

## TECHNICAL MEMORANDUM

**DATE** 24 October 2019

**Project No.** 19127573-403-TM-Rev1

**TO** Manon Turmel  
Agnico Eagle Mines Limited

**CC** Cameron Stevens

**FROM** Jenna Pearse, Julien Lacrampe

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

## 1.0 BACKGROUND

The Department of Fisheries and Oceans (DFO) requested additional information from Agnico Eagle Mines Limited (Agnico Eagle) related to Agnico Eagle's response to Technical Comment DFO 3.4 submitted to DFO in May 2019 as part of the Whale Tail Pit Expansion Project (the Project) regulatory review (Agnico Eagle 2019a,b). During the NIRB public hearing in Baker Lake (August 26-29, 2019), Agnico Eagles commitment to provide the requested information was recorded as Commitment #33.

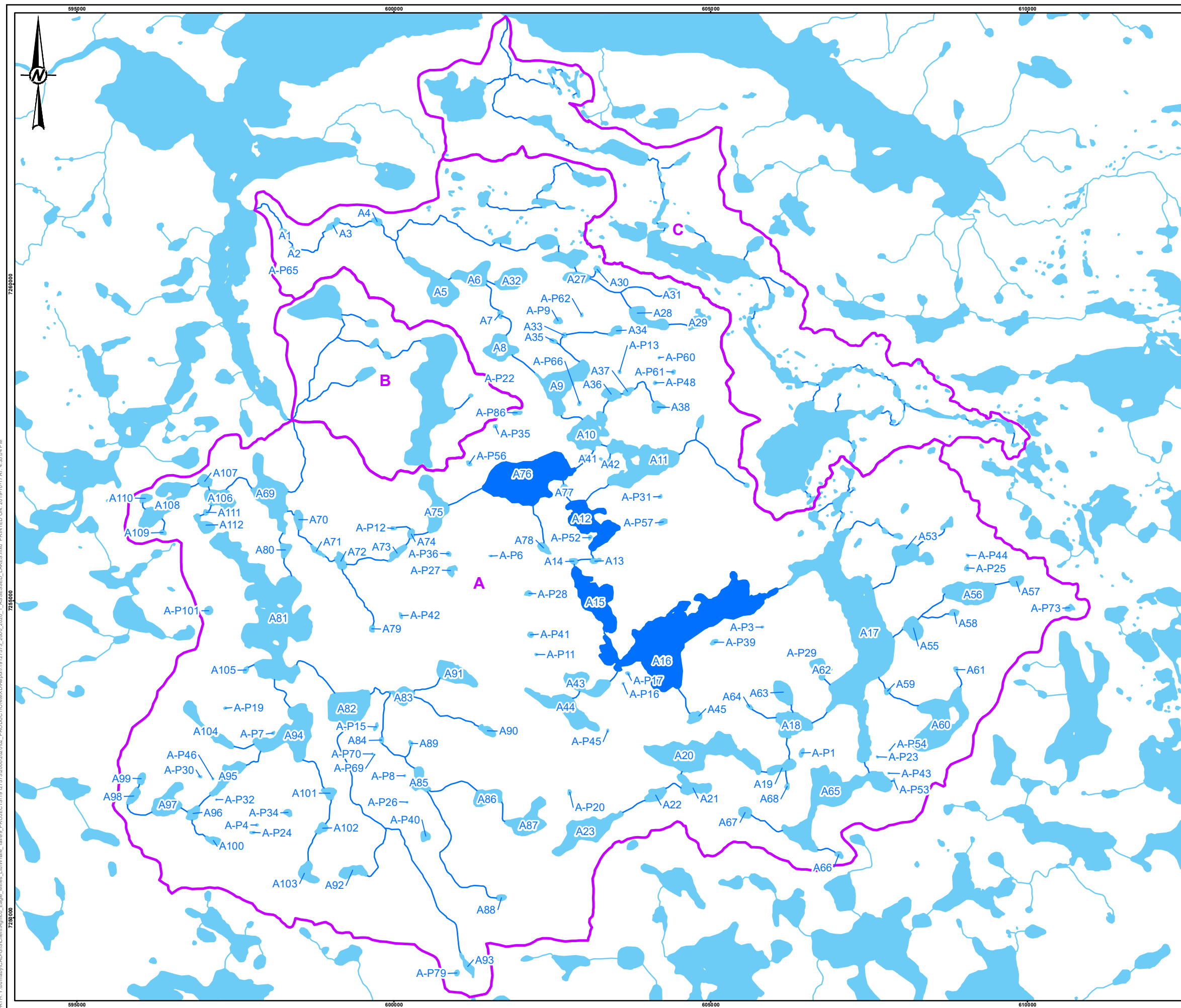
DFO specifically requested an estimate of the Project's potential impacts on the surface water areas and volumes of downstream lakes during closure when the Whale Tail Lake North Basin is being refilled (2026 to 2042). These impacts are further discussed in Volume 6 of the Project's Final Environmental Impact Statement (FEIS) Addendum (Agnico Eagle 2018). This technical memorandum summarizes the methods and results to address DFO's request. The expectation is that the results will be integrated as part of the final offsetting plan for the Project.

