Memorandum

DATE:	September 14, 2010
TO:	Chris Hanks, Hope Bay Mining Limited (HBML)
FROM:	Carol Adly (M.Sc.), Michael McGurk (Ph.D., R.P.Bio.), Greg Norton (M.Sc.), and Deborah Muggli (Ph.D., M.Sc., R.P.Bio.)
SUBJECT:	Potential effects of water level drawdown in Windy Lake as a result of increased water use

Introduction

The purpose of this memorandum is to assess the potential effects of a proposed increase in water withdrawal rates from Windy Lake.

Hope Bay Mining Ltd. (HBML) would like amend their Type B Water Licence to include additional water for domestic use and for dust suppression use. The current licence 2BE-HOP0712 allows for the withdrawal of an average of 20 m^3/day for domestic use and 80 m^3/day for drilling use, for a total annual water withdrawal of 36,500 m^3/year (100 m^3/day $\times$ 365 days). HBML requests that the permit be amended to allow for the withdrawal of an additional 43 m^3/day for domestic use and 200 m^3/day for dust suppression use between the end of May and the end of September. The proposed water withdrawal from Windy Lake would amount to an average of 210 m^3/day (maximum of 76,595 m^3/year), calculated as follows:

Domestic Use:	63 m^3/day x 365 days	= 22,995 m^3/year
Drilling Use:	80 m^3/day x 365 days	= 29,200 m^3/year
Dust Suppression Use:	200 m^3/day x 122 days	= 24,400 m^3/year
Total:		= 76,595 m^3/year

Predicted Effects of Water Level Drawdown in Windy Lake

Currently, licence 2BE-HOP0712 allows for the withdrawal of 36,500 m^3/year from Windy Lake and other sources in the vicinity. Although it is unlikely that all exploration drill water in a year would be drawn from Windy Lake, removing all of this amount of water from Windy Lake would result in an approximate annual 0.69 cm decline in the water level, a 0.062% decrease in total lake volume, and a 0.010% decrease in lake surface area (Table 1; see Appendix A for the relationship

between water level, lake volume, and lake surface area derived from the bathymetric profile of Windy Lake).

Table 1. Estimated Changes to Windy Lake Level, Volume, and Surface Area

	Total Water Use (m^3/year)	Change in Windy Lake Water Level* (cm)	Change in Windy Lake Volume* (%)	Change in Windy Lake Surface Area* (%)
Permitted Water Withdrawal:	36,500	0.69	0.062	0.010
Proposed Increase in Water Withdrawal:	40,095	0.76	0.068	0.011
Proposed Total Water Withdrawal:	76,595	1.4	0.13	0.021

** Estimates of changes in water level, lake volume, and lake surface area are based on data derived from the bathymetric profile of Windy Lake (see Appendix A).*

If it were all drawn from Windy Lake, which again would be unlikely, the proposed average of 210 m^3/day (maximum of 76,595 m^3/year) water withdrawal from Windy Lake would result in a 0.13% decrease in total lake volume. This represents an estimated decline in the mean annual water level of 1.4 cm, and a 0.021% decrease in lake surface area (Table 1).

Historical data available for 2006, 2007, and 2009 indicate that the water level in Windy Lake fluctuates by approximately 20 to 30 cm during the ice-free season. In comparison, the estimated 1.4 cm decline in water level is expected to have no significant impact on lake water levels and hence fish habitat because it lies within the normal range of seasonal water level variation in Windy Lake. Lake water levels vary naturally on an hourly, daily, seasonal, and annual basis as a result of variation in precipitation, snowmelt runoff, evaporation, as well as ice formation and break-up. Moreover, normal wind-induced wave action can cause local variation in the height of the wetted shoreline that exceeds 2 cm. Fish within Windy Lake have adapted to variation in water elevations of this magnitude.

The lake's live-water storage volume is also an important parameter to consider. Live-water storage is defined as the upper layer of a waterbody that is located above the invert elevation of the lake's outlet. On a seasonal basis, the lake's live storage volume is affected by hydrologic

input and output processes (i.e., snowmelt runoff, rainfall, rain-on-snow, evapotranspiration). With respect to hydrologically wet and dry water years, the amount of live storage available will change in response to associated fluctuations in the hydrologic processes within the lake's drainage catchment area. If the live-storage volume is not substantially affected, then downstream flow discharges along the outlet channel will likely not be affected as well. However during a more severe hydrologically dry water year, it is expected that the water withdrawal rates would begin to encroach upon the volume of water that would be available for downstream flow discharges. Ongoing monitoring of the lake's water outflow would detect if such conditions were present so that mitigative measures could be undertaken.

