



Inspiring sustainable thinking

## **G37 Interchange — Stage 1 Detour, Innovation and Integrated Project Delivery**

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## ABSTRACT

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ISL Engineering and Land Services Ltd. and CH2M HILL Canada Ltd. partnered with The City of Calgary as lead consultants for planning, design, and construction of a new interchange at Glenmore Trail and 37 Street SW. To address potential conflict with the Province's future Southwest Ring Road, the team responded with a unique design to build a temporary, low-cost interchange: Calgary's first interchange to be fully serviced by roundabouts. With the functional plan approved on April 1, 2010, the consulting and contracting team opted for an Integrated Project Delivery (IPD) model, which allowed for completion of design with constructor input, while early phases of construction proceeded. The project was completed in a record time of five months, with the interchange opening to traffic on September 11, 2010.

To achieve this tight timeline, the IPD model was used to leverage the team's contributions of knowledge and expertise early in the project, allowing all team members to realize their highest potential while expanding the value they provide throughout the project life cycle. Through IPD, owners, designers, and builders can move toward unified models and improved design, construction, and operations processes. Characteristics of IPD include the following: Early Involvement of Participants, Shared Risk and Reward, Multiparty Contract, Collaborative Decision-Making, Liability Waivers, and Jointly Developed Goals. The project had each of these to the extent possible within City procurement policy.

There were many advantages to involving each participant (such as City departments, utilities, vendors, and contractors) at the first opportunity. For example, having ENMAX Corporation on the team early on meant that when plans changed and a transmission line had to be completely relocated, the impacts of realigning the transmission line, including public notification and regulatory processes, could be quickly communicated to all stakeholders. Shared risk and reward was put in place by having all participants commit to the City Council's project schedule. Contract terms provided schedule extensions for excusable delay, but explicitly stated that no price adjustment would be made for delay of any kind. While City policy disallowed multi-party contracts, strong mandatory partnering had a similar effect in that it encouraged collaborative decision-making. The project's guiding light came from the underlying commitment to do what is right for the project and acceptance of the overall goal to open the interchange prior to freeze-up in 2010. With overall goals agreed, the owner, designers, and builders all improved design and construction.

## THE CHALLENGE: CONCEPT TO COMPLETION IN FIVE MONTHS

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On November 6, 2009, ISL Engineering and Land Services Ltd. (ISL) and CH2M HILL Canada Ltd. were selected by The City of Calgary to provide engineering consulting services for the planning, design, and construction administration of the grade separation of Glenmore Trail at 37 Street SW (the G37 Project). On that day, the scope required refining the opening day concept plan (which had been developed previously by ISL and endorsed by City Council in early September 2009), and design of detailed plans in order to start construction in spring 2010 and open the interchange by fall 2010. These tight timelines required a running start, innovative approaches, and concentrated, dedicated team work.

As leading local consultants, our firms pooled the necessary resources to provide a cohesive, complete team for The City of Calgary (the City). Specific responsibilities were divided amongst the project design team: Project Management, Quality Management, Alternate Delivery, Transportation Planning, Roadway Design and Construction, Structural Design and Construction, Drainage and Utility Design, Geotechnical Engineering, Noise Analysis, Road Safety Audit, ESC Plans, Streetlighting, and Partnering. Later, as project needs required, this single project team concept was extended to include the general contractor PCL Construction Management Inc. (PCL) and its major subcontractors Lafarge Canada Inc. and Armtec Canada (formerly Con-Force Structures), as well as the major third party contractor ENMAX Corporation (ENMAX). “Integrated Project Delivery” was used as the approach for working on such a complex project involving this large team, while ensuring that tight timelines were met. Through effective partnering, all of these firms became a single project team committed to delivering the project on-time and within-budget.

