

## INTRODUCTION

The City of Calgary opened a new light rail transit (LRT) line in December 2012, marking a key milestone in sustainable transportation for Calgary that we can offer as a national case study.

Calgary is recognized as an expansive and growing prairie city, but less well known are The City's vision, plans and efforts in moving towards a more sustainable future. Sustainability principles and considerations are now embedded in all plans and investments. The City is making decisions and building infrastructure today that will affect citizens for the next 100 years or more. A case in point is the newest LRT line routing which will be highly influential to where and how people will live, work and move around the city. The West LRT Project is the largest capital project ever undertaken by The City, and it's the sole new transit line developed in Calgary in over 20 years. Many aspects of the project are remarkable, both in terms of project approach (construction practices, stakeholder engagement, and project financing) and outcomes (expanded mobility choices, shifting urban form).

The 8.2km long LRT line extension from downtown to the west serves several communities in Southwest Calgary and provides the most convenient access to the greatest number of people. The chosen alignment allows the shortest possible feeder bus trips for travel to and from the LRT stations for those people who are beyond walking distance. The new transit line enables mobility and mobility choice for the area's current 105,000 residents, and for the rest of the city's 1.2 million residents to access that area. Its carefully selected alignment sets the ground work for transit oriented development (TOD) opportunities in the surrounding areas of two stations that represent high potential for compact, mixed use urban development (refer to Figure 1, Appendix). A significant "triple bottom line" (social, environmental and economic) return on investment is anticipated.

## A SIGNIFICANT ADDITION TO CALGARY'S SUSTAINABLE TRANSPORTATION SYSTEM

The West LRT Project meets any definition of "sustainable urban transportation", as the themes of sustainability and the triple bottom line have purposefully run as a thread through all phases of the project: from the outset of planning and initial stakeholder engagement through procurement, design, construction, and the start of operation. The City of Calgary since 2003 has required triple bottom line components to all reports prepared for consideration by Council committees, and in 2004 Council endorsed a Triple Bottom Line Policy Framework to promote a comprehensive, systematic and integrated approach to municipal decision-making. Accordingly, social, economic, environmental and "smart growth" considerations are reflected in The City's Corporate policies and actions including the planning, procurement and execution of capital projects.

The TAC Sustainable Urban Transportation Award program presents an opportunity for City of Calgary to share ideas and "best practices" information with other municipalities, and in this section of our submission we've chosen to highlight three elements of transportation sustainability for this project: planning for "smart growth"; enabling personal mobility and mobility choice; and environmentally sustainable design and construction practices.

### ***Planning for "Smart Growth"***

Calgary's public transit network, including both bus service and (since 1981) light rail transit, has been developed in response to the needs of a growing city. With LRT lines established to the south, northwest, and northeast areas of the city successively throughout the 1980s, engineering studies and public consultation were undertaken to investigate an extension of the northeast line through

downtown to the west, among other potential new routes to other areas of the city. The West LRT alignment was approved by City Council in 1988 as the highest priority for a new LRT line once funding became available to build it. In November 2007, City Council confirmed the recommended West LRT alignment was the optimal solution given that it provided service to the largest populated area, therefore attracting higher ridership at a lower per capita cost. And in 2009 both the Calgary Transportation Plan and the complementary Municipal Development Plan (jointly developed through the “PlanIt” process) were approved; the “smart growth” and sustainability principles of those plans and their emphasis on multi-modal mobility options were well aligned with the City’s allocation of provincial Municipal Sustainability Initiative (MSI) funding toward investments in public transit.

The West LRT is designed to serve communities in Southwest Calgary that are generally located west of the downtown, which is an area expected to grow significantly both in its resident population and in terms of employment growth. The alignment for West LRT is centrally located within the service area. This was a key factor in route selection since it provides the most convenient and shortest access to the greatest number of residents, employees and students in the area. For those who do not live within walking distance of the stations, this alignment allows the shortest possible feeder bus trips for travel to and from the service area.

