



Nares River (Naataase Héén) Bridge Replacement

Author :

Khusru Zaman, M.Eng., P.Eng. Regional Program Manager, Bridges
Government of Yukon

Co-Author :

Paul Murchison, P.Eng. Director, Transportation Engineering Branch
Government of Yukon

Paper prepared for presentation at the Structural Session of the 2019 TAC-ITS Canada Joint Conference, Halifax, NS



Abstract

Nares River Bridge is located at km 105.2 on the Klondike Highway #2, Yukon, in the village of Carcross, and approximately 75 km south of Whitehorse. The existing Nares River Bridge was constructed in 1970 and consists of 17 trestle spans with a total span of 129 m. The bridge carries two traffic lanes of Klondike Highway #2 across the Nares River. The superstructure is comprised of longitudinal timber wearing planks on a transverse timber sub-deck. The substructure consists of steel trestles comprised of steel cap beams, pipe piles, and bracing. The ballast wall at the abutments uses staggered wooden planks.

The southern part of the Klondike Highway is an important link in the Yukon highway system because it serves the mining, international commerce and tourism industries. The bridge is a vital piece of infrastructure because there is no other reasonable detour route for the transportation of goods and services between Yukon and the Skagway port. While the bridge remains safe for usage today, heavy haul loads are no longer permitted on account of compromised bridge capacity. Because of the importance of Nares River Bridge, inadequacy of the existing structure, and asset depreciation, the bridge has been prioritized for replacement.

Highways and Public Works (HPW) is currently replacing Nares River Bridge at Carcross with a budget of \$15 millions for the project over two years. The Nares River Bridge replacement project will provide Yukoners with a bigger and better bridge as part of Yukon's highway network. Not only will this new asset ensure the South Klondike Highway is ready and able to meet future traffic demands and support the community of Carcross and the Carcross/Tagish First Nation, the project is also providing economic opportunities for Yukoners. For the first time on an infrastructure project of this nature, the Government of Yukon procurement process included a First Nation participation plan intended to address employment and training for Carcross/Tagish First Nation citizens and Carcross/Tagish First Nation firms.

Many challenges were faced during the planning, consultation and procurement stages.

1. Background

The existing bridge crosses Nares River which is a short narrow channel flowing between Bennett and Nares Lakes. This bridge was built in 1970 to service mining activity in the area at that time, is a lightly constructed 17 span trestle type structure with a timber superstructure and is now part of the Klondike Highway, connecting Whitehorse, Yukon to the seaport in Skagway, Alaska. This highway presently carries bulk commodity haul vehicles with gross vehicle weights (GVW) over maximum (Yukon) legal GVW. The total length of the bridge is 129 m (425 ft.) with a +2% grade (towards Skagway) and it provides two 3.66 m (12 ft.) wide traffic lanes. A timber deck sidewalk was added to the bridge in 1981 with the access stair located at the South-West side of the bridge. The clear opening of the sidewalk is 1.22 m (4 ft.).

The timber sub-deck and wear deck were replaced in 1985, however the wear deck has required frequent repair. The timber stringers are reported to be in good condition but the continual maintenance of the wear deck combined with the use by heavily loaded bulk haul traffic is expected to cause deterioration of the superstructure and the economic life of the structure is considered to be limited. Design of a replacement/rehabilitation structure has therefore been considered. The annual average daily traffic (AADT) at the border crossings near Skagway is approximately 270 vehicles per day. It is higher at the Nares River Bridge due to uncounted local trips.

2. Constraints

New Bridge Design

The constraints on the design of a new Nares River Bridge are many and varied. Most of them were actual limits placed on design and construction that have a real cost. Initially, it was clear that keeping the construction working limit within the right-of-way would be preferable to avoid the possibility of having to acquire the extra property. Other constraints included: keeping navigational and roadway clearances the same; considering the impact of highway grade changes on approach roads; and maintaining vehicle and pedestrian traffic during construction.

Existing Bridge Decommission

The southern part of the Klondike Highway is an important link in the Yukon highway system because it serves the mining, logging and tourism industries. The Nares River Bridge is vital because there is no viable detour route for highway transport around the bridge and the previous means of transport of goods, the White Pass and Yukon Railway, is no longer an option. Therefore, in spring and summer due to high traffic volume on the Klondike Highway, one lane and walkway must be kept open during total construction period.

Restrictions to Marine Traffic

The existing railway bridge is located approximately 100 m upstream of the Nares River Bridge and was constructed in 1900. Originally designed as a swing bridge, it has since been modified and repaired several times. It would be highly impractical to restore this to an operating swing bridge from an economic or physical perspective. This bridge is likely to remain in place for reasons of historical nature and railway operation.

