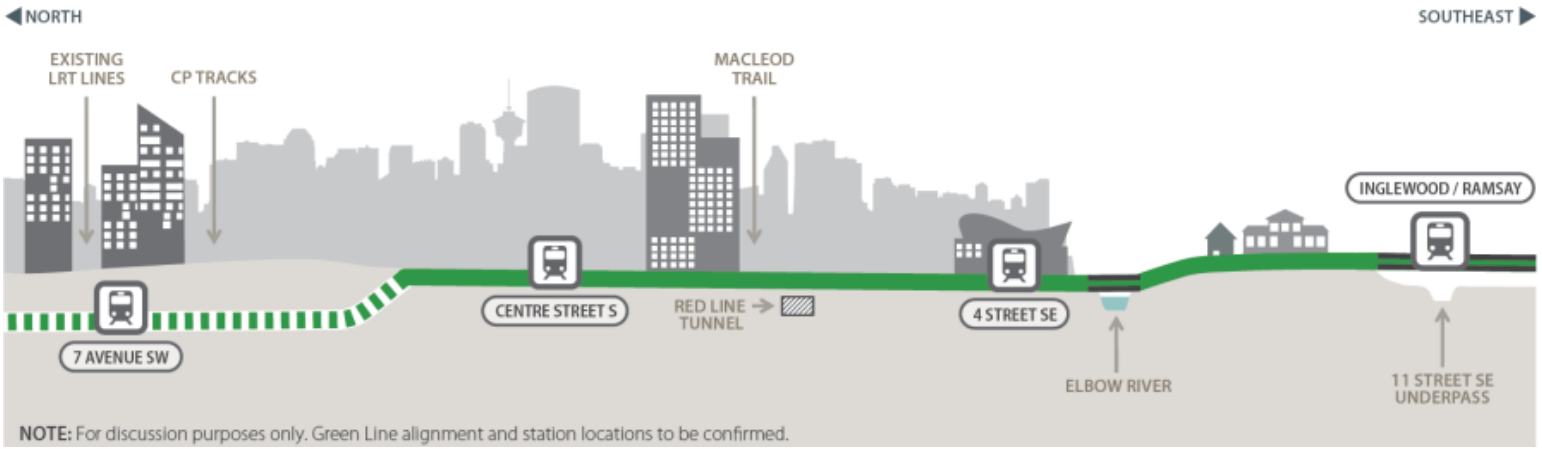
In this option the alignment begins at the Inglewood/Ramsay station and continues on the surface to a new Elbow River LRT bridge. Immediately after the bridge, the alignment continues on the surface around the northwest side of the Victoria Park Transit Facility and on to 12 Avenue at 6 Street SE. The alignment continues west along 12 Avenue with surface stations at 4 Street SE Station and Centre Street S. The alignment continues west along 12 Avenue, turning north onto 2 Street SW. The alignment descends into a portal on 2 Street SW between 11 Avenue S and 10 Avenue S and continues under the CPR tracks to connect to the Centre City tunnel alignment.

Challenges

- Traffic, cycling and parking disruptions
- Winding track geometry east of 6 Street SE

Opportunities

- High potential for integration into existing public realm
- High potential for long-term redevelopment
- Better connects the Beltline communities
- Lowest relative cost



3.2.4 12 Avenue S Tunnel + Surface

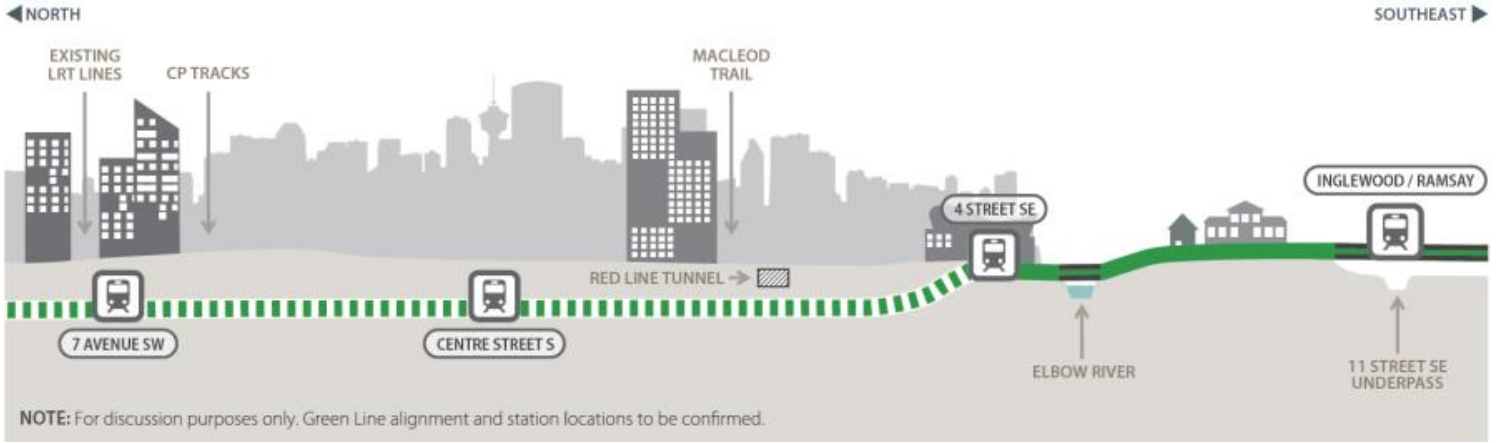
This option begins at the Inglewood/Ramsay station and continues at-grade to a new Elbow River LRT bridge. Immediately after the bridge, the alignment continues at-grade around the northwest side of the Victoria Park Transit Facility and onto 12 Avenue S at 6 Street SE. The alignment continues west to a surface station at 4 Street SE. Immediately west of the station, the alignment descends into a tunnel with a portal on 12 Avenue S between 4 Street SE and 5 Street SE. The alignment continues underground, below the Red Line tunnel, to an underground station at Centre Street S. West of the Centre Street S station, the alignment turns north under 2 Street SW and continues underground under the CPR tracks and connects to the Centre City tunnel alignment.

Challenges

- Higher relative cost
- Winding track geometry east of 6 Street SE
- Portal located next to future development in East Victoria Park

Opportunities

- High potential for long-term redevelopment of the corridor
- Better connects the Beltline communities
- Preserves transportation network in the Beltline west of 4 Street SE



4 Public & Stakeholder Engagement

The engagement strategy for the Beltline alignment focused on exploring the opportunities and challenges presented by different alignment options through the Beltline community, connecting over the Elbow River to the Inglewood/Ramsay station.

Stakeholders included local residents, community associations, business owners and business groups, development industry partners, sports organizations, business improvement areas, major landholders in the area and interested members of the public throughout the city.

Building on the approach used to determine the Centre City alignment, stakeholder engagement was conducted in tandem with the technical, financial, economic, environmental, and community-focused study required for the detailed options evaluation. Engagement was conducted over three phases, with the project team narrowing the number of potential options at each phase based on a combination of stakeholder input and information gleaned from the broader options evaluation process.

Phase One
- April - June 2016
- Eight Beltline Options

Phase Two
- September - October 2016
- Four Beltline Options

Phase Three
- November 2016
- Detailed Option Evaluation Results

Phase Four
- Q1 / Q2 2017 Alignment Recommendation

TABLE 1 SUMMARY OF TOTAL PARTICIPANTS REACHED

	Date	Event	Participants
Phase One	April 18 – May 11	Beltline and Centre City alignment pop-up events	1189
	April 18 – May 11	Beltline Options online engagement on engage.calgary.ca	819
	April - May	Beltline alignment brochures distributed by Calgary Transit	*9200
	May 26	Beltline Developers Lunch Workshop	6
	June 1	Beltline Options Open House	101
Phase Two	September 14	Beltline Options Open House (Ramsay)	103
	September 15	Beltline Options Open House (Beltline)	46
	September 14 – October 18	Beltline Options online engagement on engage.calgary.ca	498
	October 13	Beltline Stakeholders Workshop	16
Phase Three	November 2	Beltline Detailed Option Evaluation Results Open House	59
		Total Participants (*not including brochures)	**2,837**

4.1 Phase One Engagement

4.1.1 What we did

Phase One of the engagement program began in April 2016, with combined Beltline and Centre City alignment pop-up events, online engagement at www.engage.calgary.ca, and a public open-house on June 1. Stakeholders were presented with eight Beltline alignment options and were asked to comment on the opportunities and challenges for each option:

- 10 Avenue S Tunnel + Surface
- 10 Avenue S Surface
- 10 Avenue S Elevated
- 11 Avenue S Tunnel + Surface
- 11 Avenue S Surface
- 11 & 12 Avenue S Couplet
- 12 Avenue S Tunnel + Surface
- 12 Avenue SW Surface

4.1.2 What we heard

All of the options generated conversations about potential opportunities and challenges. Major and recurring themes from this input included:

- **Traffic flow is a priority**
  Every option generated significant conversation about the opportunities and challenges as they relate to traffic flow, as well as pedestrian and bicycle movement. In particular, concerns were expressed about interruptions to traffic flow east-west along 11 Avenue S and 12 Avenue S, as well as north-south traffic flow along Macleod Trail and 1 Street SE, and the impact to the cycle track along 12 Avenue S.

- **More opportunities are perceived with tunnel options**
  More support was expressed for the tunnel options compared to surface or elevated options. The most common reasons for the tunnel preference were to minimize impact on traffic flow and avoiding splitting neighborhoods and walking routes. The challenges associated with the tunnel options focused on user safety, cost, and lost opportunity for street-level revitalization.

- **More perceived challenges for surface options**
  More challenges than opportunities were identified for surface level options. The most common concerns were about traffic disruptions. Preferences for surface options included the comparative low cost and the potential for business revitalization along the corridors.

- **Street-level revitalization is important**
  Participants shared different perspectives as to whether surface options would provide the opportunity to revitalize streetscapes and adjacent businesses or would pose a challenge in the form of limited access, parking, or negative streetscape impacts.

- **Little interest in elevated option or couplet**
  Both options generated the least amount of conversation. Concerns about the elevated configuration focused on the potential community impacts and lack of

accessibility. The main opportunities with the elevated configuration were the unimpeded movement of the LRT through the Beltline, and the minimal impact on traffic flow. The couplet also received minimal support and comment. Participants identified that, while it offered some traffic flow and bike lane opportunities, there were more challenges with traffic crossings and two impacted streetscapes.