Based on the available Windy Lake outflow monitoring information from 2008 and 2009, the lake's live-storage zone includes the estimated upper 0.3 m to 0.4 m of water depth across the lake surface. This is equivalent to a volumetric capacity of approximately 1,600,000 m^3 to 2,100,000 m^3. Given the proposed average of 210 m^3/day (maximum of 76,595 m^3/year), the estimated reduction in water volume ranges from 3.6% to 4.8% of the annual live-storage that is available from Windy Lake. This is considered to be within the normal variation of Windy Lake's live storage capacity and is expected not to cause any significant downstream effects.

Based on the information available, we conclude that the requested increase in water withdrawal under Licence No. 2BE-HOP0712 to an average of 210 m^3/day (maximum of 76,595 m^3/year) meets Fisheries and Oceans Canada's Nunavut Operations Statement for Mineral Exploration Activities; Water Withdrawal, section 11.2:

> 11.2. Ensure water withdrawal volumes do not impact fish or fish habitat. Withdrawals from fish-bearing waters should not result in any noticeable change in water level or downstream flows, particularly during sensitive life stages (e.g., by dewatering spawning or egg incubation areas).

References

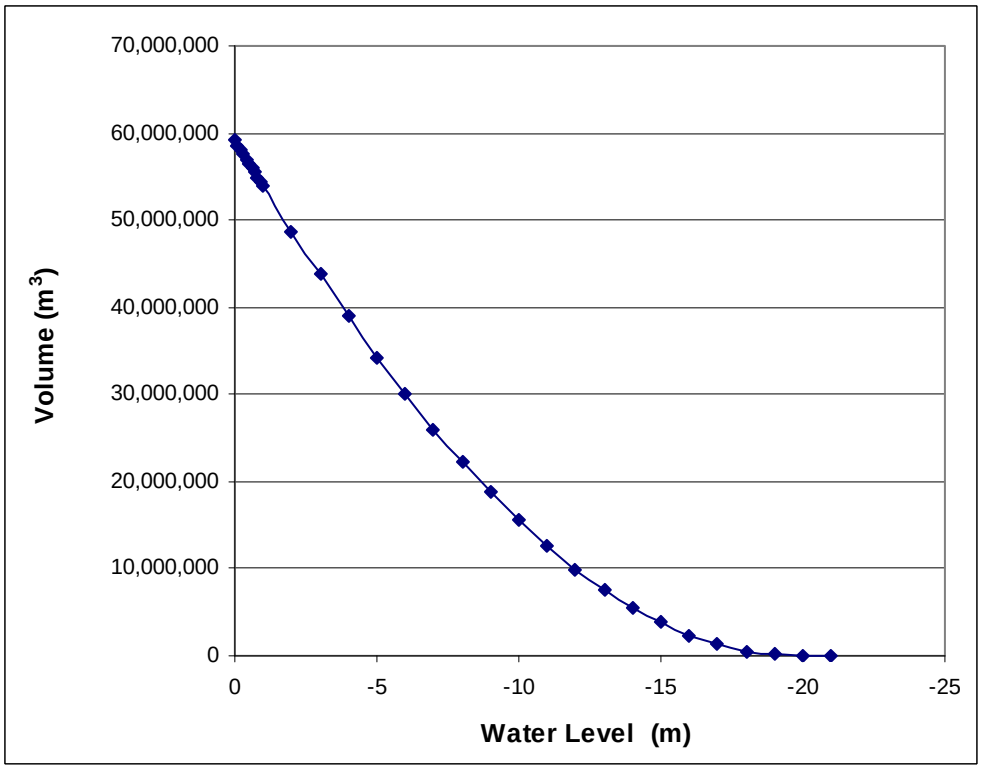
Golder Associates Ltd. 2006. *Report on Bathymetric Surveys, Hope Bay Project, Hope Bay, Nunavut*. Prepared by Golder Associates Ltd. for SRK Consulting Canada Inc. October, 2006.

