D3 SURFACE WATER HYDROLOGY UPDATED EFFECTS ASSESSMENT

Marathon Palladium Project Environmental Impact Statement Addendum
Appendix D3: Surface Water Hydrology Updated Effects Assessment Report

FINAL

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Abbreviations

A	area
CEAA	Canadian Environmental Assessment Agency
CEA Act	Canadian Environmental Assessment Act
CIAR	Canadian Impact Assessment Registry
CRA	commercial, recreational, and Aboriginal
Cu	copper
DEM	digital elevation mode
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EA Act	Environmental Assessment Act
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
Fe	Iron
GenPGM	Generation PGM Inc.
IDF	intensity-duration-frequency of precipitation or Inflow Design Flood, which is the maximum inflow flood for which a water impounding/forwarding dam/berm is designed to manage
IR	Information Request
LIDAR	light detection and ranging
LRIA	Lakes and Rivers Improvement Act
LSA	Local study area
MAF	mean annual flow
MDMER	Metal and Diamond Mining Effluent Regulations
MECP	Ministry of the Environment, Conservation and Parks
MMF	mean monthly flow
MNRF	Ministry of Natural Resources and Forestry
MRSA	mine rock storage area
MTO	Ministry of Transportation

NPA	Navigation Protection Act
OWRA	Ontario Water Resources Act
PGM	platinum group metals
PSMF	process solids management facility
Q	discharge
RCP	representative concentration pathways
RMSE	Root Mean Square Error
RSA	Regional study area
SID	Supplemental Information Document
SSA	Site study area
SWM	Stormwater management
WMP	Water Management PWSC
WSC	Water Survey of Canada
WTP	Water Treatment Plant

1.0 INTRODUCTION

Generation PGM Inc. (GenPGM) proposes to develop the Marathon Palladium Project (the "Project"), which is a platinum group metals (PGM), copper (Cu) and possibly iron (Fe) open pit mine and processing operations near the Town of Marathon, Ontario. The Project is being assessed in accordance with the *Canadian Environmental Assessment Act* (CEAA, 2012) and Ontario's *Environmental Assessment Act* (EA Act) through a Joint Review Panel (the Panel) pursuant to the *Canada-Ontario Agreement on Environmental Assessment Cooperation* (2004).

The Project is located approximately 10 km north of the Town of Marathon, Ontario (Figure 1, Appendix A). Marathon is a community of approximately 3,300 people (Statistics Canada, 2017) located adjacent to the Trans-Canada Highway (Highway 17) on the northeast shore of Lake Superior, approximately 300 km east of Thunder Bay and 400 km northwest of Sault St. Marie. The centre of the Project footprint sits at approximately 48° 47' N latitude, 86° 19' W longitude (UTM NAD83 N16 Easting 550197 and Northing 5403595). The footprint of the proposed mine location is roughly bounded by Highway 17 and the Marathon Airport to the south, the Pic River and Camp 19 Road to the east, Hare Lake to the west, and Bamoos Lake to the north. Access is currently gained through Camp 19 Road (Figure 1, Appendix A). For a more detailed description of the Project, refer to Chapter 2 of the Environmental Impact Statement (EIS) Addendum.

Stantec Consulting Ltd. (Stantec) has been retained by GenPGM to conduct an updated assessment of potential effects on surface water hydrology as a result of the Project. This report provides an update to the effects assessment described in the information currently on the record, including:

- Supplemental Information Document (SID) No.20: Baseline Hydrologic Conditions at the Marathon PGM-Cu Project Site prepared by Calder Engineering Ltd. (2012) (Calder 2012a) (CIAR #227)
- SID No.21: Marathon PGM-Cu Project – Surface Water Hydrologic Impact Assessment prepared by Calder Engineering Ltd. (2012) (Calder 2012b) (CIAR #227)
- Responses to IR Nos. 24.13 and 24.14 (CIAR #380)

This Surface Water Hydrology impact assessment has been completed to inform the Addendum to the Marathon PGM-Cu Environmental Impact Statement (EIS Addendum) as input to the Joint Review Panel process. It has been prepared pursuant to the *Canadian Environmental Assessment Act, 2012* and in consideration of the *Guidelines for the Preparation of an Environmental Impact Statement – Marathon Platinum Group Metals and Copper Mine Project* (EIS Guidelines) (Canadian Environmental Assessment Agency (CEAA) and Ontario Ministry of Environment (MOE), 2011). A Surface Water Quality Updated Effects Assessment has been prepared under separate cover and is included in the EIS Addendum (Appendix D11 of the EIS Addendum [Vol 2]).

1.1 ASSESSMENT PURPOSE AND OBJECTIVES

The purpose of this updated impact assessment is to address 'changes' that may have occurred since the original assessment, including:

- Changes to the characterization of existing baseline conditions since previous baseline studies
- Changes to applicable criteria, standards, and/or thresholds for determining the significance of potential residual environmental effects
- Changes to the Project, including refinements to project components and activities implemented by GenPGM

The information presented in this report is intended to summarize and document existing conditions and to identify changes in surface water hydrology at key receptors in order to determine potential and residual cumulative changes to surface water hydrology. The impact assessment includes the following sections:

- Project overview and purpose of this assessment, as well as the identification of spatial and temporal Project boundaries and surface water hydrology receptors (Section 1.0)
- Summary of previous impact assessment findings (Section 2.0)
- Identification of regulatory framework used for the assessment (Section 3.0)
- Review of baseline conditions in the SSA, LSA and RSA specific to the relevant effects being assessed (Section 4.0)
- Explains the assessment approach used to conduct the impact assessment (Section 5.0)
- Presents the assessment results and a discussion of them (Section 6.0)
- Updated summary of potential predicted residual and cumulative effects (Section 7.0)

1.2 ASSESSMENT BOUNDARIES

For the purpose of this assessment, the spatial boundaries considered include the direct and indirect effects related to site preparation, construction / commissioning, operation, and decommissioning / post-closure of the Project. These areas are generally consistent with the spatial boundaries used in the original EIS (2012) and associated supporting information documents, with appropriate revisions / refinements and rationale provided below.

1.2.1 Site Study Area (SSA)

The Site Study Area (SSA) is the direct footprint of the Project. Based on refinements to the Project footprint and in recognition of project components originally located outside of the SSA, a revised SSA has been developed that encompasses the immediate area in which Project activities and components may occur and, as such, represents the area within which direct physical disturbance may occur as a result of the Project, whether temporary or permanent. The SSA is depicted on Figure 2 (Appendix A).

1.2.2 Local Study Area (LSA) and Regional Study Area (RSA)

The Local Study Area (LSA) is the maximum area within which environmental effects from Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence.

The Regional Study Area (RSA) is the area within which residual environmental effects from Project activities and components may interact cumulatively with the residual environmental effects of other past, present and future (i.e., certain or reasonably foreseeable) physical activities. The RSA is based on the potential for interactions between the Project and other existing or future potential projects.

The defined LSA differs slightly from the one originally delineated in Calder (2012a), with additional watersheds that may be potentially affected by the Project. Updates to the effects assessment report herein include changes to the delineated watersheds as indicated in Section 4.2.1.3. The RSA used in this report has been refined from the RSA used in the original EIS and Calder (2012a; SID #21) (CIAR #234). Refinements to the RSA were made to better be consistent with the LSA, with the RSA extending just past the LSA within the ultimate receivers, as presented on Figure 2 (Appendix A).The LSA and RSA for the Project are shown on Figure 2 (Appendix A).

1.3 TEMPORAL BOUNDARIES PHASES

The temporal boundaries for the Project are defined by the duration and timing of the individual Project phase (Phase I – Site Preparation and Construction, Phase II – Operations, Phase III – Decommissioning and Post Closure). Through refinements to the Project, the timing and duration of these phases has been revised as follows:

- **Phase I – Site Preparation and Construction**: This phase consists of pre-operation activities to prepare the site for extraction activities, which includes site preparation and construction activities to be completed concurrently over a period of 18 to 24 months (previously 18 months).
    - **Phase IA Site Preparation**: This phase consists of site clearing, grading and excavation to permit the subsequent construction.
    - **Phase IB Construction**: This phase consists of the building of the physical infrastructure and structures necessary to bring the Project into production.

- **Phase II – Operations**: This phase consists of the extraction and processing of selected minerals and will last for approximately 12.7 years (previously 11.5 years)
- **Phase III – Decommissioning and Closure**: While the site will be reclaimed on an on-going basis to the extent practical during all previous phases, this phase consists of the relatively intense period of reclamation and decommissioning upon cessation of mine operations and the duration of time required for the mine site to be stabilized following implementation of the closure plan.
    - **Phase IIIA – Decommissioning / Closure**: This phase will occur throughout the life of the project but the most intensive part (i.e., decommissioning activities), which will occur post-operation, will last for approximately 2 years (no change, previously 2 years).
    - **Phase IIIB – Post-Closure**: This phase will occur following substantial completion of all on-site decommissioning activities and will consist primarily of follow-up and monitoring programs and the subsequent stabilization of existing environmental conditions specific to each VEC (i.e., regeneration of vegetative cover, stabilization of water levels in the pits). For the purposes of the effects assessment, this phase is anticipated to last for up to approximately 45 years (to be confirmed based on the results of the effects assessment) (no change, previously 45 years).

2.0 PREVIOUS ASSESSMENT OF POTENTIAL EFFECTS

Previous work was undertaken by Calder (2012b) to assess the potential environmental impacts of the Project on surface water in the study area in support of the overall Environmental Assessment (EA) process under the Canadian Environmental Assessment Act (CEA Act).

The potential environmental impacts of the Project were assessed by investigating the potential impacts on peak flows, mean flows, low flows, erosion and stream morphology, surface and groundwater interaction, and existing watercourse crossings for key locations in the study area.

The application of relationships established in the Baseline Hydrology Report by Calder (2012a) and a Water Balance Model developed for the project were used to assess the potential impacts of the Project on the hydrologic flow regime. The Water Balance Model was applied to assess impacts in watersheds experiencing substantive land use and drainage area changes and where pits, the processing plant, process solids management facility (PSMF) and mine rock storage area (MRSA) will be located. The relationships established in the baseline report were applied to the watersheds with minor drainage area or land uses changes.

2.1 METHODOLOGY

The methodology used previously by Calder (2012b) focused on assessment of impacts of the Project on flow regime in watersheds affected by the Project, Hare Lake, surface and groundwater interactions, erosion and channel morphology, and existing watercourse crossings. The potential impacts of the Project on flow regime was estimated by evaluating the impacts of the Project on mean annual flow (MAF), mean monthly flow (MMF), peak flows, and low flows. Effects on mean annual and mean monthly flows were assessed through a spreadsheet-based water balance model for the project through mine phases. The water balance model used local weather station information and natural ground inputs derived from both field and regional hydrology assessments and a runoff coefficient basis for other types of prepared and disturbed ground surfaces within the SSA. The water balance assessed specific years through life of mine and examined results under dry to wet climatic conditions. The Northern Ontario Hydrology Method was used to estimate the potential impact of the Project on peak flows (MTO, 1997). The unit area average low flow relationships established for the Northwestern Region of Ontario (Cumming Cockburn Ltd., 1990) was used to develop relationships between 7-day duration low flow and drainage areas.