4.1.3 How the input was used

Public feedback on the options presented in Phase One was used to help inform the evaluation process, as well as gauging the overall public acceptability of each of the options. Determining the level of public acceptability was based on the number of positive opportunities and negative challenges identified by participants.

Stakeholder feedback was one of the inputs considered by the project team – along with the technical, financial, economic, environmental, and community-focused criteria – in conducting the evaluation and narrowing the potential alignment options from eight to three:

- 10 Avenue S Tunnel + Surface
- 10 Avenue S Surface
- 12 Avenue S Surface

4.2 Phase Two Engagement

4.2.1 What we did

Phase Two engagement included two public open houses in September in the Beltline and Ramsay neighbourhoods, as well as online engagement at www.engage.calgary.ca.

On October 4,2016, Calgary City Council voted to continue to explore the 12 Avenue S tunnel option that had been dropped from consideration after the Phase One engagement and evaluation, for affordability and other considerations. This resulted in four options being presented to the public for feedback and discussion:

- 10 Avenue S Surface
- 10 Avenue S Tunnel + Surface
- 12 Avenue S Surface
- 12 Avenue S Tunnel + Surface

A workshop with local developers, business representatives, the Beltline Neighbourhoods Association, the Victoria Park Business Improvement Area (BIA) and major area stakeholders (Calgary Municipal Land Corporation, Calgary Sports and Entertainment, Remington and the Calgary Stampede) was also held in early October 2016. Stakeholders were presented with the four short-listed Beltline alignment options and asked to share what they felt where the opportunities and challenges for each.

4.2.2 What we heard

All the options generated conversations around potential opportunities and challenges. Major and recurring themes from this input included:

- **Traffic flow and congestion**
  The most common response in all categories was traffic flow and congestion; this was identified as a challenge for both surface options, and as a positive opportunity for the tunnel options. The 12 Avenue S surface option received equal concern from participants about traffic flow on Macleod Trail crossing the alignment, as well as along 12 Avenue S. Concerns about traffic flow along 10 Avenue S were less common.

- **Service to Beltline population**
  After traffic flow, the next most common theme was the strong desire for increased access and integration into the Beltline community and to a lesser extent, access to transit service to and from the East Village.

- **Impact to cycle-track pilot**
  Several participants expressed concern that surface LRT along 12 Avenue S would negatively impact the cycle-track pilot. Participants stated that the cycle track is well-used and it was a hard-fought process to get it built. It was suggested that surface LRT on 12 Avenue S could result in a loss of a community amenity in order to meet commuter needs.

- Participant feedback was once again split on whether surface running options would afford opportunities or challenges for increased local development and public realm improvements.

- Conversations about cost were also divided. The sentiment that the benefits of tunnelling outweighed the added cost compared to surface options.

4.2.3 How the input was used

Feedback collected during Phase Two of the engagement was reviewed and major themes about opportunities and challenges identified for each option. The results were used to inform the evaluation of the options. As well, overall public acceptability of each of the options was gauged based on the number of opportunity or challenge comments that were received, and the potential scope of the positive opportunity or negative challenge that these themes represented. Input received through the engagement program has been incorporated into the scores presented in this document under the Stakeholders account.

4.3 PHASE THREE ENGAGEMENT

4.3.1 What we did

Phase three engagement includes a presentation of the results of the detailed options evaluation to the public at an open-house in the Beltline Community, as well as online at www.engage.calgary.ca. Stakeholders were asked to provide feedback on the results and whether there is anything else that should be considered when choosing a preferred alignment for the Beltline.

4.3.2 Area Stakeholders

The evaluation of the Beltline options is one part of a larger evaluation process and it was through stakeholder engagement that it was understood that the alignment options must closely reflect the ongoing plans for redevelopment in Victoria Park. As a result, the team will continue to develop and evaluate 12 Avenue S alignment options determining how to best connect to the Council approved southeast alignment and based on a set of principles that have been established with the key stakeholders in Victoria Park.

The Green Line LRT Beltline alignment options are to be based on the following principles as agreed to with the Victoria Park stakeholders:

- Establish a common vision and masterplan for the area
    - Our team will work with the community and key stakeholders to develop the best plan for Green Line in the Beltline.
    - Green Line LRT is important to meet the City's rapid transit and transportation needs.
    - Urban realm (creating a street vibe) contiguous to the alignment through the Beltline will be addressed in the detailed design, once the alignment has been confirmed
- Support development in the area
    - LRT alignment (portal and stations) will be integrated with future development planned for the area east of Macleod Trail Southeast. This includes consideration of:
        - Land use and development in Victoria Park
        - Future plans for the Stampede grounds and the Saddledome.
        - Future plans for the Calgary Transit bus facility to best integrate with future development and for operational efficiency
- Flexibility
    - Local access and circulation will continue to be accommodated through traffic analysis and suggestions to optimize traffic movement, with emphasis on the area east of Macleod Trail Southeast and access/egress to Stampede grounds.
    - Cycling access in the Beltline, currently a pilot project cycle track on 12 Avenue South and 5 Street Southwest, may be reconfigured with construction/implementation of Green Line.

4.3.3 Next Steps

Engagement with the public as well as area stakeholders will continue in early 2017 as options on 12 Avenue S are further defined. Based on the principles outlined above, additional engagement will continue the inform the inform how to best integrate the LRT into the area to address station placement and portal configuration. Further evaluation may result in a different configuration for the LRT on the east end of Victoria Park.

In the spring/summer of 2017, City administration will present the recommended Beltline alignment to city council. This recommendation as well as the results of all public and stakeholder engagement will be presented to Calgary City Council in June of 2017 for decision.

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View of a portal on 10 Avenue S east of Macleod Trail

5 EVALUATION PROCESS

The Beltline options were evaluated using the same set of technical, financial, city shaping and community-focused accounts that were developed and used during the Centre City MAE. These accounts, which align with the overall objectives of the program and long term vision for the Green Line, were based on the City's targets outlined in the 2020 Sustainability Direction plan and reflect the project's vision of taking advantage of city-shaping opportunities and public input. This section summarizes the Beltline MAE results. Appendix A contains a detailed scoring table. Figure 4 illustrates the accounts and project objectives.

Within each account, the criteria and metrics were defined to help determine which option best meets the program objectives and best aligns with the City's sustainability direction and long-term priorities. To differentiate between the two potential corridors in the Beltline, metrics were adjusted to help highlight corridor differences. All the criteria used in the evaluation have equal weight in the evaluation to minimize subjective value judgment in the evaluation process. For example, cost is equal in weight to community impacts.

The accounts were reviewed and approved by Council in December 2015. Additional details on the criterion included within each account are shown on the following page.

FIGURE 4 ACCOUNTS & PROJECT OBJECTIVES

Financial Capacity

+ Capital Cost
+ Land Impact
+ Operating & Maintenance Cost

Community Well-being

+ Community Cohesion
+ Impact to Recreational Uses
+ Safety, Security & Emergency Access
+ Accessibility

Transportation

+ Ride Time for LRT
+ Transportation Network Reliability
+ Integration of Existing & Future Transit Service and Customers
+ LRT Service Reliability
+ Catchment Area
+ Complete Streets: Multi-modes, Connectivity & Accessibility

Urban & Neighbourhood Development

+ Transit Oriented Development Potential
+ Streetscape & Public Realm
+ Impact on Parking
+ Urban Vision

Sustainable Environment

+ Impact on Existing Natural Environment
+ Environmental Soil Conditions & Contamination
+ Adaptability to Extreme Climate Conditions
+ Noise & Vibration Impacts

Feasibility & Deliverability

+ Constructability
+ Construction Impacts
+ Impacts to Residences & Businesses
+ Archaeological & Heritage Impacts

Stakeholders

+ Public Acceptability
+ Alignment with City of Calgary Plans & Policies

View of an underground station. 27

Financial Capacity

An affordable and cost-effective service. Costs are achievable, sustainable in the long term and provide good value for money.

5.1 Financial Capacity

GOAL

To deliver an LRT system that is affordable and provides cost-effective service. Costs are achievable, sustainable in the long term and provide good value for money.

EVALUATION RESULTS

Overall, 12 Avenue S surface ranks the highest in the Financial Capacity account as it has the lowest estimated capital cost, lower land-acquisition costs, and lower maintenance costs for stations. It provides the best opportunity to deliver an LRT system that is affordable.

Presented below is a summary of the criteria included in this account.

Capital Cost

Considers the full costs to construct the LRT system based on the capital cost estimates.

Capital cost estimates were developed based on unit quantities derived from functional design alignment plans and profiles. The unit price for these quantities were derived from a cost database developed from similar transit projects throughout North America.

12 Avenue S surface option ranked the highest overall as it is the lowest capital cost option because it involves fewer utility relocations compared to 10 Avenue S, the option with the next-lowest capital cost.

Land Cost

Considers the cost of land to be purchased to accommodate the LRT system and other required infrastructure.

Land cost is based on the amount of land anticipated to be required for the LRT track and stations on a parcel-by-parcel basis measured from the property line. In general, if access to a property was irreparably affected, it was assumed as a full land acquisition.

12 Avenue S tunnel + surface option had the lowest anticipated land acquisition costs and, therefore, ranked the highest based on this criterion. Although this option does result in some property takes due to impacted accesses at the surface station platforms, the cost of the parcels required are lower than those for the 10 Avenue S options.

