

# Canadian Consulting Engineering Awards 2013

## Deh Cho Bridge

Fort Providence, Northwest Territories



Lead Engineering Consultant : Associated Engineering

Owner/Client: Government of the Northwest Territories

Other Consultants:

- Levelton Consultants Ltd.
- Infinity Engineering Group Ltd.
- EBA (A Tetra Tech Company)
- Sargent & Associates Engineering Ltd.
- BPTEC-DNW Engineering Ltd.
- T.Y. Lin



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# Deh Cho Bridge

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## Executive Summary



The Deh Cho Bridge provides a year-round connection for northern residents with the rest of Canada, and will help create economic development opportunities in the North.

For decades, the majority of residents in the Northwest Territories had no fixed link to the rest of the country. Travellers and goods had to cross the Mackenzie, Canada's longest river, via a limited-operation ferry. The connection was often affected by the river's water levels during the summer season. In the winter, travellers crossed an unreliable and potentially dangerous ice bridge. In the spring thaw and fall freeze-up, locals and visitors had no fixed link with the rest of the country, relying instead on expensive air travel.

In 2010, the Government of the Northwest Territories assumed control of the project mid-construction, and appointed Associated Engineering as Project Manager.

Working together, we implemented a specific project management plan, addressing project challenges, including a geographically dispersed team, a remote

site, extreme weather conditions, and quality management.

Effective planning and communication between all stakeholders was a critical factor in managing the project's progress and facilitated the project's ultimate success.

In addition to collaborative project meetings and a highly-effective project document control system, our team worked closely with the client to develop unique approaches to control schedule, budget, quality, and risk.

The community was kept fully informed via quarterly newsletters, information boards, a project website, a live webcam, and consistent contact with the media, thus providing a clear understanding of the construction progress and eventual grand opening.

The project management team overcame a series of challenges by developing a highly effective on-site construction inspection team, ensuring the project followed a robust quality assurance program, implementing a unique and deliberate management protocol, and by being solution oriented and highly focused on delivering the Deh Cho Bridge.

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**Spanning over one kilometre across  
the Mackenzie River,  
the new Deh Cho Bridge is a  
remarkable achievement in  
engineering management.**

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## Introduction



For decades, most residents in the Northwest Territories had no fixed link to the rest of Canada. In 2002, a Public Private Partnership initiated design of the Deh Cho Bridge, near Fort Providence. Construction of the bridge began in 2008; however, the project soon encountered difficulties.

With continuing setbacks and delays, in 2010, the Government of the Northwest Territories assumed control of the project mid-construction, after only part of the substructure was completed, retaining a new bridge engineer and contractor.

Recognizing it needed assistance to deliver the project, the Government appointed Associated Engineering as Project Manager.

At the time, the task of managing the completion of the bridge was likened to “changing a wheel on a moving vehicle”. Construction had to proceed without delay, while the design was being finalized. It was also important to rapidly assess the quality of the previously completed construction and design work, while continuing with the construction.

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**With a total length of 1045 metres, the structure is the longest bridge in the Northwest Territories.**

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## Project Challenges



Upon taking over the project, the team faced immense public pressure, fueled by years of delays and cost escalation. It was immediately clear that the project presented many unique and diverse challenges that would require innovative project management approaches to overcome.

Technically, the bridge is unique - a continuous Extradosed Bridge System that has two vertical, Warren trusses supported by stay cables. The 4.5 metre deep steel truss, fabricated from built-up, W-shaped members, is composite with the 11.3 metre-wide, precast concrete deck. To reduce weight, the deck spans two directions and is only 235 millimetres thick.



The truss length has 55 individual segments, field bolted together, with two truss sections connected with Chevron cross frames and top and bottom chord wind bracing. Stay cables, attached to two A-shaped pylons on either side of the main span, support the 190 metre span.

There was a strong need to proceed immediately with construction; however, the engineering consultant was still completing the design. Meanwhile, the quality of the constructed works needed to be confirmed, and the team needed to understand the project issues. A project of this magnitude had never been constructed so far north in Canada.

Our team needed to quickly strategize and address a large number of issues. These included:

- Document control
- Highway, structural and electrical design
- Hydrotechnical review
- Construction supervision
- Environmental services
- Communication
- Graphic design.

The Mackenzie River itself posed particularly significant challenges. The bridge piers had to be designed to withstand the force of ice sheets up to 1.8 metres thick rushing down the river during spring break-up. The annual freeze and thaw cycles also limited the in-river activities during construction.

This determined the methodology for the pier construction, as well as for the approach in erecting the superstructure. The location of the project site, where daylight shrinks to 5½ hours during the

winter, necessitated the development of a design which allowed for year-round construction, with materials carefully selected to have the toughness and durability to withstand the encountered -40 degrees Celsius temperatures.

The construction site was remote, even by Canadian standards. All of the materials had to be shipped to site from far-away locations, including 11,000 tonnes of structural steel from New Brunswick and Quebec. Some of the more specialized components were sourced from overseas. Heavy equipment had to be mobilized, and a large, mobile batch concrete plant was erected on-site.