2.2 PREVIOUS ASSESSMENT RESULTS

The results of the analysis showed that permanent changes to the surface water flow regime will occur for watersheds 101, 102, 103, 106, 107, and 108 where substantive land use changes will occur due to the Project. A summary of the main findings for each watershed is provided below:

- In watershed 101, hydrologic flow regime changes were expected as a result of the Project construction and operation. The drainage area of watershed 101 was expected to permanently decrease from 435 hectares to 405 hectares with development of the Project due to the PSMF construction. MAFs were expected to decrease by 300 m^3/day (7%) and 200 m^3/day (6%) during operation and post-closure, respectively, compared to the baseline condition. Peak flows were estimated to decrease by 5% to 10% during operation and 20% to 25% post-closure compared to the baseline condition. Regarding low flows, the $7Q_2$ values are expected to decrease by less than 0.001 m^3/s (11%) during operation and post-closure. No changes were anticipated on the 5, 10, and 20-year 7-day low flow return period.

- In watersheds 102, 103, 107 and 108, changes to land use were predicted to occur with construction of the Project. In watershed 102, MAFs were expected to decrease by 1.3 million m^3/year (75%) during operation due to the centralized management of drainage and increase by 600,000 m^3/year (35%) post-closure due to an increase in drainage area by approximately 150 hectares on closure. In watershed 103, MAFs were anticipated to decrease by 500,000 m^3/year (60%) during operation and post-closure due to management of the drainage areas during operation and a reduction in drainage area by approximately 135 hectares on closure. In watersheds 107 and 108, no change to MAFs were expected during Year 3 and Year 6 of mine operation. However, MAFs were expected to increase by 30,000 m^3/year (14%) and 20,000 m^3/year (10%) for watersheds 107 and 108, respectively, during Year 11 of mine operation with placement of mine rock which results in seepage from the mine rock stockpile. MAFs were estimated to increase by 30,000 m^3/year (14%) and 90,000 m^3/year (35%) for watersheds 107 and 108, respectively, post-closure. No watercourse crossings of interest were identified in watersheds 102, 103, 107 and 108 and, therefore, peak flows were not evaluated quantitatively; however, it was expected that peak flows would decrease during operation due to centralized management of the drainage areas. As a result of a decrease in drainage area and centralized water management, an increased frequency of low flow conditions was expected in watersheds 102, 103, 107 and 108 during operation.

- In watershed 104, hydrologic flow regime, peak flows and low flows were anticipated to remain similar to baseline conditions.

- In watershed 105, the projected hydrologic changes were expected to only occur in the lower area of the watershed such as Hare Creek and Hare Lake with exception of the S10 tributary located upstream of Hare Lake. Hare Lake would start receiving effluent discharge in Year 2 and continue through the mine life. During operation, MAFs downstream of Hare Lake (S11) were expected to increase by 1,000 m^3/day (3%) in Year 3 and Year 6, and 4,000 m^3/day (10%) in Year 11 compared to the baseline condition. MAFs at the outlet of watershed 105 (S30) were anticipated to increase by 1,000 m^3/day (3%) in Year 3 and Year 6, and 4,000 m^3/day (9%) in Year 11 from the baseline condition due to the effluent discharge to Hare Lake. Post-closure, MAFs were expected to decrease by less than 1% at both S11 and S30 compared to the baseline condition because of a permanent decrease of 12 hectares in drainage area due to the PSMF construction. Peak flows were expected to increase by approximately 1% during mine life due to the effect of effluent discharge from the Project.

Hydrologic flow regime and peak flows would remain similar to the baseline condition post-closure. The reduction in drainage area would not affect low flows during operation and post-closure.

- In watershed 106, MAFs at the outlet of Stream 6 (S31) were anticipated to decrease by 3,000 m^3/day (34%) during mine operation due to the PSMF construction and increase by 400 m^3/day (4%) in post-closure due to an increase in drainage area by 42 hectares. The 100-year peak flows were anticipated to decrease by 3 m^3/s (36%) and 2.5 m^3/s (13%) at S14 and S31, respectively, during the operational phase of the Project due to the PSMF construction in the headwater areas. The 100-year peak flows were expected to increase by 2.3 m^3/s (27%) and 2.0 m^3/s (11%) at S14 and S31, respectively, in post-closure. During operation, the $7Q_{20}$ values were expected to decrease by 0.003 m^3/s (60%) and 0.003 m^3/s (27%) at S14 and S31, respectively. The $7Q_{20}$ values were anticipated to return to the baseline condition post-closure.

3.0 REGULATORY BACKGROUND AND ASSESSMENT CRITERIA

Since preparation of the original baseline reports and completion of the original EIS (2012), some regulatory changes or updates have been implemented by federal and provincial authorities. The most current standards, criteria or guidelines have been applied as part of this review to characterize existing conditions, as follows:

Fisheries Act

The Fisheries Act, administered primarily by Fisheries and Oceans Canada (DFO) with some provisions administered by Environment and Climate Change Canada (ECCC, formerly Environment Canada), focuses on protecting the productivity and sustainability of commercial, recreational, and Aboriginal (CRA) fisheries. Any alteration of fish habitat must not result in "serious harm" to fish that are part of or support a CRA fishery, otherwise an authorization and associated offsetting is required. The *Fisheries Act* applies to the Project through protection of fish habitat.

The Metal and Diamond Mining Effluent Regulations (MDMER) are promulgated under the *Fisheries Act*. The MDMER defines effluent concentration limits for metal mines, monitoring parameters, minimum flow thresholds for applicability, and environmental effects monitoring requirements.

Canadian Navigable Waters Act

The *Navigation Protection Act*, administered by Transport Canada, was amended to the Canadian Navigable Waters Act (CNWA) in 2019. The amendment to the CNWA included the addition of an online registry for projects and approvals, introduced a public notification system, added consideration of Indigenous knowledge and traditional use of the waters, and expanded the Act to regulate major works and obstructions on all navigable waters. Approval from the Minister of Transport is required for construction of any structure in, over, under or through navigable water that would interfere with navigation (e.g., bridge, boom, pipeline, outfall, effluent diffuser or dam).

Lakes and Rivers Improvement Act

The *Lakes and Rivers Improvement Act* (LRIA), administered by the Ministry of Natural Resources and Forestry (MNRF), applies to the design, construction, operation, maintenance, and safety of waterbodies and watercourses in Ontario. For the purposes of the LRIA, this includes online dams, channelizations, water crossings, enclosures, and pipeline installations. Approval is required from the MNRF for the construction of dams which may alter fish habitat, natural amenities, and riparian owner rights.

Ontario Water Resources Act and Related Regulations

The *Ontario Water Resources Act* (OWRA) is the principal statute governing water quality and quantity in Ontario. It is a general management statute that applies to groundwater and surface water. Administered by the Ministry of the Environment, Conservation and Parks (MECP), the OWRA contains important regulations that protect water resources, including:

- *Ontario Regulation 387/04: Water Taking and Transfer Regulation* (O.Reg. 387/04), which requires a permit for water takings of more than a total of 50,000 L/d (with some exceptions). Section 34 of the OWRA requires the proponent to obtain a Permit to Take Water and Section 9 of O.Reg. 387/04 requires all permit holders to collect, record and report data on daily volumes of water withdrawals

4.0 EXISTING CONDITIONS

Previous work was undertaken by Calder (2012a) to assess the hydrological baseline conditions for the Project. Stantec Consulting Ltd. (Stantec) provided an updated assessment of hydrological baseline conditions by summarizing and documenting changes to the existing environmental conditions in order to support the updated assessment of potential environmental effects provided in the EIS Addendum (Stantec, 2020) (CIAR #722). Information reviewed to update the baseline condition included a review of historical information, supplemental field studies conducted by True Grit Engineering Ltd. (now Stantec) (2008-2018) and Stantec (2019-2020), and the updated design plans for the Project provided by Knight Piésold Consulting (2020).

4.1 BASELINE STREAM FLOW MONITORING UPDATE

In previous work undertaken by Calder (2012a), the baseline streamflow monitoring program was implemented during open-water conditions from August 2008 to November 2011 by True Grit Consulting Ltd. The streamflow monitoring program included manual flow measurements and the installation of water pressure recorders at six hydrometric stations (S10, S11, S14, S15, S22, S41). The stage-discharge relationships (rating curves) were developed using Microsoft Excel and the accuracy of the developed regression equations in estimating flow based on the continuous stage data was expressed by the coefficient of correlation (R^2) that ranged from 0.73 to 0.91.

The baseline streamflow monitoring program was continued at 11 hydrometric stations (S1, S2, S3, S4, S6, S8, S9, S10, S11, S13, and S14) from 2008 to 2018 by True Grit and subsequently by Stantec from 2018 to 2020 to update the hydrology baseline conditions. With the continuation of field hydrometric monitoring, rating curve confidence was increased and the subsequent confidence of monitored flow measurements was also improved. All stations had R^2 values between 0.82 to 0.98 indicating a sufficient estimation of flows.

4.2 BASELINE HYDROLOGY CONDITIONS UPDATE

4.2.1 Hydrology Desktop Assessment

4.2.1.1 Climate

In Calder (2012a), historical climate data was collected from four (4) climatic stations from Environment Canada (2020) within a 35 km range of the LSA. Climatic information was used to supplement barometric pressure data and to calculate the mean annual and monthly precipitation and temperature range for the Project area. The climatic stations included Marathon (Station ID 6044959), Marathon Airport (Station ID 6044961), Pukaskwa National Park (Station ID 6046770), and Hemlo Battle Mountain (Station ID 6043452).

To update the hydrology baseline condition, nine (9) climatic stations within a 40 km range of the LSA were selected: Marathon (Station ID 6044959), Marathon Airport (Station ID 6044961), Pukaskwa National Park (Station ID 6046770), Hemlo Battle Mountain (Station ID 6043452), Marathon A (Station ID 6044962), Marathon A (Station ID 6044963), Marathon A (Station ID 6044967), Pukaskwa (AUT) (Station ID 6046767), and Pukaskwa (AUT) (Station ID 6046768). The Marathon A stations were identified by Calder (2012a) but had limited data sets at the time of the Calder baseline hydrology report. The Pukaskwa (AUT) stations have more recent data sets and were not included in the Calder report as they did not have a robust data set at the time of the report.

