TECHNICAL MEMORANDUM

DATE 4 December 2019 19122020-435-TM-Rev0

TO Manon Turmel
Agnico Eagle Mines Limited

CC Michel Groleau, Jamie Quesnel

FROM Cam Stevens and Julien Lacrampe **EMAIL cestevens@golder.com**

'WHALE TAIL PIT EXPANSION PROJECT: RESPONSE TO TECHNICAL COMMENT DFO 3.4' ADDENDUM

Introduction

The Department of Fisheries and Oceans Canada (DFO) requested additional information from Agnico Eagle Mines Limited (Agnico Eagle) related to the technical memorandum (memo) submitted to the Nunavut Impact Review Board (NIRB) titled 'Whale Tail Pit Expansion Project: Response to Technical Comment DFO 3.4' (Golder 2019). The previously submitted memo was provided as Commitment #33 for the environmental assessment of the Whale Tail Expansion Project (Expansion Project). DFO's information request was sent by email to Agnico Eagle on 19 November 2019, and included requests for the following information:

- A description of how predictions in hydrology will be monitored for the representative lakes, and lakes further downstream associated with Nodes 1 and 2 (as listed in DFO Technical Comment 3.4.7); and
- A description of how changes in water volumes/surface areas for lakes further downstream of the representative lakes are expected to fall within natural variation.

Monitoring commitments related to the first bullet will be included as part of the monitoring section in the final offsetting plan to be completed for the Expansion Project. This technical memorandum summarizes the methods and results to address DFO's second bullet, and is an extension of the previously completed study on downstream effects during closure. As done for the previously submitted memo (Golder 2019), the baseline characterization of the hydrology of Project lakes was completed using the hydrological model developed for the baseline study area for the Approved Project (Golder 2016), combined with available bathymetry (Golder 2019).

Assessment Approach

The assessment considered the closure period, during which the effects of the Expansion Project on surface water quantity are expected to be the greatest. As per the Approved Project, the closure phase will occur over the period of refilling of Whale Tail Lake and IVR Pit to its baseline level, prior to breaching of the Whale Tail Dike and Mammoth Dike. Refilling of the diked area (open Whale Tail Pit and Whale Tail Lake [North Basin]), including the IVR Pit will be accomplished by pumping water from Whale Tail Lake (South Basin). The Whale Tail Pit and IVR Pit will be filled with a combination of natural runoff and contact water from the entire site, and water pumped from Whale Tail Lake (South Basin). During the spring of 2026, the water accumulated in Whale Tail Lake (South Basin) over the years of operations will be pumped into the underground mine until it is filled and into the IVR Pit thereafter. Refilling of Whale Tail Lake (North Basin) to 153.5 masl is estimated to take from 2026 to 2042. During refilling,

Golder Associates Ltd.
16820 107 Avenue, Edmonton, Alberta, T5P 4C3, Canada T: +1 780 483 3499 F: +1 780 483 1574

water levels and discharges are expected to be reduced in Lake A16 (Mammoth Lake) from 2026 to 2041 (2029 in the Approved Project) and effects on discharges and water levels diminish with increases in drainage area (i.e., at downstream locations) (as described in Section 6.5.4.3.2 in Agnico Eagle [2018]).

Using the hydrological model developed as part of the Approved Project (Golder 2016), combined with available bathymetry (Golder 2019), the baseline variability in hydrology was characterized for lakes immediately downstream of the Project, including Lake A16 (Mammoth Lake), Lake A15, Lake A12, and Lake A76, downstream of which, the potential impacts of the Project on surface water quantity are expected to diminish rapidly in the downstream direction (Agnico Eagle 2018). Baseline variability in the hydrology of Whale Tail Lake and Lake A18 were also characterized to supplement a general characterization of lakes in the Expansion Project study area for future monitoring. Hydrology characteristics included mean monthly water level or elevation (m), lake surface area (ha or m^2), and lake volume (m^3) per summer month (June, July, August, and September). The range of baseline variability of these characteristics was described for average to below average flow conditions as a suitable reference for comparison of Project effects during closure; where the average condition was the calculated median statistic of historical flows and the below average condition was the 1 in 10 year low-flow (dry) event statistic.