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Numerous challenges included extreme northern conditions, remote site, equipment and materials delivery, and a geographically dispersed team.

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## Solution



To maintain construction continuity, our team began by scheduling several large project meetings and facilitating the flow of information between the contractor, fabricators, and designer so these activities could proceed.

Our management team identified what site condition and design information was

available, and what was required to move the project forward. We then managed a team of subconsultants to undertake required work, such as a design continuity investigation, quality audits, survey and materials testing. We also mobilized an experienced construction supervision team.



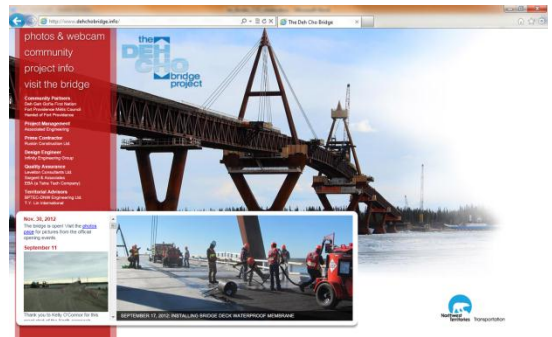
## Communication

Managing a large and geographically dispersed project team was accomplished through effective communication and a tailor-made document control system. The management team formed a strong alliance with the client's staff through a series of regular meetings and gatherings which helped to open up communication lines and foster an environment of partnering and team spirit. Recordings of all meetings, made available to all participants, helped to eliminate misunderstandings and ensure the team was moving forward with a unified vision.

Regulators were included in the meetings to mitigate potential regulatory issues. The unique, web-based document control system gave all team members access to time-stamped files, such as meeting minutes, reports, drawings and background information. The document control system allowed the project to proceed quickly with a unified place for information.

To overturn the prevailing negative public image of the project, based on issues with

the original P3 project, we made a significant investment to provide as much project information as possible to the public. Working with the Government of Northwest Territories, our in-house team developed a project logo, brochures, project website ([www.dehchobridge.info](http://www.dehchobridge.info)), design and content for a quarterly newsletter, public display boards, and two scale models for display in prominent public locations. The project website displayed webcam images in real time. Our team facilitated media tours at the site, provided interviews with magazines, and participated in TV news conferences.



## Budget & Schedule Control

To regain and maintain control of the project's budget, schedule, risk, and overall quality, as project manager, our team identified critical elements to address. Based on the state of the project at the start of our involvement, a new schedule was required.

Our team worked with the contractor and the client to develop a revised schedule to complete the bridge. With a large project, a small taxpayer base, a number of government levels involved in funding, and close scrutiny by the public, control of the budget was paramount. By carefully tracking the budget and working closely with the contractor and the client, we controlled cost escalations on the project.

## Quality & Risk Management

Quality concerns, resulting from issues with the previous P3 project, were addressed by establishing a comprehensive quality management program. We appointed a specialist consultant to oversee quality control issues on the project.

Our team worked with the client to develop a risk management plan. We developed a risk matrix and risk mitigation strategy. The risk matrix and mitigation strategy was reviewed and updated at regular meetings.

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Effective communication, budget and schedule control, and quality and risk management helped avoid further delays and cost escalation.

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## Innovation



Applying our experience in bridge and erection engineering in the North, we developed a specific project management plan, including communications, construction planning, risk management, quality control, and budget and schedule control, to address project issues.

Effective communication with the geographically dispersed project team, as well as regulators and the public was critical. Our communications program included:

- A tailored, internet-based, document control system to distribute all project documents to team members
- A comprehensive project website, complete with real-time web camera feeds that kept the public informed of the project status
- Quarterly project newsletters distributed to each household in the Northwest Territories
- Two scale models of the bridge, which helped the public to visualize the structure and understand its complexity
- Monthly project meetings involving all team members, including regulators, which helped avoid costly delays

The public communication program helped to improve the project's negative image.

We worked closely with the contractor and the Government to plan construction, considering the extreme weather, short days in the winter, suitable construction methods, and material fabrication and delivery schedule, all aimed at avoiding further delays and cost escalation.

The team established a risk matrix to help identify and mitigate risks. We developed a comprehensive quality program, and appointed a consultant to oversee quality management. The systems, procedures and processes helped guide successful delivery of the Deh Cho Bridge.

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Developing and implementing a customized project management plan helped to guide successful project delivery.

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## Complexity



When Associated Engineering stepped in as Project Manager, bridge construction had started, but the design was incomplete. Our team quickly mobilized to understand the Government's project goals, regulatory requirements, and the many issues that had delayed the original project.

We developed a plan to address these issues, and managed the highway, structural and electrical design completion, hydrotechnical review, bridge fabrication and delivery, construction planning, document control, communication, graphic design, environmental services, construction inspection, and quality management.