Since the West LRT was approved, new communities that have developed toward the LRT’s westernmost end were planned with higher residential densities, future services and amenities including commercial and retail developments, park and ride facilities, a bus terminal, a recreation centre and several school sites located around the LRT’s western terminus (Figure 2). Importantly, from the perspective of planning for smart growth, the LRT alignment was an impetus for shifting urban form and providing TOD opportunities.

The West LRT Land Use Study began in 2006 and continued through 2008. The entire alignment was assessed for major redevelopment opportunities, including market feasibility for retail, office and residential uses. The Westbrook and Sunalta areas along the LRT were selected as having the highest potential for mixed-use development and high yielding ridership. The Westbrook Station was conceived as Calgary’s first underground LRT station with redevelopment of 3 hectares of land above it (over 200,000 square metres of residential, retail, and office space), providing prime access to the transit plaza and station. Westbrook Station consists of four parcels that will be sold as fully serviced land. The City of Calgary is selling the land on the open market through an RFP process. The successful proponent will build a transit oriented development that is to incorporate high quality urban architectural and landscape design, to become an example of a pedestrian friendly, mixed-use urban development (Figure 3). Additionally, the successful proponent is obligated to develop 2 per cent of the residential units on each of the parcels as affordable housing, which reflects the social aspect of The City’s triple bottom line policy.

The four storey station building, built by The City as part of the project and named Westbrook Centre, incorporates green building design features (LEED Gold standard) and will house a mix of commercial and office space plus Calgary Transit’s Operations Control Centre above the LRT station head.

Another aspect of this project that differs from more traditional transit developments in Calgary is that detailed neighbourhood plans and zoning regulations to implement them were approved and in place before construction of the LRT line. These plans allow for a range of build-out scenarios that could accommodate approximately 30,000 new residents and 22,000 jobs. Land use planning and public consultation were performed prior to and concurrent with detailed design of LRT

infrastructure, allowing for a high degree of integration between the new stations and neighbourhoods including pedestrian and cycling connectivity, streetscape design, community-enhancing built form and densities that support transit ridership.

### ***Enabling Mobility and Mobility Choice***

With reference to the social and economic elements of the triple bottom line, and to the smart growth philosophy that is reflected in The City's more recent plans, the West LRT through its design principles and execution enables the basic access needs of individuals while balancing them with the needs and values of the communities through which the LRT line extends. One example of that balance being achieved through this project was The City's response to community input by adjusting project scope and designs to include a below-ground trenched section of the LRT line in one location in order better integrate with the neighbourhood and maintain unimpeded road access at the entry to the local fire hall and policing facilities (Photo 1). Another example of balance and mobility choice is the provision of secure bicycle parking at all LRT stations (bikes also are accommodated off-peak on LRT cars), and the creation of 10km of new and realigned cycling routes that connect West LRT riders to the existing 1,000km bicycle network in Calgary (Photos 2 and 3). Similarly, while a parkade and separate Park and Ride facility were developed to facilitate LRT ridership by people who start their trips from more distant communities by personal vehicle, the West LRT service design emphasizes community residents (pedestrians) and feeder bus routes as primary sources of ridership (Photo 4).

In summary, the West LRT transit service was designed to be operated efficiently and affordably, to offer mobility choice, and to support walkable, complete and vibrant communities. In the broader city-wide context, the West LRT project delivered an 8.2km long extension to the existing Northeast line to form what is now known as the Blue Line, which interconnects downtown with the Red Line (extending from Northwest to South) to provide Calgarians with reliable access to key employment centres, education, health care, and other services and amenities throughout the city.

As an endnote to this discussion, the opening of the West LRT in December 2012 coincided with another, directly related milestone: Calgary Transit carried over 100 million customers annually for the first time. In 2012 there were more significant extensions of the transit system made than in any other year in the city's history, with two of the extended lines entering revenue service for a projected additional ridership of 45,000 passengers daily. The expanded LRT service areas and mobility choices, and the resulting increases in transit ridership, translates to a reduction in the order of millions of private vehicle kilometres travelled annually, and a corresponding reduction in fuel consumption, GHG emissions, and traffic congestion on Calgary's roadways.