For the purposes of this memo, residual effects to fish habitat downstream of Whale Tail Lake during closure (specifically Lake A16 [Mammoth Lake], Lake A15, Lake A12, and Lake A76) were based on whether the hydrological model predictions for the closure (Golder 2019) period lie outside or beyond the normal below-average flow condition. In other words, if an average closure year is not similar to a below-average (dry) baseline year, then there is potential for effects to large-bodied fish species, such as Arctic Char, Lake Trout, Burbot, and Round Whitefish. However, hydrological alterations (measured using relative changes in depth, lake surface area or volume) beyond the baseline low-flow condition but within an alteration of less than 10% in amplitude was deemed as having a low probability of detectable residual impacts to the aquatic ecosystem as per technical guidance in DFO (2013). Another benchmark considered for determining whether residual effects are measurable was the water elevation change associated with a 10% under-ice withdrawal for each waterbody (DFO 2010), which was derived from storage-volume curves (Lake A16 = 0.34 m; Lake A15 = 0.15 m; Lake A12 = 0.17 m; Lake A76 = 0.58 m; also see methods in Golder 2018).

Results

Based on the mean of the calculated hydrological characteristics for all six lakes, the average to below average flow condition was characterized by values within 3.57% of the median volume, 2.64% of the median lake area, and 1.4% of the median lake depth (Tables 1 to 3). The low-water level condition was also described by a mean maximum decrease of 8.7 cm in water levels (where values range from a decrease of 11.9 cm in Whale Tail Lake to a decrease of 6.6 cm in Lake A76; n = 6). Under the low-water condition for all months combined, Lake A16 (Mammoth Lake) was described by a maximum decrease in surface area of 34,495 m^2, and by a maximum decrease in volume of 164,447 m^3; whereas the low-water condition for Lake A76, which is approximately half the size of Lake A16 (Mammoth Lake), was described by a maximum decrease in surface area of 9,269 m^2, and by a maximum decrease in volume of 41,888 m^3.

Seasonal effects on the variability in lake volume statistics were noted across the four study months (Table 3). Lake volumes were generally most variable in September, followed by August, June, and July. The variability of lake depths and variability of surface areas were generally consistent across the study months (Tables 1 and 2).

As per the results provided in the previously submitted memo by Golder (2019), the results presented in Table 1 show a longitudinal trend of diminishing effects on water levels during closure with the smallest effect predicted for Lake A76. Water levels are reduced, on average, during the summer months by 0.17 m in Lake A16 (Mammoth Lake), 0.10 m in Lake A15, 0.10 m in Lake A12, and 0.07 m in Lake A76. The results presented in Tables 2 to 3 also show a longitudinal trend of diminishing effects on surface areas and volumes during closure with the smallest effect sizes in Lake A76. Surface areas are reduced, on average, during the summer months by 3.45% in Lake A16 (Mammoth Lake), 2.80% in Lake A15, 2.98% in Lake A12, and 1.35% in Lake A76. Volumes are reduced, on average, during the summer months by 4.40% in Lake A16 (Mammoth Lake), 4.85% in Lake A15, 4.19% in Lake A12, and 1.08% in Lake A76.

Presented in adjacent columns to the 1 in 10 year low-flow statistics in the below Tables (1 to 3), the closure predictions for Lake A76 for water levels, surface area, and volume typically fall within the range of expected baseline conditions for Lake A76 (see shaded cells in Tables 1 to 3). Results for both Lake A15 and A12 also show that closure predictions fall within the baseline range of below average conditions, but only for the month of September; whereas the results for Lake A16 (Mammoth Lake) show that none of the closure predictions fall within the baseline range of below average conditions for any month. However, effects sizes for relative changes in depths, surface areas, and volumes remain well below the 10% criteria for all lakes through the summer months, suggesting a low probability of detectable residual impacts to the aquatic ecosystem. The potential for a measurable residual effect on fish habitat during closure was identified only for Lake A16 (Mammoth Lake) where water levels may change up to 20 cm during the summer months; however, this change meets the threshold derived from a guideline for the protection of fish habitat during water withdrawals.