## 2.0 METHODS

The hydrological assessment was completed on the 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). The present assessment does not consider potential mitigation to reduce the magnitude of downstream changes on hydrology during closure, if identified as a requirement for closure planning purposes. The assessed lakes are shown in Figure 1.

The hydrological assessment was completed using the following methods:

- The assessment considered the closure period, during which the impacts of the Project on surface water quantity are expected to be the greatest, from the Project's closed-circuited activities resulting in reduced contributing areas at downstream lakes.
- The potential impacts on mean monthly lake depths provided in the FEIS Addendum (Agnico Eagle 2018) were applied to the bathymetry of the assessed lakes, available from the FEIS (Lake A16 [Mammoth Lake]), or collected in September 2019 by Portt and Associates (Lake A15 and Lake A12) and by Azimuth Consulting Group (Lake A76). Bathymetric data were supplemented by Light Detection and Ranging (LiDAR) data.



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FIGURE 1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI D

### 3.0 RESULTS

The results are presented for the 2-year (median, representing both wet and dry conditions), 10-year dry, and 10-year wet return periods in the sub-sections below. The storage characteristics of each lake, derived from the bathymetric data to support this assessment, are provided in Attachment 1.

#### 3.1 2-Year Return Period

The derived mean monthly water levels, surface areas, and volumes are shown for the months of June, July, August, and September for each lake under baseline and closure conditions, in Table 1 (Lake A16 [Mammoth Lake]), Table 2 (Lake A15), Table 3 (Lake A12), and Table 4 (Lake A76). The effects on water level, surface areas, and volumes are presented relative to the baseline value of the corresponding month.

**Table 1: Lake A16 Baseline and Closure Water Level Conditions (2-Year Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 152.48             | 1,474,405              | 5,799,059                | -0.20             | 152.28             | 1,410,699 (-4.3%)               | 5,511,467 (-5.0%)                   |
| July      | 152.30             | 1,416,241              | 5,538,939                | -0.20             | 152.10             | 1,360,868 (-3.9%)               | 5,263,495 (-5.0%)                   |
| August    | 152.21             | 1,391,108              | 5,414,358                | -0.14             | 152.07             | 1,352,012 (-2.8%)               | 5,219,269 (-3.6%)                   |
| September | 152.24*            | 1,398,819              | 5,452,582                | -0.14             | 152.10             | 1,360,061 (-2.8%)               | 5,259,462 (-3.5%)                   |

Note: \* = baseline elevation based on the Project's LiDAR data, collected on 28 August 2015