The mean temperature and annual precipitation, where applicable, were calculated at each climatic station. The Marathon, Marathon Airport, Pukaskwa National Park, and Hemlo Battle Mountain average annual precipitation and mean temperature range from the Calder report (2012a) were found to be highly consistent with the updated data presented in the Hydrology Baseline Report update (CIAR #722). The Marathon dataset (1945-1984) was combined with the Marathon Airport (1988-1999) and both Pukaskwa (AUT) stations (2000-2020) to provide a more recent dataset. The average annual precipitation (818.2 mm/year) and temperature range (-13.4˚C in January to 15.1˚C in August) remained relatively consistent with what was presented in Calder (2012a). The mean monthly precipitation values were reasonably consistent with the data provided by Calder (2012a) for Marathon.

4.2.1.2 Climate Change

Climate change is a scientifically recognized issue that has already seen Ontario's climate warm by up to 1.6˚C over the past 63 years and is projected to continue increasing the temperature and change precipitation patterns in the years to come (Colombo, et al. 2007).

Stantec (2020) (CIAR #722) presented climate projections for the next 20 years to compare the changing conditions over the active period of the Project prior to post-closure in the LSA. Three representative concentration pathways (RCPs) were focused on to provide the best-case scenario (RCP2.6), intermediate-case scenario (RCP4.5), and worst-case scenario (RCP8.5).

The results, presented in the Hydrology Baseline Report update (CIAR #722), showed that even under the best-case RCP scenario, climate change is expected to result in some significant changes to precipitation events, with higher total rainfall and increased rainfall intensities occurring more frequently. Generally, lower duration with shorter return periods and higher durations with longer return periods are predicted to experience increased total rainfall, while medium duration for all return periods will experience a decrease in total rainfall for all RCPs. It is recommended that the RCP4.5 intensity-duration-frequency (IDF) curves be used to estimate Project conditions as they reflect realistic precipitation changes due to climate change for an intermediate stabilization scenario.

4.2.1.3 Local Watersheds

The naming conventions of the watersheds were kept constant with the watersheds included in Calder (2012a). However, changes to the existing watersheds were identified, with the inclusion of an additional nine (9) watersheds (109-117) delineated to define the original SSA more fully. Revisions to the SSA since the Calder (2012a) report now show a smaller area that more closely follows the project infrastructure footprint (Figure 2, Appendix A). As shown on Figure 2 (Appendix A), watersheds 107, 109, 110, 113, 114, and 115 no longer have portions of their watersheds within the SSA but are included in the effects assessment as changes to the groundwater discharge to watercourses and lakes were identified in the Hydrogeology Effects Assessment (Appendix D4 of the EIS Addendum [VOL 2]).

The watershed delineations were updated from the original baseline report (Calder 2012a) using satellite-based light detection and ranging (LIDAR) derived digital elevation mode (DEM) as the topographic data source. The use of satellite LIDAR enhances the accuracy of the watershed boundaries from the best available data source and resulted in some minor shifts in the watershed boundaries. The original watershed boundaries were delineated using 5 m contours which had been derived from the satellite LIDAR derived DEM. Using the contours rather than the source data (DEM) as the topographic data input caused a degree of generalization to be introduced to the watershed delineation. Elevation changes of less than 5 m were generalized out of the original watersheds. Using the DEM from the raw data source has allowed for the elevation changes to be factored back into the watershed delineation and represents the best practice for watershed delineation.

One of the additional watersheds (117) was previously included in Calder (2012a) as part of watershed 103, but upon further inspection the original watershed 103 had two separate watercourses discharging to the Pic River. In comparison to the Calder (2012a) watersheds, watershed 103 has an area 13% smaller than originally presented and watershed 108 has an area 7% greater. The remaining identified six watersheds (101, 102, 104, 105, 106 and 107) are reasonably consistent in area.

A visual assessment of the watershed delineation for the project area was completed as a quality assurance / quality control measure. Clarification was requested with respect to the lake network southeast of Rag Lakes in watershed 109, which is shown on Figure 2 (Appendix A) to be disconnected from a stream system. Visual field inspection on site of this lake network showed water flowing south towards a wetland with no discharge pathway, indicating a possible connection into the groundwater system at the south end of the lake network. As such, the lake network south of Rag Lakes was kept within watershed 109 as the flow pattern was not directed towards watersheds 101 or 116.

A visual inspection was completed to confirm the watershed delineation around Canoe Lake, which receives water from headwaters to the north, and discharges to both the east and west due to beaver damming activity within the lake. At the time of the visual inspection, Canoe Lake was observed to be flowing predominantly to the west into watershed 105 and has therefore been left within watershed 105.

4.2.2 Regional Hydrology Assessment Update

4.2.2.1 WSC Stations selection for the Regional Hydrology Assessment

Calder (2012a) used the hydrologic data from Water Survey of Canada (WSC) stations within a 35 km radius of the Project including the Little Pic River near Coldwell (Station ID 02BA003), the Pic River near Marathon (Station ID 02BB003), the Black River near Marathon (Station ID 02BB002), and Cedar Creek near Hemlo (Station ID 02BB004). Five WSC stations were chosen to update the hydrology baseline conditions in addition to the ones originally presented by Calder (2012a) including Steel River Below Santoy Lake (Station ID 02BA006), Whitesand River Above Schreiber at Minova Mine (Station ID 02BA005), Pukaskwa River Below Fox River (Station ID 02BC006), Gravel River Near Cavers (Station ID 02AE001), and Wawa Creek at Wawa (Station ID 02BD006). Black River near Marathon was removed as it had a large catchment area (1980 km^2) and the baseline hydrology update focused on bringing smaller WSC stations into the preliminary dataset to better represent the smaller catchment areas of the local watersheds.

Selection of WSC gauging stations in the Hydrology Baseline Report update (CIAR #722) was made based on initial selection criteria (catchment area, distance to project site, flow regime) and was tested to determine the homogeneity of the data set including mean slope, percent area of waterbodies, average annual precipitation, unit flow, flow duration curve, index flood flow, index low flow, and the regionally based 10-year flood flows. Station 02BD006 (Wawa Creek at Wawa) was determined to be the least homogeneous, did not pass several of the homogeneity tests, and was removed from the WSC stations selected for the regional hydrology assessment.

4.2.2.2 Regional Hydrology Assessment Results

The regional hydrology assessment was used to calculate the relationship between flow and catchment area to estimate local hydrological conditions in the LSA. Hydrological relationships were calculated for the MAF, mean monthly flow, peak flows, and low flows. An exponential relationship was used for the mean monthly flow regression relationships as opposed to a linear relationship in the Calder (2012a) report. The exponential relationship showed a higher coefficient of correlation, ranging from 0.94 to 0.99 with an average of 0.965, than the linear relationship presented previously.

4.2.3 Local Hydrology Assessment Update

The relationships derived from the regional hydrology assessment were used to characterize local hydrology. MAFs, mean monthly flows, peak flows, and low flows were calculated for the local watersheds, and used to determine the environmental flows and environmental water balance for the Project (See Appendix D5 [Site Water Balance Summary] of the EIS Addendum [Vol 2]). Comparing the results of updated local hydrology assessment with Calder (2012a) showed that the actual evapotranspiration and runoff coefficient computed from the unit flows were fairly consistent.

Peak flows were compared to the Calder (2012a) peak flows for watersheds 104, 107, and 108, which were calculated for the entire watershed rather than at a stream gauge node as with watersheds 101, 102, 103, 105, and 106. It was found that there was a difference with the updated hydrology peak flows, showing a range of 20% to 68% smaller peak flows than that calculated by Calder (2012a). The reason for the variance was determined to be the difference in peak flow calculation methodologies. Calder (2012a) used the Northern Ontario Hydrology Method for estimating peak flow values which is a conservative method used to represent northern Ontario. In the Hydrology Baseline Report update (CIAR #722), instantaneous flows were used from seven regional WSC stations to calculate the peak flow for various return periods to update the baseline condition. The difference in watershed area ranged from 2% to 7% and, therefore, the difference in watershed area did not account for the differences observed in the peak flows.

A portion of the Project SSA is within watersheds that discharge to the Pic River. The Pic River has a baseline watershed area of 4,207.6 km^2 which is predominantly north of the Project SSA. An existing WSC station is located on Pic River downstream of the SSA (station ID: 02BB003) which collects real-time and historical flow data and was included as one of the stations used in the hydrology baseline update for the regional assessment. The same methodology as the local assessment was used to estimate the MAF, MMFs, and environmental flows for the Pic River. Regional regression equations for the MAF and MMFs were used to calculate expected flows for the Pic River to determine the environmental flows for the Pic River, as shown in Table 4.1. The MMFs show less than a 1% change during baseline, construction, operation, closure, or post-closure phases for each month of the year.

Table 4.1: Pic River Environmental and Mean Monthly Flows

	Baseline Environmental Flows	Mean Monthly Flows				
		Baseline	Construction	Operation	Closure	Post-Closure
Units	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
Area (km^2)	4207.6	4207.6	4200.7	4200.7	4202.5	4207.8
Jan	7.70	19.26	19.23	19.24	19.24	19.27
Feb	5.34	13.35	13.33	13.34	13.34	13.36
Mar	5.75	14.38	14.36	14.37	14.37	14.39
Apr	30.22	75.54	75.43	75.44	75.47	75.55
May	58.21	145.52	145.30	145.31	145.37	145.54
Jun	28.97	72.43	72.31	72.33	72.35	72.45
Jul	17.62	44.04	43.97	43.98	44.00	44.06
Aug	10.03	25.09	25.04	25.06	25.06	25.09
Sep	12.00	30.00	29.96	29.97	29.98	30.01
Oct	21.64	54.09	54.01	54.03	54.04	54.10
Nov	20.48	51.20	51.13	51.14	51.16	51.22
Dec	13.13	32.82	32.76	32.78	32.79	32.83

4.3 BASELINE HYDROLOGY UPDATE SUMMARY

In the Hydrology Baseline Report update (CIAR #722), longer continuous and spot measurement periods were considered compared to Calder (2012a) to develop the rating curves and estimate local stream flows at ungauged stations which improved the estimation of local stream flows. In addition, longer precipitation data records were obtained by considering additional climatic stations and combining the datasets. The local hydrology assessment results mostly concurred with Calder (2012a) but showed deviations in the peak flows and low flows. Differences in the peak flows and low flows may be a result of the updated baseline hydrology report regional assessments which expanded upon the Calder (2012a) report. The updated baseline hydrology used the equations developed from instantaneous results in the regional assessments to develop hydrology for the local watersheds. In comparison, Calder (2012a) peak flows and low flows were based on a less extensive field data, which did not have complete data sets throughout the year and conservative estimation methods covering northern Ontario. Therefore, the results from the updated baseline conditions (Stantec, 2020) (CIAR #722) are considered to be more locally representative and were used to estimate the environmental impact of the Project on surface water hydrology.