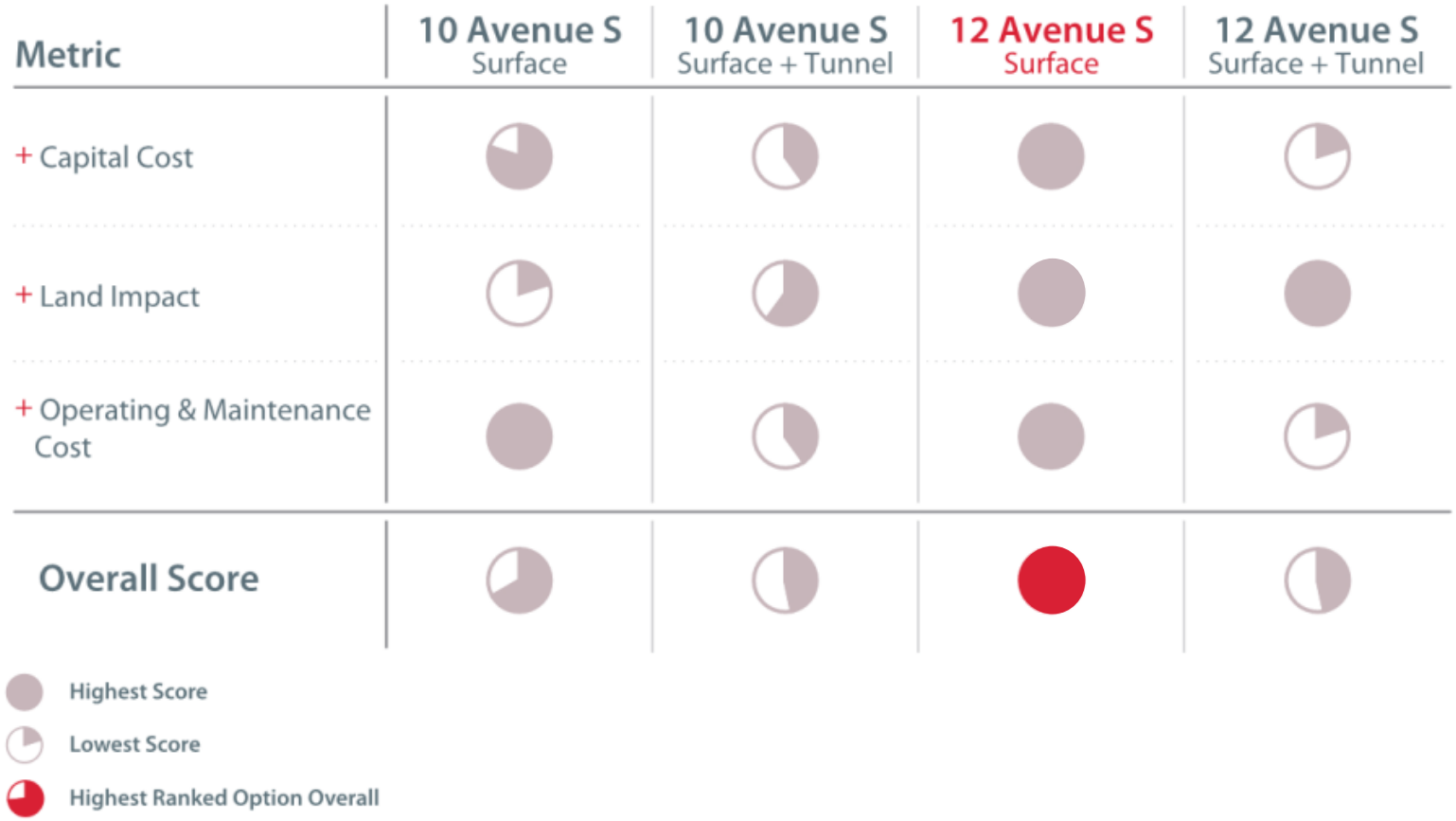
Operating and Maintenance Cost

Considers the overall life-cycle costs to operate and maintain the LRT system.

Each option was ranked based on the costs associated with operating and maintaining the alignment. Overall surface and underground systems are anticipated to have similar operations and maintenance costs over a thirty year lifecycle. However, based on further analysis done on operations and maintenance

costs, it was determined that tunnels and underground stations have higher maintenance costs than surface stations with the addition of escalators, elevators, and heating and ventilation requirements. Surface options ranked the highest as they include surface stations, which have lower maintenance costs.

The following chart summarizes the evaluation results for Financial Capacity account.



Community Well-being

A safe and socially inclusive service that improves access to key community destinations and provides transportation choices to Calgarians.

5.2 COMMUNITY WELL-BEING

GOAL

To provide a safe and socially inclusive service that improves access to key community destinations and provides transportation choices for Calgarians.

EVALUATION RESULTS

12 Avenue S surface ranks the highest in the Community Well-Being account. This option provides the best opportunity for a socially inclusive service that better serves the Beltline communities.

Presented below is a summary of the criteria included in this account.

Community Cohesion

Considers the effect of visual intrusion and severance of neighbouring communities specifically around physical barriers.

Two metrics were used to assess options against this criterion:

- **Physical disruptions**

  Retaining walls and portals (the open entry where the LRT system descends or ascends from a tunnel) introduce a high level of disruption to communities by creating a permanent physical barrier. Options were compared by the measured area of portal structure. All four options have a portal located in the Beltline to connect to the Centre City tunnel alignment. However, 10 Avenue S surface ranked the lowest because it's portal on 10 Avenue S between 2 Street SW and 1 Street SW is the most disruptive. Requirements for traffic circulation result in minimal space for sidewalks confined between the heritage buildings and the portal wall.

- **Views and privacy**

  View protection and residential and commercial privacy are determined by the length of LRT alignment that obstructs views or interferes with privacy. As all options have the LRT system on the surface for some length, are adjacent to currently vacant land, or rail corridors, all options were ranked equally.

Impact to Recreational Uses

Consideration for the ability of the LRT system to serve community events or high-profile festivals.

The Beltline community hosts several high-profile events. However, because all options are within two blocks of each other, they were ranked equally. Regardless of location, the LRT system will serve these events at major activity sites in the Beltline, including the Saddledome, the Stampede grounds, as well as the National Music Centre with proximity to options on 10 Avenue S. Impacts to vehicular access for major activity centres in the Beltline are addressed under the Transportation account.

Safety, Security, and Emergency Access

Consideration of the perceived safety and security of the LRT system, including how emergency services could access different parts of the system.

Two metrics were used to assess options against this criterion:

- **Perception of safety and security**

  This metric was based on the principles of "Crime Prevention Through Environmental Design (CPTED) for Transit Users".

  Both surface options ranked higher because their stations would be on the surface, providing the most natural surveillance. However, 12 Avenue S surface option ranked the highest because 12 Avenue S has more street activity or "eyes on streets", which contributes to a higher sense of personal security. The interaction between large crowds and the LRT operation would need to be managed for the 12 Avenue S options, this is addressed under the Transportation account.

- **Emergency access**

  To evaluate the ease of emergency access, the path of travel for emergency responders to reach an emergency on the system was measured. Tunnelled options are more constrained as emergency responders have to access emergency locations through portal entrances and underground stations, while surface options would allow emergency access freely along the alignment.

  12 Avenue S surface option ranked highest because it has the most surface alignment and an established grid in the road network at the 4 Street SE station. 10 Avenue S surface option ranked second highest because the road network at 4 Street SE station in not determined.

Accessibility

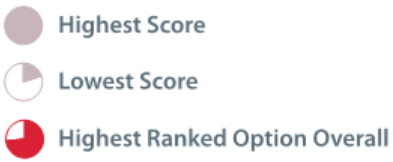
Consideration of a service that would be accessible to all users.

At-grade stations and underground stations provide a different ease of access for users. Options with shorter distances for users to access station platforms are considered more easily accessible and were ranked higher.

12 Avenue S surface option ranked the highest as it has two at-grade stations in addition to an established road network around 4 Street SE station. Although 10 Avenue S surface option also has two surface stations, the lack of road definition around the 4 Street SE station adjacent to CPR will introduce longer distances for users to access the station compared to 12 Avenue S.

The following chart summarizes the evaluation results for the Community Well-Being account.

Metric	10 Avenue S Surface	10 Avenue S Surface + Tunnel	12 Avenue S Surface	12 Avenue S Surface + Tunnel
+ Community Cohesion				
+ Impact to Recreational Uses				
+ Safety, Security & Emergency Access				
+ Accessibility				
Overall Score				



Transportation

A high-priority transit service that attracts transit use, walking and cycling as preferred mobility choices for Calgarians.

5.3 TRANSPORTATION

GOAL

To provide a high-priority transit service that attracts transit use, walking and cycling as preferred mobility choices for Calgarians. As well as, an integrated service that improves customer experience, meets future demand and strengthens regional and local transit networks.

EVALUATION RESULTS

Both the tunnel + surface options on 10 Avenue S and 12 Avenue S ranked the highest in the Transportation account. Due to the grade separation west of Macleod Trail, both options allow mobility patterns to be maintained for pedestrians, automobiles and cyclists in the Beltline.

Presented below is a summary of the criteria included in this account.

Ride Time for LRT

Consideration for the travel time for each option.

Maintaining run times through the Beltline is important for the operation of the overall Green Line LRT system. The 10 Avenue S tunnel + surface option ranked the highest because it has the shortest ride time from 7 Avenue SW station to the Inglewood/Ramsay station. This short run time is the result of having the shortest and most direct route through the Beltline and avoiding tight track geometry that could slow down the train.

Transportation Network Reliability

Consideration of impacts to traffic, and demand on the overall transportation network.

Two metrics were used to assess options against this criterion:

- **Downtown network impacts**

  This metric assesses the effects on traffic throughout the downtown network. 10 Avenue S tunnel + surface option ranked the highest because it has the least effect on the overall downtown network.

- **Traffic impact on special events**

  This metric assesses the effect on traffic during special events in the Beltline. Both options on 10 Avenue S ranked the highest because the LRT on 10 Avenue S has the least effect on traffic in the Beltline, resulting in existing traffic patterns being mostly maintained for special events access. Although the 12 Avenue S tunnel +

surface option is grade separated at Macleod Trail, the placement of the portal between 4 Street and 5 Street may introduce localized access constrains for special events.

Integration with Existing and Future Transit Service

Considers opportunities to strengthen regional and local transit networks by providing convenient connections to existing and future rapid transit routes.

Options were assed by their ability to provide a direct connection to the Red Line at Victoria Park Station or to the future high speed rail (HSR) station at Rail town on 10 Avenue S. With access to the two connections equally weighted, all options ranked equally as options on 10 Avenue S are closer to the future HSR, while options on 12 Avenue S are closer to the Red Line.

LRT Service Reliability

Consideration of factors that could influence the reliability of the LRT service, such as the interaction of light-rail vehicles (LRVs) and pedestrians, cyclists or vehicles that may disrupt transit service.

The option with the fewest conflict points between LRVs and pedestrians, cyclists and vehicles at crossings and intersections will rank highest against this criterion.

Two metrics were used to assess options against this criterion:

- **Number of Conflict Points**

  For each option, the number of conflict points between a LRV and pedestrians, cyclists or vehicles at surface crossings were counted. Tunnelled options ranked the highest as they minimize the number of conflict points with the LRV.

- **Provision for special trackwork**

  Options that can easily accommodate special trackwork, including crossovers and setoff tracks, are able to preserve operational flexibility for the LRT system in the Beltline.

  All options were tied as they have the potential to accommodate special trackwork. However, the location of the portal in the 12 Avenue S tunnel + surface option may constrain the location of special trackwork.

Catchment Area

Consideration for the catchment area predicted for each option.

