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MEMORANDUM **NOTE DE SERVICE**

TO / À

Garth I. Haack
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FROM / DE

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SECURITY - CLASSIFICATION - DE SÉCURITÉ N/A
OUR FILE - NOTRE RÉFÉRENCE 4547:928-7H4
YOUR FILE - VOTRE RÉFÉRENCE N/A
DATE November 21, 2007

SUBJECT / OBJET **Highfield Dam – Updated Flood Frequency Analyses**

In response to a request by Glenn McLaughlin via an e-mail to Ron Woodvine dated June 22, 2007, I have conducted detailed flood frequency analyses of both snowmelt and rainfall events for the purpose of reassessing and updating the inflow hydrographs for Highfield Dam. The results of the analyses are provided in Table 1.

Table 1

Highfield Dam – Updated Inflow Estimates

Return Period	Snowmelt (Spring) Events		Rainfall (Summer) Events	
	Instantaneous Peak Flow (m^3/s)	Runoff Volume (dam^3)	Instantaneous Peak Flow (m^3/s)	Runoff Volume (dam^3)
1:2	13	5,200	1.2	82
1:5	30	11,200	7.6	696
1:10	41	15,100	19	2,020
1:20	53	19,200	39	4,610
1:50	71	24,700	80	10,600
1:100	85	29,200	123	17,400
1:200	101	33,900	180	26,900
1:500	121	40,100	274	43,600
1:1,000	139	45,500	361	60,300

Associated snowmelt and rainfall hydrographs are attached.

With the exception of rainfall runoff volumes at relatively large return periods (i.e. 1:500 and greater), the magnitude of both the flood peaks and the runoff volumes for rainfall and snowmelt events are somewhat

lower than values determined in the previous analysis (August 2003). While the results of the previous analysis are considered to be appropriate for the database (i.e. a 36-year period 1966-2001) that was available at that time, the primary reason for this difference in the magnitude of the values is that the current analyses are based on six additional years of data (a 19% increase in the database period). Furthermore, all relationships (i.e. MDM versus instantaneous and MDM versus runoff volume) were revised using the current available database 1965-2006. The additional years of record contained the 5th largest snowmelt event (MDM of 19.3 m^3/s) in 2003 and the largest recorded rainfall event (MDM of 37.3 m^3/s) in 2005.

Snowmelt Events

The snowmelt analysis was based solely on recorded maximum daily mean (MDM) flows of Rushlake Creek Above Highfield Reservoir (05JC004) for the period 1965-2006. No attempt was made to extend the database by correlation with data for stations in other basins because there did not appear to be any hydrologically-similar basins in the vicinity for which data was available for extension purposes. The resulting array of recorded (1965-2006) MDMs at 05JC004 was analyzed using Environment Canada's Consolidated Frequency Analysis (CFA) program to determine the most appropriate frequency distribution. While the Three-Parameter Lognormal frequency distribution provided the best statistical data fit of the four distributions (Generalized Extreme Value, Three-Parameter Lognormal, Log Pearson Type III, and Wakeby) that were examined, it was not a satisfactory fit from a visual perspective. Thus, a frequency curve was "drawn by eye" that fit the plotted data and provided realistic values at larger return periods.

Snowmelt inflow hydrographs to Highfield Reservoir were developed from the derived parameters at station 05JC004 located upstream of Highfield Reservoir. MDMs for nominal flood events (i.e. 1:2 to 1:1,000) at 05JC004 were multiplied by an effective drainage area ratio to a nominal exponent of 0.75 to obtain inflow MDMs to Highfield Reservoir. These inflow MDMs were subsequently multiplied by the corresponding instantaneous/MDM flow ratio developed for 05JC004 and a Fuller Factor adjustment ratio to obtain instantaneous flows to Highfield Reservoir for nominal flood events. Runoff volumes for associated nominal flood events at 05JC004 (as determined using the MDM versus runoff volume relationship for 05JC004) were multiplied by a corresponding contributing drainage area ratio (linear relationship between the effective drainage area ratio at a 1:2 event and the gross drainage area ratio at a 1:500 event on arithmetic probability paper) to obtain runoff volumes for nominal flood events at Highfield Reservoir. A typical rising limb "k" value (11.531/day) was determined by assessing the rising limbs of the six largest snowmelt runoff events recorded at 05JC004. An in-house program HYDROGRAPH was used to generate the nominal inflow hydrographs using the derived rising limb "k" value (a corresponding value of 1.107 was used for a hydrograph coordinate interval of one hour), the estimated instantaneous flow, and the estimated runoff volumes at Highfield Reservoir.

Rainfall Events

The rainfall analysis was based solely on recorded maximum daily mean (MDM) flows of Rushlake Creek Above Highfield Reservoir (05JC004) for the period 1965-2006. No attempt was made to extend the database by correlation with data for stations in other basins because there did not appear to be any hydrologically-similar basins in the vicinity for which data was available for extension purposes. The resulting array of recorded (1965-2006) MDMs at 05JC004 was analyzed using Environment Canada's Consolidated Frequency Analysis (CFA) program to determine the most appropriate frequency distribution. While the Log Pearson Type III frequency distribution provided the best visual and statistical data fit of the four distributions (Generalized Extreme Value, Three-Parameter Lognormal, Log Pearson Type III, and Wakeby) that were examined, it was not a satisfactory fit because the frequency curve was concave up. Thus, a frequency curve was "drawn by eye" that fit the plotted data and provided realistic values at larger return periods.