5.0 EFFECTS ASSESSMENT METHODOLOGY

Flows and water levels under pre-development conditions were used as the baseline against which Project-related changes during the construction, operation and decommissioning, rehabilitation and closure phases were assessed. Pre-disturbance (baseline) watershed areas are presented on Figure 2 and expected changes to these watersheds were delineated for subsequent phases of the mine life, as shown on Figure 3 (construction and operation watershed areas) and Figure 5 (closure watershed areas). Placement of infrastructure and mine waste was purposely designed to stay within specific watershed areas, for better water management, reducing overall footprint and impact to surface water and groundwater systems. The changes in watershed areas are primarily a result of the construction of mine infrastructure and the implementation of measures to manage water on site.

Project-related changes in surface water quantity were assessed at the watershed scale using the following tiered approach:

- A WMP will be developed to guide the efficient and responsible use and management of water throughout the Project. The WMP will provide an overview of all contact and non-contact water streams managed by the Project and, where applicable, how the stream will be drained or pumped, stored, diverted and discharged. The WMP will be provided and updated through the detailed design of the mine and will be finalized prior to the commencement of site preparation.
- A site-wide water balance model was developed in GoldSim™ to predict the water quantity changes through the Project phases. The water balance model includes the open pits, overburden stockpiles, MRSA, process plant, PSMF, and ore stockpiles. See Appendix D5 (Site Water Balance Summary) of the EIS Addendum (Vol 2) for details
- Change in MAF from pre-disturbance conditions was used as a screening threshold to determine whether further assessment of changes in flow were required. Changes in MAF were calculated for watersheds during each phase of mine development. MAF was calculated using regional relationships developed in the Hydrology Baseline Report update (CIAR #722). Watersheds with an expected change in MAF of greater than 10% were carried forward to subsequent assessment steps. The ±10% threshold was selected based on case studies presented by Richter et al. (2011), which indicate that a high level of ecological protection is provided when flow alterations are within 10% of the natural flow, and guidance provided by DFO (2013).
- For watersheds with an expected MAF decrease of over 10%, the MMF was compared with baseline environmental flows. The residual effect was considered to not be significant if the predicted MMF was greater than the baseline environmental flows. If the expected MMF was lower than the baseline environmental flows, a locally significant surface water quantity residual effect is expected within the LSA.

- For watersheds with an expected increase in MAF of over 10%, expected flood flows (Q100) were compared with baseline conditions to assess the potential for flooding and erosion.

- Pre-development watersheds at the extent of the LSA are shown on Figure 2, Figure 3 and Figure 5 (Appendix A) show the LSA watersheds for construction and operation, and closure mine phases. Expected MMFs for these phases were compared with pre-development conditions to establish expected changes in surface water quantity at the boundary of the LSA. If a residual effect for surface water is propagated to the boundary of the LSA and beyond, it is considered a significant residual effect.

- Project changes in watershed flows were developed using groundwater flows developed in the Hydrogeology Effects Assessment (Appendix D4 of the EIS Addendum [VOL 2]), GoldSim water balance modelling results (Appendix D5 [Site Water Balance Summary] of the EIS Addendum [Vol 2]), and changes in watershed area.

5.1 MEAN ANNUAL FLOW

Expected changes to watersheds during the phases of the mine life were delineated for construction and operation (Figure 3, Appendix A) and closure (Figure 5, Appendix A) to compare with the baseline watersheds delineated in the Hydrology Baseline Report update (CIAR #722). The MAF was calculated for watersheds 101 to 117 using the regression equation derived in the Hydrology Baseline Report update (CIAR #722) with the revised watershed areas for construction, operation, and closure phases of mine life.

Groundwater discharge to watercourses and lakes under dewatered (Year 12) and post-closure (Pit Lake full) conditions calculated in the Hydrogeology Effects Assessment (Appendix D4 of the EIS Addendum [VOL 2]) were added to the calculated MAF to capture the changing baseflow in the total flow. To avoid double counting the groundwater rates in the total flow, the percent of groundwater contributing to the baseline MAF (baseflow) was calculated for each watershed and applied to the MAF for construction, operation, and closure phases. The difference between the baseflow and the total groundwater discharge to surface water presented in the Hydrogeology Effects Assessment (Table 6.3, Appendix D4 of the EIS Addendum [VOL 2]) was then added to the MAF for the appropriate watersheds in construction, operation, and closure phases.

5.2 MEAN MONTHLY FLOW

The MMF was calculated for watersheds 101 to 117 using the monthly regression equations derived in the Hydrology Baseline Report update (CIAR #722) with the revised watershed areas for construction, operation, and closure phases of mine life. Groundwater discharge to watercourses and lakes under dewatered (Year 12) and post-closure (Pit Lake full) conditions were added to the monthly flows using the groundwater rates discussed in Section 5.1. Discharge to Hare Lake (watershed 105) occurring during ice-free periods was added to the total monthly flows in watershed 105 from April through November.

5.3 HARE LAKE WATER LEVEL

Water levels in Hare Lake were estimated using the rating curve developed in the Hydrology Baseline Report update (CIAR #722) for the hydrological monitoring station S11 at the outlet to Hare Lake. The stage at the monitoring station could be determined through the rating curve equation by inputting the baseline MAF into the rating curve equation and solving for water depth. The expected total flow during the phases of mine life could then be used in the rating curve equation to compare the mine phase stage to the baseline stage to determine a change in water levels due to project activities.

6.0 RESULTS AND DISCUSSIONS

6.1 PROJECT MECHANISMS FOR CHANGE IN HYDROLOGY

During construction, operation, closure, and post-closure of the mine, mining infrastructure and physical works have the potential to impact the baseline flows and water levels of waterbodies in the SSA. As indicated in Section 4.2.1.3, 11 watersheds remain within the revised SSA (Figure 1) and have been included in the effects assessment. Six additional watersheds in the LSA expected to experience a change in baseflow are also included in the effects assessment. Project activities during each phase of mine life having the potential to affect hydrology in the SSA include the following:

Site Preparation and Construction

- Site timber harvest for preparation of the construction of mine infrastructure within the SSA.
- Construction of an access road off of Camp 19 Road and associated hydraulic structures (e.g. culverts, bridges, etc.) to convey water across the new roadway, may result in an increase in runoff and/or flooding due to an increase in imperviousness.
- Construction of mine infrastructure that will overprint existing waterbodies and require either dewatering and/or watercourse realignment, including:
    - Several small headwater streams for the construction of the PSMF, MRSA, and/or open pit.
    - Several small lakes for the construction of the PSMF, MRSA, and/or open pit.
- Dewatering of the open pit which is expected to affect groundwater quantity and subsequent quantity of groundwater discharging to surface water.
- Construction of seepage collection basins (perimeter of the PSMF) which may affect groundwater quantity and subsequent quantity of groundwater discharging to surface water.
- Construction of catch basins (east side of MRSA) which may affect groundwater quantity and subsequent quantity of groundwater discharging to surface water.
- Collectively, during the construction phase, centralization of water management commences directing disturbed ground runoff to the Water Management Pond for further treatment prior to release to the environment.

Operation

- Ongoing water management to collect runoff and groundwater seepage from the MRSA, pumping collected water from watersheds 102 and 103, to the water management pond where it will be used to offset mill demand.
- Ongoing water management to collect runoff and groundwater seepage from the open pit, PSMF, and stockpiles from watersheds 102, 103, 105, and 106 to discharge to Hare Lake (watershed 105) and ultimately to Lake Superior. The water management pond and SMP which will accept Project contact water is located within watershed 101.
    - Dewatering of the open pit which may affect groundwater discharge to surface water features (described in detail in the hydrogeology VEC chapter).
- Build-up of mine rock in the MRSA, which may have a groundwater mounding effect and result in increased groundwater flow to watersheds 110, 111, 112, 113, 114, 117, and the Pic River, as detailed in the Hydrogeology Effects Assessment (Appendix D4 of the EIS Addendum [VOL 2]).
- Ongoing dewatering of the open pit, which is expected to affect groundwater quantity and subsequent quantity of groundwater discharging to surface water.
- Ongoing access road maintenance off of Camp 19 Road and associated hydraulic structures (e.g. culverts, bridges, etc.) to convey water across the new roadway, which may result in increased runoff and/or flooding due to an increase in imperviousness.

Closure and Post-Closure

- Decommissioning and removal of the process plant, water treatment plant, and ancillary buildings. The demolition and ground disturbance resulting from the removal will affect surface water runoff, infiltration, and evapotranspiration.
- Rehabilitation of the MRSA and other disturbed areas with appropriate cover materials and vegetation to stabilize soils, reduce overland flow and surface erosion, increase evapotranspiration, and reduce infiltration.
- Pumping from the PSMF, process plant, and catch basins to the open pits to accelerate pit filling during the first five years of closure.
- Removal of the catch basin dams on the east side of the MRSA prior to the overflow of the North Pit to watershed 103.
- Reclamation the PSMF.

- Construction of a discharge channel from the PSMF into the existing watercourse in watershed 106 following the five years of pumping to the open pits, contingent upon water quality meeting regulatory criteria discussed as part of this EIS Addendum in the Surface Water Quality Effects Assessment (Appendix D11 of the EIS Addendum [Vol 2]).

- Construction of a discharge channel from the water management pond into an existing watercourse on the east side of the pond, leading to the stormwater management (SWM) pond. The SWM pond will have a discharge channel constructed on the east side of the pond to discharge into the existing watercourse in watershed 101. Flows from the water management pond and SWM pond are expected to increase the surface water quantity in watershed 101 from operations.

- Filling of the open pits during closure may affect water quantity through additional seepage increasing flow to adjacent watersheds. Once pits are filled, overflow would occur to watershed 103.

6.2 MITIGATION FOR CHANGE IN SURFACE WATER QUANTITY

Upon completion of detailed engineering, the conceptual site water management plan presented in IR 24.17 will be implemented prior to construction. The mitigation measures presented in Table 6.1 are proposed to avoid or reduce Project-related effects on surface water quantity.