The integration of the LRT system into the Beltline has the potential to extend the catchment area further south into the Beltline, providing new transit service to this community. Both options on 12 Avenue S would be able to increase the catchment area with the LRT alignment and, as a result, rank highest.

Complete Streets: Multi-modes, Connectivity and Accessibility

Consideration of the addition of new cyclist or pedestrian facilities along the corridor to support active transportation.

Two metrics were used to assess options against this criterion:

- **Preservation of cycling network**

  Preserving the pilot cycle track network in the Beltline is important for making sure that transportation mode choices exist in the Beltline. Both options on 10 Avenue S and the 12 Avenue S tunnel + surface option rank highest as the LRT on 10 Avenue S would minimally disrupt the pilot cycle track and preserves the cycling network. Should the pilot be made permanent, we would accommodate a facility in all green line designs.

- **Space for public realm**

  Space available for public realm for each option was considered to be the area from the back of the proposed curb to the property line. Options with the largest public realm are considered to have the most potential for enhancements to public realm. 12 Avenue S tunnel + surface option ranked the highest because it provides the most public realm space with the LRT underground on 12 Avenue S.

The following chart summarizes the evaluation results for the Transportation account.

Metric	10 Avenue S Surface	10 Avenue S Surface + Tunnel	12 Avenue S Surface	12 Avenue S Surface + Tunnel
+ Ride Time for LRT				
+ Transportation Network Reliability				
+ Integration of Existing & Future Transit Service and Customers				
+ LRT Service Reliability				
+ Ridership				
+ Complete Streets: Multi-modes, Connectivity & Accessibility				
Overall Score				

Highest Score

Lowest Score

Highest Ranked Option Overall

Urban + Neighbourhood Development

A service that supports current and future land use and development along the corridor and integrates with neighbouring communities.

5.4 URBAN AND NEIGHBOURHOOD DEVELOPMENT

GOAL

To provide a service that supports current and future land use and development along the corridor and integrates with neighbouring communities.

EVALUATION RESULTS

12 Avenue S tunnel + surface option ranks the highest because it has the highest near-term development potential, has more opportunities to integrate stations within the existing urban realm, preserves on-street capacity and parking, and has the potential to provide for near-term place making. This option provides the best opportunity to support redevelopment along the corridor because the alignment is underground in the Beltline, with minimal disruptions on the surface. 10 Avenue S as a corridor also has long-term redevelopment potential, however, existing land uses along the avenue may pose short-term redevelopment challenges as well as limitations with the existing railway setback on the north side.

Presented below is a summary of the criteria included in this account.

Transit Oriented Development (TOD) Potential

Consideration of how well station locations and the alignment integrate into existing land uses and provide opportunities for future development.

The measure of success of an LRT system is how well it is able to shape a city and provide for future development along its corridor and is measured by the alignments ability to spur development.

Two metrics were used to assess options against this criterion:

- **TOD integration potential**

  Options were ranked based on their ability to spur redevelopment in the direct area of the station. Options on 12 Avenue S ranked highest because the existing adjacent land uses near stations on 12 Avenue S are more conducive to redevelopment compared to on 10 Avenue S.

- **Near-term redevelopment potential**

  Options were ranked based on their near-term redevelopment potential along the corridor. Due to the high amount of redevelopment that is already in the planning stages for the Victoria Park area there is redevelopment potential on both corridors. However, options on 12 Avenue S ranked slightly higher because the existing urban fabric along 12 Avenue S is more established. 12 Avenue S has a many development permits in the works, construction of new buildings already underway, as well as underutilized lands prime

for redevelopment. In comparison, 10 Avenue S has far fewer active development permits or planned redevelopments, as has more established building stock, such as large parkades along the corridor which will remain in place in the near term.

- **Number of access agreements**

  Although access agreements may be required to tie stations into developments, particularly for underground stations, all options have been planned to assume that primary access can be provided through the public right-of-way (ROW). Thus, all options were ranked the same relative to each other.

Streetscape and Public Realm

Evaluation of potential ways to improve the street environment and create high-quality public spaces.

The potential for improvements to the streetscape and public realm at the station locations was considered because the stations have the highest amount of activity that can contribute to improved streetscape and public realm.

Two metrics were used to assess options against this criterion:

- **Legibility of stations**

  Locating stations so that they are easily legible to the public is an important part of improving the public realm. 12 Avenue S surface option ranked highest because it has two at-grade stations, which are noticeably more legible and easy to decipher in comparison to underground stations which are only noticeable at the station entrances. The 4 Street SE station would also be more legible in the existing urban realm on 12 Avenue S in comparison to 10 Avenue S due to limited street network and pedestrian access at that location.

- **Integration of stations**

  This metric is used to assess if stations can be integrated seamlessly into existing and future public realm with present and future streetscape and public realm improvements. Due to the well-established existing urban fabric on 12 Avenue S, those options ranked the highest.

Impact on Parking

Consideration of public and private parking availability and access.

Within the Beltline parking is a major consideration. This criterion relates to the affect the option will have on existing parking.

Two metrics were used to assess options against this criterion:

- **Number of on-street parking stalls removed**

  The ability to preserve on-street parking in the Beltline is an asset to any option because on-street parking encourages redevelopment. Both tunneled options preserve the most on-street parking because they reduce disruptions to the street for more than half of the alignment.

- **Number of private parking access restrictions**

  Running the LRT system through the Beltline will restrict access to various private parking lots. Such restrictions may result in traffic problems that may inhibit redevelopment in the area. Both tunnel + surface options rank the highest because they each include a tunnel for more than half the alignment.

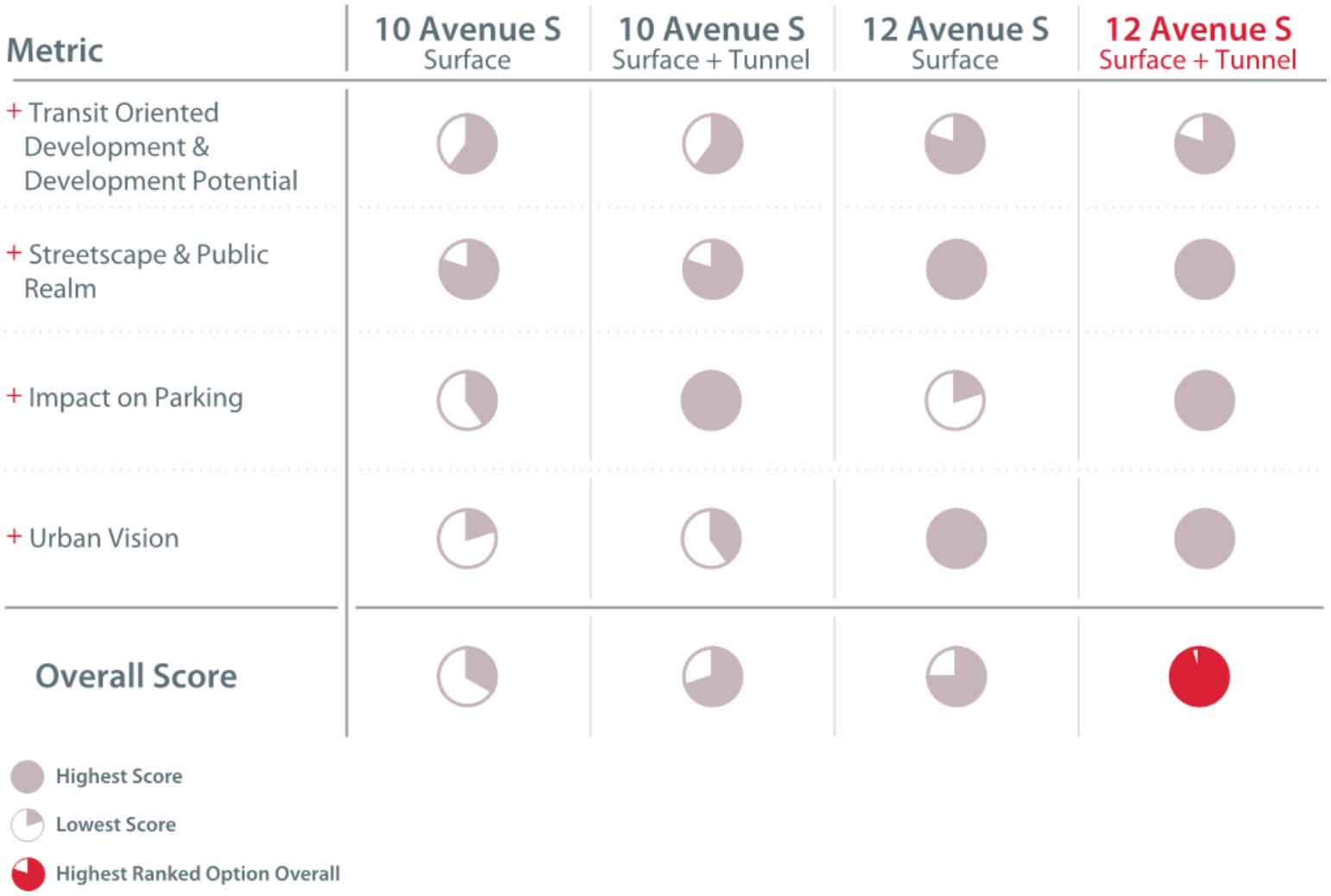
Urban Vision

Consideration for the near-term ability of the option to capitalize on the local community's assets and potential to create an urban realm that promotes community well-being.

This criterion focuses on the ability to provide for place making opportunities in the Beltline.

Both options on 12 Avenue S rank the highest because 12 Avenue S provides more such areas for place making opportunities due to the existing urban fabric of the corridor.

The following chart summarizes the evaluation results for the Urban and Neighbourhood Development account.



Sustainable Environment

A service that promotes sustainable development by reducing greenhouse gases and minimizes the effect on the existing natural environment.

5.5 SUSTAINABLE ENVIRONMENT

GOAL

To provide a service that promotes development by reducing greenhouse gases and minimizing effects on the existing natural environment.

EVALUATION RESULTS

All four options have the same river crossing and are close to the CPR tracks and the Victoria Park Transit Centre. However, the 12 Avenue S tunnel + surface option is ranked slightly lower because of the location of the tunnel portal is close to the Elbow River and has potential higher exposure to flooding.

Presented below is a summary of the criteria included in this account.

Impact on the Existing Natural Environment

Consideration of the impact on biodiversity and natural environment, both during and after construction.