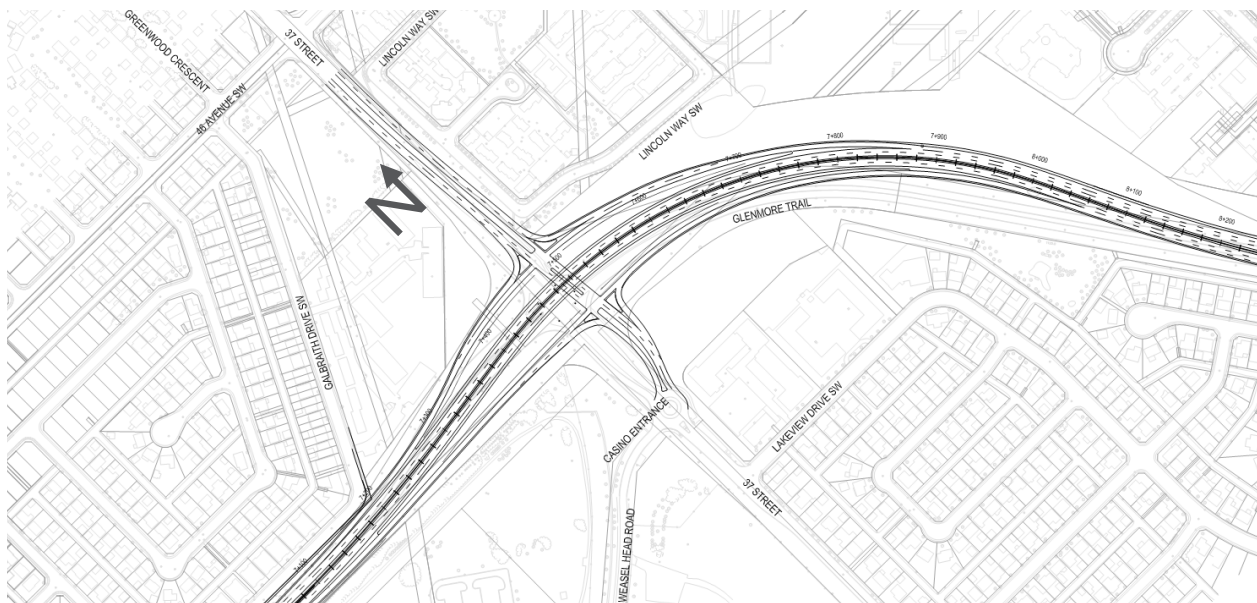
The Council’s tight construction schedule spurred interaction with the contracting industry to develop and execute an alternate delivery strategy. Modifications to both traditional (design-tender-construct) and alternate (qualify-design-build) delivery strategies were considered. A specialized Alternate Delivery team developed a contracting strategy that identified and considered all aspects of the evolving scope. ISL and CH2M HILL Canada (CH2M Hill) both brought hands-on experience of using “fast-track” contracting for the City’s successful Glenmore Causeway Upgrades Project and of using a “Modified Design-Build” process for the equally successful Glenmore Trail / 18 Street SE Interchange Project. Both projects are prior winners of awards for Transportation Infrastructure.

There was a good chance that external agencies and stakeholders (utilities and the Tsuu T’ina Nation) could have an effect on the desired schedule. Therefore, ENMAX and ATCO Gas were quickly engaged and temporary relocations negotiated and designed early on in order to abate any potential delay. The City consulted the Tsuu T’ina Nation on an advisory basis; upon being informed that the project would provide access to its Grey Eagle Casino at all times, the First Nation raised no objection to the City’s plans.

## CHANGING THE PROJECT'S DIRECTION

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Following the Tsuu T'ina Nation's rejection of proposed plans for Alberta Transportation's Southwest Ring Road (SWRR) and subsequent to the City's call for proposals on the G37 project, the Province of Alberta concurrently initiated a new Functional Planning Study for the SWRR. The City and Province of Alberta (the Province) had agreed to cooperate in developing this new plan; thus, the City's existing approved interchange concept had to be modified so that it did not significantly limit the Province's alignment choices for the ring road. Ensuring that the G37 interchange would not restrict the Province's choices for the SWRR became the primary focus of the team's Transportation Planning effort. ISL and CH2M HILL first adapted the existing Council-approved configuration to accommodate the Province's concepts. While Alberta Transportation staff members agreed that their initial concepts were accommodated, they pointed out that their arrangement was far from finalized and that other conflicting plans could evolve that would cause the interchange to be "throw-away," a condition neither the Province nor the City desired.