A light timber trestle type footbridge is located upstream of the railway bridge. Both bridges are restricting navigational clearance between Bennett Lake and Nares Lake. As a result of these two

bridges narrowing of the channel width for the design of the new bridge in order to reduce length was not feasible.

Highway Gradeline

The gradeline for a new crossing will be higher than the existing crossing, as determined by the need to maintain the following:

- Minimum height clearance between underside of bridge superstructure and the water surface for passage of marine traffic.
- Bridge deck top elevation cannot exceed the existing elevation to avoid the challenge related to road encroachment as a result of increased highway approach elevations.
- The highway alignment and location is fixed by lake and land features to the present crossing of the narrows. Relocation of the crossing is further restricted by the present disposition of property, especially at the south side of the narrows.

3. Conceptual Options Study and Load Rating

In 2014-2015 MMM Group Limited was commissioned by Yukon Highways and Public Works, Transportation Engineering Branch, to provide engineering services for the Nares River Bridge. The major scope of work for this project included:

- A detailed, visual, inspection of bridge elements including both superstructure and visible substructure elements;
- Load rating and structural assessment of the existing bridge;
- Evaluation of the existing bridge;
- Option study (Replacement/Rehabilitation/Alignment change) and cost estimate; and
- Preliminary report and conceptual drawings for the selected option including life cycle cost and design criteria.

Following the assessment by MMM group limited, it was determined that the existing bridge had limited load capacity. As a result, TEB posted load, travel and users restrictions for this bridge.

Feasibility study

Four options were selected for consideration in the analysis including two rehabilitation options consisting of a superstructure replacement using the existing substructure and two replacement options with two and three span arrangements.

- Rehabilitation
- Replacement
 - ✓ Upstream (U/S)
 - ✓ Downstream (D/S)

Rehabilitation

The rehabilitation option consists of replacing the superstructure with a concrete deck on steel girders using the existing substructure. For the existing roadway alignment, a “half-and-half” staged construction is required to ensure the minimum detour requirements can be met. With no practical existing detour, a minimum of one lane and walkway must be kept open during construction and two lanes must be open during winter season.

Replacement

Two replacement options have been developed to assist in determining a strategy for maintaining the crossing of the Klondike Highway #2 over Nares River. Replacement options consider two and three span arrangements, each developed to address issues with the existing structure, roadway approaches, and stream hydraulics to varying degrees.

Pros – U/S

- Shorter south span length
- Abutments location above low water level
- Less material required to construct new approach roads
- Less permits required for geotechnical investigation
- Lower cost

Cons – U/S

- Close to the existing marina
- Poses safety issues for marina users during construction period
- Requires analysis to find minimum maneuver between marina and abutment

Pros – D/S

- No impacts to existing marina
- Fewer safety issues for marina users during construction

Cons – D/S

- Longer south span length to accommodate existing underpass road
- Relocate existing driveway for the houses located on the side
- Relocate/demolish existing unauthorized boat dock
- Abutments location into low water level
- More material required to construct new approach roads
- Poor foundation soil exists at north approach.
- Higher cost

TEB reviewed and selected the replacement with three span arrangements on the upstream side of the existing bridge.

4. Design and Construction

New Bridge Design Criteria

- Design Code: CAN/CSA S6-14
- Live load: CL-800
- Seismic Importance Category: Life Line
- Design Lanes: Two lanes traffic
- Guardrail: Test Level (TL-4)
- Service Life: 75 years
- Maximum Daily Mean Temperature: 23°C

- Minimum Daily Mean Temperature: -47°C
- Hydrological design: Q100 years



Figure 1: Rendering – side view

New Bridge Configuration

- Three-span continuous structure with an overall length of 145 m (35m+75m+35m)
- Clear Roadway: 10m (1.3mX1 Shoulder+3.7mX2 Lanes)
- Sidewalk: 2.15m wide including bicycle rail and one pedestrian access stairs
- Luminaire: 8 on the bridge
- Approach Road: 775m new alignment to connect with existing highway including 75mm thickness Warm Mix Asphalt (WMA) paving
- Girders: 2.1m deep five lines steel I girders
- Deck: Cast-In-Place concrete
- Piles: A group of four 914mm diameter open-ended pipe piles (reinforced concrete infill) at each abutment and pier
- System Behaviour: Semi-Integral
- Bearings:
 - Abutments: Elastomeric type (total 10)
 - Piers: Pot type (total 10)

