Trow Associates Inc.
154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Telephone: (613) 225-9940
Facsimile: (613) 225-7337
E-mail: ottawa@trow.com
Web Site: www.trow.com

Reference: OTCD00017307B

September 8, 2005

Phyllis Beaulieu
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU
X0B 1J0

Pangnirtung Health Centre
Drainage Channel Flow Capacity

Dear Ms. Beaulieu:

The Government of Nunavut proposes to construct a new Health Centre for the Hamlet of Pangnirtung on a site that currently consists of a single residential dwelling and a drainage ditch. The existing drainage ditch conveys flows from a 600 mm diameter CSP culvert that crosses the gravel road situated south of the proposed building site (refer to Drawing GP-1). In order to proceed with the proposed building construction, the existing drainage ditch that transects the site must be diverted along the northeastern boundary of the site. Flows from the proposed diverted ditch will join the existing drainage ditch directly north of the proposed site. The following letter includes a discussion of pre-development and post-development flow conditions in the vicinity of the proposed site.

Existing Flow Condition

The existing drainage ditch that transects the proposed building site is not well defined as illustrated in Figure 1 attached. The ditch has a slope of approximately 3% from the upstream culvert to the downstream limit of the proposed construction. The ditch conveys flows mainly during spring melt and, to a lesser extend, from occasional rainfall events. The existing culvert crossing the gravel road, as illustrated in Figure 2, has been in place for many years with no visible signs of erosion problems at either the upstream or downstream ends.

Due to a lack of information regarding the upstream contributing area to the existing culvert south of the proposed building site, the theoretical capacity of the culvert under free-flowing state was used to estimate flow rate and velocity in the existing drainage ditch that currently transects the site. As detailed in the attached Flow Capacity Computation Form, Manning's equation for steady uniform flow conditions was used to estimate the maximum flow and velocity. Based on a 600 mm diameter CSP culvert with a 7% slope, the peak flow and velocity are calculated to be 880 L/s and 3.1 m/s, respectively. This flow rate was assumed to be the peak flow that is conveyed by the existing drainage ditch that has to be diverted. The actual peak flow

conveyed through the culvert is likely less than the calculated peak flow due to the fact that culverts are commonly oversized as a conservative approach to addressing urban drainage.

Proposed Drainage

The proposed diversion ditch will have an average slope of 0.5%, a bottom width of approximately 2 metres and a top width of approximately 5 metres (refer to Drawing GP-1). As detailed in the attached Open Channel Flow Computation Form, Manning's equation was used to estimate the maximum flow capacity of the proposed diversion swale. Based on the above mentioned swale details and a Manning's 'n' value of 0.018, consistent with a clean, uniform earth section, the calculated capacity is 1120 L/s.

Summary

As demonstrated by the attached calculation sheets, the proposed diverted ditch will have a capacity greater than the calculated capacity of the contributing upstream culvert under free-flow condition. Therefore, the proposed drainage ditch is adequate for conveying flows originating from the upstream catchment area through to the undisturbed ditch downstream of the proposed building site.

Yours truly,

Trow Associates Inc.

Dave Turcotte, B.Sc M.E.S.
Environmental Scientist
Civil Engineering Services

Alam Ansari, M.Sc., P.Eng.
Senior Project Manager
Civil Engineering Services

Enclosures: Flow Capacity Computation Form
Open Channel Flow Computation Form
Drawing SG-1 – Grading Plan

Photograph No. 1: Existing Drainage Ditch Flowing Through Proposed Building Site

Photograph No. 2: Existing Culvert at Upstream End of Proposed Building Site

FLOW CAPACITY COMPUTATION FORM

Trow

Manning's Equation for steady uniform flow conditions

$Q = 1000 * R^{2/3} * S^{1/2} * A/n$

Where:
Q = Flow (L/s)
R = Hydraulic Radius (m)
A = Cross-Sectional Pipe Area (m^2)
n = Manning Roughness Coefficient
S = Channel Slope (m/m)

$V = (1/n) R^{2/3} * S^{1/2}$

Where:
V = Flow Velocity (m/s)
n = Manning Roughness Coefficient
R = Hydraulic Radius (m)
S = Channel Slope (m/m)

R = A / P

Where:
R = Hydraulic Radius (m)
A = Cross Sectional Area (m^2)
A = Pi/4 * Diameter^2 (m)
P = Wetted Perimeter (m)
P = Pi * Diameter (m)

Manning "n" for CSP:	0.024	(Corrugated Steel Pipe - Unpaved) (MOE Drainage Management Manual)	**USER DEFINED**

Diameter =	600 mm	**USER DEFINED**
Slope =	7 %	**USER DEFINED**

A =	0.2827 m^2
P =	1.8850 m
R =	0.1500 m
Q =	879.95 L/s
V =	3.11 m/s

OPEN CHANNEL FLOW COMPUTATION FORM

Trow

	Bottom Width	Left Side Slope	Right Side Slope	Flow Depth	Wetted Perimeter	Top Width	Area	Hydraulic Radius	Boundary Material	Manning's n	Bottom Slope	Average Velocity	Flow Rate	Flow Rate
	m	X horizontal : 1 vertical	X horizontal : 1 vertical	m	m	m	m^2	m			m/m	m/s	m^3/s	L/s
Proposed Swale East of Health Centre	1.0	7	7	0.30	5.04	5.00	0.90	0.18	Earth, uniform section, clean	0.018	0.0050	1.24	1.120	1120