*Figure 1: Original Interchange Approved by City Council, September 2009*

After lengthy deliberations in late January 2010 (which essentially resulted in an impasse between the municipal and provincial visions), ISL and CH2M HILL responded with a plan to construct a temporary, low cost interchange located as far as possible from the critical area of the potential ultimate SWRR. This interchange could serve as the detour for the eventual SWRR construction. The new plan was the essence of simplicity: two roundabout ramp terminals, one on each side of Glenmore Trail, provided access to a two-lane fly-over situated to the east. In mid-February, the City and Province agreed that the configuration was viable, so that functional plans for the "Glenmore Trail / 37 Street SW Interchange - Stage 1 Detour" could be prepared for circulation. Plans were circulated and comments received during March. By April 1, a new functional plan for the completely revised temporary interchange configuration was approved.



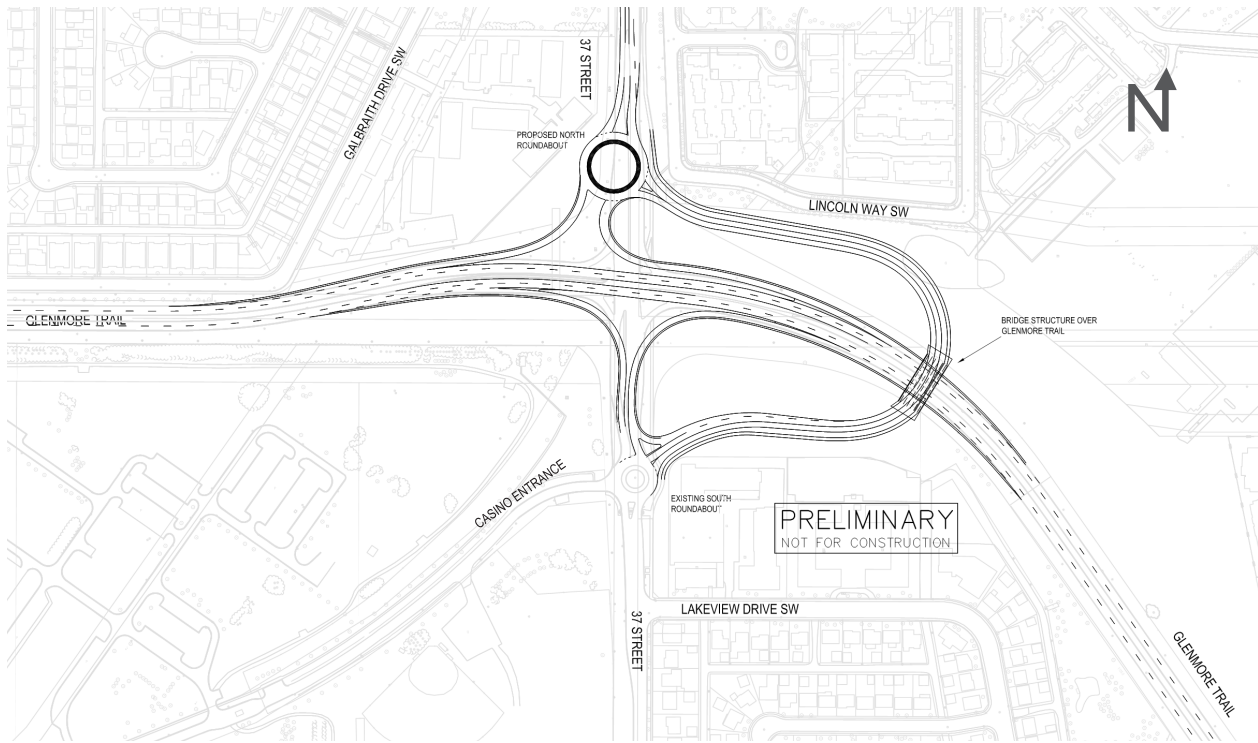


Figure 2: Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour Approved by City Council, April 2010

## Opportunities for Innovation

The start of detailed design was substantially delayed by this process. Without a workable alternate delivery strategy, the schedule would have been lost. However, every project management challenge presents opportunity, and the project team discovered at least two such opportunities to incorporate innovation in an alternate delivery strategy, as follows.

### Opportunity 1

- Since the detour interchange was temporary in nature it was open to innovative design and construction approaches in a manner that would not be available for permanent infrastructure.