**Table 2: Lake A15 Baseline and Closure Water Level Conditions (2-Year Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 151.61             | 332,428                | 725,470                  | -0.11             | 151.50             | 322,461 (-3.0%)                 | 688,731 (-5.1%)                     |
| July      | 151.49             | 321,570                | 685,574                  | -0.12             | 151.37             | 311,221 (-3.2%)                 | 648,924 (-5.3%)                     |
| August    | 151.44             | 317,377                | 670,727                  | -0.09             | 151.35             | 309,350 (-2.5%)                 | 642,298 (-4.2%)                     |
| September | 151.46*            | 319,072                | 676,729                  | -0.09             | 151.37             | 311,209 (-2.5%)                 | 648,882 (-4.1%)                     |

Note: \* = baseline elevation based on the Project's LiDAR data

**Table 3: Lake A12 Baseline and Closure Water Level Conditions (2-Year Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 148.75             | 283,750                | 644,834                  | -0.10             | 148.65             | 271,272 (-4.4%)                 | 615,509 (-4.5%)                     |
| July      | 148.64             | 271,116                | 615,144                  | -0.11             | 148.53             | 261,803 (-3.4%)                 | 585,797 (-4.8%)                     |
| August    | 148.59             | 265,345                | 599,306                  | -0.08             | 148.50             | 259,860 (-2.1%)                 | 578,388 (-3.5%)                     |
| September | 148.61*            | 266,900                | 605,235                  | -0.08             | 148.53             | 261,476 (-2.0%)                 | 584,549 (-3.4%)                     |

Note: \* = baseline elevation based on the Project's LiDAR data

**Table 4: Lake A76 Baseline and Closure Water Level Conditions (2-Year Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 147.70             | 700,261                | 3,967,752                | -0.06             | 147.64             | 686,200 (-2.0%)                 | 3,926,108 (-1.0%)                   |
| July      | 147.61             | 680,261                | 3,908,517                | -0.08             | 147.53             | 666,022 (-2.1%)                 | 3,855,794 (-1.3%)                   |
| August    | 147.56             | 668,000                | 3,872,204                | -0.07             | 147.49             | 663,139 (-0.7%)                 | 3,831,873 (-1.0%)                   |
| September | 147.56*            | 668,000                | 3,872,204                | -0.06             | 147.50             | 664,145 (-0.6%)                 | 3,840,217 (-0.8%)                   |

Note: baseline elevation based on the Project's LiDAR data

### 3.2 10-Year Wet Return Period

The derived mean monthly water levels, surface areas, and volumes are shown for the months of June, July, August, and September for each lake under baseline and closure conditions, in Table 5 (Lake A16 [Mammoth Lake]), Table 6 (Lake A15), Table 7 (Lake A12), and Table 8 (Lake A76). The effects on water level, surface areas, and volumes are presented relative to the baseline value of the corresponding month.

**Table 5: Lake A16 Baseline and Closure Water Level Conditions (10-Year Wet Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 152.60             | 1,517,180              | 5,970,754                | -0.24             | 152.36             | 1,433,424 (-5.5%)               | 5,624,109 (-5.8%)                   |
| July      | 152.41             | 1,449,289              | 5,698,248                | -0.22             | 152.19             | 1,385,462 (-4.4%)               | 5,386,304 (-5.5%)                   |
| August    | 152.33             | 1,423,498              | 5,574,911                | -0.17             | 152.15             | 1,374,878 (-3.4%)               | 5,333,450 (-4.3%)                   |
| September | 152.37             | 1,436,525              | 5,639,480                | -0.18             | 152.19             | 1,384,391 (-3.6%)               | 5,380,957 (-4.6%)                   |