List of Consultants

- Bridge Design: WSP Canada Group Limited, Vancouver, BC
- Geotechnical Investigation and Design: Tetra Tech EBA, Whitehorse, Yukon
- Hydraulic Study: Tetra Tech EBA, Whitehorse, Yukon
- Fish Habitat Surveys: Tetra Tech EBA, Whitehorse, Yukon
- Heritage Resources Impact Assessment: ECOFOR, Whitehorse, Yukon
- Rare Plant Survey: ELR, Whitehorse, Yukon
- Birds Survey: ElknWillow Environmental Consulting, Whitehorse, Yukon
- Existing Bridge Paint Analysis: ALS, Burnaby, BC
- Riprap ML/ARD Analysis: Tetra Tech EBA, Whitehorse, Yukon
- Arsenic (Soil and Water): Stantec Consulting Ltd. Whitehorse, Yukon
- Electrochemical Testing on 20mm minus Gravel: Valley Consulting Engineering, Abbotsford, BC
- Ground Survey: Challenger Geomatics Ltd. and CAP Engineering Whitehorse, Yukon

General Contractor and sub-contractors

- General Contractor:
 - ✓ Ruskin Construction Ltd., Prince George, BC
- Sub-Contractors:
 - ✓ QC Engineering - CAP Engineering, Whitehorse, Yukon
 - ✓ Environmental Monitor – Yucan Planning, Whitehorse, Yukon
 - ✓ Structural Steel – All-Span, Delta, BC
 - ✓ Reinforcing Steel – LMS, Calgary, AB
 - ✓ Earthworks - Castlerock Enterprises, Whitehorse, Yukon
 - ✓ Concrete – Territorial Contracting, Whitehorse, Yukon
 - ✓ Electrical – CTMC, Whitehorse, Yukon
 - ✓ Bearings – GOODCO Z-TECH, Laval, QC

Construction

- *Funding:* Building Canada Small Communities Fund (75% Canada and 25% Government of Yukon)
- *Total Projected Project Cost:* \$15 Millions
- *Schedule*
 - ✓ Start: November 03, 2017
 - ✓ Completion: February 14, 2020
- *Progress:* 60% (up to June, 2019). Project is on schedule.

Traffic Management

The bridge is located on a major highway traffic route which carries a mix of heavy commercial, tourist and local traffic. Therefore, a very high level of planning, preparation, development of highly efficient construction procedures, and well-organized traffic control procedures have been used for this project. To mitigate traffic disruption, the Contractor constructed a temporary bridge on the U/S of the new and existing bridges.

Navigational Clearance

Nares River (Naataase Héen) Bridge crosses the Nares River which is not included in the “List of Scheduled Waters” under the Navigation Protection Act (NPA). The bridge has been “opted out” of the NPA works regims. “Overhead Works Ahead” signs were installed on both banks of the waterways at 100 metres upstream and downstream of the bridge.

Environmental Monitoring

This project is located in an environmentally sensitive area (e.g migratory birds, heritage, fish habitat, rare plant etc.). As per the requirement of the contract, the Contractor retained an Environmental Monitor as a third party which is not a direct employee of the Contractor. The role of the Environmental Monitor is to oversee the implementation of the mitigation measures and ensure that every effort is made to minimize potential impacts of the works on the environment including but not limited to migratory birds, fish and fish habitat.

Boron in Steel

The Contract documents requires that all steel purchased outside of Canada, U.S and/or any countries in the European Union (EU), the following criteria shall be met:

- A total maximum boron of 0.008%.
- Material testing of each steel batch to confirm the steel meet or exceed CSA G40 or the applicable ASTM Standards and the maximum boron specified (0.008%).
- Testing of the steel to be performed in Canada by an ISO 17025 accredited testing laboratory with the appropriate testing scope.

5. Procurement Methodology

Meet and Greet

YG organized a meet and greet event with all contractors interested in learning about the upcoming Nares River Bridge project and how this project will be procured. This meeting took place in Whitehorse, Yukon. The event was broadcasted via Webex webinar for those who could not attend in-person.

As part of Yukon government's (YG) obligation under a land claim agreement, YG and the FN agreed to include language in all tenders related to this project that would address employment and contracting opportunities for FN.

In 2017, YG conducted a Request for Qualifications (RFQ) and then a Request for Proposal (RFP) to select a qualified contractor for the Nares River Bridge Replacement Project.

Request for Qualifications/Request for Proposals Construction Contract

The RFQ method was chosen to short list qualified contractors (four highest ranked) for this type of work, who would then respond to the RFP for the Construction Contract tender. This process was selected in order to obtain the best value for the work to be done by awarding to the highest ranked proponent.