### Opportunity 2

- As City Council had not relinquished its desire to complete the interchange during 2010, this meant City Administration would support an expedited review and accept project innovation, within a framework that ensured fiscal responsibility and best value for money spent.

# BUILDING THE TEAM

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## Selection of the Contractor

From the outset, the project team had been preparing an Expression of Interest request for the purpose of pre-qualifying three contractors who would then submit unit-price proposals for construction. The City received six responses on January 7, 2010, and three pre-qualified proponents were short-listed. On March 10, a Request for Proposals (RFP) was issued based on the functional plans of each pre-qualified contractor. In the evaluation criteria, equal weighting was given to two components: the proponent's price, and the proponent's plan of execution. Unit price proposals were received April 1. Since the two lowest prices differed by less than 1 percent, it was clear that the evaluation committee would make the final selection based on assessment of the two proponents' execution plans and their ability to document and communicate their plans.



PCL differentiated itself by specifically addressing each important RFP element and by including plans for traffic accommodations on Glenmore Trail. PCL also described in detail how each major activity would be accomplished, so that, as the design evolved, a sound basis was in place for negotiating changes that could not be accommodated within the unit price schedule. It was noted during evaluations that PCL identified nine specific innovations they would bring to the project team for consideration, demonstrating that PCL thoroughly understood the nature of the project.

On April 20, the first project team meeting was held with PCL, the winning proponent, in order for the project team's design engineers to begin incorporating the construction contractor's input into their design. Thus, a Contractor was on board and ready to build less than three weeks after the new functional plan was approved.

## Strengthening the Team through the IPD Approach

According to Jerry Guerra of The JAGG Group,

*“Integrated Practice/Integrated Project Delivery (IP/IPD) leverages early contributions of knowledge and expertise through the utilization of new technologies, allowing all team members to better realize their highest potentials while expanding the value they provide throughout the project life cycle. Through an integrated project delivery method, owners, designers, and builders can move toward unified models and improved design, construction, and operations processes” (1).*

He lists the characteristics of IPD as the following:

- Early Involvement of Participants
- Shared Risk and Reward
- Multiparty Contract
- Collaborative Decision-Making
- Liability Waivers
- Jointly Developed Goals

The G37 project had each of these to the extent possible within the City’s procurement policy.

Because each participant (including City departments, utilities, vendors, and contractors), was involved in the team at the earliest opportunity, schedules were maintained and the value provided was significantly improved. For example, under the first design scenario ENMAX’s transmission line needed simply to be raised. When detour scheme plans changed, this line required complete relocation. With ENMAX already active on the team, the impacts of re-aligning the transmission line, including public notification and regulatory processes, were well-communicated and understood by all stakeholders.