Conclusion

Changes in hydrological characteristics of Lake A16 (Mammoth Lake) during closure are predicted to be the same for both the Approved and Expansion Projects, but closure will extend longer for the Expansion Project (Agnico Eagle 2018). Although the environmental assessment conservatively predicted that downstream changes during closure may result in measurable residual effects for the abundance and distribution of Arctic Char, Lake Trout, Burbot, and Round Whitefish (Golder 2018), the follow-up work presented in the memo removes some of the uncertainty underlying the conclusion in the previously submitted environmental assessment. Effects sizes for surface area and volume for all lakes remain well below the 10% criteria through the summer months, and absolute changes in water levels (e.g., up to 20 cm in Mammoth Lake) remain within criteria derived from available guidelines for the protection of fish habitat. Therefore, refilling activities during the closure period are expected to have a low probability of detectable residual impacts on the downstream aquatic ecosystem. Monitoring of water levels in Lake A16 (Mammoth Lake), and if required, in Lakes A12, A15, and A76 during closure is expected to provide a reasonable surrogate for detecting changes in surface areas and volumes during that time, and will be conducted to verify predictions provided in this memo and the environmental assessment.

Table 1: Baseline Average to Below Average Water Elevations Relative to Closure Predictions Per Summer Month.

Waterbody (Upstream to Downstream)		Median	Q10 (1 in 10 year low-flow event)			Closure Predictions (Median)		
	Month	Water Level (m)	Water Level (m)	Δ Water Level (m)	% Δ versus Depth	Water Level (m)	Δ Water Level (m)	% Δ versus Depth
Lake A18	June	153.96	153.92	-0.05	-2.72%	-	-	-
	July	153.87	153.80	-0.06	-3.66%	-	-	-
	August	153.84	153.75	-0.09	-5.43%	-	-	-
	September	153.86	153.78	-0.08	-4.76%	-	-	-
Lake A17 (Whale Tail)	June	152.72	152.59	-0.12	-0.70%	-	-	-
	July	152.55	152.47	-0.08	-0.46%	-	-	-
	August	152.46	152.33	-0.13	-0.76%	-	-	-
	September	152.50	152.36	-0.14	-0.77%	-	-	-
Lake A16 (Mammoth)	June	152.48	152.35	-0.13	-0.77%	152.28	-0.20	-1.18%
	July	152.30	152.22	-0.08	-0.49%	152.10	-0.20	-1.19%
	August	152.21	152.09	-0.12	-0.75%	152.07	-0.14	-0.86%
	September	152.24	152.11	-0.13	-0.79%	152.10	-0.14	-0.84%
Lake A15	June	151.61	151.53	-0.08	-1.45%	151.50	-0.11	-1.93%
	July	151.49	151.45	-0.04	-0.65%	151.37	-0.12	-2.04%
	August	151.44	151.36	-0.08	-1.49%	151.35	-0.09	-1.60%
	September	151.46	151.37	-0.09	-1.63%	151.37	-0.09	-1.56%
Lake A12	June	148.75	148.66	-0.09	-1.30%	148.65	-0.10	-1.56%
	July	148.64	148.59	-0.05	-0.83%	148.53	-0.11	-1.72%
	August	148.59	148.51	-0.07	-1.11%	148.50	-0.08	-1.29%
	September	148.61	148.52	-0.09	-1.42%	148.53	-0.08	-1.27%
Lake A76	June	147.70	147.63	-0.07	-0.43%	147.64	-0.06	-0.38%
	July	147.61	147.57	-0.04	-0.28%	147.53	-0.08	-0.51%
	August	147.56	147.49	-0.07	-0.47%	147.49	-0.07	-0.45%
	September	147.56	147.48	-0.08	-0.52%	147.50	-0.06	-0.36%