### ***Environmentally Sustainable Design and Construction Practices***

The West LRT Project involved over one billion dollars worth of construction activity within established communities and along busy roadways, and it entailed significant brownfield remediation. A significant element of this project which set it apart from The City's other transportation infrastructure projects was its use of a design-build procurement model, which bundles together planning, design, engineering and construction. The design-builder was required to prepare and implement various environmental management plans in accordance with contract requirements and City policy, including environmental construction operations (ECO) plans, waste management plans, tree protection plans, and erosion and sediment control (ESC) designs. The communication and implementation of these plans, including the installation of environmental controls and mitigations, site monitoring, and maintenance required for the plans to be effective and

legally compliant, entailed significant coordination efforts across the construction partnerships that were formed by the design-builder for this project.

One of the more challenging aspects of construction was the underground station and associated TOD land disposition planned for Westbrook. The presence of a gas station and a 50 year old high school and playing fields in that location were the specific challenges. Environmental due diligence and site investigations had identified petroleum hydrocarbon contamination in the vicinity of the gas station, which ultimately required over 100,000 tonnes of soil to be excavated and removed from site for appropriate disposal prior to construction of an 800m long section of underground LRT line and station (Photo 5). Soils classified in the field as hazardous were passed through a screener and vapour recovery system (Photo 6) to increase their flashpoint to non-hazardous levels suitable for transport and secure landfill disposal. The construction at this site also required the installation of a water collection, monitoring and treatment system (Photo 7) designed to minimize release from this area of the historically contaminated groundwater, and ensure any drainage to the municipal storm sewer and receiving water bodies met water quality standards. During the excavation and construction in 2010 and 2011, several hundred million litres of water were collected from the site and effectively treated for hydrocarbon contamination. The temporary water treatment system was replaced with a semi-permanent treatment system for groundwater that flows through the area post-construction.

Another sustainability win resulting from this project was the replacement (in another location, to free up the Westbrook site for TOD land disposition) of the aging high school, with a new school built to modern energy and water efficiency standards. The demolition of the school was approached with sustainability principles in mind: first, a deconstruction audit was performed to identify all potentially salvageable materials; next, salvageable materials were sold or donated to community associations, for reuse; and then the remaining materials were completely separated on site, before and during demolition, into waste streams for recycling or landfill disposal (Photos 8 and 11). The large quantities of reinforced concrete that formed the school's foundations and walls were completely broken down to remove the reinforcing steel bar from the concrete to enable recycling of both (Photos 9 and 10). As a result, the high school demolition component of this project achieved the target of 80 per cent of demolition waste materials being recycled and only 20 per cent going to landfill.

Similar landfill diversion rates were achieved in the construction of the new school, which was built to Leadership in Energy and Environmental Design (LEED) certification standards. Compared to a conventional building of its type, the new school was designed for 45 per cent greater water use efficiency and 35 per cent more energy efficiency. Specific elements of this "green building" approach included a classroom glazing design that allows more effective natural daylight penetration higher in the space, which minimizes the need for perimeter lighting, and the use of occupancy sensors to further increase the efficiency of the lighting systems throughout the school (Photos 12 and 13).

Throughout the 8.2km length of the West LRT project area during construction there was evidence, and externally audited validation, of environmentally sustainable design and construction practices. Another of the challenges encountered was in managing the storm runoff from large areas of bare ground that were in various stages of civil works including roadway and utility realignments and installation of the LRT guideway and associated facilities (Photo 14). The design-builder with oversight and support from The City and its consultants employed erosion and sediment controls (Photo 15), minimized the spread of invasive noxious weeds, diverted waste from landfills through waste stream separation and recycling, and managed other aspects of the construction to limit its negative effects on neighbouring residents and on the natural environment.

## **INNOVATION**

The West LRT Project demonstrates technical innovation, process innovation and to some degree financial innovation for sustainable urban transportation, as described below.