Using the same standardized method for phase one biophysical impact assessments, the following three metrics were used to assess options against this criterion:

- **Permanent effect on the environment**
- **Effects of construction on the environment**
- **Effects on wildlife**

In the Beltline, the only natural area that the options cross is the Elbow River valley area. All four options cross the Elbow River with a bridge in the same location; therefore, all four options were ranked the same for this criterion.

Environmental Soil Conditions and Contamination

Consideration of the number of contaminated sites that may be disturbed during construction.

A high-level modified phase 1 environment site assessment (ESA) was done for the Beltline study area from the CPR tracks to 13 Avenue S.

Two options were used to assess options against this criterion:

- **Number of contaminated sites**

  This metric used the results of the modified phase 1 ESA, which identified sites within 25 metres of the alignment with a moderate or high risk of contaminated soil. Because the options are within two blocks of each other, they each contained almost the same number of sites. However, options on 12 Avenue S ranked slightly higher because they had fewer sites.

- **Level of remediation**

  The level of remediation required for the sites identified in the modified phase 1 ESA is based on professional judgement and a literature review of historical data for the sites. In general, surface options ranked highest

because surface construction displaces less soil than tunnel construction.

Adaptability to Extreme Climate Conditions

Consideration of the impact of extreme weather conditions and climate change on the LRT infrastructure.

The alignments of all the Beltline options will be exposed to the risk of flooding effects because portions of each alignment option are located within the flood inundation zone for the 1:100-year design flood event. However, having a tunnel portal located outside the 1:100-year flood event area would greatly reduce the risk associated with an option.

10 Avenue S tunnel + surface option ranked the highest because it's portal is placed outside the floodplain. Although the underground Centre Street station is in the floodplain area, design mitigations such as raising the elevation of the station entrance can be used to reduce the risk of flooding at the station.

Noise and Vibration Impacts

Consideration of the effects of noise and vibration on residents and businesses in the area during LRT operations.

Options were assessed based on the effects of noise and vibration on residents and businesses within the area during operation of the LRT system.

The following two metrics were included in the metrics used to assess options against this criterion:

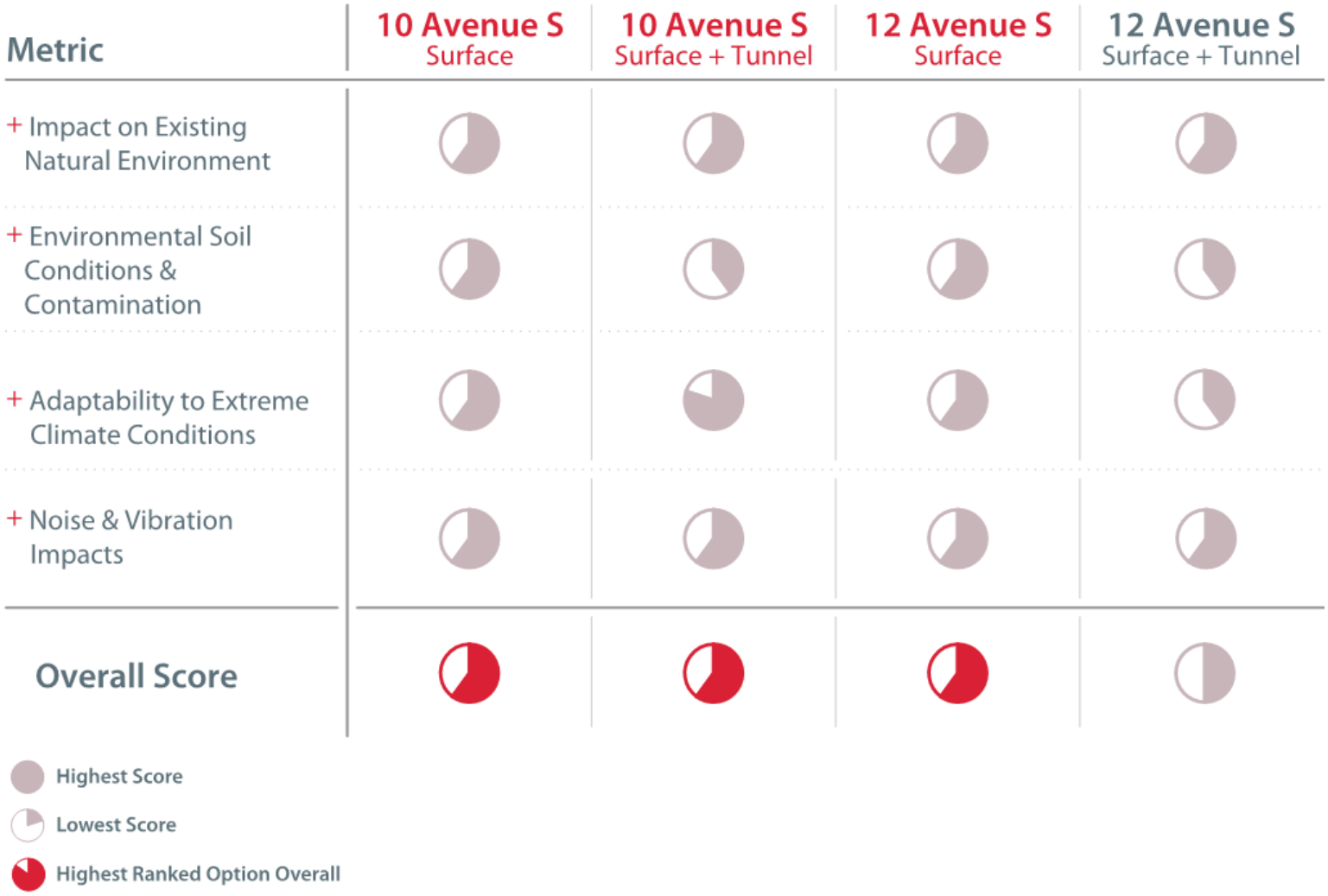
- **Level of noise pollution during operation**

  Based on the relatively high ambient noise level in the Beltline area, the effect of the LRT system on noise levels would not be discernible for underground or at-grade options. Noise levels for the at-grade LRT would be expected to be within urban noise levels based on City bylaws. As a result, all options were ranked the same relative to each other.

- **Number of high-sensitivity vibration receptors**

  The number of potential sensitive vibration receptors along each corridor was counted. These receptors included locations with vibration sensitive equipment at dentist's and doctor's offices and veterinary clinics. Because the options are located within two blocks of each other, all options were ranked the same.

The following chart summarizes the evaluation results for the Sustainable Environment account.



Feasibility + Deliverability

A service that can be constructed and operated without significant technical issues or constraints.

5.6 Feasibility and Deliverability

GOAL

To provide an LRT system that can be constructed and operated without significant technical issues or constraints.

EVALUATION RESULTS

10 Avenue S tunnel + surface option ranked the highest because it has the smallest surface component, minimizing the potential to affect surrounding residences and businesses, and minimizing any potential risk to existing heritage sites in the area. However, there are risks related to technical constraints at the portal and to the large number of utility relocations required along the corridor.

Presented below is a summary of the criteria included in this account.

Constructability

Consideration of technical constraints such as existing utilities, ground conditions and system-wide challenges, and construction risk related to each option.

The risk associated with constructing a tunnelled LRT segment is assumed to be higher than risk associated with constructing a surface LRT segment. The risk of a schedule delay is also included in this criterion.

12 Avenue S surface option ranked the highest as it has the LRT on surface, which minimizes the potential for construction risks and avoids 10 Avenue S which has a high concentration of utilities within its right of way. Also, it avoids disputed lands in the Beltline area which reduces potential schedule risks.

Construction Impacts

Consideration of traffic impacts and disruptions to the surrounding community during construction activities.

Preliminary assessment of staging and laydown area requirements for each option was assessed based on the amount of anticipated surface disruption. The option with the lowest staging/laydown area requirements was ranked as most favourable.

10 Avenue S tunnel + surface option ranked the highest as it is mostly grade separated with assumed bored tunnel construction. In the area where the LRT is on the surface the alignment is mostly adjacent to the CPR in privately owned land, which would not require the same type of staging as surface running LRT on 12 Avenue S.

Impacts to Residences and Businesses

Consideration of impacts to neighbourhoods, business operations and traffic flow during construction.

Construction impacts to neighbourhoods and existing business operations as well as changes to access and circulation during the construction period will be different for each option.

The following two metrics were included in the metrics used to assess options against this criterion:

- **Construction disruption to residences and businesses**

  Construction of tunnel portals, underground stations, and surface LRT components, are assumed to have the highest disruption to nearby residences and businesses. Both tunnel options ranked highest because they have localized disruptions only at stations and portals with less surface impacts.

- **Accesses for residences and businesses**

  Integrating the LRT into the Beltline may introduce new accesses that benefit nearby residences and businesses, but may also replace or remove previous accesses. In general, if access were removed the property would be flagged for potential acquisition and would be included under land cost for the project in both 10 Avenue S and 12 Avenue S options. Thus, all the options ranked the same as remaining properties would have access maintained.

Archaeological and Heritage Impacts

Consideration of potential effects on land or buildings with historical or architectural significance.

As referenced in the Heritage Buildings and Sites document, historical sites are classified as either “Evaluated Historic Resource” or “Legally Protected/Federally Recognized”. “Legally Protected/Federally Recognized” properties are weighted more heavily than others. The number and type of effects resulting from construction or operation of the LRT system on properties with local or regional heritage value, architectural merit or known archaeological sites, or that are community facilities were considered for this criterion.

The following three metrics were included in the metrics used to assess options against this criterion:

- **Number of heritage sites close to the LRT alignment**

  Options with more heritage sites fronting onto the alignment will require more care and attention during LRT construction and operations. 10 Avenue S tunnel + surface option ranked highest because it has the fewest heritage sites along the corridor.