Table 6.1: Mitigation Measures for a Change in Surface Water Quantity

Mitigation Measures for a Change in Surface Water Quantity	Mitigation Category	Construction	Operation	Closure
Limit and stage construction footprint (SSA) to the extent practicable	General	✓	✓	✓
Maintain existing drainage patterns with the use of culverts	General	✓	✓	✓
Inspect culverts periodically. Remove accumulated material and debris upstream and downstream of the culverts to prevent erosion, flooding, habitat damage, property damage, and mobilization of sediment.	General	✓	✓	✓
Maintain access roads by periodically regrading and ditching to improve water flow, reduce erosion, and manage vegetation growth.	General	✓	✓	✓
Attenuate peak discharges and augment baseflows to the environment through use of Project water storage features (i.e., catch basins, collection ponds, SWM ponds)	General	✓	✓	✓
Collection of runoff and groundwater seepage from the open pits and run-of-mine stockpile within Collection Pond 1	Open Pit Dewatering	-	✓	-
Excess water pumped from Collection Pond 1 to the water management pond for use in process plant or treatment, as needed and discharge to Hare Lake	Open Pit Dewatering	-	✓	-
Recycling of contact water for use as mill reclaim	Freshwater Withdrawals	-	✓	-

Table 6.1: Mitigation Measures for a Change in Surface Water Quantity

Mitigation Measures for a Change in Surface Water Quantity	Mitigation Category	Construction	Operation	Closure
Construction and use of existing watershed boundaries to divert fresh water away from Project components	Runoff and Seepage Collection	✓	✓	-
Construction and use of perimeter runoff and seepage collection ponds to collect overland flow, seepage, and intercept shallow groundwater flow, and divert fresh water away from Project components	Runoff and Seepage Collection	✓	✓	-
MRSA catch basins designed to contain the 1:25-year storm event.	Runoff and Seepage Collection	✓	✓	-
PSMF designed with two cells to allow progressive development	Process Solids Management Facility	-	✓	-
PSMF seepage collection basins on the perimeter of the PSMF designed to capture shallow groundwater seepage from the PSMF to be pumped back into the PSMF.	Process Solids Management Facility	-	✓	-

NOTE:
✓ Mitigation measures are applicable
- Mitigation measures are not applicable

6.3 ASSESSMENT OF HYDROLOGY THRESHOLDS

The change in watersheds due to the activities described in Section 6.1 are discussed below under climate normal conditions and quantified in Table 6.4. Watersheds during each phase of mine life are presented on Figure 3 and Figure 5 (Appendix A), with water management shown on Figure 4 and Figure 6 (Appendix A).

6.3.1 Construction and Operation

Watershed 101

The S1 watershed (watershed 101) includes a network of nine unnamed headwater watercourses, four of which have an associated unnamed lake. The headwater streams discharge into the main second-order watercourse that flows southeast to the Pic River. Four existing stream monitoring stations are located within this watercourse network, including station S1.

Approximately 1.55 km^2 (34%) of watershed 101 (including one headwater stream and lake) will be overprinted by project infrastructure, namely the portions of the Process Plant area, SWM pond, water management pond, and PSMF. Water collected in the SWM pond will be transferred to the water management pond where it will be either pumped to the mill for process water reclaim or pumped as discharge to Hare Lake. An additional 0.23 km^2 (5%) of watershed 101, including two headwater streams and one small unnamed lake, will be overprinted for the access road. Construction of the access road is expected to have no effect on the existing watershed area and is not considered to be watershed area loss. Overland flow on the west side of the road will be directed downgradient (southeast) via culverts below the access road and runoff on the road will also drain by gravity to remain within the watershed. Culverts will be placed at topographic lows along the road corridor to facilitate the passage of water below the road, with a maximum spacing between culverts of 300 m as per Ministry of Transportation Ontario (MTO) guidelines for steep ground slopes (>10%) and rock, soil, sand, and gravel. It is estimated that no less than 14 culverts will be constructed below the 2.8 km length of the access road. Culvert locations will use existing defined channel paths to the extent feasible. The access road is expected to increase the imperviousness along its pathway, which will result in a marginal change in flow as less evapotranspiration will occur and less water will infiltrate the groundwater system.

The MAF, considering both surface water and groundwater changes, is expected to decrease from the baseline MAF of 0.074 m^3/s to 0.050 m^3/s during construction and 0.057 m^3/s during operation due to watershed loss. The net change in MAF is expected to be -33% during construction and -22% during operations, which is greater than the +/-10% assessment threshold. Watershed 101 is included in Table 6.5 and discussed in Section 6.4 to compare the MMF to baseline environmental flows developed in the baseline assessment to determine whether the change in flow is considered to have a significant residual effect.

Watershed 102

The Terru Lake watershed (watershed 102) includes a network of four unnamed headwater watercourses (including Stream 2), two lakes including Terru Lake, and a couple of small, unnamed ponds. Depending on beaver dam activity and water levels in lake L5, existing flows may be directed into either watershed 102 or watershed 105 as indicated in Section 4.2.1.3. The headwater streams in watershed 102 discharge into the main second-order watercourse that flows east to the Pic River. Four existing stream monitoring stations are located within this watercourse network, including station S4.

Approximately 3.43 km^2 (98%) of the 3.50 km^2 watershed will be overprinted by mine infrastructure (MRSA and open pit), including the headwaters, lakes, ponds, and second-order watercourse east of Terru Lake, with most of the infrastructure directing flow out of watershed 102 to Collection Pond 1 and subsequently to the water management pond. However, the stream 2 catch basin on the far east side of the watershed will collect water from the southern half of the MRSA. A similar catch basin (stream 3) in watershed 103 will collect the contact water from the northern half of the MRSA and pump it to the stream 2 catch basin in watershed 102, where it will be pumped to the water management pond to be used as mill reclaim as required. The watershed area associated with the collected MRSA water will contribute to watershed 105 via discharge to Hare Lake. Therefore, the catchment area will undergo a 98% reduction.

The MAF, considering both surface water and groundwater changes, is expected to decrease from the baseline flow of 0.058 m^3/s to 0.001 m^3/s during construction and 0.002 m^3/s during operation as a result of watershed loss. The net change in MAF from baseline conditions is therefore -98% during construction and -97% during operations, which is greater than the +/-10% assessment threshold. Watershed 102 is included in Table 6.6 and discussed in Section 6.4 to compare the MMF to baseline environmental flows developed in the baseline assessment to determine whether the change in flow is considered to have a significant residual effect.

Watershed 103

Watershed 103 contains four unnamed headwater watercourses (including Stream 3), each with an associated unnamed lake, that contribute to a second-order watercourse that flows east to discharge to the Pic River. Three existing stream monitoring stations are located within the watershed.

Approximately 1.80 km^2 (96%) of the 1.87 km^2 watershed area will be overprinted by mine infrastructure (MRSA and open pit), including the four headwater streams and unnamed lakes. A catch basin constructed near the outlet on the east side of the watershed on stream 3 will collect runoff and seepage from the north half of the MRSA. Collected water will be pumped to the catch basin within Watershed 102 where it will be pumped to the water management pond and used as reclaim water for the Process Plant or discharged as required. The 1.80 km^2 watershed area associated with the discharge of MRSA water will contribute to watershed 105 via discharge to Hare Lake.

The MAF, considering both surface water and groundwater changes, is expected to decrease from the baseline flow of 0.032 m^3/s to 0.001 m^3/s during construction and 0.002 m^3/s during operation as a result of watershed loss. The net change in MAF from baseline conditions is expected to therefore be -96% during construction and -95% during operation. The net change is greater than the +/-10% assessment threshold and watershed 103 is therefore included in Table 6.7 and discussed in Section 6.4 to compare the MMF to baseline environmental flows developed in the baseline assessment to determine whether the change in flow is considered to have a significant residual effect.

Watershed 104

The Claw Lake watershed (watershed 104) includes a network of small first- and second-order watercourses and small lakes, including Claw Lake. Water in the Claw Lake watershed flows northeast and ultimately discharges to the Pic River. One existing flow monitoring station (S8) is located within the Claw Lake watershed.

A small portion of the open pit will be located within the 3.46 km^2 Claw Lake watershed with no direct impact to existing waterbodies other than contributing watershed area loss of 0.05 km^2 (1%). Runoff and seepage from the watershed area overprinted by the open pit will be directed into the open pit sump, where it will first be pumped to Collection Pond 1, and then to the water management pond for use in the mill or discharged to Hare Lake (watershed 105).

The MAF, considering both surface water and groundwater changes, is expected to have an associated change in MAF from baseline conditions of 0.057 m^3/s to 0.056 m^3/s during construction and 0.059 m^3/s during operation. The net change in flow is expected to be -1% during construction and 4% during operation. As the percent change for the MAF is less than 10%, it is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 105

The Hare Lake watershed is the largest watershed within the Project area. The watershed includes many small unnamed lakes and larger lakes such as Nellie Lake, Seeley Lake, Bill Lake, Bamoos Lake, and Hare Lake. The network of lakes and watercourses lead to the fourth-order watercourse Hare Creek, which flows in a southwest direction and discharges at Port Munro to Lake Superior. Eighteen existing flow monitoring stations are located within the Hare Lake watershed.

Approximately 1.15 km^2 of the 47.83 km^2 watershed (2%) is expected to be overprinted by the PSMF and Process Plant area. However, as project contact water collected within the SSA will be directed to the water management pond for treatment as required and discharged to Hare Lake, an additional watershed area of 11.26 km^2 will be directed to watershed 105, for a net change in effective watershed area of 22%. The treated contact water is expected to have a seasonal discharge to Hare Lake during ice-free periods (April to November).

The MAF, considering both surface water and groundwater changes, is expected to decrease from the baseline MAF of 0.691 m^3/s to 0.676 m^3/s during construction and 0.682 m^3/s operations, a 2% and 1% decrease, respectively. The additional watershed area from Project infrastructure modelled in the water balance will contribute a discharge of treated contact water from the pits, MRSA, ore stockpile, mill, and PSMF at an expected rate of 0.092 m^3/s to Hare Lake during operation. No water is expected to be discharged to Hare Lake during construction. Therefore, the total net flow is expected to be 0.676 m^3/s during construction (2% decrease) and 0.774 m^3/s during operations (12% increase). As the percent change for the MAF during operations is greater than 10%, it is included in the flood flow comparison in Table 6.9 and discussed in Section 6.5.

Watershed 106

Angler Creek is the main second-order watercourse in watershed 106 that flows west and discharges to Lake Superior via Sturdee Cove. Four existing flow monitoring stations are currently situated along the watercourse network.

The PSMF will overprint the eastern portion of watershed 106, including the headwaters and eastern portion of Angler Creek, with water directed to the water management pond for treatment in the WTP before discharging into Hare Lake in watershed 105 (Figure 4, Appendix A). A small headwater portion of watershed 106 not overprinted by Project infrastructure is expected to be hydrologically orphaned from the remaining natural watershed with the placement of the PSMF. The perimeter of the PSMF will be graded such that the orphaned section will be redirected to watershed 109. As such, a net reduction of 3.98 km^2 of the 10.52 km^2 watershed (38%) is expected to occur during the construction and operation phases of mine life.