**Table 6: Lake A15 Baseline and Closure Water Level Conditions (10-Year Wet Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 151.68             | 338,234                | 747,602                  | -0.13             | 151.55             | 327,096 (-3.3%)                 | 705,145 (-5.7%)                     |
| July      | 151.57             | 328,839                | 711,788                  | -0.13             | 151.44             | 316,854 (-3.6%)                 | 668,874 (-6.0%)                     |
| August    | 151.51             | 323,828                | 693,573                  | -0.10             | 151.41             | 314,782 (-2.8%)                 | 661,537 (-4.6%)                     |
| September | 151.54             | 326,225                | 702,062                  | -0.11             | 151.43             | 316,842 (-2.9%)                 | 668,831 (-4.7%)                     |

**Table 7: Lake A12 Baseline and Closure Water Level Conditions (10-Year Wet Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 148.81             | 291,455                | 662,941                  | -0.11             | 148.70             | 277,692 (-4.7%)                 | 630,598 (-4.9%)                     |
| July      | 148.73             | 280,949                | 638,252                  | -0.13             | 148.60             | 266,279 (-5.2%)                 | 602,868 (-5.5%)                     |
| August    | 148.66             | 273,029                | 619,639                  | -0.09             | 148.57             | 264,076 (-3.3%)                 | 594,466 (-4.1%)                     |
| September | 148.69             | 276,596                | 628,022                  | -0.10             | 148.59             | 265,682 (-3.9%)                 | 600,592 (-4.4%)                     |

**Table 8: Lake A76 Baseline and Closure Water Level Conditions (10-Year Wet Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 147.75             | 712,425                | 4,003,781                | -0.07             | 147.68             | 696,625 (-2.2%)                 | 3,956,984 (-1.2%)                   |
| July      | 147.66             | 692,843                | 3,945,782                | -0.08             | 147.58             | 673,880 (-2.7%)                 | 3,889,618 (-1.4%)                   |
| August    | 147.62             | 681,574                | 3,912,406                | -0.06             | 147.56             | 668,123 (-2.0%)                 | 3,872,567 (-1.0%)                   |
| September | 147.62             | 682,944                | 3,916,464                | -0.06             | 147.56             | 668,981 (-2.0%)                 | 3,875,109 (-1.1%)                   |

### 3.3 10-Year Dry Return Period

The derived mean monthly water levels, surface areas, and volumes are shown for the months of June, July, August, and September for each lake under baseline and closure conditions, in Table 9 (Lake A16 [Mammoth Lake]), Table 10 (Lake A15), Table 11 (Lake A12), and Table 12 (Lake A76). The effects on water level, surface areas, and volumes are presented relative to the baseline value of the corresponding month.

**Table 9: Lake A16 Baseline and Closure Water Level Conditions (10-Year Dry Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 152.35             | 1,430,288              | 5,608,565                | -0.16             | 152.19             | 1,384,276 (-3.2%)               | 5,380,379 (-4.1%)                   |
| July      | 152.22             | 1,392,688              | 5,422,190                | -0.17             | 152.05             | 1,345,466 (-3.4%)               | 5,186,581 (-4.3%)                   |
| August    | 152.09             | 1,356,958              | 5,243,970                | -0.11             | 151.98             | 1,327,245 (-2.2%)               | 5,094,107 (-2.9%)                   |
| September | 152.11             | 1,362,657              | 5,272,427                | -0.11             | 152.00             | 1,331,983 (-2.3%)               | 5,119,008 (-2.9%)                   |

**Table 10: Lake A15 Baseline and Closure Water Level Conditions (10-Year Dry Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 151.53             | 324,920                | 697,439                  | -0.090            | 151.44             | 316,915 (-2.5%)                 | 669,090 (-4.1%)                     |
| July      | 151.45             | 318,262                | 673,861                  | -0.12             | 151.33             | 307,424 (-3.4%)                 | 635,478 (-5.7%)                     |
| August    | 151.36             | 309,864                | 644,119                  | -0.08             | 151.28             | 303,202 (-2.1%)                 | 620,826 (-3.6%)                     |
| September | 151.37             | 310,856                | 647,633                  | -0.07             | 151.30             | 304,962 (-1.9%)                 | 626,758 (-3.2%)                     |

