

2020 CANADIAN CONSULTING ENGINEERING AWARDS

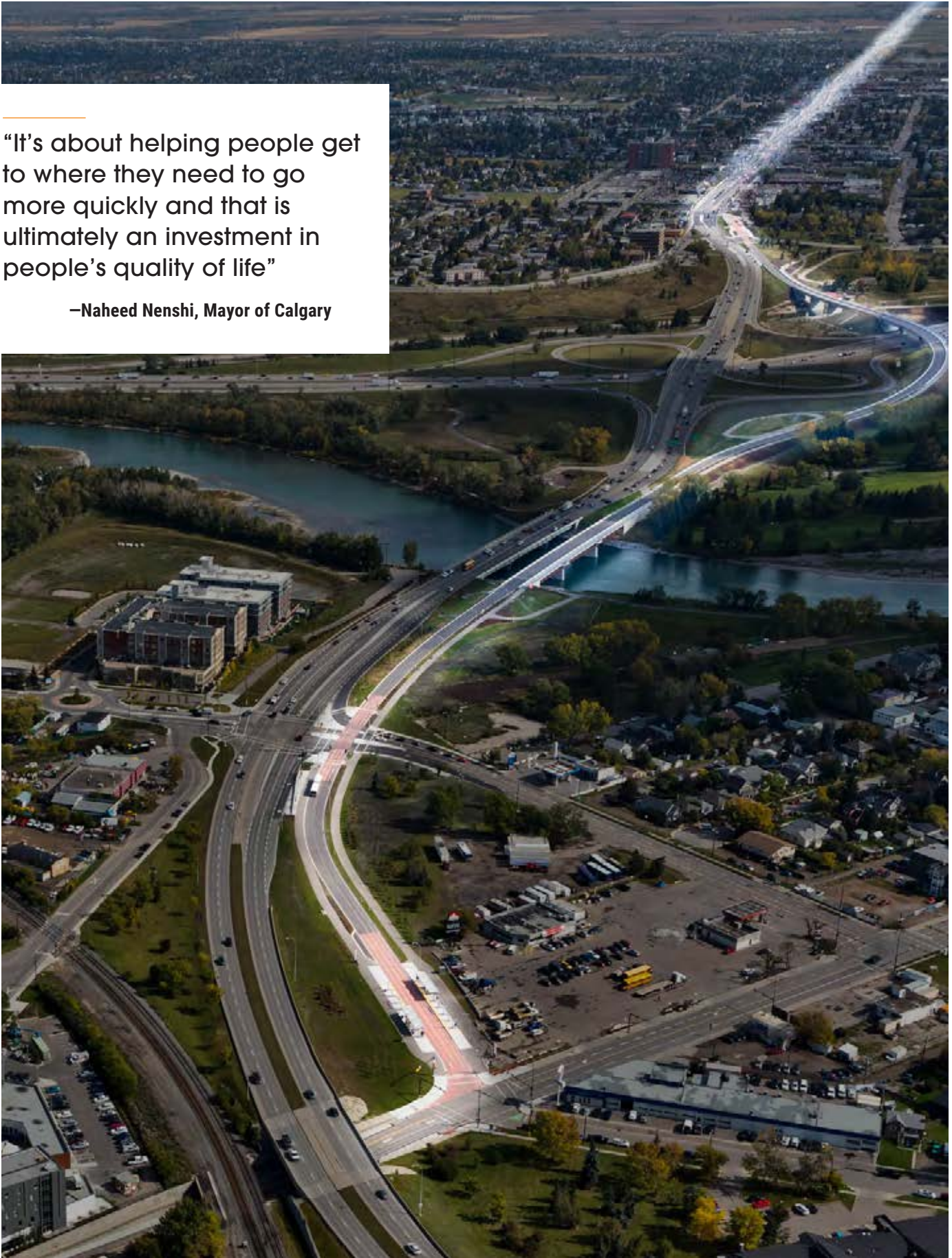
MAX PURPLE BUS RAPID TRANSIT (BRT)

Category G: Project Management



“It’s about helping people get to where they need to go more quickly and that is ultimately an investment in people’s quality of life”

—Naheed Nenshi, Mayor of Calgary



Aerial view looking east along the MAX Purple Transit corridor – showing International Avenue in the distance