RFQ Evaluation Criteria

Experience of the company – general construction company or bridge construction specialists – portfolio of bridge construction projects similar scale to Nares River Bridge, similar type of work, extent of public sector clientele, remote locations, extreme climate, projects within First Nations or community locations (Maximum 40%).

Project Team – resumes indicating experience and academic, technical and professional qualifications of the following key team members – project site superintendent, project manager, project site safety officer, project coordinator for Community and First Nations engagement – provide an organizational chart clearly showing each critical team member, various resources group/type (welder, steel worker, surveyor) and subcontractors required (Maximum 40%).

Risks and Mitigations – provide specific constraints and challenges that are typically encountered and your proposed approaches to address them (Maximum 10%).

First Nations and Community Participation – how you have offered and delivered benefits and economic opportunities from the work for this type of project to First Nations and community members (training/capacity development, direct employment, local purchase) (Maximum 10%).

Statements of Qualifications (SOQs) scoring less than 600 points out of 1000, were considered technically unacceptable and not included on the Qualified Source List (QSL). Four proponents were technically accepted out of seven for this project.

Three proponents were technically unacceptable.

RFP Construction Contract Evaluation Criteria

Project Team – provide concise resumes for project site superintendent, project manager, site quality control engineer, site environmental monitor, project site safety officer, project coordinator for Community and First Nations engagement, site surveyor (Maximum 10%).

First Nation Participation Plan (FNPP) – Training/Capacity Development Plan; Direct Employment Plan; Sub-contracting plan (Maximum 10%)

Schedule (Maximum 1.5%)

Price (Maximum 78.5%)

Total Technical points 215 and price 785.

Two envelope system

- ✓ Envelope 1: Technical proposal
- ✓ Envelope 2: Price information – The price envelope remain seal until the technical evaluation was complete

Proposals that did not meet the minimum score of 65 points (out of 100) for the Carcross/Tagish First Nation (C/TFN) Participation Plan and the minimum score for the total Technical Evaluation of 130 points (out of 215) were considered technically unacceptable and the price envelope was returned to the proponent unopened. Three out of the four proponents passed the technical evaluation.

Mandatory Site Visit

YG included a mandatory site visit for all bidders during the RFP tendering stage, the mandatory site visit, included an opportunity to meet with the FN and visit the project site.

FN Representative

YG included a C/TFN government representative in the value-driven procurement evaluation process. As part of this process, the FN provided a technical advisor to observe and participate in the evaluation of the proposal for the FNPP only. The FN chose a representative from their government administration who had seniority, authority, and represented the FN interests, and was an acceptable choice to YG. The technical advisor role was limited to informing the scoring for the FNPP criteria, but was not considered a member of the evaluation team.

Fairness Monitor

A fairness monitor was commissioned by Government of Yukon (YG) to act as an independent and impartial third-party observer and advisor in the RFP tendering and proposal evaluation process. The fairness monitor ensured the fairness of the procurement process.

Additional External Fairness Monitor

A consultant structural engineer also participated as a technical advisor for the evaluation of the submission and was also involved as an additional external fairness monitor during the evaluation process.

Project Open House

YG organized two open house for the public in co-ordination with the FN and the local community.

1st Open House: Preliminary Design Stage – YG shared the preliminary design with the public for their opinion, suggestion and feedback.

2nd Open House: After Awarding the Contract – YG and the successful contractor presented the work schedule, materials, resources and opportunities for employment, subcontractors, sub-trades, equipment and safety.

6. Project Agreement in Relation to Non-Settlement Land

The C/TFN Final Agreement (the “C/TFN FA”), Chapter 22, Schedule A-Part I, 2.18 to 2.34 thereof (the “YACA Provisions”), sets out the commitment of Yukon, until January 9, 2026, to negotiate with the C/TFN a Yukon Asset Construction Agreement (a “YACA”) where Yukon intends to construct an Asset in the Traditional Territory of the C/TFN with a Capital Cost of \$2 million or more. A YACA is one of the specific economic measures by which the Parties seek to achieve the objectives of Chapter 22 of the C/TFN FA. The Parties wish to address the YACA provisions of the C/TFN FA with respect to the construction of a bridge in Carcross.

YACA was signed on June 26, 2017 between YG and C/TFN to maximize FN training, employment, capacity development, contracting opportunities, sole source opportunity and financial contribution.

7. Significant innovations

Through the RFQ and RFP procurement approaches, Government of Yukon obtain the most experience contractor who had experience working with First Nation and delivering this type of project within a community and fulfil the contract requirements.