**Table 11: Lake A12 Baseline and Closure Water Level Conditions (10-Year Dry Return Period)**

| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 148.66             | 273,326                | 620,336                  | -0.09             | 148.58             | 264,806 (-3.1%)                 | 597,251 (-0.9%)                     |
| July      | 148.59             | 265,639                | 600,427                  | -0.11             | 148.48             | 258,672 (-2.6%)                 | 573,858 (-1.3%)                     |
| August    | 148.51             | 260,617                | 581,273                  | -0.09             | 148.43             | 254,989 (-2.2%)                 | 559,812 (-0.8%)                     |
| September | 148.52             | 260,858                | 582,192                  | -0.07             | 148.45             | 256,270 (-1.8%)                 | 564,696 (-0.7%)                     |



**Table 12: Lake A76 Baseline and Closure Water Level Conditions (10-Year Dry Return Period)**

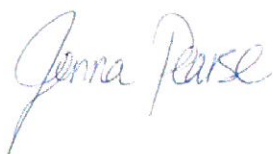
| Month     | Baseline           |                        |                          | Closure           |                    |                                 |                                     |
|-----------|--------------------|------------------------|--------------------------|-------------------|--------------------|---------------------------------|-------------------------------------|
|           | Water Level (masl) | Area (m <sup>2</sup> ) | Volume (m <sup>3</sup> ) | Δ Water Level (m) | Water Level (masl) | Area (m <sup>2</sup> ) (Δ Area) | Volume (m <sup>3</sup> ) (Δ Volume) |
| June      | 147.63             | 684,189                | 3,920,152                | -0.05             | 147.58             | 672,470 (-1.7%)                 | 3,885,442 (-0.9%)                   |
| July      | 147.57             | 670,079                | 3,878,361                | -0.09             | 147.48             | 662,542 (-1.1%)                 | 3,826,918 (-1.3%)                   |
| August    | 147.49             | 662,864                | 3,829,594                | -0.05             | 147.44             | 659,384 (-0.5%)                 | 3,800,718 (-0.8%)                   |
| September | 147.48             | 662,313                | 3,825,019                | -0.04             | 147.44             | 659,290 (-0.5%)                 | 3,799,943 (-0.7%)                   |

## Closure

This technical memorandum was prepared and reviewed by the undersigned.

Prepared By:

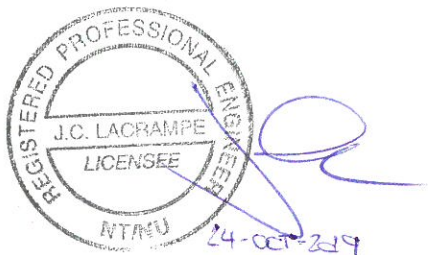
Reviewed By:



Jenna Pearse, B.Sc. Civil Engineering  
Water Resources Specialist



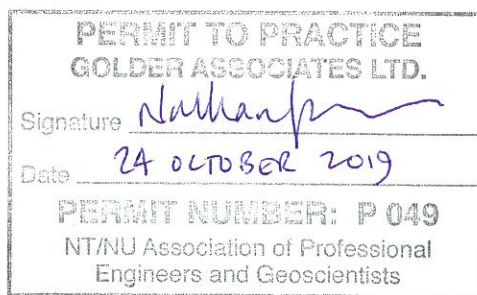
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Senior Water Resources Engineer



Nathan Schmidt, Ph.D., P.Eng. (NWT/NU)  
Principal, Senior Water Resources Engineer



## References

- Agnico Eagle (Agnico Eagle Mines Limited). 2018. Final Environmental Impact Statement Addendum, Whale Tail Pit – Expansion Project. December 2018.
- Agnico Eagle. 2019a. Technical Comment Responses – Whale Tail Pit Expansion Project. Submitted to the Nunavut Impact Review Board. Submitted by Agnico Eagle Mines Limited – Meadowbank Division. May 29, 2019. 222 pages.
- Agnico Eagle. 2019b. Final Written Statement Responses – Whale Tail Pit Expansion Project. Submitted to Nunavut Impact Review Board. Submitted by Agnico Eagle Mines Limited – Meadowbank Division. August 9, 2019. 105 pp.