Note: Shaded cells represent changes that fall within defined baseline conditions

Table 2: Baseline Average to Below Average Lake Surface Areas Relative to Closure Predictions Per Summer Month

Waterbody (Upstream to Downstream)		Median	Q10 (1 in 10 year low-flow event)			Closure Predictions (Median)		
	Month	Area (m^2)	Area (m^2)	Δ Area (m^2)	% Δ versus median	Area (m^2)	Δ Area (m^2)	% Δ versus median
Lake A18	June	162,198	155,190	-7,008	-4.32%	-	-	-
	July	147,890	138,984	-8,906	-6.02%	-	-	-
	August	144,094	132,600	-11,494	-7.98%	-	-	-
	September	147,160	136,196	-10,964	-7.45%	-	-	-
Lake A17 (Whale Tail)	June	1,590,666	1,570,344	-20,322	-1.28%	-	-	-
	July	1,564,027	1,552,344	-11,683	-0.75%	-	-	-
	August	1,551,578	1,532,273	-19,305	-1.24%	-	-	-
	September	1,557,152	1,537,586	-19,565	-1.26%	-	-	-
Lake A16 (Mammoth)	June	1,474,405	1,430,288	-44,117	-2.99%	1,410,699	-63,706	-4.32%
	July	1,416,241	1,392,688	-23,554	-1.66%	1,360,868	-55,373	-3.91%
	August	1,391,108	1,356,958	-34,149	-2.45%	1,352,012	-39,096	-2.81%
	September	1,398,819	1,362,657	-36,162	-2.59%	1,360,061	-38,758	-2.77%
Lake A15	June	332,428	324,920	-7,508	-2.26%	322,461	-9,967	-3.00%
	July	321,570	318,262	-3,307	-1.03%	311,221	-10,349	-3.22%
	August	317,377	309,864	-7,513	-2.37%	309,350	-8,028	-2.53%
	September	319,072	310,856	-8,216	-2.57%	311,209	-7,863	-2.46%
Lake A12	June	283,750	273,326	-10,424	-3.67%	271,272	-12,478	-4.40%
	July	271,116	265,639	-5,477	-2.02%	261,803	-9,313	-3.44%
	August	265,345	260,617	-4,728	-1.78%	259,860	-5,485	-2.07%
	September	266,900	260,858	-6,042	-2.26%	261,476	-5,424	-2.03%
Lake A76	June	700,261	684,189	-16,072	-2.30%	686,200	-14,061	-2.01%
	July	680,261	670,079	-10,182	-1.50%	666,022	-14,239	-2.09%
	August	668,000	662,864	-5,136	-0.77%	663,139	-4,861	-0.73%
	September	668,000	662,313	-5,687	-0.85%	664,145	-3,855	-0.58%

Note: Shaded cells represent changes that fall within defined baseline conditions

Table 3: Baseline Average to Below Average Lake Volumes Relative to Closure Predictions Per Summer Month