Major successes

For the first time on an infrastructure project of this nature, the Government of Yukon procurement process included a First Nation participation plan intended to address employment and training for First Nation citizens and firms.

As part of Government of Yukon’s obligation under a land claim agreement with a Yukon First Nation, Government of Yukon and the First Nation agreed to include language in all tenders with respect to this project that would address employment and contracting opportunities. The

Contractor implemented a First Nation Participation Plan (FNPP) and addressed the contract requirements (training/capacity development plan, direct employment plan and subcontracting plan for the specific First Nation citizen). The Contractor has had challenges maintaining the average commitment of their proposed FNPP due to the limited experience related to bridge construction of the C/TFN Citizen workers applying for the work. The Contractor has been providing training, developing capacity, hiring labour for general works and sub-contracting opportunities from the beginning of the project. As per the contract, based on the progress report for the payment period, in the event the Contractor does not meet the targets set out and fails to demonstrate diligent efforts have been made to fulfill the requirements for implementing the C/TFN FNPP, the Engineer reserves the right to retain a holdback amount up to 7.5% of the value indicated in the progress report for that payment period. Targets are assessed separately for each criteria: Training/Capacity Development Plan, Direct Employment Plan and Sub-contracting Plan.

Based on the written progress reports provided by the Contractor, the Engineer reserves the right to release the cumulative hold back amount, or a portion thereof, as targets are met in implementing the Carcross/Tagish First Nation participation plan.

YG and the C/TFN representative jointly reviews each progress reports provided by the Contractor and makes a final decision together on the holdback.

Major challenges

The First Nation government was aware of what would go into the procurement documents in order to address the needs of the community because they had provided input on the language and helped to determine the weighting of each criteria in the FNPP. The FNPP was intended to help the proponent create meaningful economic and employment opportunities. The tender documents informed the proponents that because the First Nation was participating in the process on the procurement team, contact with the First Nation government was limited.

8. Potential Considerations

Conflict of Interest or Unfair Advantage

Individuals from a FN involved in the process of developing the tender documents or reviewing proposal submissions must not be involved, or perceived to be involved, with any bidders. Conflicts of interest or unfair advantage could arise where an individual who is part of the procurement team on the FN government side, and who has the ability to influence the decision-making process, is also involved in some way with a bidders or has some other interest that means that his or her decision-making might be affected. Under YG's procurement rules, neither is acceptable and that message needs to be clear with all FN governments, their businesses and development corporations, before the procurement planning begins.

9. Benefits

Transparency

The FNPP was intended to help the proponent create meaningful economic and employment opportunities. The FN government was aware of what would go into the procurement documents that would address the needs of their community because they had provided input on the language and helped to determine the weighting of each criteria in the FNPP. Tender documents

informed the proponents that because the FN was participating in the process on the procurement team, contact with the FN government was limited.

Openness

The FN was given an opportunity to voice concerns during the evaluation process prior to the evaluation outcomes being announced. Although the FN did not mark the proposal submissions against the FNPP criteria, they did observe to ensure that the process was fair and could communicate that to their citizens. This contributed to a foundation of trust between governments, and between the FN and their citizens, building confidence for the project moving forward.

10. Photographic Illustrations



Fig. 1. Existing Bridge – Side View



Fig. 2. Existing Bridge – Deck View



Fig. 3. Meet and Greet

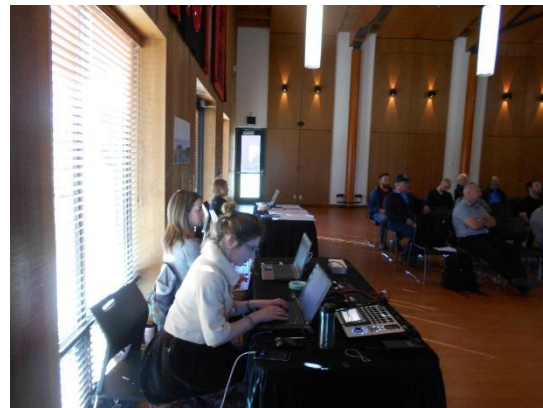


Fig. 4. Meet and Greet – via Webex webinar



Fig. 5. Open House



Fig. 6. Open House



Fig. 7. Existing Bridge - Underpass.



Fig. 8. Construction – Girder Installation



Fig. 9. Construction – Pier Pipe Piles



Fig. 10. Construction – Girders



Fig. 11. Construction – Pier Cap



Fig. 12. Construction – 24/7 Monitor Camera