The MAF, considering both surface water and groundwater changes, is expected to decrease from 0.16 m^3/s during baseline conditions to 0.105 m^3/s during construction and 0.110 m^3/s during operations. The net change in the MAF is therefore expected to be -36% during construction and -33% during operation, greater than the +/-10% assessment threshold. Watershed 106 has been included in Table 6.8

and discussed in Section 6.4 to compare the MMF to baseline environmental flows developed in the baseline assessment to determine whether the change in flow is considered to have a significant residual effect.

Watershed 108

Watershed 108 is one of the smallest watersheds in the SSA, with headwaters draining into an unnamed second-order watercourse. The unnamed watercourse flows northeast and discharges to the Pic River. There are no existing flow monitoring stations within the watershed.

Construction of the open pit on the south side of the watershed is not expected to overprint the existing headwater streams or directly impact the morphology of the watercourses. Construction of the open pit within watershed 108 will reduce the 0.57 km^2 baseline watershed area by 4%, for a total watershed area during construction and operation of 0.54 km^2.

The MAF, considering both surface water and groundwater changes, is expected to decrease from baseline conditions of 0.0103 m^3/s to 0.0099 m^3/s during construction and 0.0096 m^3/s during operations. The net change in MAF is therefore -4% during construction and -7% during operations. As the percent change for the MAF is less than 10%, it is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 109

Watershed 109 is a large watershed that contains a second-order watercourse that flows west and discharges to Lake Superior in Peninsula Harbour. Rag Lakes contribute to the flow regime as the headwaters of the second-order watercourse and Shack Lake within the watercourse system. A small lake network southeast of Rag Lakes is also included in watershed 109 which, as discussed in Section 4.2.1.3, is thought to be connected to the groundwater system as it is not connected to another stream system and does not have a discharge pathway. Marathon Airport is also located within watershed 109, as indicated on Figure 2.

A small portion of watershed 109 is expected to be overprinted by the PSMF. However, as discussed earlier, a small portion of watershed 106 will have surface flows redirected towards watershed 109 during the construction and operation phases of mine life. The resulting net change to watershed area is expected to be a 2% increase from the baseline area of 12.04 km^2 to 12.27 km^2.

The MAF, considering changes to surface water and groundwater changes, is expected to increase accordingly from 0.187 m^3/s during baseline conditions to 0.190 m^3/s during construction and 0.195 m^3/s during operations, for a net increase of 2% and 4%, respectively. Therefore, as the percent change for the MAF is less than 10%, it is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 111

Watershed 111 is the second smallest watershed with one first-order watercourse that drains east to the Pic River. No project infrastructure is expected to overprint the watershed.

The MAF, considering both surface water and groundwater changes, is expected to remain consistent with the baseline flow of 0.0024 m^3/s during construction and increase to 0.0025 m^3/s during operation due to mounding of the water table in the vicinity of the MRSA as detailed in the Updated Hydrogeology Effects Assessment Report (Appendix D4 of the EIS Addendum [VOL 2]). As the net change for the MAF is 0% during construction and 5% during operation and is less than the 10% assessment threshold, it is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 112

Watershed 112 is the smallest watershed within the LSA with two small headwater streams that converge into a second-order watercourse that drains east to the Pic River. Similar to watershed 111, no project infrastructure is expected to overprint the watershed.

The MAF, considering both surface water and groundwater changes, is expected to remain consistent with the baseline flow of 0.0021 m^3/s during construction and increase to 0.003 m^3/s during operation. The net difference in MAF from baseline to construction and operation is expected to be 0% and 53%, respectively. As the percent change for the MAF is greater than 10% during operation, it is included in Table 6.9 and discussed in Section 6.5 to compare the expected flood flows with baseline conditions to assess the potential for flooding and erosion.

Watershed 116

Watershed 116 is a relatively small watershed with one first-order watercourse (unnamed) that drains to the Pic River. The access road will be constructed in the northwest area of the watershed and is not expected to impact the existing watercourse. Under baseline conditions, the catchment area for watershed 116 is 2.94 km^2. Similar to watershed 101, construction of the access road is expected to have no effect on the existing watershed area, as runoff will be directed downgradient (northeast) towards the existing watercourse. Therefore, although the access road within watershed 116 is expected to overprint approximately 2% of the total watershed area, runoff is expected to remain within the existing watershed, for a total net change in watershed of 0%. No change is expected to the MAF during construction and operation as the contributing watershed area remains constant.

The access road is expected to increase the imperviousness along its pathway, which will result in a marginal change in flow as less runoff will infiltrate the groundwater system. The MAF, considering both surface water and groundwater changes, is expected to be consistent with the baseline MAF of 0.049 m^3/s during construction and increase to 0.0051 m^3/s during operations. The net change is therefore less than 10% and watershed 116 is screened out from further assessment and is not considered to have a significant residual effect.

Watersheds 107, 110, 113, 114, 115, and 117

Watersheds 107, 110, 113, 114, 115, and 117 are not within the SSA and are not expected to have watershed loss due to project infrastructure. However, groundwater flow is expected to contribute to the overall flow in watersheds 110, 113, 114, 115, and 117 due to a groundwater mounding effect associated with the development of the MRSA during operation (Appendix D4 of the EIS Addendum [VOL 2]). Groundwater discharge in watershed 107 during operation is expected to decrease due to the permanent lowering of the groundwater table in the vicinity of the open pits

The MAF, considering changes to both surface water and groundwater, is expected to increase in watershed 110 from 0.0026 m^3/s during baseline and construction to 0.0027 m^3/s during operation (4%), increase in watershed 113 from 0.0045 m^3/s during baseline and construction to 0.0047 m^3/s during operation (4%), increase in watershed 114 from 0.023 m^3/s during baseline and construction to 0.024 m^3/s during operation (3%), increase in watershed 115 from 0.0058 m^3/s during baseline and construction to 0.0059 m^3/s during operation (1%), and increase in watershed 117 from 0.0049 m^3/s during baseline and construction to 0.0051 m^3/s during operation (3%).

As the net change in both watershed area and hydrology is expected to be less than 10% for watersheds 107, 110, 113, 114, 115, and 117, they are screened out from further assessment and are not considered to have a significant residual effect.

Hare Lake

Water levels in Hare Lake are expected to increase as a result of the treated effluent discharge into Hare Lake during operation. The treated effluent will be discharged during the ice-free periods with the onset of the spring freshet in April and continue to the end of November, a period of approximately 8 months.

The periodic discharge during ice-free periods is expected to have an average flow of 92 L/s during operation. The existing MAF of 0.691 m^3/s is expected to decrease to 0.675 m^3/s during construction and operation due to the overprinting of watershed 105 with the construction of the PSMF. The reduction in contributing watershed during construction is expected to account for a 0.25 cm reduction in water level for Hare Lake, while the net increase in flow during operation is expected to account for a 1.16 cm increase in water level for Hare Lake. The corresponding change in the baseline stage of 0.309 m is 0.306 m during construction and 0.321 m during operation.

Pic River

Changes in flow to Pic River are expected to be negligible due to large watershed contribution to Pic River as a whole, and the relatively small watershed associated with the mine footprint in comparison. Table 6.2 presents the calculated change in total flow expected for the Pic River as a result of changes to the contributing watershed during construction and operation. It is expected that 6.84 km^2 of watershed will be redirected during construction and operation, a reduction from the 4,207.6 km^2 baseline Pic River watershed of 0.16%. The change in MAF and groundwater flow result in a reduction in total flow from

48.43 m^3/s to 48.35 m^3/s during construction and 48.37 m^3/s during operation. As the change in total flow is below 10%, it is considered not to be significant.

Under extreme, extended dry conditions at the mine (approximately the 2nd percentile dry conditions), water deficit may affect Process Plant operations. To avoid processing reductions or shutdown, a supplemental water taking from the Pic River was assessed. Under these extreme, extended dry conditions, PSMF discharges would be recycled to the mill and a supplemental taking from the Pic River of up to 300 m^3/h (0.083 m^3/s) may be required. The 300 m^3/h taking equates to 0.17% of MAF. Even though the supplemental taking is a small portion of MAF, under dry weather conditions at the mine, the Pic River would also be experiencing low flows, potentially at or below monthly environmental flows (presented in Section 4.2.3). As a result, supplemental takings from the Pic River may be restricted or prohibited. A low flow trigger for the Pic River that considers the environmental flows and is protective of the river will be developed. Water taking will be allowed when the flows in the Pic River are above the low flow trigger. It is therefore recommended that the mine actively monitor current weather and weather forecasts and maintain daily inventory records of water in storage and daily pumping rates including discharge to Hare Lake, pit dewatering and pumping from mine stormwater ponds and catch basins. To reduce Pic River supplementation under extreme, extended dry conditions, it is recommended that dry weather trigger thresholds be linked to water storage inventory to potentially commence supplementation from the Pic River before extreme, extended dry conditions arrive. Taking water into storage from the Pic River before and after the passage of extreme, extended dry conditions could mitigate against environmental taking constraints or restrictions during those extreme, extended dry conditions.

Table 6.2: Pic River Change in Hydrology Under Construction and Operation

Mine Phase	Pic River Watershed Area (km²)	% Change in Watershed Area	MAF (m3/s)	Net Groundwater Change (m3/s)	Total Flow (m3/s)	% Change in Total Flow
Baseline	4207.6		48.43	0	48.43	
Construction	4200.7	-0.16%	48.35	0	48.35	-0.15%
Operation	4200.7	-0.16%	48.35	0.014	48.37	-0.13%

6.3.2 Closure and Post-Closure

The possible variability of MRSA and PSMF effluent quality in watershed 102, 103, and 106 led to two possible scenarios that were analyzed for the closure phase of mine life for the three affected watersheds.

In scenario 1, the MRSA and PSMF effluent discharge quality meets effluent requirements for discharge to the environment in the sixth year of closure. If effluent discharge criteria are met, collected water within MRSA stream 2 catch basin will no longer be pumped to the stream 3 catch basin, which will no longer be pumped to the open pit. The PSMF will no longer be sent to the water management pond and pumped to the open pit to assist in pit filling. Instead, the stream 2 and 3 catch basin dams will be breached to allow discharge to the existing watercourse within watershed 102 and 103, respectively. The PSMF Cell 1 wall will also be breached to allow discharge into the existing watercourse in watershed 106. During this scenario, pit filling is expected to take approximately 35 years without water from the MRSA catch basins and PSMF used to speed pit filling.

In scenario 2, the MRSA stream 2 catch basin, stream 3 catch basin, and PSMF effluent discharge quality do not meet effluent requirements for discharge to the environment in the sixth year of closure. Water from the MRSA stream 2 catch basin will continue to be sent to the stream 3 catch basin and pumped to the open pit. Water in the PSMF will continue to be sent to the water management pond where it will be pumped to the open pit to accelerate pit filling. During this scenario, pit filling is expected to take approximately 17 years with water from the MRSA catch basins and PSMF used to speed pit filling.