MAX Purple BRT bypassing traffic congestion on the new dedicated transitway

INTRODUCTION

For decades, the International Avenue community in Calgary, Alberta relied on a lack of consistent, reliable, high-quality public transit as their most common means of transportation. To revitalize the transportation infrastructure in this area, The City of Calgary (The City) engaged Stantec to design and administer the construction of the MAX Purple Bus Rapid Transit (BRT). This \$180 million infrastructure project is the first piece of a critical multi-modal transportation corridor connecting downtown Calgary to Chestermere (a bedroom community on the outskirts of Calgary). The current and future developments along the corridor will be home to more than 40,000 residents and will provide a significant amount of employment in the area.

The project area, especially International Avenue, is home to a large population of new Canadians and small business owners, primarily with low-income households. This BRT is tailored to the transit experience preferences of Calgarians, providing reliability, convenience, and enhanced comfort and safety. The project also acts as a catalyst for The City's redevelopment strategy along International Avenue to promote social and economic growth. A unique corridor in Calgary, The City's investment in streetscape revitalization and multi-modal transportation will attract private investments along the BRT corridor.

The consulting team, led by Stantec, was brought on board by The City in October 2015 to complete Phase 1 of the project. Our team worked collaboratively with The City to update the conceptual road design, undertake traffic analysis, engage closely with public stakeholders, complete utility, geotechnical and environmental assessment requirements, deliver a detailed design, and undertake construction administration. In late 2016, a funding commitment by the federal government pushed for commencement of Phase 2 of the project, which was only at a conceptual design state. Despite this tight schedule, our team completed the detailed design, construction, and commissioning of both phases on time and within budget for the BRT's opening in November 2018.

The MAX Purple BRT provides a unique, cost effective, and precedent setting enhancement to the Calgary Transit system while positioning The City for smart transit-oriented redevelopment and growth. The project has been designed to allow for future conversion to Light Rail Transit (LRT), enabling The City to cost effectively upgrade this transportation corridor to accommodate long term population growth and transit ridership. The delivery of this iconic piece of infrastructure represents how Calgary is evolving to accommodate new forms of transit service to get Calgarians moving efficiently, and comfortably around their city.



MAX Purple crossing Deerfoot Trail

Q.6 COMPLEXITY

MAX Purple BRT is the first dedicated bus transitway in Calgary, and is built with separated transit lanes to emulate the speed and reliability associated with an LRT system. The project consisted of two geographical phases. Phase 1 started in 2015, to accommodate a first-in-Alberta median-running transitway complete with urban streetscape revitalization. Phase 2 began in fall of 2016, consisting of a transit-only corridor that included the construction of three bridges—paired with the challenge of meeting the federal funding grant deadlines. Overcoming these challenges, the BRT successfully opened on schedule just over two years from the beginning of Phase 2.

In Phase 1, the Stantec project management team overcame two main challenges, incorporating the stakeholders' initial vision into the end product, and maintaining access to as many of the existing businesses as possible. The International Avenue Business Revitalization Zone (BRZ – the local community business organization) initially had a vision of the area; however, this vision and The City's regulations required alterations to fit within budget and available land. Our team realized this vision and managed to maintain access to local businesses through delicately managing all stakeholders. We worked with the BRZ and The City to minimize required property acquisitions, with portions of properties negotiated to avoid full expropriations, ultimately saving on project costs and keeping businesses open. With The City, we worked out solutions including implementing

Calgary's first U-turn signals and relocating customer parking to side streets.

In Phase 1, our team implemented the design-bid-build project delivery method for construction. This is the traditional project delivery method in Calgary, where design, tendering (contractor hiring process), and construction occur in sequential order. However, for Phase 2, we worked with our client to implement a Construction Management (CM) approach, where construction was completed simultaneously with design, the main contributing factor in helping us achieve project deadlines. Phase 2 required a preliminary design to be completed in less than two months, a process that typically takes up to a year to complete. This phase incorporated three new bridges: over Deerfoot Trail, the city's busiest roadway; the Western Headworks Canal; and the Bow River, the city's largest waterway. Each bridge required unique regulatory approvals and construction techniques. Phase 2 was an exercise in project management – what can we build quickly, while we figure out the whole design.