## Attachment 1: Lake Storage Characteristics

The derived lake storage characteristics are provided in the figures below. It is noted that the depth data of the bathymetric surveys were converted into elevation data by assuming that the Project's LiDAR data were representative of the water elevation on the day of bathymetric surveys.

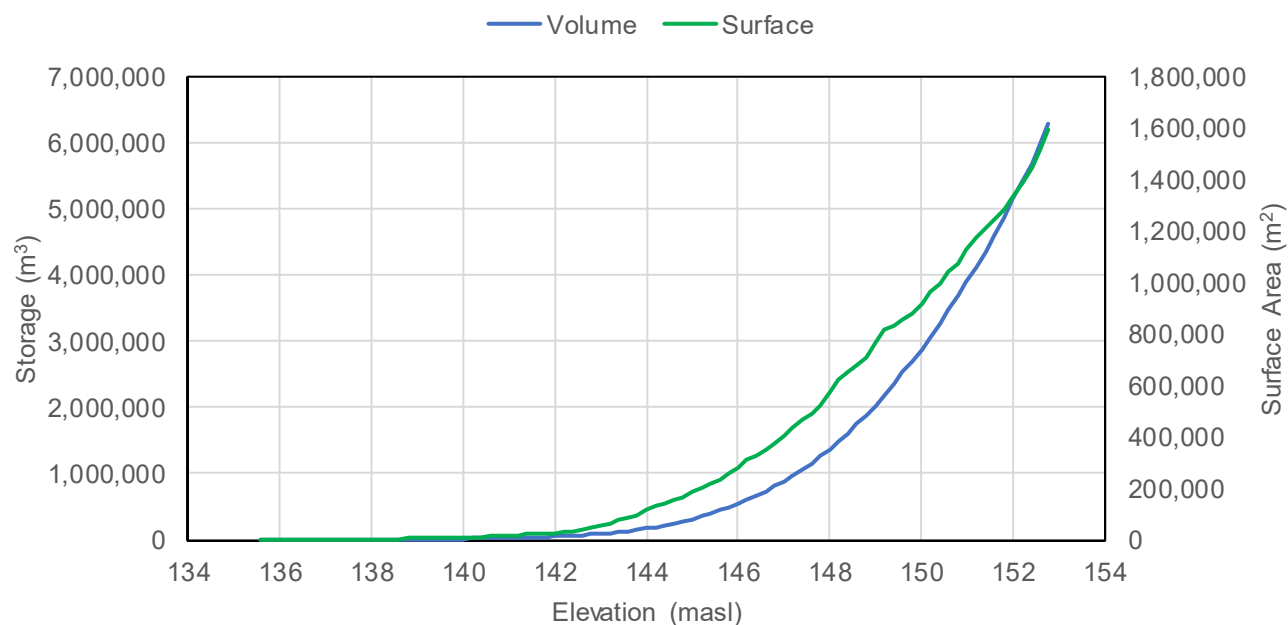
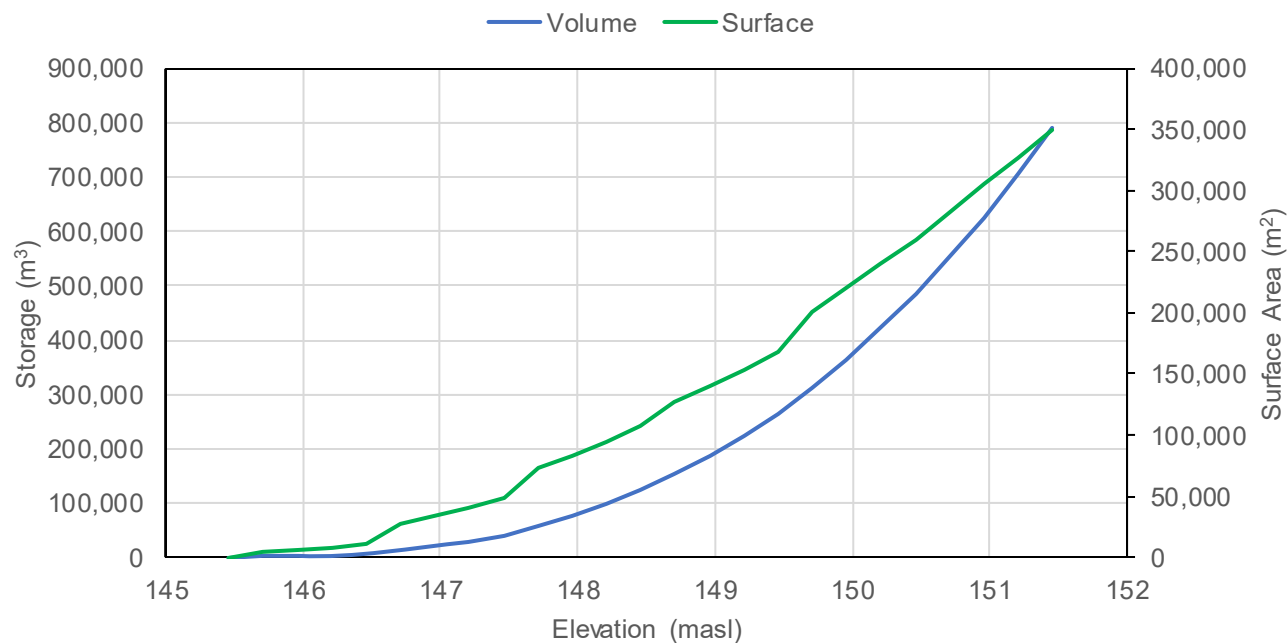
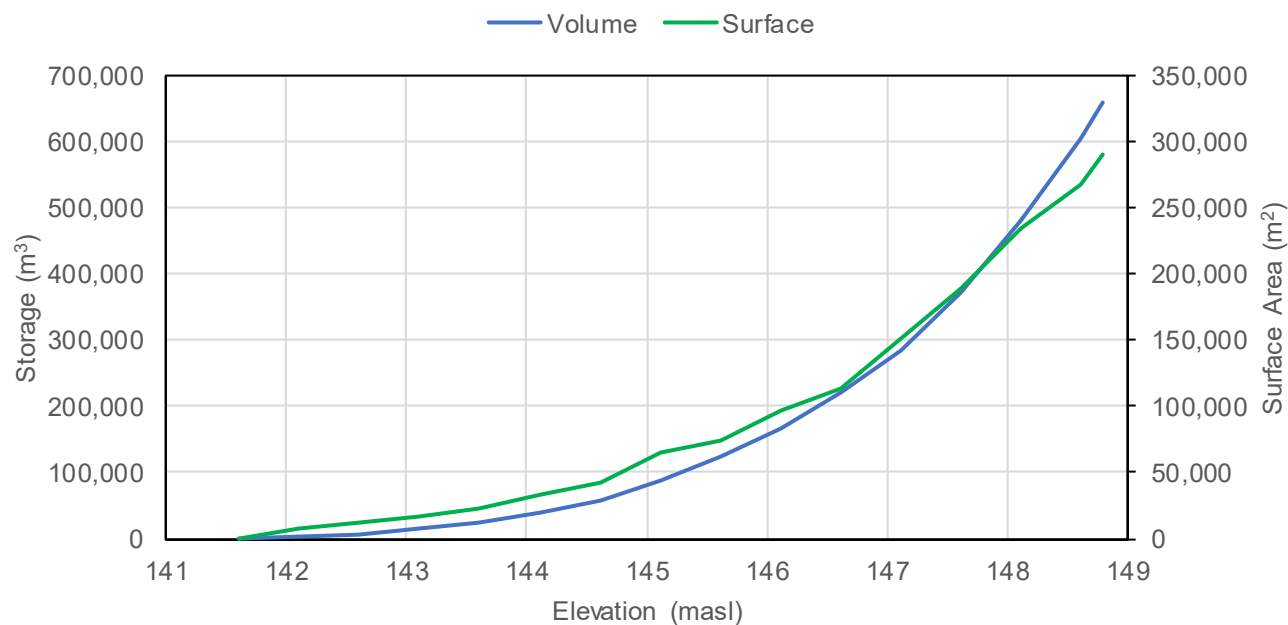