Watershed 101

Watershed 101 is expected to reclaim the 1.55 km^2 of watershed area during closure and post-closure conditions that was redirected during the construction and operation phases to encompass the SWM pond, process plant, and ancillary buildings. Demolition and removal of the process plant and ancillary buildings will allow for reclamation of the land, while the SWM pond will have a spillway constructed to allow discharge to the existing watercourses in watershed 101. The site access road will also be regraded, removed, and reclaimed, returning the runoff coefficient to the baseline value. Reclamation of the water management pond in watershed 106 during closure and post-closure will permanently add 0.244 km^2 of watershed area to watershed 101, for a total watershed area increase from 4.438 km^2 to 4.782 km^2 (5%) from baseline conditions.

The permanent increase in watershed area, considering changes to surface water and groundwater, is expected to increase the baseline MAF from 0.074 m^3/s to 0.080 m^3/s during closure and post-closure for an overall increase of 8%. The increase of 8% is lower than the 10% threshold to be considered a significant residual effect and, therefore, watershed 101 is screened out from further assessment.

Watershed 102

As described in Section 6.3.2, two possible scenarios were analyzed for the closure phase of mine life due to the possible variability of MRSA catch basin effluent quality in watershed 102.

During closure scenario 2, contact water from the MRSA will be collected in the Stream 2 catch basin and pumped to the open pit to accelerate pit filling. During this period of pit filling, the only active portion of watershed 102 contributing to the MAF is the 0.069 km^2 of natural watershed downstream of the catch basin, similar to operations phase. The change in natural watershed from the baseline area of 3.495 km^2 equates to a 98% decrease. The open pit is expected to take approximately 35 years to fill, should the PSMF and MRSA water quality meet effluent discharge requirements to the environment during year 6 of closure, or 17 years to fill if the water quality in the PSMF and MRSA is not acceptable for discharge to the environment and continues to be routed to filling the open pit. The area contributing to the pit filling is estimated to be 1.11 km^2.

Following the filling of the open pit or during scenario 1 in which water quality meets discharge criteria, the Stream 2 catch basin dam will be breached, allowing runoff and seepage to drain to the Pic River via the existing Stream 2 channel. The western half of watershed 102 originally defined in the baseline update will have runoff redirected to watershed 103 (Figure 6) via drainage to the central and northern pits.

The MAF, considering changes to surface water and groundwater, is expected to decrease from 0.058 m^3/s during baseline conditions to 0.002 m^3/s (-98%) during the pit-filling period of closure and/or during scenario 2 and 0.02 m^3/s (-66%) during scenario 1 of closure and post-closure once the stream 2 catch basin dam has been breached. Watershed 102 is included in Table 6.6 and discussed in Section 6.4 to compare the MMF to baseline environmental flows developed in the baseline assessment to determine whether the change in flow is considered a significant residual effect.

Watershed 103

As described in Section 6.3.2, two possible scenarios were analyzed for the closure phase of mine life due to the possible variability of MRSA catch basin effluent quality in watershed 103.

During closure, water from lake L8 will be directed south to the area previously occupied by the primary crusher and ROM stockpile area, which will be reclaimed. Water will then flow towards the central pit, where it will be directed to the north pit. Contact water from the MRSA will be collected in the Stream 3 catch basin and pumped to the north pit to accelerate pit filling to create the pit lake. Thus, during pit filling, runoff from watershed 103 will remain as it was during operations (scenario 2). As indicated in watershed 102, the open pit is expected to take approximately 35 years to fill should the PSMF and MRSA water quality meet effluent discharge requirements to the environment during year 6 of closure (scenario 1), or 17 years to fill if the water quality in the PSMF and MRSA is not acceptable for discharge to the environment and continues to be routed to the pit during filling (scenario 2). Once the pit lake has filled or during scenario 1 if water quality meets discharge criteria, water will overflow from the north pit lake via the MRSA within watershed 103, where it will be collected in the Stream 3 catch basin and discharge by overflow to the existing stream within watershed 103. Stream 3 under the MRSA footprint will be backfilled with large mine rock to facilitate drainage toward the watershed 103 catch basin. The resulting change in natural watershed area due to the redirection of water from the south, north, and central pits, as well as L8 and the northern half of the MRSA during closure reduces the natural watershed area for watershed 103 contributing to the Pic River from 1.87 km^2 under baseline conditions to 0.070 km^2 during the pit-filling closure and post-closure period, a decrease of 96%. Approximately 0.709 km^2 of watershed area associated with the MRSA within watershed 103 will contribute to the discharge to Pic River during scenario 1 with an additional 3.42 km^2 of watershed area associated with the open pits following the filling of the pit lake. A net change in watershed area of -58% during closure scenario 1 and 125% during post-closure is anticipated compared to baseline conditions.

The MAF, considering changes to both surface water and groundwater, is expected to decrease from baseline conditions of 0.0318 m^3/s to 0.009 m^3/s during closure scenario 1 (-73%), 0.002 m^3/s during closure scenario 2 (-95%), and increase to 0.056 m^3/s during post-closure conditions (74%). Watershed 103 is included in Table 6.7 and discussed in Section 6.4 to compare the closure MMFs to baseline environmental flows developed in the baseline assessment to determine whether the reduction in flow during pit-filling closure scenario 1 and scenario 2 is considered a significant residual effect. Watershed 103 is also included in Table 6.9 and discussed in Section 6.5 regarding the increase in total flows during post-closure after pit-filling above 10% compared to baseline conditions.

Watershed 104

Watershed 104 is not expected to reclaim the 0.009 km^2 of catchment area originally redirected to watershed 103 during construction and operation due to the construction of the north pit. The watershed area of 3.457 km^2 during baseline conditions will be permanently reduced by 1% to 3.408 km^2 during closure and post-closure.

The minor decrease in watershed area from baseline conditions and considering changes to groundwater flow is expected to decrease the baseline MAF from 0.057 m^3/s to 0.06 m^3/s during closure and post-closure for an overall increase of 5%. As the net change in total flow is expected to be less than 10%, watershed 104 is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 105

The natural area in watershed 105 under closure and post-closure will be 46.8 km^2, a 2% decrease in area from the pre-development watershed area of 47.83 km^2. An additional 0.38 km^2 in watershed area will be directed to watershed 105 following the PSMF discharge to the environment, which will allow the water collection ponds north of the PSMF to naturally overflow to the existing watercourses in watershed 105 rather than being pumped back into the PSMF.

The minor decrease in watershed area from baseline conditions and considering changes to groundwater flow is expected to decrease the baseline MAF from 0.691 m^3/s to 0.683 m^3/s (-1%) during closure and post-closure. As the net change in total flow is expected to be less than 10%, watershed 105 is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 106

As described in Section 6.3.2, two possible scenarios were analyzed for the closure phase of mine life due to the possible variability of PSMF effluent quality in watershed 106.

Under closure conditions for both scenario 1 and scenario 2 during the PSMF contribution to pit filling, the watershed 106 MAF will remain the same as operations with 6.54 km^2 contributing to the natural watershed area. The 3.61 km^2 of watershed area associated with the PSMF will contribute to watershed 106 during scenario 1 of closure and post-closure conditions, following the acceptability of water quality in the rehabilitated PSMF to discharge to the environment. The total contributing watershed area will then be 10.15 km^2, a reduction of 4% from the baseline watershed 106 area, during post-closure. Differences to the contributing watershed area include the loss of the orphaned watershed area redirected during construction and operation phases of mine life due to the PSMF as described in Section 6.3.1, the loss of watershed area previously associated with the water management pond which will be redirected to watershed 101, and the addition of watershed area from the north side of the PSMF which will redirect flows from watershed 105 to watershed 106. Discharge flows during scenario 1 to watershed 106 are added to the MAF calculated from the natural watershed area and the expected change in groundwater flows for the total flow.

The decrease in natural watershed area from baseline conditions contributing to the MAF and considering changes to groundwater is expected to decrease the MAF from 0.164 m^3/s under baseline conditions to 0.11 m^3/s (-33%) during closure (Scenario 2). Once the PSMF meets discharge criteria and begins discharge to the environment, a flow of 0.047 m^3/s is expected to add to the total flow, for a MAF of 0.157 m^3/s (4% decrease) under closure Scenario 2 and post-closure. As the net reduction in total flow during closure Scenario 2 is expected to be greater than 10%, watershed 106 is included in Table 6.8 and discussed in Section 6.4 to compare the MMF to baseline environmental flows.

Watershed 108

Watershed 108 is expected to have minor permanent watershed loss (-1%) from a baseline watershed area of 0.567 km^2 to 0.563 km^2 under closure and post-closure due to the construction of the north pit. The MAF, considering both surface water and groundwater changes, is expected to decrease from 0.0103 m^3/s during baseline conditions to 0.009 m^3/s during closure and post-closure (8% decrease). As the net change in total flow is expected to be less than 10%, watershed 108 is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 109

Watershed 109 is expected to have an increase in watershed area of 3% from baseline conditions, increasing from 12.037 km^2 to 12.35 km^2 during closure and post-closure. Approximately 2% of the increased area is expected to occur during construction and operation phase due to the orphaning of a small portion of watershed 106 from the construction of the PSMF that will be redirected to flow into watershed 109 once the PSMF cell 1 walls are constructed. During closure, the PSMF cell 1 south embankment will be regraded to allow surface flows into watershed 109, accounting for the additional 1% of watershed area increase above that gained during construction and operation. The increase in watershed area is expected to be permanent.

The increase in watershed area from baseline conditions and considering changes to groundwater is expected to increase the baseline MAF from 0.187 m^3/s to 0.196 m^3/s (5%) during closure and post-closure. As the net change in total flow is expected to be less than 10%, watershed 109 is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 111

Consistent with construction and operation conditions, watershed area in watershed 111 is not expected to change from baseline conditions during closure and post-closure.

The MAF, considering changes to both surface water and groundwater, is expected to increase from 0.0024 m^3/s during baseline conditions to 0.0025 m^3/s during closure and post-closure. As the percent change for the MAF is 6% during closure and post-closure, and less than the 10% assessment threshold, it is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 112

Consistent with construction and operation conditions, watershed area in watershed 112 is not expected to change from baseline conditions.

The MAF, considering changes to both surface water and groundwater, is expected to increase from 0.0021 m^3/s during baseline to 0.0034 m^3/s during closure and post-closure, an increase of 58%. As the percent change for the total flow is greater than 10% compared to baseline conditions, it is included in Table 6.9 and discussed in Section 6.5 to compare the expected flood flows with baseline conditions to assess the potential for flooding and erosion.

