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April 16, 2013

Nava Pokharel, Senior Project Manager
Xeneca Power Development
5255 Yonge Street
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Toronto, ON
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Dear Nava:

Re: Screening Assessment - Water Temperature - Blanche River (Marter Twp)
ORTECH Reference #61001

This letter report outlines the screening assessment for water temperature changes related to Xeneca's proposed waterpower project (Marter Twp) on the Blanche River. The purpose of the assessment is to identify triggers that could lead to a significant change in water temperature, either at a macro habitat scale over a significant portion of the watershed, or over a micro habitat scale within the inundation area or immediately downstream thereof.

Of special interest in Ontario's cold climate are summer months and how elevated water temperatures may affect dissolved oxygen levels and/or habitat stress on cold water seeking fish species. Elevated water temperatures occur under conditions of low flow (i.e. long residence time) and extended periods of warm summer weather. Stream systems warm up progressively in the spring and summer over many days until heat gain begins to equal heat loss. Once an average summer baseline temperature range has been reached, consecutive days or weeks of hot, sunny conditions can further raise temperatures above the baseline. Consecutive cool and cloudy days can decrease temperature below the baseline. Due to the variability of flow and climatic conditions from one summer to another, the prevailing water temperature can vary several degrees from year to year and throughout a given summer.

A significant change in water temperature would be either, a subtle but persistent change to the average summer baseline temperature affecting the macro habitat of the watershed, or a significant localized micro habitat change in or immediately downstream of the proposed inundation. Change in open water area, residence time and stratification are some of the primary factors in water temperature impact from new inundation. Other factors are solar radiation input, air temperature/heat loss and shoreline shading. For this screening assessment, only the change in open water area, residence time and stratification were considered. Due to the scope of the screening approach, possible triggers that could lead to significant temperature changes can be identified. Calculation of projected changes in water temperature is not included in this screening assessment but can be carried out where significant triggers are identified.

1) **Open Water Surface Area:** The open water surface area upstream of any point in the watershed is related to solar radiation input and retention time in the stream network (Bartholow, 1989). Assessing the amount of new inundation provides some perspective, at a macro level, on the potential additional contribution to the baseline water temperature equilibrium in the watershed. Using the water polygon data available from Land Information Ontario, and analysis of satellite images from GeoBase (see map in Appendix 1), the existing open water area for the Blanche River and its tributaries upstream of Marter Twp was determined as shown in Table 1. These values were then compared to the proposed new open water inundation polygons predicted for the proposed Xeneca waterpower projects shown in Table 2.

   The area ratio between the proposed inundation and the existing open water area in the watershed was calculated as shown below.

   - Marter Twp area ratio (ha): 13 / 7785 = 0.2%

   <u>The resulting change in area due to the new inundation of Marter Twp is less than 1% of the total open water area of the watershed. The calculation results suggest that the contribution to the overall summer temperature baseline in the watershed at the macro scale is insignificant.</u>

2) **Residence Time:** Upstream dams affect downstream temperatures through (i) changes in the release temperatures at the dam sites and (ii) through changes in downstream flows (Rounds, 2010). Recent studies show that small, manmade dams have limited impacts on thermal regimes (Lessard, 2000). These studies state that when residence times are relatively low in reservoirs, agents of thermal regime change have less time to act upon the water body.

   Residence time for the proposed projects was calculated by dividing reservoir volume (Table 4) by various summer low flow scenarios (Table 3), including August and September flow rates for available sample years 2003 and 2004, recorded in m^3/s. The results of the analysis suggest increases in residence time ranging from a half day (13 hours for Marter Twp in July 2004 scenario) to 3 days (62 hours for Marter Twp in September 2004 scenario). The average increase in residence time for the inundation from the sample data is approximately 1 day.

   <u>Based on the knowledge that a series of hot consecutive days are required to *cause* a notable increase in water temperature from the summer baseline, the additional average residence time of 1 day in typical summer months is not likely to result in a significant change in water temperature under normal conditions. This result appears consistent with the above referenced literature of Lessard, 2000.</u>

3) **Stratification:** Temperature stratification can occur in deep reservoirs whereby the water at depth remains cooler than the water at the surface (Miller 2004). In such reservoirs, a surface layer typically develops where water temperatures are relatively uniform due to

mixing from wave action and flow currents. This mixing layer is typically several meters deep. For the purpose of a screening assessment, it is assumed that inundation of less than 6 meters depth will be fully mixed. It is further assumed that the mixing layer behaves similar to the river channel, where water temperature is directly affected by heat gain and heat loss to the surroundings.

Where stratification exists, the engineering design of the dam and powerhouse will determine if flow is released from the upper, mixed layer, or the lower, cooler layer. Release of cooler water can have a significant effect on water temperatures immediately downstream. This effect can be most notable in the summer, when cooler water is discharged into a warm river channel.

Average new inundation depth for the proposed Marter Twp project was calculated by dividing the proposed inundation volume by the inundation area as shown in Table 4 below. The result provides the average new inundation depth of 4.3 meters.