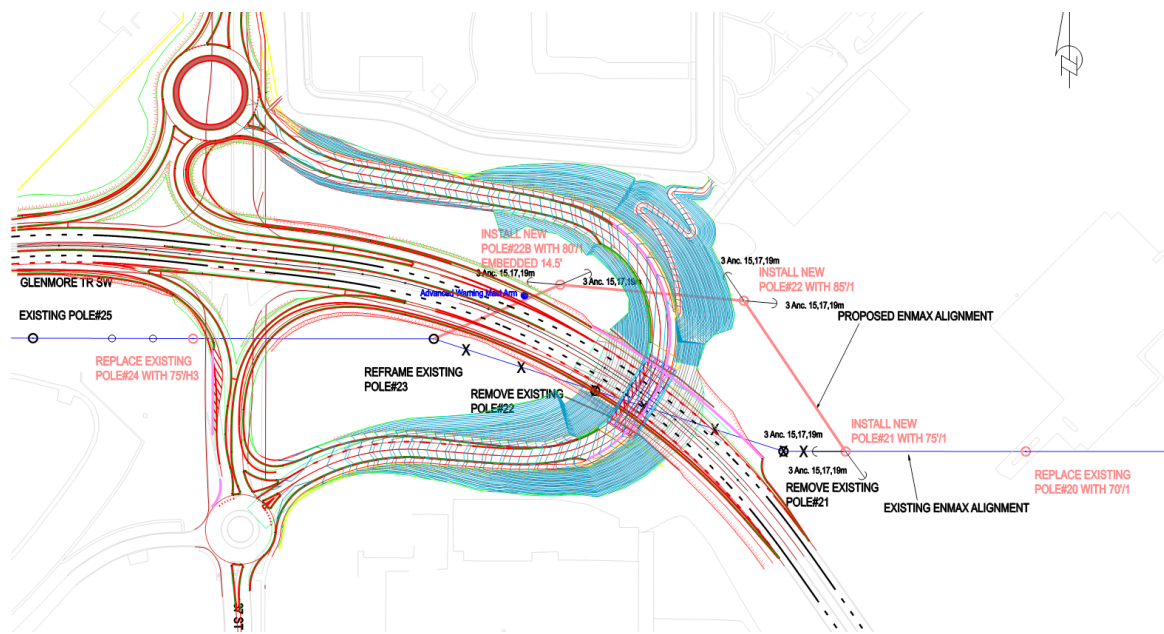


Figure 3: Glenmore Trail / 37 Street SW Interchange - Stage 1 Detour, ENMAX Transmission Line Relocation Plan

By having all participants commit to the project schedule established by City Council, a system of shared risk and reward was established early in the project. Contract terms provided schedule extensions for excusable delay but explicitly stated no price adjustment would be made for delay of any kind. While City policy disallowed multi-party contracts, strong mandatory partnering facilitated the effect of a multi-party contract and the collaborative decision-making that it encouraged. The project's guiding light came from the underlying commitment to do what is right for the project and acceptance of the overall goal to open the interchange prior to freeze-up in 2010. Interim milestone dates were jointly developed and goals agreed to within this framework. The owner, designers, and builders all improved design and construction.

## **DELIVERING THE PROJECT**

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### **Incorporating Sustainability**

The temporary nature of this project permitted the team to exploit several new approaches to construction, such as full-depth, full-width precast bridge deck panels. The three R's of sustainability—Reduce, Re-use, and Recycle—were adopted as a measure for the suitability of both design and materials. These sustainability considerations were incorporated into the interchange design as below.

#### **Reduce**

- Spread footing bridge abutments were founded on Mechanically Stabilized Embankments (MSE). Using these abutments meant that piles were not required, thereby avoiding future abandonment of the piles underground.
- Surface routing of drainage was employed wherever possible to maximize ground infiltration and minimize underground piping. Drainage was configured to take advantage of the existing underground pipe network wherever possible, avoiding the introduction of unnecessary new underground infrastructure.
- The interchange geometry was optimized to minimize both the cost and quantity of materials used.
- Major materials were sourced locally, and the requirement for imported fill was minimized by designing for on-site earth balance.
- Instead of signals, modern roundabouts were used as ramp terminals to reduce maintenance and idling costs.

#### **Re-use**

- Re-usable pre-stressed girders, surplus to another project, were sourced and utilized.
- The fly-over bridge was designed so that it could be taken apart and re-used in its entirety, as were the MSE Wall Panels.



## Recycle

- The road and sidewalk materials selected for this project can all be recycled when the temporary interchange is replaced by the ultimate roadwork.

Thinking about the interchange design in these terms also helped to reduce costs.

## Meeting the Tight Schedule through the IPD Approach

The schedule was already a challenging one when the project was conceived, planned, and approved as a tight split-diamond interchange. However, the challenge was further intensified due to the significant time spent on reaching an agreeable solution (the Detour Plan). The new situation meant that the detailed design and construction would be literally concurrent. Introducing IPD and using the experience and knowledge of all the project participants facilitated the whole process. With detailed design beginning in early April and the interchange to be opened in early September of the same year, the goal was set to bring the interchange from concept to completion in five months. This was record time for an interchange in Calgary.

PCL mobilized in early May and, by the third week, had their Environmental Construction Operations Plan submitted and had installed Erosion and Sediment Control measures according to the plan prepared by project design team. Stripping and grading could begin soon after as the project had been designed to occupy what was vacant land in three corners of the intersection. For obvious reasons, no access or intrusion onto First Nation land in the southwest corner was allowed.

The construction sequence is shown clearly in the following aerial photographs.



*Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour, May 21, 2010 (Looking Southeast)*



By August, the MSE Wall and Bridge Abutments were taking shape and portions of the new roadways were completed.



*Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour, August 9, 2010 (Looking Southeast)*

By late August, the bridge deck was in place and most of the exit and entrance ramps connecting 37 Street to Glenmore Trail were paved.



*Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour, September 4, 2010 (Looking Southeast)*



On September 10 at 7:00 PM, 37 Street north of Glenmore Trail was closed when existing intersection features that conflicted with the new interchange, including the traffic signals, were removed. A levelling course of pavement was placed where needed for final roadway tie-ins, while line painting and signing proceeded through the night. The new interchange opened to traffic at 6:00 AM on September 11.



*Glenmore Trail / 37 Street SW Interchange - Stage 1 Detour, Open to Traffic, September 11, 2010 (Looking Southeast)*



A series of overnight closures of 37 Street north of Glenmore Trail followed for ten nights until all on-road features of the ramp and roundabout were in place, with final finishing touches to the roadway completed by 6:00 AM on September 21. Then the remaining work in the median of Glenmore Trail proceeded and was completed by early October.



*Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour, September 21, 2010 (Looking Southeast)*



## PROJECT PARTNERING

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Partnering was a mandatory component of the project, and K-3 Project Management Ltd. (Dr. George Jergas) was named as the facilitator. George's method entailed endorsement of the important project goals, recognizing and addressing major risks, and regular follow up "health checks" as a basis for establishing and maintaining a trusting environment. This method was a contract requirement. Partnering provided the foundation on which a trusting collaborative approach could be built.



This approach requires a trusting, communicative environment in which each member of the project team feels empowered to contribute his or her specialized knowledge. The project team recognized this need at an early stage and started to have regular meetings with each Discipline Lead on the project team.

There are many examples of risks shared and addressed effectively by the team in this way. At one stage, all members of the project team recognized ENMAX's limited ability to provide a fixed duration for public process and so worked together to enable this to happen effectively within the shortest possible timeline. As another example of risk, the actual timetable for receiving Alberta Utilities Commission (AUC) approval to relocate the high voltage transmission line was not known when construction proposals were called. Further, while the construction contract provided for a time extension, it did not provide for a change in cost to mitigate a possibility that the AUC would not approve the application for re-alignment of the transmission line. This was a risk shared by the whole project team.

## INNOVATIVE BRIDGE DESIGN

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When the City recognized the temporary nature of the interchange, the project team was empowered to explore innovative approaches in bridge building on the interchange. As a result, three innovations were incorporated into the project as follows.

### Innovation 1

The first of these innovations was to found the bridge on spread footings resting on MSE embankments. With reasonable soils in most places, most Alberta bridges are founded on piles or caissons. This can result in both MSE Walls being constructed and piles being installed. To save time and effort, the project team proposed, and successfully employed, MSE bridge abutments without pile foundations.



*Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour, Setting First Precast Girder, August 19 10:35 PM*



## Innovation 2

The second innovation involved sourcing the bridge girders. On bridge-building projects, the critical path is typically purchasing, detailing, reviewing, fabricating, and delivering the girders. The project team was aware of suitable pre-cast girders that, for reasons of durability, were surplus to another project and were readily available. Recognizing that the design lifespan of the temporary interchange bridge was one half to one quarter of a typical design, the opportunity for time and cost savings was identified. Investigations found that, with minor remedial work, the girders would be well suited to a temporary interchange. The roadway was configured to make the span useful in situ. Because it used girders that were ready to set in place, this clever design shortened the schedule by at least three months.

## Innovation 3

The third major bridge innovation was the use of full-depth, full-width precast concrete deck panels. The idea originated with a desire to make the bridge wholly re-useable. While partial-depth panels had been used on previous projects to span between individual girders, panels spanning the entire width of a multi-lane six-girder bridge had never been used (so far as the project team found). A design was developed on this basis. Before issuing the RFP, this design was thoroughly checked with the local manufacturer for constructability, once again employing IPD early in the project.



*Glenmore Trail / 37 Street SW Interchange – Stage 1 Detour, Setting Precast Deck Panels, August 24 10:18 PM*

The combination of these three major innovations, the many other small thought-out details, plus careful engineering for the remainder of the bridge resulted in a significant advantage. PCL (with support from the project team) was able to begin construction of the superstructure on August 19 and have it completed by September 10: a total duration of just 23 days.