### ***Technical innovation***

This large scale and complex project required the importation to Calgary of certain innovative approaches and technologies which are now manifest in the completed project, and in the project experience and skill sets of local workers. A 2km long section of the LRT track extending west from the downtown was designed as an elevated guideway, which is cost effective because it avoids the reconstruction of underground infrastructure at all but the supporting pier locations. Its construction required the use of a highly specialized launching truss and related technologies and skills to produce match cast segmented, post-tensioned girders for the elevated guideway and balanced cantilever spans. The manufacturing precision required to erect twelve 3m girder segments under the erection truss and have them fit together perfectly through complex horizontal and vertical geometry did not exist within the local pre-casting industry. Skilled tradesmen accompanied the metal forms and the launching truss from their previous assignments (from elsewhere in Canada) and they worked side by side with local shop hands to transfer the knowledge.

In addition to the elevated guideway innovation, West LRT incorporated extensive runs of trenched guideway (Photo 1), cut-and-cover tunnelling, and Calgary's first underground station. Trenching in constrained rights of way (e.g. the median of Bow Trail and adjacent to 17 Avenue) required near vertical excavation faces that would remain open for extended periods while the guideway floor, walls and roof were constructed. The design-builder employed the use of a passive grouted soil nailing system with a shotcrete facing for linear excavations to depths of up to 14m, with alternating cuts to allow safely drilling and grouting in successive rows of the horizontal anchors.

### ***Process innovation***

A feature of this project which set it apart from The City's prior transportation infrastructure projects was its use of a design-build procurement model, which may be considered a process innovation. Design-build is a method of project delivery where the design and construction aspects are contracted with a single entity, commonly referred to as the design-builder, in order to reduce project delivery time by overlapping the design and construction phases of a project. Working with one design-builder, rather than coordinating the work of several firms, reduces the likelihood of cost and schedule overruns. The West LRT project was delivered on schedule and on budget.

Another aspect of this project which demonstrated process innovation was in the realm of public engagement. The extensive community and stakeholder engagement process is described more fully under the Added Value section heading, below. However, special mention is deserved here of the particularly innovative "infographic video" that was produced to introduce the completed West LRT upon project completion (Photo 16). The video provides a virtual high-speed tour of the entire 8.2km long line, and incorporates photos and graphics to highlight many features of the new line and the mobility options it presents. The video recently won two bronze Telly Awards in the categories of "Internet/Online Commercial – Transportation", and "Online Programs, Segments, Promotional Pieces – Public Relations". The Telly Awards is the premier award honouring outstanding TV commercials and programs, video and film productions, and web commercials, videos and films.

### ***Financial innovation***

There are three economic aspects of this project that may be considered innovative. First, in a departure from all previous projects, The City gained provincial approval to utilize short term borrowing to bridge grant fund cash flows and take advantage of favourable industry capacity and pricing, resulting in early project delivery using a design-build procurement model. That approach had significant implications for the viability and completion of the project on time and on budget.

The City initiated and funded redevelopment components such as land use amendments, site preparation and land servicing with the vision that sale proceeds of redeveloped properties would be returned to the capital project budget to offset real costs. Urban renewal and intensification uplift on property taxes along the West LRT line is generating revenue to be re-invested.

Transit ridership revenues represent user-pay for approximately 50 per cent of operating costs. The West LRT line has seen initial daily ridership figures of 28,000 into and out of the downtown core. While some of those riders are considered transfers from the previously-existing bus system, a large percentage are new riders. Convenience, access and speed of service will combine with community growth to attract new riders in the future.

### **ADDED VALUE**

Preceding sections of this award submission have touched on several aspects of the project which clearly demonstrate that the West LRT Project is anything but a traditional infrastructure project, with its design approach and outcomes achieving very good value for money invested in sustainable urban transportation. There are two aspects in particular that we wish to highlight as areas of added value, which are in the realm of community engagement and partnerships.

### ***Partnership***

A conflict of the planned routing of the West LRT alignment with the Ernest Manning High School at Westbrook Station required that the school be relocated. The school, built in 1965, contained systems and materials which faced some maintenance and operational challenges. It was to be replaced in another location with a modern structure to suit current academic and functional needs of 1800 students. A Memorandum of Understanding was signed by The Province of Alberta, The City of Calgary and the Calgary Board of Education outlining joint responsibilities for the replacement of Ernest Manning High School. This \$55 million “Public- Public Partnership” project leveraged the available resources of these stakeholders to produce a single integrated solution of a new school and public transit at an existing community amenity hub, thereby enabling pedestrian-friendly “smart growth” in that location, and transit oriented development at the vacated 5 hectare school site.