The CM approach allowed us to build berms in the Bow River to facilitate foundation construction to start before entire bridge designs had been completed. To accelerate approval by Navigation Canada for the bridge over the Bow River, we obtained buy-in from Calgary's emergency services—Navigation Canada's main concern for the project, which expedited preliminary approvals in months instead of



Bow River Bridge foundation construction work

“This is a huge boost for our businesses and for the people who live along the corridor, we worked closely with Stantec at every step along the way, and the design we got is going to work well with the needs of our community.”

—**Alison Karim-McSwiney,**
International Avenue BRZ

years. Alberta Transportation (AT) approvals were also a challenge as the BRT was the first instance where The City was building a bridge over Deerfoot Trail, since AT began operating Deerfoot Trail 20 years ago. To navigate this challenge, we filtered through our key relationships with AT to find the key decision makers for our project. After extensive discussions with streamlined communications, approval for this bridge was granted six months earlier than the typical one year to facilitate foundation construction.

CM also fostered a cooperative environment between the project owner, the designer, and the builder. Rather than an adversarial relationship that often develops on construction projects, the CM helped create a collaborative discussion. In a typical contracting scenario, the contractor with the lowest bid would be engaged to build the tendered design, this often leads to each party defending their own interests when a conflict arises (e.g. cases of design omissions, errors on tenders). However, with CM, all parties engage in a mindset outside of what their role typically dictates. Our design team was able to solve construction challenges with the construction manager during design, while the construction manager also made suggestions for more efficient materials or methods to modify design. Through this project, Stantec’s relationship with the construction manager developed so positively, that we are currently pursuing future design-build projects together.

All buried major utilities were safely exposed to confirm that their location and depth of bury matched records so

that construction could proceed according to design. During this process, a significant issue arose when a watermain was discovered to be approximately six metres away from its recorded location. This challenge could have potentially delayed the project schedule for months, impacted water supply for many residents in the area, and would require an expensive rebuild of the water main to match the original record location. CM helped us manage this risk by adjusting timelines so that the tendering of underground work could be updated simultaneously with the design modifications. As contractors are typically selected based on the lowest price, any design modifications would be very costly to negotiate with the contractor once the tender is closed. With CM, we were able to close the tender after the design was finished, so that all modifications were included without the need for negotiations after the tender closed. Coordination with The City’s Water Resources group on the watermain also commenced immediately, and prioritized meetings brought the rapid design update to completion without significant impact to the project schedule.

Given the schedule constraints, expediting approvals with all stakeholders was crucial to complement our project management approach. This project is a new type of transit service to not only Calgary, but all of Alberta. As such, The City requirements were more stringent towards the project during the initial phases of design, and the approval process took longer to mitigate risks. To help these stakeholders understand and become familiarized with the project, we reviewed precedent BRT projects like the Los Angeles BRT



“The MAX Purple Line is a key element of our plan to expand transit options to Calgary residents and to set the stage for future growth in the city, working with Stantec’s design team, we realized the design vision and accomplished the objectives we set out.”

—Howard Kai, Project Manager - City of Calgary

← International Avenue construction – keeping business accesses open

System and brought in international experts to dissect the intricacies involved with implementing a new BRT system in the city. This not only gave The City a peace-of-mind, but also gave them the confidence to expedite the approval process for the project and prioritize keeping this project on track.

As an added challenge, throughout the duration of the MAX Purple project, the project team was led by three different project managers. As this complex project spanned over several years, changes in schedules and new emergent projects created conflicts with the assigned project manager’s availability, leading to a change in the project manager in charge. This is why, although most projects would boast the continuity of one PM team through the entire project, the flawless execution of this project through our evolving PM team further exemplifies project management excellence. Not only was this project delivered on time and on schedule through the smooth transition of three project managers, we were also able to bring on the team members with the necessary experience and strengths for the specific phase of design and construction. Leveraging the right team members also alleviated the stress that came with unexpected personnel changes as each member took responsibility for their respective phase(s) of the project.

