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Effective January 1, 2004

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN

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Nunavut Water Board
SEP 28 2004
Public Registry

WATER LICENCE APPLICATION FORM

Application for: (check one)

_X_ New ___ Amendment ___ Renewal ___ Assignment

LICENCE NO: (for NWB use only) NWB4DUV	
1. NAME AND MAILING ADDRESS OF APPLICANT/LICENSEE Applicant: Nelson Pisco, P.Eng. Manager, Regional Projects Department of Community & Government Services, Government of Nunavut P.O. Box 379, Pond Inlet, NU X0A 0S0 Phone: (867) 899-7303 Fax: (867) 899-7328 e-mail: npisco@gov.nu.ca	**2. ADDRESS OF CORPORATE OFFICE IN CANADA** (if applicable) Consultant: Jivko I. Jivkov, P.Eng. Principal, Jivko Engineering 5610-50A Avenue Yellowknife, NT X1A 1G3 Phone: (867) 920-4455 Fax: (867) 873-6090 e-mail: jivko@theedge.ca

3. LOCATION OF UNDERTAKING (describe and attach a topographical map, indicating the main components of the Undertaking)

The Duval River Bridge is located on the east limits of the community of Pangnirtung, NU. Pangnirtung is located on the south-east shore of Pangnirtung Fiord, Cumberland Peninsula, Baffin Island.

Latitude: **N- 66° 09'**; Longitude: **W- 65° 42',** NTS Map No. **26-I/4;** Scale 1:50,000

4. DESCRIPTION OF UNDERTAKING (attach plans and drawings)

The undertaking consists of Temporary Repair of the existing bridge on Duval River, Pangnirtung, NU. Plans drawings and photo files are attached.

.1 Introduction

Recently, the GN and Municipal officials in Pangnirtung expressed concerns regarding the safe operation of the community bridge in view of a tilt of the west abutment pile-cap and significant scour under the east abutment. The GN retained the consultant Jivko Engineering of Yellowknife, NT to inspect and assess the structural condition of the bridge and to provide recommendation for temporary and long term remedial works that would guarantee safe operation of the bridge. Bridge Condition Report for the Duval River Bridge was submitted to the GN on August 25, 2004. Relevant abstracts of the Report follow:

.2 Background

The bridge is located near the eastern limit of the community, on a gravel road leading to the municipal water reservoir, to the sewage lagoon and to the community gravel sources. The bridge was constructed in 1983 according to design prepared by PWC, Bridge Branch of Ottawa, ON.

On several occasions during the last 20 years, during spring break-up the riverbed in the bridge area has been heavily scoured out and the base of the bridge abutments has been undermined. At least two major repairs and several minor ones have been carried out in the last 15 years. Reportedly, in the late 80's, after the first major damage on the bridge abutments, a load restriction was imposed limiting the vehicles travelling on the bridge to a maximum GVW of 20,000 kg. Since then, heavy construction equipment including excavators, bulldozers, off-road gravel trucks, etc, are fording the river on a detour located immediately downstream to the bridge alignment.

.3 **Description of the site conditions**

.3.1 **The Duval River Bridge:** This is a 26.67 m long simple span twin plate girder structure with 5.00 m wide timber deck. The deck is supported on a system of longitudinal and cross floor beams attached to the main girders with bolted connections. The bridge is located on a straight section of the road with deck elevated approximately 4.5 metres above the Mean Water Level of the river.

Each of the four bridge bearings lies on individual 1.6 m x 1.6 m x 0.75 m deep concrete pile-cap supported on a cluster of four 5.5" OD pipe piles. The pile-caps of each abutment are connected by a concrete back-wall and are tied back to dead-men with double 5/8" rebar. It is unclear if the piles are anchored into the ground, or just sit on the rocky bottom. In front of each abutment there is 2.7 m high gabion wall consisting of wire mesh baskets in-filled with cobble size rock. The gabion walls retain the backfill behind providing lateral support to the abutment piles. They also provide armouring for the head slopes of the bridge.

.3.2 **The Duval River:** This is several kilometres long, mostly runoff stream, fed by the melting snow and the occasional rains in the mountains above Pangnirtung. According to measurements taken in the vicinity of the bridge the natural riverbed is 40 to 50 m wide at high water discharges and the average gradient of the river is as steep as 8.5%.

As constructed, the bridge is reducing the riverbed width to less than 21 m. This significant reduction of the riverbed combined with the steep gradient leads to major increase of the flow velocity and scouring power of the river under the bridge, which is more pronounced at high water discharges.

For most part of the summer months the river runs 12 to 18 m wide. By mid September the active channel is usually reduced to less than 5 m. For 2 weeks every year, during break up, the river swells and becomes violent, capable of rolling boulders exceeding 3 feet diameter. The water discharges during this period are estimated to be dozens of times larger than the average of the rest of the year. This is due to the combination of fast melting snow, lack of vegetation to retain and slow down the runoff, and proximity to the mountains with the associated steep gradient of the riverbed.