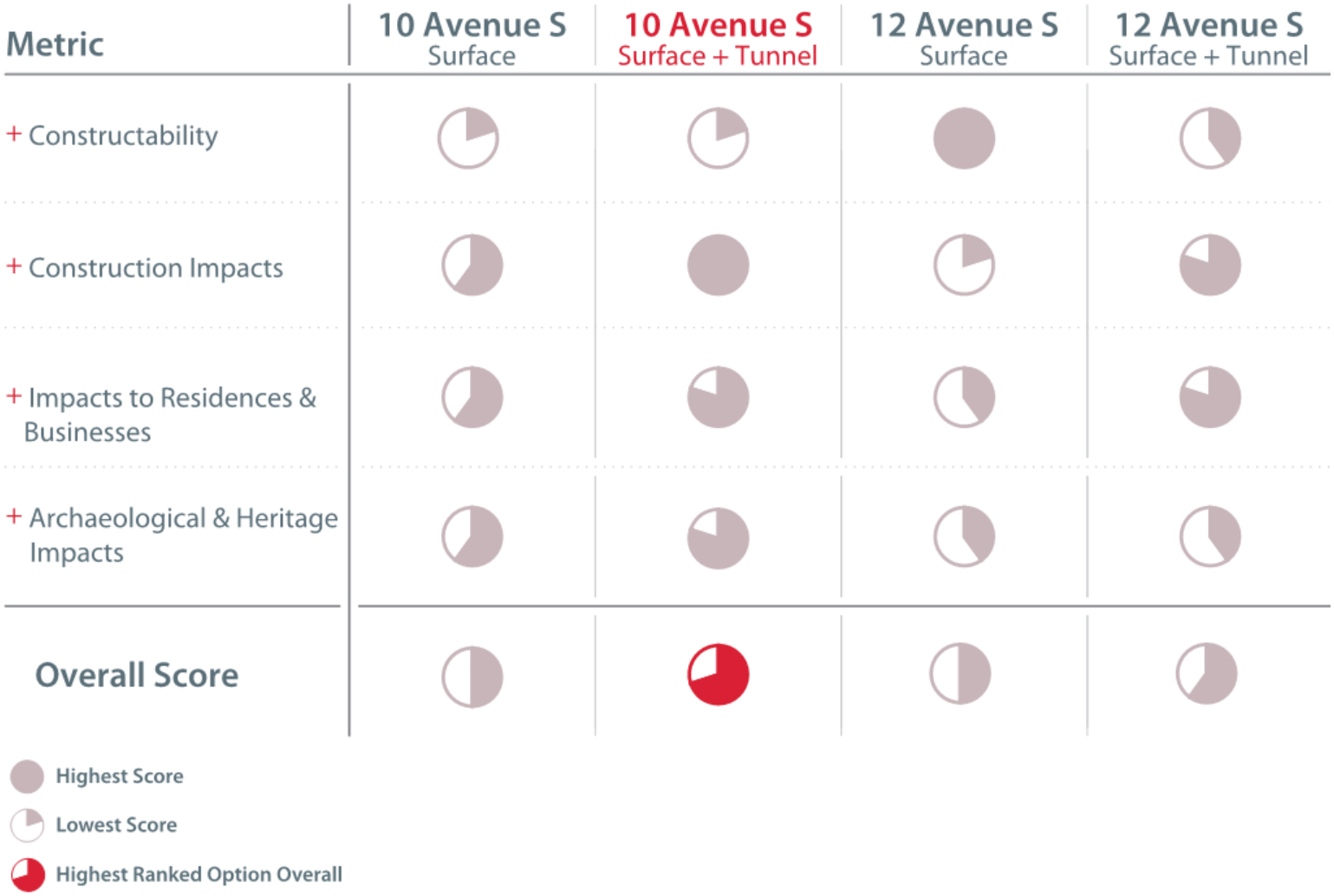
- **Level of risk to heritage sites**

  The level of risk to heritage sites is judged based on the how affected the site will be. In general, there are no locations where a heritage site is required to be removed and as a result 10 Avenue S surface option has the highest risk. The location of the portal on 10 Avenue S between 2 Street SW and 1 Street SW is adjacent to heritage sites with minimal buffer space available for sidewalks.

- **Number of archaeological or paleontological sites affected**

  Archaeological or paleontological sites are anticipated to be located adjacent to the CPR corridor or near the Elbow River valley. However, because all options need to cross this location, the options were ranked the same.

The following chart summarizes the evaluation results for the Feasibility and Deliverability account.



Stakeholders

A service that reflects the values and priorities of communities.

5.7 STAKEHOLDERS

GOAL

To provide a service that reflects the values and priorities of the communities it runs through.

EVALUATION RESULTS

Based on public and stakeholder input collected to date it is anticipated that there is high public preference for the 12 Avenue S tunnel + surface option. As a corridor there is generally more interest in 12 Avenue S, however, it is anticipated that concerns with traffic displacement suggest that tunnel options would be more preferable.

Presented below is a summary of the criteria included in this account.

Public and Stakeholder Acceptability

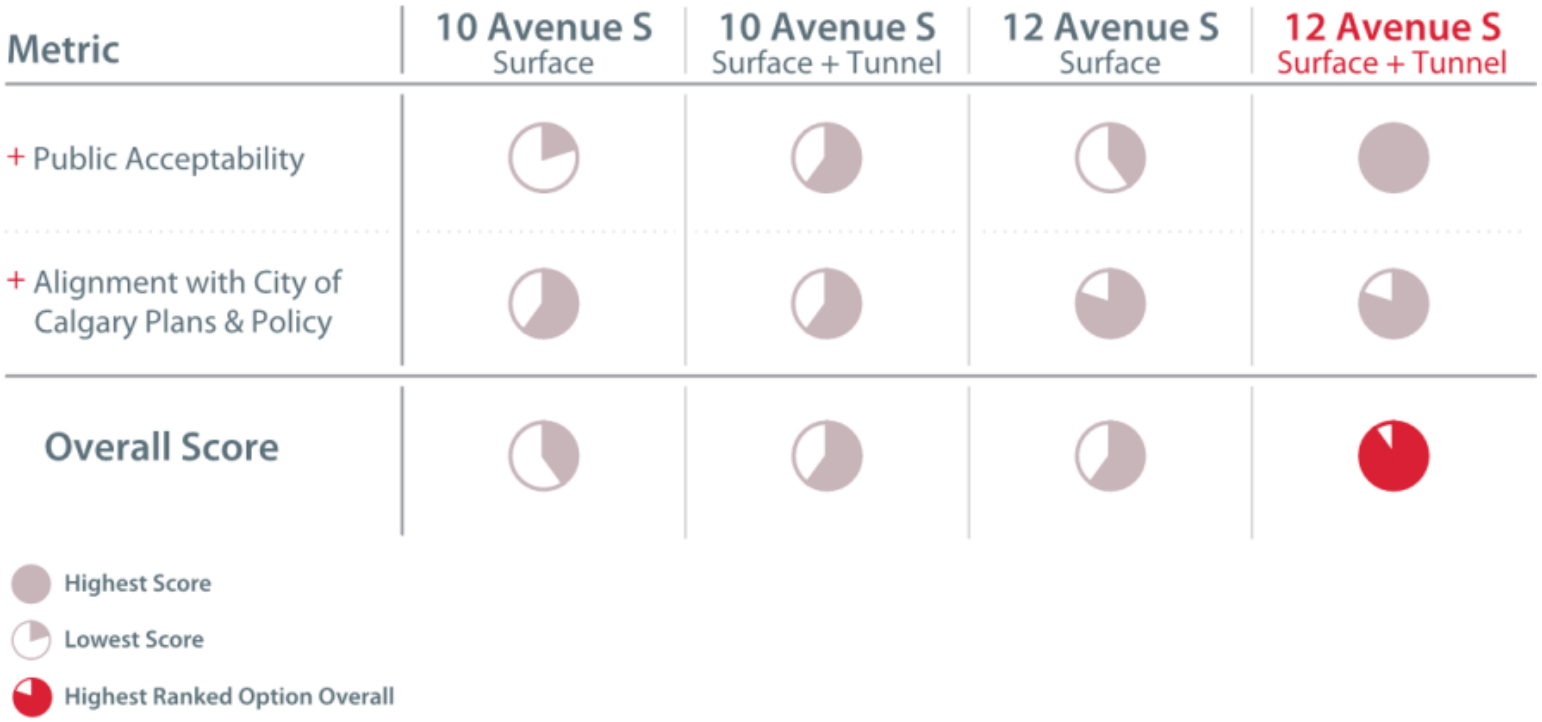
Consideration of public and stakeholder input gathered on the Beltline options.

The input gathered throughout the engagement process was included as a criterion for the evaluation process to provide a means for including stakeholder feedback as part of the trade-off analysis. 12 Avenue S tunnel + surface option was ranked the highest based on stakeholder and public feedback. Both surface options on 10 Avenue S and 12 Avenue S had concerns access and circulation from both the public and stakeholders. As outlined in section 4.3, principles have been developed with local area stakeholders to address the integration of transit with future redevelopment in the Beltline.

Alignment with City of Calgary Plans and Policies

Based on policy reviews done to date, 12 Avenue S as a corridor seems to meet the objectives of area redevelopment plans in the Beltline. Thus, the 12 Avenue S corridor options, ranked slightly higher than the 10 Avenue S corridor options.

The following chart summarizes the evaluation results for the Stakeholders account.



6 RECOMMENDATION & NEXT STEPS

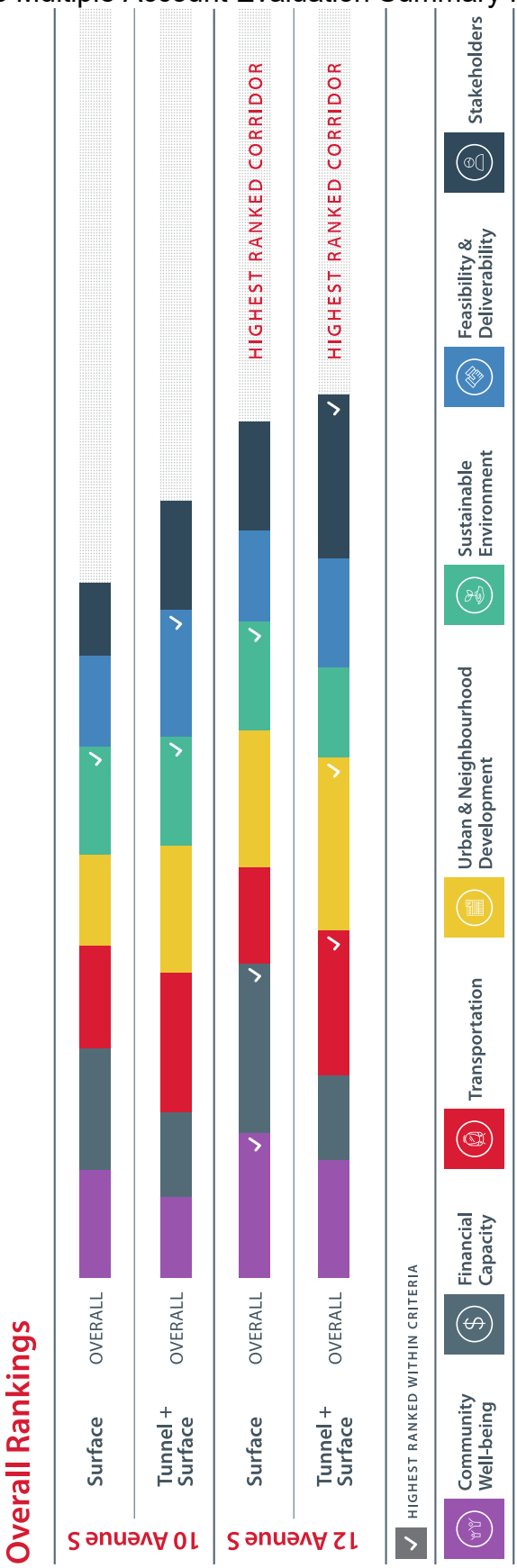
Based on the multiple account evaluation the 12 Avenue S options, the surface, and the tunnel + surface options ranked as the highest and should be carried forward for further analysis. In the Centre City MAE, the results of the evaluation provided a clearer indication for one highest ranked option.