With almost 300 professionals contributing more than 80,000 consulting hours, the sheer size of this project was a notable challenge to manage. Each team member was committed to our unified goal, opening the BRT by 2018. We brought on our transportation, geotechnical, stormwater management, river engineering, landscaping, environmental, archaeology, project management, constructability, and utility experts to connect

early and often on the project. Every specialist was entrusted to take ownership for their work, leading to productive weekly design meetings. This allowed the team to quickly address emergent design challenges and leverage potential opportunities.

Q.7 MEETING CLIENT’S NEEDS

Prior to project implementation, International Avenue was a difficult and unreliable corridor to access as a pedestrian and a transit user. Bus travel times were inconsistent and unreliable, due to congestion at main intersections of the community, and curb-side bus service yielding to other vehicular traffic. Despite long standing ambitions and vision from the surrounding community, the urban realm did not easily incorporate a mixed-use urban development, and it did not honour the area’s unique cultural heritage and history.

To address these issues, it was important to the client and Stantec to deliver a lasting design to complement and enhance the community. In addition to this, The City’s main goals included, meeting the project schedule, and staying within budget. Stakeholder engagement and safety were key in achieving these goals.

Stakeholders, like the BRZ, residents and businesses, were frequently engaged early on to discuss how they would be impacted by the project. Initiatives included a storefront on the corridor, and pop-up events at key locations within the community to capture an audience beyond standard open houses. These initiatives helped stakeholders understand



MAX Purple 26 Street Station

the opportunities presented by reliable transit, and gave surrounding businesses confidence to support this project, as shown through their contributions to the public opening event for the BRT.

Throughout this project, we looked for opportunities to also give back to the community. We hosted numerous community events, such as painting sidewalk art along the International Avenue BRZ as part of our annual Stantec in the Community Week volunteering initiative. This helped the students at the local Holy Trinity School understand how to get to the relocated crossing of International Avenue, introduced as part of the project. The team also worked with The Alex Food Centre in the community to design and build an onsite compost system to support sustainable re-use of food waste as part of their operation to address food insecurity in East Calgary. Our engagement with the community was well-received by the members of the BRZ and residents which helped us build strong relationships to support this project.

Along this corridor, there were many locations where full private property acquisition was required in the original conceptual design. Not only would private property acquisition be costly and time consuming, it could often detract from the end project goals by relocating many of the businesses that make the corridor attractive for investment to

begin with. To reduce impacts on surrounding businesses, we maintained access to businesses during construction, found alternate customer parking, and worked with owners where property acquisition was required, ultimately preserving the uniqueness of this corridor. This led to time and property acquisition cost savings for The City and reassured the BRZ and local businesses' concerns of the potential negative impacts to the community.

Safety is a priority for both our client and Stantec. Working in live traffic areas required many accommodation strategies. On Deerfoot Trail, a 100 km/hr highway, speed was reduced to 80 km/h and physical barriers were used to keep workers safe. The importance of this initiative was evident when several car accident scenes occurred along the barrier, but the safety of workers on site were not impacted. Over the 338,000 hours of work performed on site, zero lost time incidents occurred, a strong testament to our dedication to safety on this complex project.

By November 2018, MAX Purple BRT was open for service on time and on budget, only 20 months after construction started for Phase 2. The client's opening event was attended by all three levels of government, the BRZ, residents, and businesses. Local businesses even donated a variety of foods to support the opening.



Bow River Bridge in-river foundation work

Q.8 ENVIRONMENTAL BENEFITS

The MAX Purple BRT has increased ridership by 1,900 boardings per day in just the first six months, and this has increased to 2,710 boardings per day as of 2020. This is an estimated decrease of about 1,000 tons of CO₂ in the last year alone –this would have similar effects as taking about 200 cars off the road for one year. In addition to increased ridership, the new multimodal corridor is now safer and more enticing for people who walk and cycle, encouraging alternative modes of transportation to driving.

During construction, we carefully respected the wildlife in the project area. Fish passage in the Bow River was protected during the construction of the new bridge, granting the project approval from the Department of Fisheries and Oceans. Tree removals were minimized and completed outside nesting periods where possible. Several instances of birds nesting adjacent to the project required moving heavy equipment away from these nesting birds, until their young were fledged. When working in the Western Headworks Canal, although we built foundations more smoothly when annual operations drained the canal, this actually left hundreds of fish stranded in the project area. Although not an environmental requirement, our team worked to protect the fish by collecting them from this area and relocating them safely back into the Bow River.