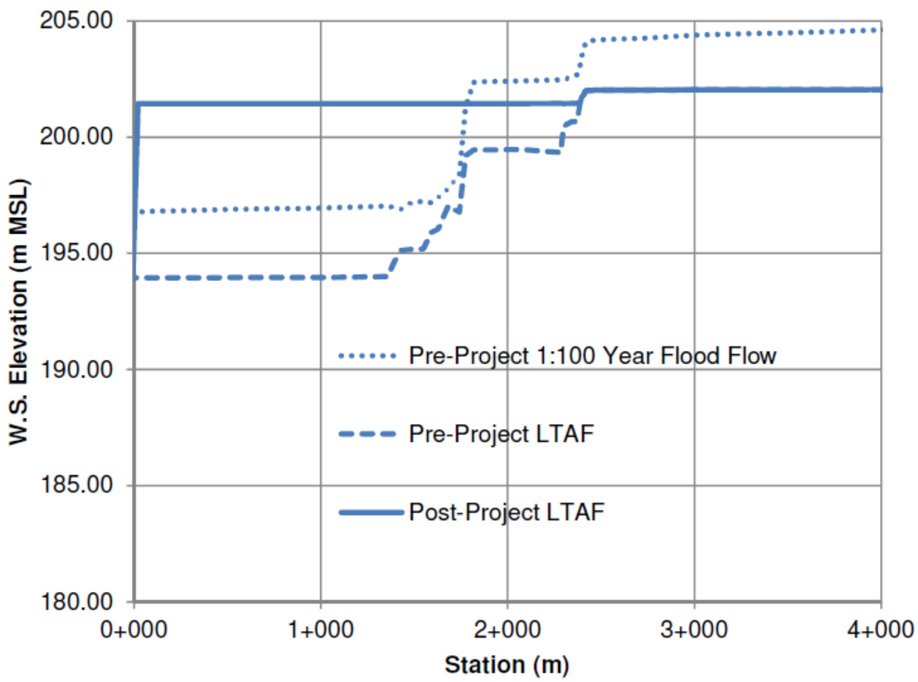

Figure 1: Marter - Pre and Post Project headpond level (CPL, 2012)

The average depth of new inundation suggests that the potential for stratification is limited. Figure 1 shows the pre and post project headpond level of Marter Twp project. The deepest part of the new inundation is up to 7 meters deep, suggesting that some stratification may occur in the deepest part of the headpond (the former channel bottom). However, the associated volume of water is very small. The conceptual design suggests that water from 1-4 meters depth will enter the powerhouse. It is reasonable to assume that the water at this depth comes from the mixed layer.

Due to the shallow average depth of the inundation and based on the proposed conceptual design drawings of the intake structures, the potential for temperature stratification in the water released from the Marter project is not likely.

4) **Monitoring:** Water temperature monitors have already been installed on the Blanche River. Baseline monitoring results have been reported as part of the water quality monitoring aspects of the environmental assessment information. The initial baseline data for 2011 in the main stem of the river at the Marter project site show the summer water temperature for July and August ranging from 22°C to 26°C (see Figure 2 attached). The short term variations of several degrees appear to reflect the variation from prevailing ambient conditions. Ongoing monitoring of discharge temperatures at the powerhouse could be used to compare the values to the baseline data and confirm the assessment made herein, if deemed necessary.

It is apparent from the small increases in open water area, the short residence times and the limited potential for stratification resulting from the proposed waterpower projects, that the propensity for water temperature changes in the Blanche River is low.

Yours truly,

Nick Collard, BA
GIS Specialist
ORTECH Consulting Inc.

Table 1: Total Open Water Surface area upstream of the project site

	Total Open Water (ha)
River Feature	
Total	7785

Table 2: Inundation Area of the Project

	Normal	Units
Inundation Area- Post Project	22	ha
Inundation Area - Pre-project	9	ha
Difference	13	ha

Table 3: Mean Monthly Flows + Residence Time

Marter						
Year	Jul (cms)	Residence Time (hr)	Aug (cms)	Residence Time (hr)	Sep (cms)	Residence Time (hr)
2003	11.2	23	6.5	40	7.0	37
2004	19.8	13	7.6	34	4.1	62

Table 4: Reservoir Volume of Marter Twp Project

Elevation (m)	Volume (m^3)
201	921,728

Table 5: Blanche - Average Reservoir Depth

Project	Avg. additional new depth at NOL (m)
Marter Twp	4.3

Figure 2: Recorded Temperature just upstream of Marter Twp Dam site

References:

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Koster, D., Karst-Riddoch, T., 2011, Effects of Impoundment on Water Quality: Literature Review and Assessment of Proposed Four Slide Falls Development on McCarthy Lake Water Quality. Hutchison Environmental Sciences Ltd., 30p

Lessard, JL. 2000. Temperature effects of dams on cold water fish and macro in-vertebrate communities in Michigan. Master's thesis. Michigan State University, East Lansing, MI 16 p

Miller, Charles B. 2004. Biological Oceanography. Blackwell Publishing).

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Appendix 1: Blanche River Water Features Map (1 page)


560000
580000
5340000
5320000
5300000
Marter Twp Blanche River
Timmins
Sudbury
© Harris Corp, Earthstar Geographics LLC © 2013 Microsoft Corporation
February 27, 2013 UTM 17N. MNR CANMAP data. Produced by: Kerri-Ann Jones
Pre - Project LTAF
Post - Project LTAF - New Open Water
Existing Open Water
Dam
ORTECH Power
N
W
E
S
4,600
2,300
0
4,600 Meters