As noted previously, the whole bridge was designed to be recycled and, via controlled demolition, can actually be re-used at another suitable site in future. This reduces both the life-cycle costs of this bridge and future project costs at another location.

## SOLVING THE PROBLEM TOGETHER

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The goal of opening Glenmore Trail to free-flowing traffic and removing commuter congestion for approximately 70,000 vehicles per day had been a defined and stated objective of The City of Calgary for well over a decade. Delivery of this promise had been repeatedly delayed and frustrated by the complexities involved in planning the Province's Southwest Ring Road.

Perhaps the true measure of the value added by the entire project team can best be understood by examining the team's employment of the Integrated Project Delivery model from project inception. In doing so, a long-standing, seemingly intractable problem was solved, and the resulting solution constructed in record time for interchanges in Calgary—only five months from start to finish.

**“The new interchange at Glenmore Trail and 37th Street S.W. is a prime example of how limited projects can bring huge benefits. The addition of a roundabout and overpass on 37th Street for left-turning traffic onto Glenmore and the corresponding removal of traffic lights has wrought an amazing change on traffic flow, reducing stops and starts and shortening commute times through the area. Construction was brief, minimally disruptive and did not put landholders' noses out of joint. In other words, the interchange is an exemplary piece of work which should serve as a model for further improvements citywide.”**

*— Calgary Herald Editorial, October 6, 2010, Copyright © The Calgary Herald*





## REFERENCES

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1. Jerome A. Guerra. PSMJ's AEC Issue Brief: Integrated Project Delivery. © 2010 PSMJ Resources, Inc. Ten Midland Avenue Newton, MA 02458. ISBN 1-55538-248-7.



## G37 INTERCHANGE AT A GLANCE

<b>Complexity</b>	<ul style="list-style-type: none"> <li>• Tight timeline – approved functional plan in April, with construction then completed by September.</li> <li>• Potential stakeholder issues were identified, risks were shared, and strategies to abate issues were employed early in the process.</li> <li>• Major scope change included redesign from the approved interchange plan to a temporary interchange. The project team saw this as an opportunity for innovation.</li> </ul>
<b>Meeting and Exceeding Client's Needs</b>	<ul style="list-style-type: none"> <li>• Project solved a decades old client problem through Integrated Project Delivery within the existing procurement framework.</li> <li>• Solution and resulting construction was completed in record time for an interchange in Calgary, just five months</li> <li>• Project team purposefully designed the G37 Interchange to be used as a road detour when Calgary's Southwest Ring Road is built.</li> <li>• Uniform public and media praise for the project.</li> </ul>
<b>Environmental Impact</b>	<ul style="list-style-type: none"> <li>• MSE bridge abutments were used without pile foundations, which would have been left in the ground when the bridge was deconstructed.</li> <li>• Project team re-used existing bridge girders.</li> <li>• Bridge was designed to be recycled and can be re-used at another suitable future site.</li> <li>• Interchange removed all traffic signals and solved traffic gridlock, decreasing emissions from idling of over 70,000 cars.</li> </ul>
<b>Innovation</b>	<ul style="list-style-type: none"> <li>• Integrated project team agreed on, set goals and built their contracts around those goals. All team members, had a stake in project success and committed to its' success.</li> <li>• The approved plan was the essence of simplicity and the first roundabout of its kind (ramp terminals) in The City of Calgary.</li> <li>• Bridge was founded on spread footings resting on Mechanically Stabilized Earth embankments to save time, effort and cost.</li> <li>• Sourcing surplus precast bridge girders shortened schedule by at least three months.</li> <li>• Using full-depth, full-width precast concrete deck panels decreased construction time, cost and limited closure of Glenmore Trail.</li> </ul>
<b>Social and Economic Impact</b>	<ul style="list-style-type: none"> <li>• The interchange decreased commute times by an average of 7 minutes for 70,000 users each day.</li> <li>• Team provided access to the Grey Eagle Casino at all times, successfully accommodating the neighbouring Tsuu T'ina Nation.</li> <li>• Reusable design will save money on future projects.</li> <li>• Project was completed with minimal impact and enhanced environment.</li> </ul>