Using the same approach at the Centre City MAE, all criteria are ranked equally which results in both the surface and tunnel + surface options on 12 Avenue S closely ranked. Additional design development, evaluation of the associated risks, refinement of cost estimates, economic impacts assessment and further engagement with key stakeholder to integrate the LRT into the emerging Victoria Park redevelopment plans will be studied further before a recommendation on the LRT configuration can be made in early 2017.

The evaluation found that the trade-offs between the 12 Avenue S Surface option and the 12 Avenue S tunnel + surface option are significant. The surface option would introduce LRT and traffic delays in the Beltline and could require substantive changes to the road network in the area. However, the tunnel + surface option has a higher cost and introduces challenges where the LRT surfaces with the portal placement on 12 Avenue S east of 4 Street / Olympic Way SE.

For both the options, additional assessment of the 12 Avenue S alignment east of 6 Street SE will continue to be reviewed to refine the geometric constraints around the Victoria Park Transit Facility and assess trade-offs in the area. For the 12 Avenue S tunnel + surface option, continued effort on integrating the portal and station with redevelopment plans in the area will be undertaken, and optimize the portal placement such that it is less disruptive. A closer plan and profile of both 12 Avenue S options are shown on figures 5 and 6.

Prior to making a final recommendation to the Standing Policy Committee on Transportation and Transit in 2017 March, additional work will be done on the 12 Avenue S options including a quantitative risk assessment (QRA), economic analysis and continued stakeholder engagement. A recommendation for an alignment will be based on maximizing the total return on investment for Calgarians.


Overall Rankings
10 Avenue S
Surface
OVERALL
Tunnel + Surface
OVERALL
12 Avenue S
Surface
OVERALL
HIGHEST RANKED CORRIDOR
Tunnel + Surface
OVERALL
HIGHEST RANKED CORRIDOR
HIGHEST RANKED WITHIN CRITERIA
Community Well-being
Financial Capacity
Transportation
Urban & Neighbourhood Development
Sustainable Environment
Feasibility & Deliverability
Stakeholders