.4 **Site Inspection and findings**

The Site Inspection carried out by Jivko Engineering included visual examination and measurement of all structural members of the bridge, the approach roads, and the riverbed in the vicinity of the bridge. Few local residents were interviewed. The results of the examination follow:

.4.1 **Bridge Superstructure:** Measurements taken on the main girders, floor beams and bearing elevations indicate that no geometric deformation of the bridge superstructure has occurred. In general the superstructure is in very good condition except for minor wear-out on the running boards on the timber deck.

.4.2 **West Abutment - Pile Caps**: Measurements taken on the west abutment indicate that the pile caps have moved 50-60 mm towards the bridge and have rotated 6°- 8° backwards. The expansion gap between the deck and the abutment is closed and the back wall is bearing directly against the superstructure.

Backfill material was excavated behind the downstream pile cap to expose the rebar tie-backs. The tiebacks were found to be under significant tension. Some cracks were noticed on the concrete wall at their embedment point. This confirmed that the system of dead men/tiebacks have failed allowing the abutment to move towards the bridge.

.4.3 **West Abutment - Gabion Wall:** The gabion baskets of this wall are displaced out and downwards in a slumping like motion. Some of the gabions of the higher rows are missing. Large amount of boulders ranging between 0.3 m and 1.2 m is placed against the base of the wall. A boulder exceeding 3.0 m in length is placed on the upstream side in front of the abutment.

Reportedly, in the late 80's and early 90's the river was running along the west wall scouring out the base under the gabions of the same. As a result, around 1992, the gabions on this side lost support and under the pressure of the backfill slumped down towards the river. Under the same earth pressure, the piles bowed out in attempt to follow the slumping backfill. Some or all of the piles might have buckled at the top end. The pile cap couldn't follow the slump, but only rotated since it was restricted by the superstructure.

In attempt to stabilise the riverbed, in 1994 large amount of boulders was placed against wall and on the aprons upstream and downstream from the bridge. The riverbed was raised by not less than 1 meter. As mentioned above these boulders are still in place.

.4.4 **East Abutment – Pile Caps**: The concrete pile caps and back-wall of the east abutment were visually examined and found to be in good condition. No rotation, sags, cracks, or other signs of deterioration were observed.

.4.5 **East Abutment – Gabion Wall**: The overall geometry of this wall appears to be as originally constructed. Reportedly, after the repair of 1994 the river slightly changed direction and started running along the east gabion wall, gradually eroding the riverbed. Presently, the riverbed along the base of this wall is scoured out to a depth of not less than 1.2 m. The lowest row of gabions is point supported only on several boulders, few of them cracked.

The scour under the base of this wall is a matter of concern. Further scouring will most likely cause, at least, slumping of the gabions and rotation of the abutment in a fashion similar to the west one. The scope of the damage will depend on the level of violence of the spring runoff. Unusually hot weather accelerates the snow melting process causing large water discharges and significant scouring. In the worst case scenario the gabion wall will fully collapse exposing the piles behind. Without lateral support from the backfill, the piles will buckle and the bridge will collapse into the river.

.4.6 **Detour Alignment:** At the detour, the riverbed is 22 to 25 metres wide with approximately 1.2 metres high, steep banks and water depth between 0.5 and 0.8 metres. The riverbed is covered with 0.3 to 0.9 meters boulders. In its present condition, the detour is being used only by heavy construction equipment mounted on tracks or large diameter tires. The detour could not be used by regular dump trucks, water trucks, sewage trucks, pickup trucks, or any other smaller vehicles.

Reportedly, before the construction of the bridge the riverbed at this location was 1.5 m to 1.8 m higher than presently. All vehicles in the community, including pickup trucks and four-wheelers were fording the river at this location.

According to their needs, the Municipality and the local contractors occasionally fill with boulders and top up with cobbles the scoured out material from the detour alignment. This type of temporary repair usually lasts until the next spring when the imported material is being washed out down the river again.

.5 Conclusions and recommendations to the GN

The present condition of the bridge and our recommendations to the GN could be summarized as follows:

- The bridge is not found to be in immediate danger of collapsing. It is unlikely that heavy vehicles travelling on the bridge would cause any further deformation on the abutments (tilt, sag, etc). The deformation on the abutments is due to significant scour of the riverbed and associated undermining the base of the gabion baskets which retain the backfill under the abutments. Scouring of the riverbed occurs almost exclusively during spring break-up, when the river has significant ice traffic and is extremely violent, with water discharges many times larger than the regular summer ones.
- The tilt of the west abutment is not considered critical. It has been caused by failure of the abutment due to scour under the gabion wall retaining the backfill under the abutment. Presently the abutment has been stabilised by placing large amount of boulders supporting the base of the gabion wall.
- The scour under of the east abutment is a matter of concern. Further scouring will most likely cause, at least, slumping of the gabions on this side and rotation of the abutment in a fashion similar to the west one.
- Unless torrential rainfall occurs, it is unlikely that further scour will occur this year. However, it is very likely that further scour, with associated damage on the east abutment will occur during the 2005 break up. The scope of the damage will depend to the level of violence of the break up. Unusually hot weather accelerates the snow melting process causing large water discharges and significant scouring. In the worst case scenario the gabion wall will fully collapse exposing the piles behind. Without lateral support from the backfill, the piles will buckle and the bridge will collapse into the river.
- The need for temporary stabilising the east abutment by replacing the scoured out riverbed material is considered urgent. The work should be completed prior to the 2005 spring break-up. Similar work in smaller scale would have to be carried out yearly, since the river will most likely continue the scouring process. This temporary remedial work is associated with in-stream construction activity including deployment of excavator and bulldozer directly on the riverbed for placing boulders under and around the bridge. According to local residents the most suitable time of the year for completion of the temporary remedial work is in the second half of September when the river flow is the lowest and the damage to the habitat will be minimal.
- A long term remedial solution consist of replacing the existing 26.7 m long bridge with a 45.0 m long structure located on a parallel alignment, upstream from the existing one. Structure of such span will cause no constriction of the river flow and associated scouring at any time of the year. The existing bridge would be dismantled and the riverbed reclaimed to its original condition.

- The GN has instructed us to apply for a permit and proceed with the temporary remedial work before the end of this month. The GN has indicated that they are including in their plans the replacement of the bridge with a larger structure in the near future.

Description of the Temporary Remedial Work

The Work consists of placing a layer of assorted boulders (size 0.2 – 0.8 m) against the east gabion wall and on the upstream and downstream aprons of the bridge. The layer will be extended 0.6 metres above the base of the gabions to the elevation of the original riverbed. Boulders of selected size will be shoved under the base of the gabions.

The total estimated amount of boulders is 300 cu m. The proposed material, clean of any organic component, is available in the local quarry located within 2.0 km from the bridge site. The material will be transported to the bridge site with dump trucks and will be placed with small bulldozer and mid size excavator mounted on tracks. The local contractor selected to carry out this Work is considered to have appropriate experience, since he was involved in a number previous repair of similar character, on the same bridge. The Work will be completed within 5 productive working days in late September or early October 2004 when the river and the surrounding ground will be frozen and the water discharge, if any, will be running under the ice. No rain or other cause for bank erosion and silt import into the river is anticipated during the repair operation. Prior to the Work, all involved equipment will be inspected for leaks and repaired as required.

In compliance with the DFO Letter of advice, additional preventive measures that will ensure adequate protection of fish, fish habitat and water quality include:

- All materials and equipment used for the purpose of site preparation and project completion will be operated in a manner that prevents any deleterious substance (e.g. petroleum products, debris, etc.) from entering the streambed
- All stockpiled materials including boulders and cobbles of different size will be stored and stabilized away from the river
- Vehicle and equipment re-fuelling and maintenance will be conducted away from the river water/ice
- Any part of equipment entering the water will be free of fluid leaks and externally cleaned/degreased to prevent deleterious substances from entering the streambed
- Only clean material free of fine particulate matter will be placed in the streambed

5. **TYPE OF PRIMARY UNDERTAKING** (A supplementary questionnaire must be submitted with the application for undertakings listed in **"bold"**)

This undertaking differs from anyone listed below. It is a repair of existing Public Infrastructure that is in danger of collapsing. The need for repair is considered urgent.

___ **Industrial**
___ **Mining and Milling**
___ **Municipal** (includes camps/lodges)
___ Power
___ Agricultural
___ **Conservation**
___ Recreational
___ **Miscellaneous** (includes exploration/drilling) (describe):_____

See Schedule II of *Northwest Territories Waters Regulations* for Description of Undertakings

6. **WATER USE**

___ To obtain water
___ To modify the bed or bank of a watercourse
___ To alter the flow of , or store, water
___ To cross a watercourse
___ To divert a watercourse
___ Flood control
X Other (describe):

To restore the bed of the water course

7. **QUANTITY OF WATER INVOLVED** (cubic metres per day including both quantity to be used and quality to be returned to source)

N/A

8. **WASTE** (for each type of waste describe: composition, quantity (cubic metres per day), methods of treatment and disposal, etc.)

No wastes will be produced.