Stormwater from the project was diligently managed to protect water quality. A pair of dry ponds and several oil and grit separators were installed to improve water quality before its release into the Bow River. Flow restriction was also

employed to reduce the surge of water, from intense storm sewer outfall, flowing into the Bow River.

With a future LRT conversion in mind, we also designed for sustainability. Bridges were designed with higher LRT loading capacities, and the road profile was limited in grade with a shallower climb, minimizing throwaway when upgrading to LRT in the future.

Q.9 INNOVATION

Aspiring to maintain business viability during construction, we created innovative techniques through the design process. Reduced motor vehicle lane widths, relocation of bicycle accommodation to a parallel corridor, and careful geometric review at each business access was undertaken to minimize property acquisitions. In total, this innovative approach reduced half the number of property impacts from the original 80.

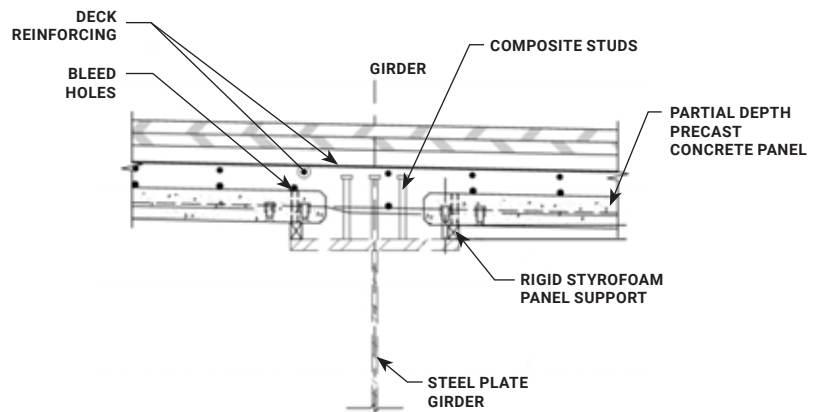
Based on conceptual design review and traffic analysis, we confirmed that a median-running transitway would be the most efficient means to bolster transportation throughput and reliability on the corridor. Curb-side bus stops are often pushed off schedule due to built-up traffic turning right at intersections while they yield to pedestrians crossing. To mitigate this, a median-running transitway was implemented, where busses are only limited by transit-priority traffic signals. This treatment accommodates



Bow River Bridge girders partially erected

two bus-only travel lanes in the median of the roadway, physically separated from adjacent general traffic lanes. This required careful application of first-in-Alberta solutions for station accessibility, median separation, and traffic signal design including allowing U-turns at signalized intersections to ensure ease of access to businesses along the corridor.

Traditional bus stations are simple and unwelcoming, so we incorporated an LRT-style station design that incorporates consideration for all users of the BRT. Amenities such as heated shelters for Calgary's colder days and colour-based wayfinding signage designed for easy comprehension by English Language Learners, were implemented to enhance the transit experience. For visually impaired riders, we installed tactile warning strips as part of every platform to signal the end of the stations' safe area and the start of the roadway. Since these stations had to be sized for 90 different stations in the system, a "Kit of Parts" approach was adopted. Like a Lego set, this allows for a set of premanufactured parts to be put together in different combinations, to suit the location-specific details of each station, while providing as many consistent parts as possible for ongoing maintenance and future expansion of the BRT system. These stations were built under a separate contract, which led to further coordination between our PM team and the construction teams for both phases, to smoothly integrate the construction of the stations into the MAX Purple BRT project.



↑ Partial Depth Precast Concrete Panel Support Detail

With the tight deadline of the federal fund grant in Phase 2, our team implemented several innovative constructability techniques to help us meet the schedule and save on costs. During construction of the bridges over the Bow River and Deerfoot Trail highway, we faced the risk of the wet concrete falling into the river or onto the highway below, causing river pollution or vehicular damage. We used an uncommon technique to address this issue, known as "partial depth precast deck panels". This technique uses cured panels of concrete (i.e. the precast panels) spanning between the girders (structural skeleton of the bridge). Afterwards, wet concrete is cast to fill the remaining depth of the deck. This technique prevented the concrete from leaking through to the areas below and the use of precast panels eliminated the need for formwork (to temporarily support wet concrete in place), which significantly reduced the time and costs associated with building the bridge deck.