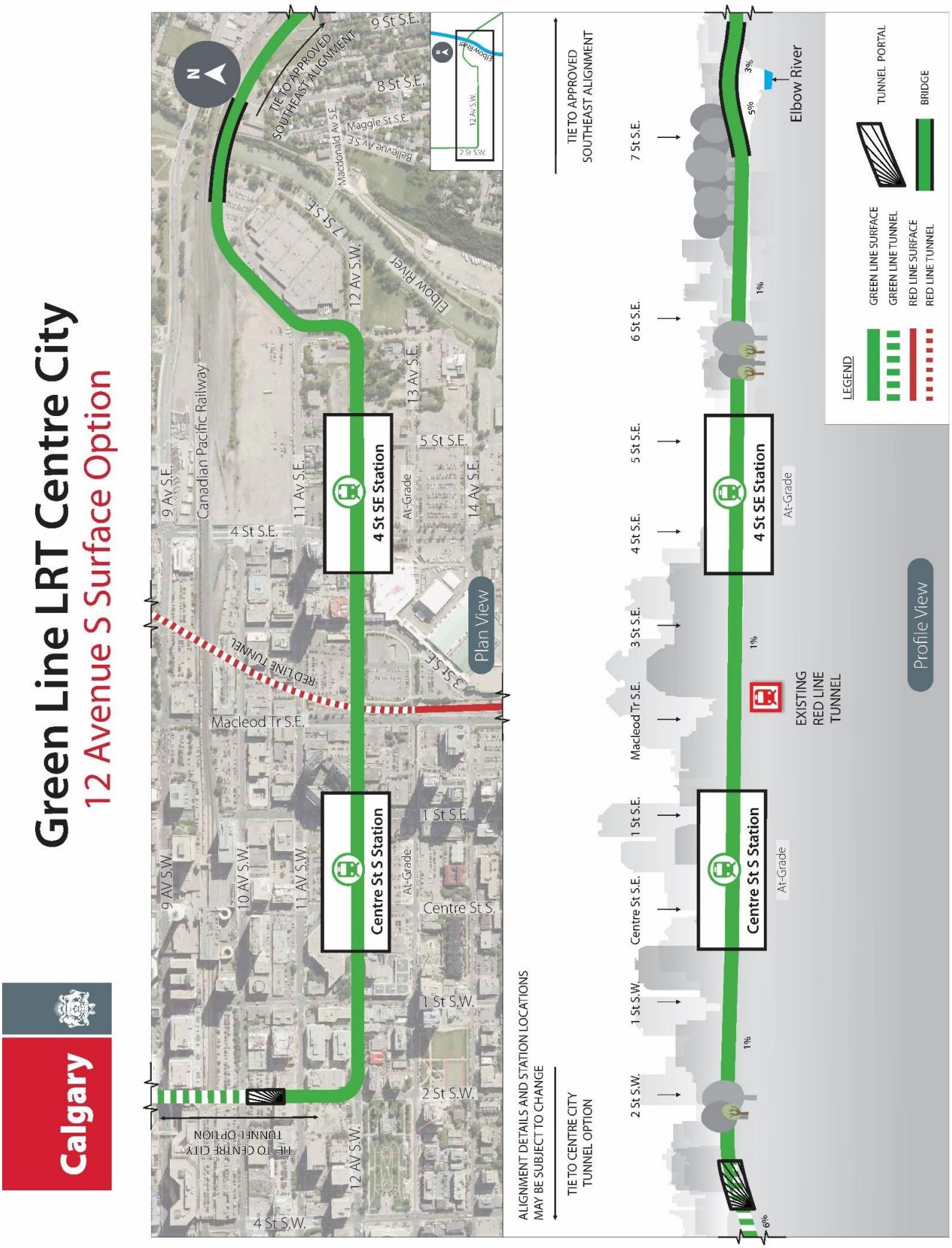


FIGURE 5 12 AVENUE S SURFACE OPTION

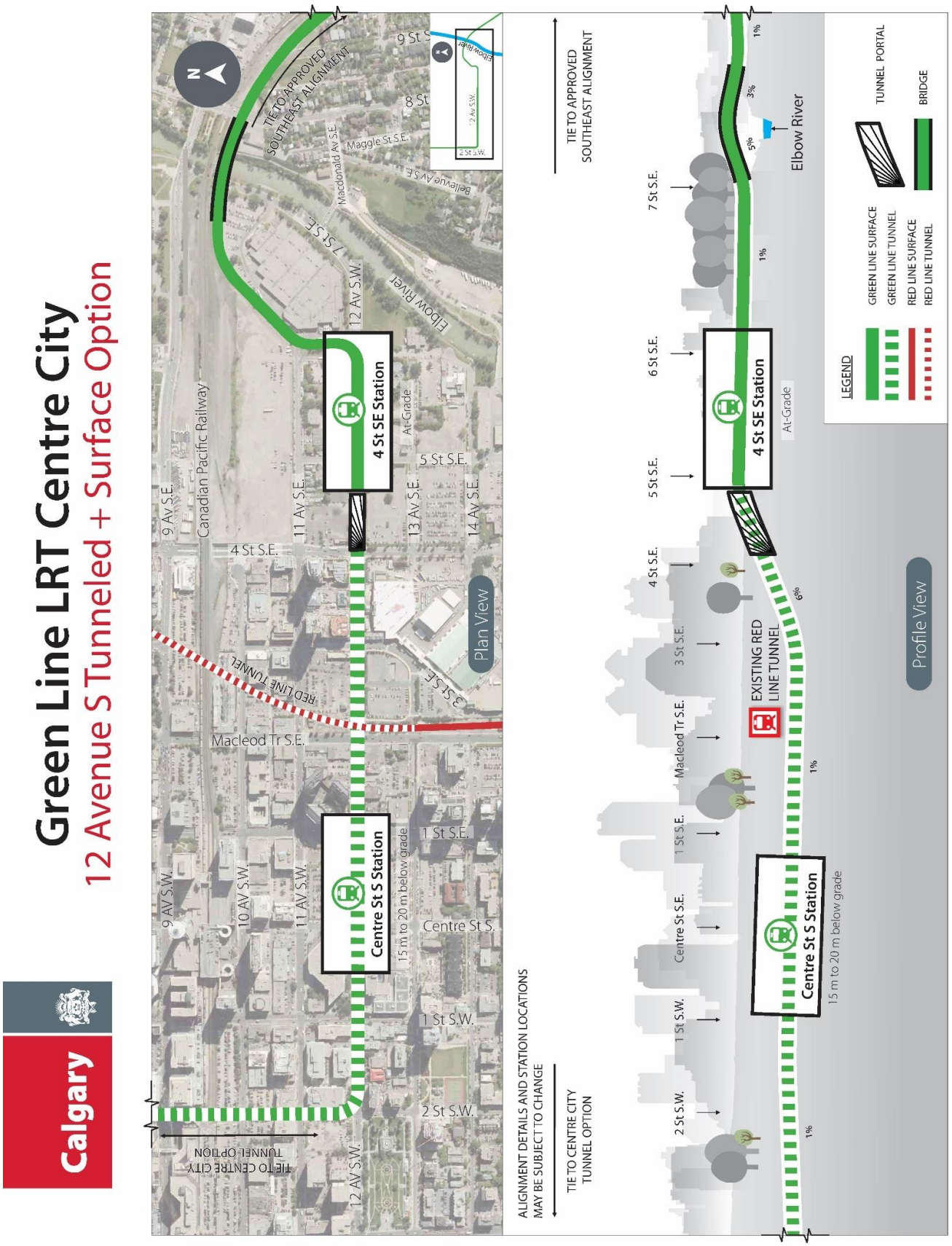


FIGURE 6 12 AVENUE S TUNNEL + SURFACE OPTION

Appendix A - Detailed MAE Summary

Beltline Multiple Account Evaluation Summary Report

Major Accounts	Project Objective	ID #	Evaluation Criteria	Expanded Description	Representative Metric	10 Avenue S Surface	10 Avenue S Tunnel + Surface	12 Avenue S Surface	12 Avenue S Tunnel + Surface
Financial Capacity / Sustainable Corporation	An affordable and cost effective service, a service that has cost that are achievable, sustainable in the long term and provide value for money.	1	Capital Cost	Consideration of full costs to construct the options based on the latest cost estimates.	$ Million	4	2	5	1
		2	Land Impact	Consideration for the cost of land to be purchased to accommodate the LRT and other required infrastructure.	$ Million	1	3	5	4
		3	Operating and Maintenance Cost	Consideration of the overall life cycle costs to operate and maintain LRT infrastructure.	Life cylce costs based on length of alingmnet that is at-grade or underground.	5	2	5	1
					Financial Capacity / Sustainable Corporation TOTAL	10	7	15	6
								✓	
Community Well-Being	A safe secure and socially inclusive service that improves access to key community destinations and encourages walking and cycling.	4	Community Cohesion	Consideration for the different level of visual intrusion and severance on neighbouring properties, as well as ease of station integration of options into existing urban form, particularly around portals.	(1) Physical disruption of ramps & portals	1	3	3	3
					(2) Access to view and protection of residential & commercial privacy	3	3	3	3
					Criteria No. 4 Total	2	3	3	3
		5	Impact to Recreational Uses	Consideration for ability of the LRT to serve community events or high profile festivals after the system has be constructed.	Number of high profile community events that are served by the LRT	3	3	3	3
		6	Safety, Security and Emergency Access	Consideration for the safety of the system, including ease of application of CPTED design principles, as well as time for emergency response services to access different areas of the system to address any emergency incident.	(1) Perception of safety & security - eyes on the street based on CPTED principles	4	2	5	3
					(2) Distance for emergency response teams to reach emergency location on system	4	1	5	2
					Criteria No. 6 Total	4	2	5	3
		7	Accessibility	While all options will be made accessible to all users, different options present a different level of ease of accessibility to station platforms. Consideration for the distance for a person with disabilities to gain access to a station platform.	Distance for system user to access the station platform	3	1	5	4
					Community Well-Being TOTAL	12	9	16	13
								✓	

Beltline Multiple Account Evaluation Summary Report

Major Accounts	Project Objective	ID #	Evaluation Criteria	Expanded Description	Representative Metric	10 Avenue S Surface	10 Avenue S Tunnel + Surface	12 Avenue S Surface	12 Avenue S Tunnel + Surface
Transportation	A high priority transit service that attracts transit use, walking & cycling as preferred mobility choices for Calgarians that integrates with, improves customer experience, meets the future demand of, and strengthens the regional & local transit networks.	8	Ride Time for LRT	Consideration for the length of LRV travel time for each alignment.	LRT ride times	3	5	1	3
		9	Transportation Network Reliability	Consideration for traffic impacts throughout the downtown network	(1) Downtown Network Impacts	1	5	1	4
				Consideration for traffic operations along the LRT corridor and on parallel streets for special events access.	(2) Traffic impact on special events	5	5	1	3
					Criteria No. 9 Total	3	5	1	4
		10	Integration with Existing & Future Transit Service	Consideration for providing quick and convenient transfers to the existing & future rail network (LRT & HSR)	Path of travel for transfers to other rail lines	3	3	3	3
		11	LRT Service Reliability	Consideration for impact to LRT reliability due to the interaction between LRV and pedestrians or vehicles that may lead to incidents that disrupt transit service.	(1) Number of potential conflict points between the LRV with pedestrians and vehicles at at-grade crossings and intersections.	3	5	1	5
					(2) Provision for special trackwork requirements	5	5	5	3
					Criteria No. 11 Total	4	5	3	4
		12	Catchment Area	Consideration for the catchment area predicted for each option.	Providing new transit service to the Beltline community	1	1	5	5
		13	Complete Streets: Multi-modes, Connectivity, and Accessibility	Consideration for addition of new cyclist or pedestrian facilities along corridor to support active transportation in the City.	(1) Potential to preserve the existing cycle track pilot	5	5	1	4
					(2) Square meters of new or improved public realm (incl. sidewalks, street landscaping, street furniture, lighting, amenities etc.)	1	2	4	5
					Criteria No. 13 Total	3	4	3	5
					Transportation TOTAL	17	23	16	24
									✓

Beltline Multiple Account Evaluation Summary Report

Major Accounts	Project Objective	ID #	Evaluation Criteria	Expanded Description	Representative Metric	10 Avenue S Surface	10 Avenue S Tunnel + Surface	12 Avenue S Surface	12 Avenue S Tunnel + Surface
Urban Development / Urban Realm	A service that support current and future land use, and intensification of development along the corridor, integrating with the communities it passes through.	14	TOD and Development Potential	Consideration for how well station locations and the alignment options integrate into existing land uses, and provide opportunity for future development.	(1) TOD integration Potential	3	3	5	5
					(2) Encouragement/ opportunity for near term redevelopment potential	3	3	5	5
					(3) Number of access agreements required to connect system to existing infrastructure and buildings	3	3	3	3
					Criteria No. 14 Total	3	3	4	4
		15	Streetscape and Public Realm	Consideration of the planned improvements for each of the alignments, focusing on urban design goals of : -Memorable Places, - Great Streets and -Quality Buildings. (i.e. amenity spaces, urban landscaping and street design)	(1) Legibility of stations in the existing and future urban realm	4	4	5	4
					(2) Integration of station into existing and future urban realm	3	4	5	5
					Criteria No. 15 Total	4	4	5	5
		16	Impact on Parking	Consideration for the impact on the availability, location and access to parking for the different options.	(1) Net number of on-street parking stalls removed	1	5	1	5
					(2) Number of parking accesses restricted (removed access, retrofit parkade access)	2	5	1	5
					Criteria No. 16 Total	2	5	1	5
		17	Urban Vision	Consideration for the near term ability of the option to capitalize on the local community's assets & potential to create an urban realm that promotes community well-being.	Ability to provide for place making	1	2	5	5
					Urban Development / Urban Realm TOTAL	10	14	15	19
									✓

Major Accounts	Project Objective	ID #	Evaluation Criteria	Expanded Description	Representative Metric	10 Avenue S Surface	10 Avenue S Tunnel + Surface	12 Avenue S Surface	12 Avenue S Tunnel + Surface
Sustainable Environment	A service that facilitates reduces GHG emissions while not impacting the city's current natural environment.	18	Impact on Existing Natural Environment	Consideration for the impact on biodiversity and natural environment and during the construction of the option and its ultimate configuration.	(1) Extent of permanent impacts environmental sites / water bodies	3	3	3	3
					(2) Extent of impacts to environmental sites / water bodies during construction	2	2	2	2
					(3) Impact to existing wildlife and wildlife habitat	3	3	3	3
					Criteria No. 18 Total	3	3	3	3
		19	Environmental Soil Conditions and Contamination	Consideration for the number of contaminated sites that may be disturbed for each option and impacts of construction in areas of sub optimal soil conditions.	(1) Number of contaminated sites encountered (negative measure) within the public ROW	2	2	3	3
					(2) Level of remediation required	3	1	3	1
					Criteria No. 19 Total	3	2	3	2
		20	Adaptability to Extreme Climate Conditions	Consideration of the ability of each option to adapt to extreme weather conditions and climate changes.	Probability of flooding / area within floodplain	3	4	3	2
		21	Noise and Vibration Impacts	Consideration for the noise and vibration during operation of the system and its impact on residences, businesses and other sensitive receptors.	(1) Level of noise pollution during operation	3	3	3	3
					(2) Number of high sensitivity vibration receptors along the alignment	3	3	3	3
					Criteria No. 21 Total	3	3	3	3
					Sustainable Environment TOTAL	12	12	12	10
						✓	✓	✓	

Beltline Multiple Account Evaluation Summary Report

Major Accounts	Project Objective	ID #	Evaluation Criteria	Expanded Description	Representative Metric	10 Avenue S Surface	10 Avenue S Tunnel + Surface	12 Avenue S Surface	12 Avenue S Tunnel + Surface
Feasibility / Deliverability	A service that can be constructed and operated without significant technical issues or constraints.	22	Constructability	Consideration for the technical constraints, including geotechnical, archaeological, existing utility infrastructure, as well as physical challenges (gradients, system expandability, etc.) associated with each type of guideway (i.e. elevated, tunnel, at-grade) and the risk premiums related to each.	Risk premium on cost & schedule delay	1	1	5	2
		23	Construction Impacts	Consideration for the impacts to neighbourhoods and existing business operations during the construction of the option as well as changes to access and circulation	Surface area impacts along the corridor	3	5	1	4
		24	Impacts to Residences and Businesses	Consideration for the impacts to neighbourhoods and existing business operations during the construction of the option as well as permanent changes to access and circulation.	(1) Severity of disruption to residences, businesses and streets depending on method of construction	3	4	1	4
					(2) Net number of accesses for residences, businesses and streets	3	3	3	3
					Criteria No. 24 Total	3	4	2	4
		25	Archaeological/Heritage Impacts	Consideration for the number and type of impacts on properties with local/regional heritage value, architectural merit or community facilities or known archaeological site, as a result of construction or operation of the option.	(1) Number of historical sites impacted	5	5	1	1
					(2) Level of risk to heritage sites	1	3	3	3
					(3) Number of archaeological/ paleontological sites impacted	3	3	3	3
					Criteria No. 25 Total	3	4	2	2
					Feasibility / Deliverability TOTAL	10	14	10	12
							✓		
Stakeholders	An engagement process that encourages public participation, promotes a shared understanding of the values and priorities, and input into the design development.	26	Public & Stakeholder Acceptability	Perceived/ understood level of public & stakeholder acceptability based on responses at engagement events	Qualitative	1	3	2	5
		27	Alignment with City of Calgary Plans & Policy	Consideration for how the options align with existing plans and policies and the potential of each option to help achieve those goals. (MDP, CTP, RouteAhead, Complete Streets etc.)	Qualitative	3	3	4	4
					Stakeholders TOTAL	4	6	6	9
									✓
					OVERALL TOTAL	75	85	90	93
						✓	✓✓	✓✓✓	✓✓✓