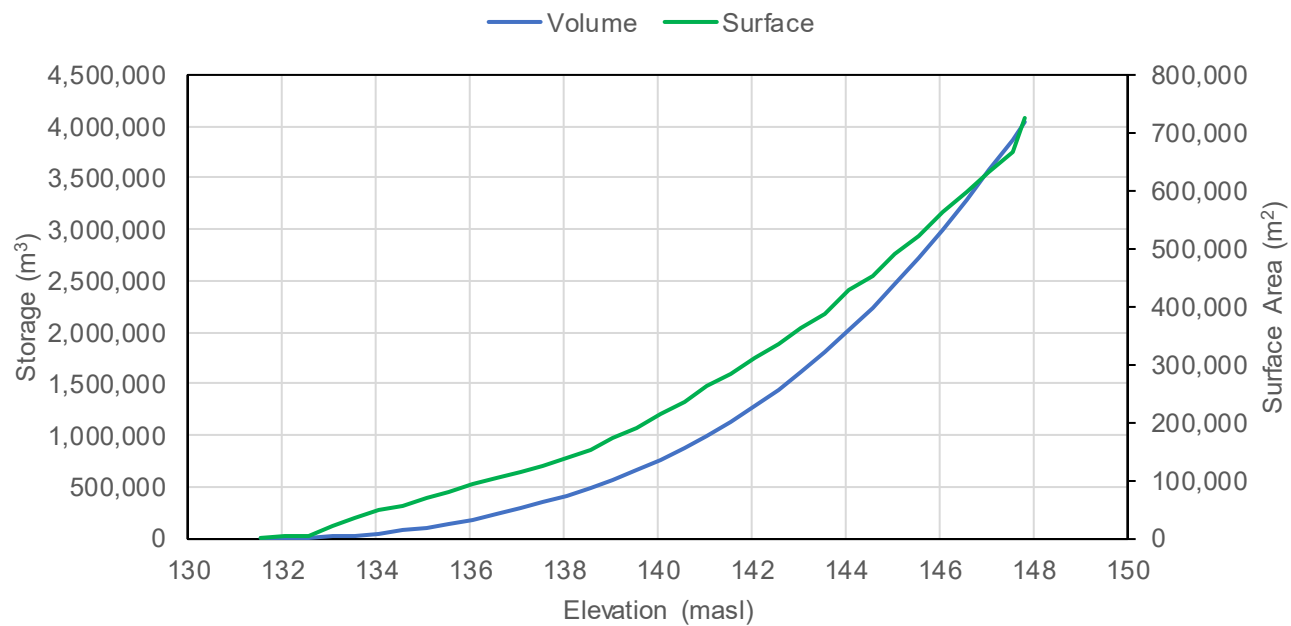
Figure 2: Lake Storage Characteristics (Lake A16 [Mammoth Lake])



**Figure 3: Lake Storage Characteristics (Lake A15)**



**Figure 4: Lake Storage Characteristics (Lake A12)**



**Figure 5: Lake Storage Characteristics (Lake A76)**