The City, which was responsible for constructing the new high school, worked closely with the CBE on building requirements and facility guidelines and built it to LEED Silver accreditation standards.

### ***Community engagement***

The West LRT project kicked off in 2007 with three years of extensive public engagement before construction began in March 2010. The public engagement process, the largest to date by The City, was based on The City’s engage! policy and framework. So interested was The City in public involvement in this project, that residents were brought in at the outset to help develop the long-term public engagement process that guided the project through development and construction.

The first step was a Community Summit attended by 60 citizens. Nine citizens were chosen to sit on a committee that developed the Public Engagement Plan. After Council approved the plan, six Community Advisory Committees (CACs) were established to guide engagement around the six proposed LRT stations. Through an application process, 70 citizens were then chosen to sit on the CACs which discussed items such as station design, urban design, traffic, parking and noise attenuation. A Community Advocate was hired to act as the liaison between the CACs and the West LRT project office, bringing concerns to the attention of City staff and acting as a technical resource during implementation of the public engagement plan.

Between 2007 and 2009, The City hosted 115 meetings with community members on a number of subjects including station design, traffic management during construction, Calgary Transit's future feeder bus network, noise attenuation, the new high school, a new pedestrian bridge, two community area redevelopment plans and mobility assessment and plans. That engagement resulted in a number of significant changes to the project scope and design, including the vertical alignment in two locations, design changes at all six stations, additional noise attenuation, and residential parking zones were implemented to reduce impacts on residents near LRT stations.

In addition to the public and stakeholder engagement described above, the West LRT project engaged and informed thousands more Calgarians through the internet, both with its website and with construction and traffic impact updates pushed out through emails, RSS feeds and online video posts. The opening event included videos that are station-specific and one for the West LRT overall to share station attributes and surrounding amenities with riders along the line. The West LRT website had 119,290 visits in 2012, including 3,172 visits on opening day and (two days later) 3,552 visits on the first day of revenue service

### **TRANSFERABILITY TO OTHER CANADIAN MUNICIPALITIES**

In the preceding sections of this award submission (and appendix) we have described in some detail various elements and aspects of Calgary's West LRT project as a case study in sustainable urban transportation that we believe can be applied with local modifications to other municipalities across the country.

With reference made to the Canadian Urban Transit Association's recent "Sustainability Guidelines for Transit Systems" and "Transit Vision 2040" documents, we believe our submission has highlighted and illustrated our approaches and best practices in each of CUTA's key theme areas:

- Community planning and design (refer to pages 2, 3, 5, and 7 of our submission)
- Innovation (pages 5-6)
- A focus on customers (pages 1-3)
- Greening transit and infrastructure development (pages 1, 3 and 4)
- Ensuring financial health (pages 6-7)
- Strengthening knowledge and practice (page 5).

Specific elements of this project that may be universally applicable for other municipalities are the approaches to community engagement, the triple bottom line approach to decision-making, transit oriented development, the design-build procurement, and the particular design and construction practices used to build a light rail transit guideway through established urban areas with minimal adverse effects.

West LRT Project: Enabling Mobility and Transit-Oriented Development



Figure 1: View east along the West LRT route to TOD areas and downtown Calgary



Figure 2: View east to the western terminus of West LRT and community hub



Figure 3: Artist rendering of Westbrook TOD illustrating potential mixed development



Photo 1 (L): trenched LRT (below grade) at 45ST; Photo 2 (R): Bicycle parking provided at stations



Photo 3 (L): Pedestrian/cyclist bridge connects communities; Photo 4 (R): Bus routes feed the LRT

