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2004 March 10

FILE: EBA-012

EBA Engineering Consultants Inc.
500-110 Melville Street
Vancouver, BC V6E 4A6

Attn: Mr. Rick Hoos

Dear Rick

Re: Prairie Creek Mine Probable Maximum Flood Profile

Hayco has carried out a very rough analysis of the flood flows in Prairie Creek, using the limited data that are available. Strictly speaking this is not a Probable Maximum Flood analysis, as such an analysis requires a lot of detailed data and some weeks of work.

Hayco adopted two approaches:

- A frequency analysis of the regional hydrometric data available; and
- An estimate of the probable maximum precipitation and a simple catchment model

Note that it has not been possible to review the earlier calculations of the PMF and the corresponding flood profile, as these have not been made available.

1. Regional Frequency Analysis

There are flow data available for the following hydrometric stations:

Table 1: Hydrometric Stations

No.	Station Name	Years	Drainage Area (sq km)
10EC002	Prairie Creek at Cadillac Mine	14	495
10EA003	Flat River near the Mouth	33	8560
10EB001	S. Nahanni R above Victoria Falls	34	14600
10EC001	S. Nahanni R above Clausen Ck	24	31100

The annual maximum instantaneous flows were analyzed using Environment Canada's Consolidated Frequency Analysis program. A generalized extreme value distribution was fitted to each set of data and the results were extrapolated to 10,000 years to be indicative of the order of magnitude of a Probable Maximum Flood. It must be stressed that there is limited accuracy associated with this approach. One cannot reliably estimate the flood of a return period longer than about twice the record length. However, this does provide an order of magnitude estimate. The results for all four hydrometric stations are given in Figure 1. Combining the results and applying the regression equation gives an estimate of the 10,000-year maximum instantaneous flow for Prairie Creek at the minesite of about **473 m^3/s**.

Note that this event uses actual hydrometric data, so could be a snowmelt or rainfall event.

2. Probable Maximum Precipitation and Catchment Model

Hershfield's method (NRC, 1989) was used to establish the Probable Maximum Precipitation using data published in the Rainfall Frequency Atlas (Hogg and Carr, 1985). This method is also very approximate due to the paucity of data and relatively short record periods, particularly when the atlas was published, however data from the (then) Cadillac Mine should be incorporated. A mean annual 24-hour maximum rainfall of 30 mm was determined from the Rainfall Atlas, along with a standard deviation of 12.5 mm. Hershfield's frequency factor K_{24} is a function of the mean annual 24-hour maximum rainfall, P_{24} and was determined to be 17.77 from the equation:

$$K_{24} = 19\ (10)^{\ -0.000965\ *\ P_{24}}$$

Substituting this value of K_{24} into the standard prediction equation gives:

$$PMP_{24} = P_{24} + K_{24} * 12.5 = 252 \text{ mm}$$

This is a point rainfall value and can be reduced to a mean value over the whole catchment using curves developed by Pugsley (1981). The probable maximum average catchment rainfall over the 495 square km of drainage area is estimated to be 227 mm in 24 hours.

This rainfall was then used in a simple catchment model (HEC-HMS) to estimate the peak flow that would result from such a storm. The lag time for the catchment was estimated at 25 hours and a curve number (CN) of 65 was assumed. The resulting peak discharge was **549 m^3/s**, which is comparable to the value determined by frequency analysis, given the approximate nature of both approaches.

3. Flood Profile Computation

A flood profile in Prairie Creek in the vicinity of the mine was computed using a discharge of 549 m^3/s (the larger of the two values determined above) and creek cross sections given in a Figure 18 by Ker Priestman & Associates, probably dating from the 1980s. The results of this analysis are presented in the table below, with the corresponding water surface profile elevations given by Ker Priestman in their Figure 18, for comparison.

Table 2: Probable Maximum Water Surface Profiles

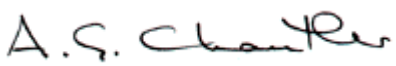
Chainage (ft)	KPA Water Level (ft)	Updated Water Level (ft)	KPA Water Level (m)	Updated Water Level (m)
102+20	2858	2854	871.1	869.9
114+00	2850	2848	868.7	868.1
120+00	2848	2843	868.1	866.5
126+00	2843	2841	866.5	865.9
131+00	2841	2836	865.9	864.4
153+60	2818	2816	858.9	858.3

It can be seen that the elevations calculated in this study are consistently lower than those calculated by KPA by between 0.6 and 1.6 m.

We hope this brief study meets your requirements. Please call if you have any questions.

