JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
2611 BROADBENT PARKWAY NE
ALBUQUERQUE, NM 87107
505-345-3407; 505-345-9920 FAX
www.shomaker.com

TECHNICAL MEMORANDUM

To: Steve Raugust, JS Raugust Consulting
Jeff Smith, New Mexico Copper Corporation

From: Steven T. Finch, Jr., Principal Hydrogeologist-Geochemist, JSAI
Annie McCoy, Senior Hydrogeologist, JSAI

Date: September 1, 2015

Subject: **Estimated evaporation rate for future Copper Flat open pit**

As discussed in the Copper Flat Project groundwater-flow model report (JSAI, 2014), potential evapotranspiration (ET), or the maximum evaporation and plant transpiration that can occur given full availability of water, is a function of geographical and climatic conditions, and is commonly estimated using the Penman-Monteith equations (Monteith, 1965). These relate maximum ET (ET_0) to meteorological parameters including temperature, relative humidity and wind speed, and to geographical parameters (altitude, latitude, and time of year). Annual ET_0 computed from results at Hillsboro meteorological station is about 60 in./yr, which compares well to previous estimates (SRK, 1997) of 65 in./yr of potential evaporation, and 64.6 in./yr estimated as 74 percent (an accepted conversion factor for the region (NOAA, 1982) between pan evaporation and evaporation from a normal open water surface) of Copper Flat pan evaporation. Actual evaporation or ET is less, depending on sun and wind exposure, ground conditions, and availability of water.

If ET_0 is estimated to be 60 to 65 in./yr at the rim of the ultimate Copper Flat open pit (where the prior land surface intersects the open pit), ET_0 will be somewhat less at the bottom of the ultimate open pit due to the fact that the bottom of the pit will have less exposure to sun and wind compared to the rim.

To estimate ET_0 for the bottom of the ultimate Copper Flat open pit, the duration of sunlight at analogous established open pits was evaluated using the "sunlight across the landscape" tool in Google Earth, for the date April 29, 2015. April is a month with close-to-average duration of sunlight (as are the months of March, September, and October; Dunne and Leopold, 1978). Table 1 presents a summary of hours of sunlight for analogous pits ranging in depth from 300 to 1,400 ft.

Table 1. Summary of hours of sunlight for selected open pits in New Mexico and California, April 29, 2015

pit	rim elevation, ft amsl	bottom elevation, ft amsl	sunlight at rim, hours	sunlight at bottom, hours	bottom / rim sunlight ratio
Cobre pit, SW NM	6,800	6,300	6:30 to 19:30 = 13 hours	9:30 to 18:30 = 9 hours	0.69
Santa Rita pit, SW NM	6,600	5,200	7:00 to 19:50 = 12.5 hours	9:30 to 16:30 = 7 hours	0.56
Tyrone main pit, SW NM	6,200	4,900	6:30 to 19:30 = 13 hours	8:30 to 17:30 = 9 hours	0.69
CHMRP pit, N. NM	7,100	6,800	7:30 to 19:30 = 12 hours	8:45 to 16:00 = 7.25 hours	0.60
Colosseum pit, S. CA	5,800	5,400	8:00 to 19:00 = 11 hours	9:00 to 16:00 = 7 hours	0.64
average			**12.3 hours**	**7.85 hours**	**0.64**

CHMRP – Cunningham Hill Mine Reclamation Project
ft amsl – feet above mean sea level
SW – southwest
N. – north
S. – south

Pan evaporation data were collected at the Cunningham Hill Mine Reclamation Project (CHMRP), near the rim of the open pit in June 2000, and at the bottom of the pit between April and July 2011 (JSAI, 2011). Pan evaporation was higher at the rim, despite higher summer precipitation in 2001 compared to 2011. The pan evaporation data were interpreted to represent an average evaporation rate of about 60 in./yr at the rim, and 54 in./yr at the bottom.

CHMRP evaporation data were used for an upper bound of 90 percent, in terms of percentage of evaporation at the rim that represents actual evaporation at the bottom of the pit, and the average sunlight ratio presented in Table 1 was used for a lower bound of 64 percent. For the ultimate Copper Flat open pit, actual evaporation at the bottom of the pit was assumed to be 50 in./yr, which is 77 to 83 percent of ET_0 values 60 to 65 in./yr estimated at the rim.

The estimate of 50 in./yr evaporation for the ultimate Copper Flat open pit is also in close agreement with the estimate of open water evaporation of 53 in./yr for the North Mine Area (Santa Rita pit) at Chino Mine in southwestern New Mexico (Golder, 2005).

STF:AMM

Enc: References

References

Dunne, T., and Leopold, L.B., 1978, Water in environmental planning: W.H. Freeman and Company, New York, 818 p.

[Golder] Golder Associates, Inc., 2005, Report on North Mine Area groundwater flow model: Chino Mine, New Mexico: consultant's report prepared for Chino Mines Company, January 13, 2005, 64 p. plus tables, figures, and appendices.

[JSAI] John Shomaker & Associates, Inc., 2011, Update and recalibration of groundwater-flow and solute-transport model for predicting potential effects from the Cunningham Hill Mine Open Pit, Santa Fe County, New Mexico: consultant's report prepared for LAC Minerals (USA) LLC, June 27, 2011, 29 p. plus figures and appendices.

[JSAI] John Shomaker & Associates, Inc., 2014, Model of groundwater flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico: consultant's report prepared for New Mexico Copper Corporation, August 15, 2014, 89 p. plus figures and appendices.

Monteith, J.L., 1965, Evaporation and environment: Symp. Soc. Exp. Biol. 19, 205-224 obtained from Forest Hydrology and Watershed Management - Hydrologie Forestiere et Amenagement des Bassins Hydrologiques (Proceedings of the Vancouver Symposium, August 1987, Actes du Co11oque de Vancouver, Aout 1987): IAHS-AISH Publication No. 167, 1987, pp. 319–327.

[NOAA] National Oceanic and Atmospheric Administration, 1982, Evaporation atlas for the contiguous 48 United States: NOAA Technical Report NWS 33.

[SRK] Steffen Robertson and Kirsten, Inc., 1997, Copper Flat Mine compilation of pit lake studies: consultant's report prepared by Steffen Robertson and Kirsten, Inc. prepared for Alta Gold Co., December 1997.