“The city and the province have truly made a beautiful future for International Avenue and for all who live in east Calgary and work here”

—Alison Karim-McSwiney,
International Ave Business
Revitalization Zone

← Building retaining wall for the Western Headworks Canal bridge

When working on the Bow River bridge, one side of the river did not have enough space to operate a crane needed to build the typical NU-girder style bridge (the more cost-effective and common design used for building bridges in Calgary). As a result, in our initial design, we planned for a rare launched steel bridge concept to build the bridge, even engaging with a specialist to help us execute this unique technique; however, an even better opportunity presented itself through our CM approach. Since construction occurred simultaneously to design, this opened the opportunity for the contractor to present design modifications. Our successful steel fabricator contractor (who already offered the most cost-effective pricing) proposed assembling the bridge in place rather than launching, further offering a 10% discount in pricing for this technique – resulting in additional cost savings to The City.

Lastly, we were faced with another challenge when designing for a section of the transitway where imported soil is piled onto the existing ground to create a higher roadway. A local golf course near the Bow River bridge limited the available space to create a side slope according to the maximum steepness required by The City. This steepness regulation was in place to ensure a safe, stable slope is used for City projects and maintenance equipment (such as lawnmowers) can safely operate. Retaining walls are generally used

in these scenarios to hold back the soil from spilling over property lines; however, the cost to build these walls is expensive relative to a wide side slope. To address the limited space and cost concerns, we proposed to build a slope steeper than City regulations, still using a retaining wall where absolutely necessary to contain the side slope, but reducing the length to save associated time and costs. Through engaging our geotechnical expertise, we were able to get buy-in from The City by proving that the stability of a steeper slope still fulfilled The City's requirement for safety, with the added benefit of removing the need for maintenance in this area (through using an alternate seeding strategy). This method not only saved on costs in construction, but also presented long-term benefits to The City.

Q.10 SOCIAL AND/OR ECONOMIC BENEFITS

The main corridor of this project, International Avenue, has a concentration of new Canadians and small family-owned businesses. This population is primarily lower-income households that need public transit as an essential means of transportation. MAX Purple not only fulfills this need but also rejuvenates the vibrancy of the community. Previously, International Avenue lacked a feeling of continuity and safety due to urban planning completed over several decades



MAX Purple in the rejuvenated International Avenue corridor

without the whole corridor in mind – dating all the way back to a time when this community was not yet part of Calgary. Through design considerations like better surveillance at stations (and help phones), improved pedestrian access, and investment in public spaces, the safety of the area has greatly improved. Pedestrians previously caught in the middle of the crossing by a changing signal can now use the median stations as a refuge while they wait for a signal change to resume their crossing.

During implementation we were also cautious of the potential economic impact construction can have on surrounding businesses. Knowing Calgary's economic situation was already strained, it was our goal to support the International Avenue business owners by using business friendly design techniques to mitigate full property acquisition, maintain access throughout construction, and retrofit site design to suit business operations. This was paired with conscious efforts throughout the project to maintain the level of traffic and accessibility for business patrons throughout the project, such as including U-turns at signalized intersections to maintain business access throughout the corridor.

Connecting people to the places they want to go through dedicated transit lanes provides Calgarians the autonomy and capacity to access destinations around the City more reliably. The MAX Purple BRT has increased ridership in this community by 1,900 boardings per day in just the first six months. By 2020, this number has increased to 2,710 boardings per day since service launch. Calgary Transit attributed a 4.5% system-wide growth to the new MAX routes, citing it's the first time in four years The City has seen this kind of growth. Ridership is currently 13% higher than the start of the previous decade—a promising boost in revenue for Calgary Transit and an indication that the MAX Purple BRT is having a positive impact on Calgary.

With increased traffic from the new multimodal streets, and easier access for people via transit as a result of construction, 16 new businesses opened along International Avenue. With reliable transportation to downtown Calgary, new developments (like high-density housing and mixed-use developments) are highly anticipated along the BRT, leading to economic growth for the community over time. This revitalization is an essential improvement for this historically segregated community and is a key piece of infrastructure for uniting Calgary as one.