Waterbody (Upstream to Downstream)		Median	Q10 (1 in 10 year low-flow event)			Closure Predictions (Median)		
	Month	Volume (m^3)	Volume (m^3)	ΔVolume (m^3)	% Δ versus median	Volume (m^3)	ΔVolume (m^3)	% Δ versus median
Lake A18	June	138,004	130,575	-7,429	-5.38%	-	-	-
	July	122,836	113,394	-9,442	-7.69%	-	-	-
	August	118,811	106,450	-12,361	-10.40%	-	-	-
	September	122,062	110,372	-11,690	-9.58%	-	-	-
Lake A17 (Whale Tail)	June	7,984,940	7,787,119	-197,821	-2.48%	-	-	-
	July	7,718,777	7,592,380	-126,397	-1.64%	-	-	-
	August	7,584,089	7,377,340	-206,750	-2.73%	-	-	-
	September	7,644,392	7,433,755	-210,637	-2.76%	-	-	-
Lake A16 (Mammoth)	June	5,799,059	5,608,565	-190,494	-3.28%	5,511,467	-287,592	-5.13%
	July	5,538,939	5,422,190	-116,749	-2.11%	5,263,495	-275,445	-5.08%
	August	5,414,358	5,243,970	-170,388	-3.15%	5,219,269	-195,089	-3.72%
	September	5,452,582	5,272,427	-180,155	-3.30%	5,259,462	-193,120	-3.66%
Lake A15	June	725,470	697,439	-28,031	-3.86%	688,731	-36,739	-5.27%
	July	685,574	673,861	-11,713	-1.71%	648,924	-36,650	-5.44%
	August	670,727	644,119	-26,608	-3.97%	642,298	-28,429	-4.41%
	September	676,729	647,633	-29,096	-4.30%	648,882	-27,847	-4.30%
Lake A12	June	644,834	620,336	-24,497	-3.80%	615,509	-29,325	-4.73%
	July	615,144	600,427	-14,716	-2.39%	585,797	-29,346	-4.89%
	August	599,306	581,273	-18,033	-3.01%	578,388	-20,919	-3.60%
	September	605,235	582,192	-23,043	-3.81%	584,549	-20,687	-3.55%
Lake A76	June	3,967,752	3,920,152	-47,601	-1.20%	3,926,108	-41,645	-1.06%
	July	3,908,517	3,878,361	-30,156	-0.77%	3,855,794	-52,724	-1.36%
	August	3,872,204	3,829,594	-42,610	-1.10%	3,831,873	-40,331	-1.05%
	September	3,872,204	3,825,019	-47,185	-1.22%	3,840,217	-31,987	-0.84%

Note: Shaded cells represent changes that fall within defined baseline conditions

Closure

This technical memorandum was prepared and reviewed by the undersigned.

Cam Stevens, MSc, PhD
Associate Senior Biology

Julien Lacrampe, PEng
Senior Water Resources Engineer

Kasey Clipperton
Principal, Senior Fisheries Biologist

CS/JL/KC/jr

https://golderassociates.sharepoint.com/sites/113014/project files/5 technical work/stage-2_tcs/01_working_responses/01_bathymetry/04_reporting/19122020-435-tm-goldermemowaterlevelswtpexpansion-rev0.docx

References

Agnico Eagle (Agnico Eagle Mines Limited). 2018. Final Environmental Impact Statement Addendum, Whale Tail Pit – Expansion Project. December 2018. Available on NIRB Public Registry Identification No. 321615 to 321762.

DFO (Fisheries and Oceans Canada). 2010. DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut.

DFO. 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/017.

Golder (Golder Associates Ltd.). 2016. Whale Tail Project 2015 Hydrology Baseline Report. Doc 037-1524321.1300 Ver 1. Prepared for Agnico Eagle Mines Ltd. 217 pages. Available at ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-WTP1826%20Agnico/1%20APPLICATION/2016%20New/2%20Individual%20Files%20(Volume%20and%20Appendices)/160630%202AM-WTP----%2003MN107%20App6%20C%20Hydrology%20Baseline-IAAE.pdf

Golder. 2018. Winter Ice Road Water Withdrawal Evaluation – Back River Project. Prepared for Sabina Gold & Silver Corp., submitted to the Nunavut Water Board. 56 pages. Available at ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-BRP1831%20Sabina/3%20TECH/E%20WATER%20USE/181203%202AM-BRP1831%202019%20Sabina%20WIR%20Technical%20Memorandum-IMLE.pdf

Golder. 2019. Whale Tail Pit Expansion Project: Response to Technical Comment DFO 3.4. Prepared for Agnico Eagle Mines Ltd. Submitted to the Nunavut Water Board. 11 pages