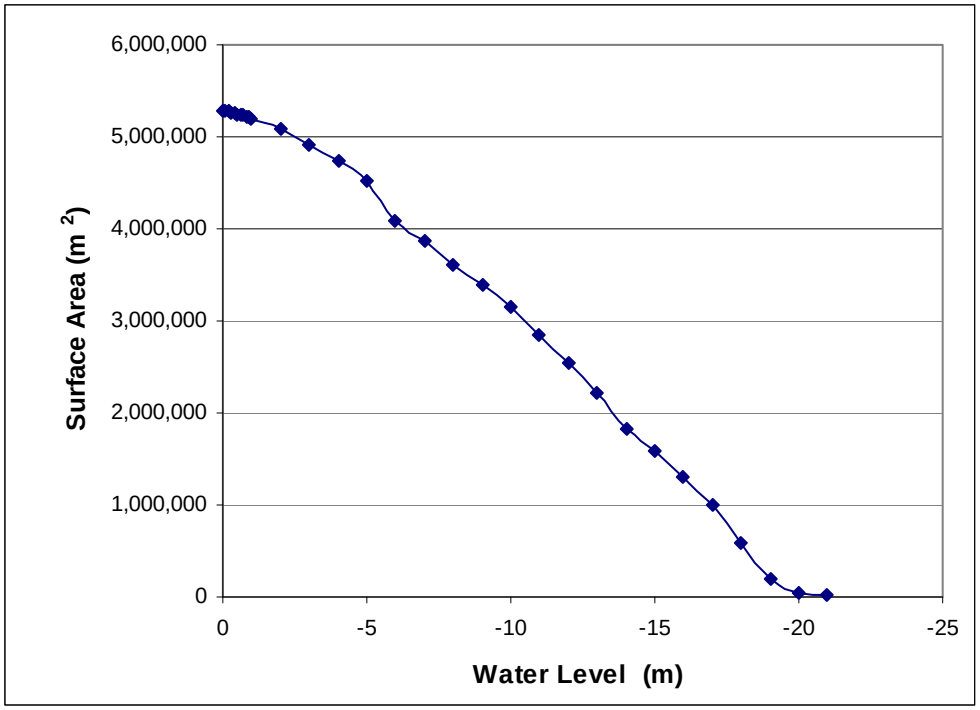
Appendix A — The Relationship between Water Level, Volume, and Surface Area for Windy Lake

Data Source: Windy Lake bathymetry data collected by Golder Associates Ltd. (2006) was processed using the Area and Volume Statistics tool from the 3D Analyst extension in ArcGIS 9.3.1 at 0.1 m intervals for the first metre and 1 m intervals for the remaining water levels. Surface area and water level changes corresponding to predicted decreases in lake volume were estimated by linear interpolation between the 0 and -0.1 m intervals.

Table A-1. Windy Lake Water Level, Area, and Volume

Water Level (m)	Surface Area (m^2)	Volume (m^3)
0	5,287,672	59,137,486
-0.1	5,279,934	58,609,105
-0.2	5,272,198	58,081,499
-0.3	5,264,094	57,554,678
-0.4	5,255,787	57,028,683
-0.5	5,247,462	56,503,521
-0.6	5,239,120	55,979,192
-0.7	5,230,759	55,455,698
-0.8	5,222,380	54,933,040
-0.9	5,213,984	54,411,222
-1	5,205,570	53,890,244
-2	5,085,888	48,741,847
-3	4,923,163	43,735,224
-4	4,738,661	38,905,519
-5	4,526,240	34,276,754
-6	4,095,189	30,019,017
-7	3,868,563	26,044,291
-8	3,601,926	22,331,743
-9	3,397,506	18,835,580
-10	3,148,113	15,564,996
-11	2,841,994	12,580,036
-12	2,541,346	9,902,886
-13	2,216,096	7,525,558
-14	1,826,438	5,542,939
-15	1,576,351	3,848,436
-16	1,312,131	2,407,662
-17	1,000,777	1,263,619
-18	586,400	464,308
-19	195,696	133,983
-20	51,288	29,731
-21	12,346	2,184
Max Depth = -21.235		


70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
Volume (m3)
0
-5
-10
-15
-20
-25
Water Level (m)


6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Surface Area (m 2)
0
-5
-10
-15
-20
-25
Water Level (m)