Rainfall inflow hydrographs to Highfield Reservoir were developed from the derived parameters at station 05JC004 located upstream of Highfield Reservoir. MDMs for nominal flood events (i.e. 1:2 to 1:1,000) at 05JC004 were multiplied by an effective drainage area ratio to a nominal exponent of 0.75 to obtain inflow

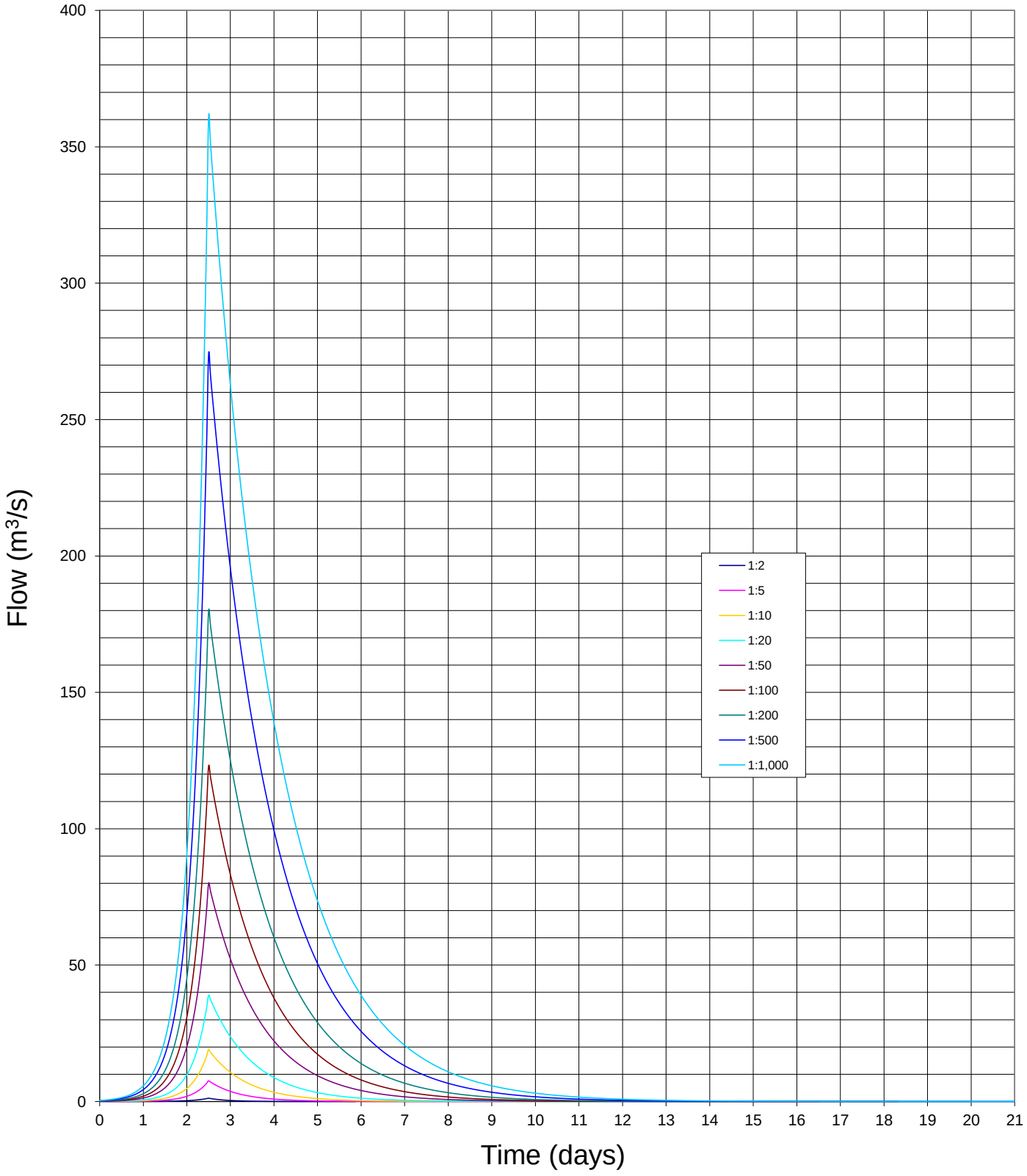
MDMs to Highfield Reservoir. These inflow MDMs were subsequently multiplied by the corresponding instantaneous/MDM flow ratio developed for 05JC004 and a Fuller Factor adjustment ratio to obtain instantaneous flows to Highfield Reservoir for nominal flood events. Runoff volumes for associated nominal flood events at 05JC004 (as determined using the MDM versus runoff volume relationship for 05JC004) were multiplied by a corresponding contributing drainage area ratio (linear relationship between the effective drainage area ratio at a 1:2 event and the gross drainage area ratio at a 1:500 event on arithmetic probability paper) to obtain runoff volumes for nominal flood events at Highfield Reservoir. A typical rising limb "k" value (15.893/day) was determined by assessing the rising limbs of the six largest rainfall runoff events recorded at 05JC004. An in-house program HYDROGRAPH was used to generate the nominal inflow hydrographs using the derived rising limb "k" value (a corresponding value of 1.122 was assumed for a hydrograph coordinate interval of one hour), the estimated instantaneous flow, and the estimated runoff volumes at Highfield Reservoir.

Fred R. J. Martin
Manager, Surface Water Unit

Attachments

cc: R. Woodvine
G. McLaughlin

Rainfall Inflow Hydrographs to Highfield Reservoir



Snowmelt Inflow Hydrographs to Highfield Reservoir