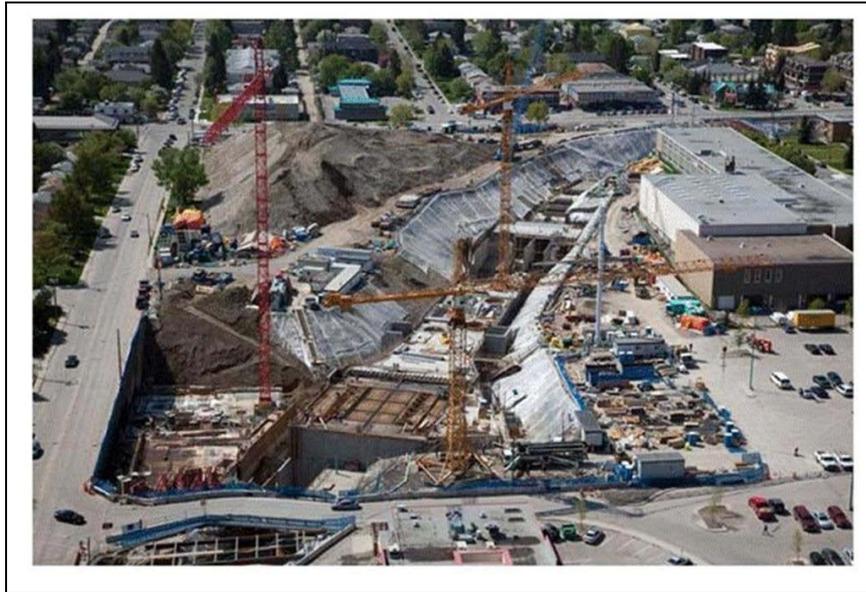


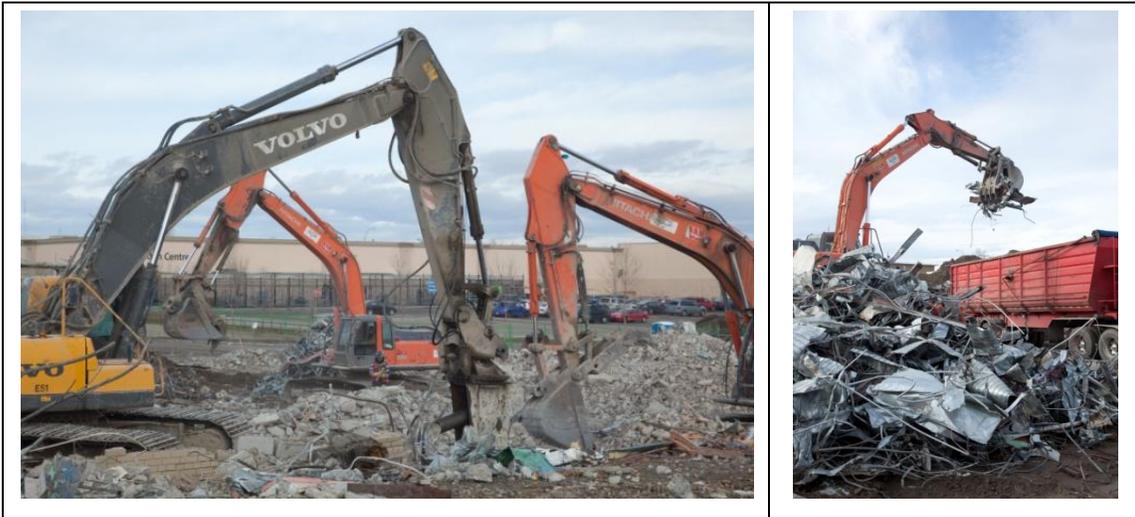
Photo 5: Excavation at Westbrook for the LRT line and station underground



Photo 6 (L) Groundwater treatment process; Photo 7 (R) Soil screening process at Westbrook



Photo 8 (L) Construction material waste stream separation; Photo 9 (R) Demolition waste stream separation



Photos 10 & 11: Demolition contractor separates reinforcing steel from concrete for recycling of both



Photos 12 & 13: LEED certified school emphasizes natural daylight and energy and water efficiency



Photo 14 (L) Aerial view of interchange requiring ESC controls; Photo 15 (R) ground view of ESC controls



Photo 16: Screen capture of award-winning video as an element of public engagement