Yours very truly,

HAY & COMPANY CONSULTANTS INC.



Dr. Adrian Chantler, P.Eng.
President
/agc

REFERENCES

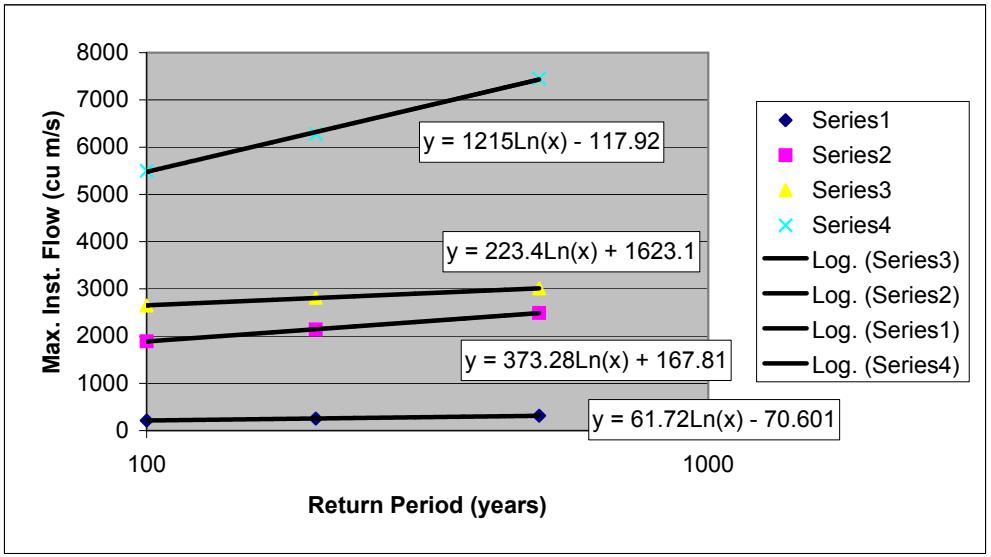
Hogg W.D., and D.A. Carr, 1985
Rainfall Frequency Atlas for Canada, Canadian Climate Program, Environment Canada

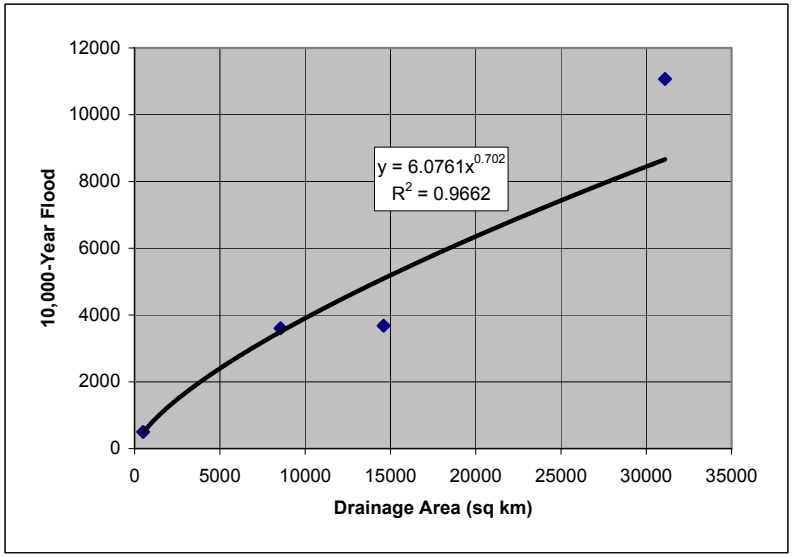
National Research Council Canada, 1989
Hydrology of Floods in Canada: A Guide to Planning and Design

Pugsley, W.I., 1981
Flood Hydrology Guide for Canada, CLI3-81, Environment Canada

Prairie Creek Flood Analysis

Station No.	Station Name	Years	Drainage km^2	Q_{100} m^3/s 100	Q_{200} m^3/s 200	Q_{500} m^3/s 500	Q_{10000}
10EC002	Prairie Creek at Cadillac Mine	14	495	215	254	314	498
10EA003	Flat River near the Mouth	33	8560	1890	2140	2490	3606
10EB001	S. Nahanni R above Victoria Falls	34	14600	2650	2810	3010	3681
10EC001	S. Nahanni R above Clausen Ck	24	31100	5500	6280	7450	11073





Based on the correlation of 10,000-year flood and drainage area, the 10,000 year flood at the minesite would be 473 m^3/s

FIGURE 1