We developed a project management plan, and implemented processes, procedures, and systems, all geared to complete design, maintain construction continuity, and avoid further delays and costs. The Government had retained design engineers, advisors, and the general contractor.

We retained additional specialists to assist with quality management, environmental monitoring, construction inspection, and communications. Team members were located across North America, so our Communications Plan included regular

meetings and partnering sessions. We recorded meetings to enable remote team members to view meetings and keep up-to-date.

While the Government had retained the contractor, Ruskin Construction, their contract was not yet in place. We assisted the Government with final negotiations for the construction contract, despite incomplete design details.

Bridge truss fabrication and on-site piling needed to commence immediately, but the components design was not finalized. Our project manager brought together the engineer, contractor, and fabricator to develop a design solution that could be quickly fabricated and delivered to site.

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Effective project management was critical to overcoming a myriad of project issues.

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## Social & Economic Benefits



For decades, Highway 3 near Fort Providence stopped at the Mackenzie River, where travellers crossed the river by ferry or ice bridge. For up to five weeks during ice freeze-up and break-up of the river, residents in the Northwest Territories had no land connection with the rest of

Canada. The only mode of transport for residents and freight was expensive: by air.

The Deh Cho Bridge establishes a new, fixed northern connection, providing economic and social benefit to the Northwest Territories. The bridge facilitates economical travel, and will help increase tourism to the Northwest Territories. Goods can now be easily transported by land, reducing the cost of air freight in the spring and fall. The most significant economic benefit will likely be to the mining sector, a leading contributor to the region's GDP.

The construction of the bridge provided residents and local businesses with immediate social and economic benefits. About 80 residents were hired and worked as labourers, heavy equipment operators, camp helpers, environmental monitors, and project assistants, providing work and on-the-job training, and building local capacity. The training enabled locals to find work on other construction projects and at mining sites, long after their roles with the Deh Cho Bridge project were completed.

Our team made a concerted effort to employ locals, including First Nations youth, to assist with on-site work. We also sponsored Northwest Territories students to a youth conference in Fort Providence. We led a group of students on a field trip to the bridge site, where they learned about the bridge's design and construction and career options in the industry, thus helping to build greater pride in their local community.

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**Deh Cho Bridge connects the North, provides opportunity for economic growth, and helps build a skilled workforce.**

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## Environmental Impact



The Deh Cho Bridge replaces the Merv Hardy Ferry that had linked the highway north and south of the Mackenzie River. The permanent bridge connection provides long-term environmental benefits by eliminating emissions from the ferry and cars idling on the ferry. In addition, the new bridge removes environmental impacts to the river and aquatic habitat from ferry operations.

Our team developed measures to mitigate any environmental impacts associated with the bridge. Since the bridge is on a major avian migratory route, we engaged biologists who determined potential impacts to migratory birds. Biologists developed a mitigation strategy that included limiting lighting and, where possible, using blue-green lighting, which has been shown to reduce stress in birds.

To mitigate the impact of in-river bridge piers, we also developed a habitat compensation plan that incorporates a high-quality spawning habitat. To stop bison from crossing the bridge and potentially spreading disease through their migration, we designed a Texas gate—an

in-road grid that allows vehicles to pass, but prevents animals from crossing.



Until the Texas gate was constructed, we strategically placed wolf cut-outs signs along the bridge approaches to discourage bison from nearing the bridge. These signs were painted by local students. The team also implemented a program to regularly spread wolf urine near the bridge entrance, as another natural deterrent to bison migration.

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Design & construction minimized  
impact on wildlife and habitat.

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## Conclusion

### Meeting Client's Needs



The Deh Cho Bridge officially opened on November 30, 2012, meeting the Government's goal to connect the North and the rest of Canada.

As the Government of the Northwest Territories' Project Manager, Associated Engineering managed the delivery of the Deh Cho Bridge project.

We developed a specific project management plan to successfully complete the construction of this major project, which had faced many setbacks before the Government took overall control.

Our key tasks included:

- Negotiating with Ruskin Construction, the contractor, to finalize its contract with the Government
- Developing and implementing a Communication Plan, including a web-based Document Control System
- Implementing a Risk Management Plan
- Implementing a Quality Management Program
- Providing project coordination and budget and schedule control of design and construction
- Working with Ruskin to plan construction and avoid major issues

The unique circumstances, challenges, and large project team, demanded a special project management approach involving staff from several parties. A careful combination of approaches contributed greatly to the success of the project, bringing this important lifeline to the North.



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“One of the huge success factors was the relationship Associated Engineering developed with the local community and, most importantly, the youth of the community. Associated Engineering staff played a huge role in being outstanding role models and giving the youth some insight in major projects and their potential. As a result of the efforts and professionalism of the team, the Deh Cho Bridge now stands as a symbol of bridging the future and connects our northern communities to new opportunities.”

- Kevin McLeod, P.Eng., Director Highways and Marine for the Government of the Northwest Territories

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