___ Sewage ___ Waste oil
___ Solid Waste ___ Grey water
___ Hazardous ___ Sludge
___ Bulky Items/Scrap Metal ___ Other (describe):_____

9. **PERSONS OR PROPERTIES AFFECTED BY THIS UNDERTAKING** (give name, mailing address and location; attach if necessary)

No persons or properties will be affected

Land Use Permit

DIAND ___ Yes ___ No If no, date expected _____

Regional Inuit Association ___ Yes ___ No If no, date expected _____

Commissioner ___ Yes ___ No If no, date expected _____

10. **PREDICTED ENVIRONMENTAL IMPACTS OF UNDERTAKING AND PROPOSED MITIGATION MEASURES** (direct, indirect, cumulative impacts, etc.)

Minimal environmental impact is anticipated. The work consists just in replacing boulders in the riverbed, that were scoured out by erosion.

NIRB Screening ___ Yes ___ No If no, date expected _____

11. **INUIT WATER RIGHTS**

Vill the project or activity substantially affect the quality, quantity, or flow of water flowing through Inuit Owned Lands and the rights of Inuit under Article 20 of the Nunavut Land Claims Agreement?

NO

If yes, has the applicant entered into an agreement with the Designated Inuit organization to pay compensation for any loss or damage that may be caused by the alteration. If no compensation agreement has been made, how will compensation be determined?

N/A

12. **CONTRACTORS AND SUB-CONTRACTORS** (name, address and functions)

Contractor: Qikiqtaq Equipment Ltd. of Pangnirtung NU
Mr. Norman Etooangat, Tel: 867 473-8538, Fax: 867 476-8551

13. **STUDIES UNDERTAKEN TO DATE** (list and attach copies of studies, reports, research, etc.)

14. **THE FOLLOWING DOCUMENTS MUST BE INCLUDED WITH THE APPLICATION FOR THE REGULATORY PROCESS TO BEGIN**

Supplementary Questionnaire (where applicable: see section 5) ___ Yes ___ No If no, date expected _____

Inuktitut/English Summary of Project X Yes ___ No If no, date expected _____

Application fee $30.00 (Payee Receiver General for Canada) X Yes ___ No If no, date expected _____

Water Use fee (see Section 9 of the *NWT Waters Regulations;* Payee Receiver General for Canada)
Yes ___ No If no, date expected _____

15. **PROPOSED TIME SCHEDULE**

X Annual (or) ___ Multi Year

Start Date: **September 25, 2004** Completion Date: **October 10, 2004**

Jivko I. Jivkov	**Principal**		**September 19, 2004**
Name (Print)	**Title (Print)**	**Signature**	**Date**

For Nunavut Water Board use only

APPLICATION FEE **Amount: $**_____ **Pay ID No.:** _____

WATER USE DEPOSIT **Amount: $**_____ **Pay ID No.:** _____

September 19, 2004

Project Summary

Duval River Bridge, Pangnirtung, NU. Temporary Repair

Recently, the GN and Municipal officials in Pangnirtung have expressed concerns regarding the safe operation of the community bridge, in view of a tilt of the west abutment pile-cap and significant scour under the east abutment. The GN retained a consultant to inspect and assess the structural condition of the bridge and to provide recommendation for temporary and long term remedial works that would guarantee safe operation of the bridge.

The conclusions and recommendations provided by the consultant are:

- The bridge is 27 metres long, single lane steel structure with timber deck. It was constructed in 1983 according to design provided by the Federal Government. The deformation on the abutments (tilt, sag, etc) is due to significant scour of the riverbed and erosion under abutment walls. Scouring of the riverbed occurs almost exclusively during spring break-up, when the river has significant ice traffic and is extremely violent, with water discharges many times larger than the regular summer ones. The reason for the scour is that the bridge span is significantly smaller than the riverbed width. The constricted river rushes through the narrow channel under the bridge and erodes the riverbed.
- The bridge is not in immediate danger of collapsing. It is unlikely that heavy vehicles travelling on the bridge would cause any further deformation on the abutments. Unless torrential rainfall occurs, it is unlikely that further scour will occur this year. However, it is very likely that further scour and more damage on the abutment walls will occur during the 2005 break up. The magnitude of the damage will depend to the level of violence of the break up. Unusually hot weather accelerates the snow melting process causing large water discharges and significant scouring. In the worst case scenario the abutment wall will fully collapse exposing the piles behind. Without the support from the wall, the piles will buckle and the bridge will collapse into the river.
- The Temporary Repair will consist in stabilising the abutments by placing 300 cu m assorted boulders in the scoured areas. This repair is considered urgent and the GN is planning to complete in by the end of September, or early October this year. The cost of this repair is estimated at $40,000 to $50,000. Similar repair to a smaller scale would have to be carried out in subsequent years until the implementation of a long term remedy.
- The Long Term remedy will consist in replacing the 27.0 metres long existing bridge with a 45.0 meters long one that corresponds to the natural river width. The cost of the new bridge is estimated at $700,000. The GN is looking into including the new bridge for construction in the near future.

Prepared by:
Jivko I. Jivkov, P. Eng
Jivko Engineering