Watershed 116

No change is expected to the 2.94 km^2 watershed area in watershed 116. However, the 2% of watershed area discussed in Section 6.3.1 to be overprinted by the access road will be scarified and rehabilitated in closure which will reduce its imperviousness along its pathway, restoring closure conditions similar to baseline. The MAF, considering changes to both surface water and groundwater, is expected to increase from baseline conditions of 0.049 m^3/s to 0.0051 m^3/s during closure and post-closure, for an increase of 4%. As the total changes to the MAF are less than 10%, watershed 116 is screened out from further assessment and is not considered to have a significant residual effect.

Watershed 107, 110, 113, 114, 115, and 117

As discussed in Section 6.3.1, Watersheds 107, 110, 113, 114, 115, and 117 are not within the SSA and are not expected to have watershed loss due to project infrastructure. Changes in groundwater flow from the closure and post-closure phases of mine life in watersheds 110, 113, 114, 115, and 117 are expected to be minor as a result of the groundwater mounding effect associated with the MRSA.

The MAF, considering changes to surface water and groundwater, is expected to increase in watershed 110 from 0.0026 m^3/s during baseline to 0.0027 m^3/s during closure and post-closure (5%), increase in watershed 113 from 0.0045 m^3/s during baseline to 0.0048 m^3/s during closure and post-closure (5%), increase in watershed 114 from 0.023 m^3/s during baseline to 0.024 m^3/s during closure and post-closure (4%), increase in watershed 115 from 0.0058 m^3/s during baseline to 0.0059 m^3/s during closure and post-closure (1%), and increase in watershed 117 from 0.0049 m^3/s during baseline to 0.0051 m^3/s during closure and post-closure (4%).

As the net change in total flow is expected to be less than 10% for watersheds 107, 110, 113, 114, 115, and 117, they are screened out from further assessment and are not considered to have a significant residual effect.

Hare Lake

Water levels in Hare Lake are expected to return to baseline conditions during closure and post-closure conditions as PSMF discharge to Hare Lake will cease towards the end of operations. The small change in watershed area contributing to Hare Lake during closure and post-closure as detailed in watershed 105 is expected to result in a decrease in relative water level from 0.309 m to 0.307 m (0.2 cm).

Pic River

Changes in flow to the Pic River are expected to be negligible due to large watershed contribution to the Pic River as a whole, and the relatively small watersheds associated with the mine footprint in comparison as indicated in Section 6.3.1. Table 6.3 presents the calculated change in total flow expected to the Pic River as a result of changes to the contributing watershed during closure and post-closure. It is expected that 5.03 km^2 of watershed will be redirected during closure to pit-filling, a reduction from the 4,207.6 km^2 baseline Pic River watershed of 0.12%. The change in MAF and groundwater flow result in a reduction in total flow from 48.43 m^3/s to 48.38 m^3/s during closure (0.10%).

To further accelerate pit filling, a supplemental water taking from the Pic River was assessed to submerge type 2 mine waste earlier during the closure phase of mine life. A supplemental taking from the Pic River of up to 300 m^3/h (0.083 m^3/s) during the pit-filling period of closure and post-closure equates to 0.17% of MAF. Even though the supplemental taking is a small portion of MAF, under dry weather conditions the Pic River would also be experiencing lower flows, potentially at or below monthly environmental flows. As a result, supplemental takings from the Pic River may be restricted or prohibited. It is therefore recommended that if a supplemental water taking from the Pic River is selected to accelerate pit filling, that the taking be rated to actively monitor flows at the WSC Pic River gauge at Marathon and that takings cease when dry conditions have reduced Pic River flows to environmental flow thresholds.

Post-closure, the 5.03 km^2 of watershed associated with filling the open pit during closure will be returned to the Pic River watershed. Once the open pit has been filled, overflow from the pit will be directed to the stream 3 catch basin. Both the stream 3 and stream 2 catch basin dams will be breached to allow collected water from the open pit and MRSA to flow through the existing watercourses in watershed 103 and 102 to the Pic River. The redirection of watershed back to the Pic River watershed will provide a 0.01% increase in Pic River watershed compared to baseline conditions, increasing the 4207.6 km^2 to 4207.8 km^2. Additional contributions to the total flow from the filled pit lake will provide an associated 0.05% increase in MAF.

As the change in total flow is below 10% for both closure and post-closure conditions, it is considered not to be significant.

Table 6.3: Pic River Change in Hydrology Under Closure

Mine Phase	Pic River Watershed Area (km^2)	% Change in Watershed Area	Natural MAF (m3/s)	Mine Footprint Flow (m3/s)	Net Groundwater Change (m3/s)	Total Flow (m3/s)	% Change in Total Flow
Baseline	4207.6	-	48.43	-	0	48.43	-
Closure Scenario 1	4204.4	-0.08%	48.37	0.03	0.009	48.40	-0.04%
Closure Scenario 2	4202.5	-0.12%	48.37	0	0.009	48.38	-0.10%
Post-Closure	4207.8	0.01%	48.37	0.07	0.009	48.45	0.05%

Table 6.4: Changes in Hydrology Through Project Mine Phases

Watershed ID	Watershed Location	Catchment Area (km^2)				Mean Annual Flow (m^3/s)						Largest Change in MAF (%)
		Baseline	Construction	Operation	Closure	Post-Closure	Baseline	Construction	Operation	Closure	Post-Closure	
101	S1 Watershed	4.54	2.99	2.99	4.78	4.78	0.074	**0.050**	0.057	0.080	0.080	-33%
102	Terru Lake Watershed	3.50	0.07	0.07	1.18	1.18	0.058	**0.001**	0.002	0.020/0.002	0.020	-98%
103	S4 Watershed	1.87	0.07	0.07	4.20	4.20	0.032	**0.001**	0.002	0.009/0.002	0.056	-96%
104	Claw Lake Watershed	3.46	3.41	3.41	3.41	3.41	0.057	0.056	0.059	**0.060**	**0.060**	5%
105	Hare Lake Watershed	47.83	58.39	58.39	47.18	47.18	0.691	0.676	**0.774**	0.683	0.683	12%
106	Angler Creek Watershed	10.52	6.54	6.54	10.15	10.15	0.164	**0.105**	0.110	0.157/0.110	0.157	-36%
107	Watershed East of Claw Lake	0.50	0.50	0.50	0.50	0.50	0.009	**0.009**	**0.009**	**0.009**	**0.009**	-1%
108	Watershed South of Claw Lake	0.57	0.54	0.54	0.56	0.56	0.010	0.010	0.010	**0.009**	**0.009**	-8%
109	Shack Lake Watershed	12.04	12.27	12.27	12.35	12.35	0.187	0.190	0.195	**0.196**	**0.196**	5%
110	S25 Watershed	0.13	0.13	0.13	0.13	0.13	0.003	0.003	0.003	**0.003**	**0.003**	5%
111	Watershed east of Terru Lake	0.12	0.12	0.12	0.12	0.12	0.002	0.002	0.002	**0.003**	**0.003**	6%
112	Watershed east of Terru Lake	0.11	0.11	0.11	0.11	0.11	0.002	0.002	0.003	**0.003**	**0.003**	58%
113	S24 Watershed	0.24	0.24	0.24	0.24	0.24	0.005	0.005	0.005	**0.005**	**0.005**	5%
114	Malpa Lake Watershed	1.34	1.34	1.34	1.34	1.34	0.023	0.023	0.024	**0.024**	**0.024**	4%
115	Watershed South of Malpa Lake	0.31	0.31	0.31	0.31	0.31	0.006	0.006	**0.006**	**0.006**	**0.006**	1%
116	Watershed South of S1	2.94	2.94	2.94	2.94	2.94	0.049	0.049	**0.049**	**0.049**	**0.049**	1%
117	Watershed North of S6	0.26	0.26	0.26	0.26	0.26	0.005	0.005	0.005	**0.005**	**0.005**	4%

NOTES:

1. Bolded numbers indicate the Project phase with the largest change in mean annual flows compared to baseline conditions.
2. Highlighted red cells indicate the change in MAF is above the threshold for an assessment
3. Underlined number indicates flow is for scenario 2 as described in Section 6.3.2

6.4 COMPARISON OF MEAN MONTHLY FLOWS TO ENVIRONMENTAL FLOWS

Environmental flows developed during the hydrology baseline update are compared to the MMF for each watershed determined in Section 6.3 to have a reduction in MAF of 10% or greater compared to baseline conditions. The results of the comparison are presented in Table 6.5 to Table 6.8 below for watersheds 101, 102, 103, and 106.

Table 6.5: Summary of Environmental Flows and Mean Monthly Flows for Watershed 101

Month	Watershed 101		
	Baseline Environmental Flow	**Construction**	**Operation**
	m³/s	**m³/s**	**m³/s**
January	0.0139	**0.0089**	0.0166
February	0.0107	**0.0069**	0.0146
March	0.0296	**0.0209**	**0.0286**
April	0.0670	0.1154	0.1231
May	0.0949	0.1604	0.1681
June	0.0296	0.0425	0.0502
July	0.0296	**0.0240**	0.0316
August	0.0223	**0.0145**	**0.0222**
September	0.0296	0.0371	0.0448
October	0.0496	0.0856	0.0933
November	0.0360	0.0611	0.0688
December	0.0296	**0.0223**	0.0300

NOTES:
Bolded numbers indicate the predicted flow is below the baseline environmental flow
Presented MMFs are for mine phases that exceed the 10% screening threshold

The MMF in watershed 101 is predicted to be below the baseline environmental flows for January, February, March, July, August, and December during construction, for a total of 6 months of the year. During operation, the MMF is expected to be below the baseline environmental flow by less than 5% for March and August.

Table 6.6: Summary of Environmental Flows and Mean Monthly Flows for Watershed 102

Month	Watershed 102					
	Baseline Environmental Flow	Construction	Operation	Closure Scenario 1	Closure Scenario 2	Post-Closure
	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
January	0.0105	**0.0002**	**0.0004**	0.0185	**0.0004**	0.0185
February	0.0081	**0.0001**	**0.0004**	0.0185	**0.0004**	0.0185
March	0.0231	**0.0007**	**0.0010**	**0.0190**	**0.0010**	**0.0190**
April	0.0530	**0.0040**	**0.0042**	**0.0223**	**0.0042**	**0.0223**
May	0.0743	**0.0047**	**0.0049**	**0.0230**	**0.0049**	**0.0230**
June	0.0231	**0.0009**	**0.0011**	**0.0192**	**0.0011**	**0.0192**
July	0.0231	**0.0005**	**0.0007**	**0.0188**	**0.0007**	**0.0188**
August	0.0170	**0.0003**	**0.0006**	0.0181	**0.0006**	0.0186
September	0.0231	**0.0011**	**0.0014**	**0.0195**	**0.0014**	**0.0195**
October	0.0393	**0.0030**	**0.0033**	**0.0213**	**0.0033**	**0.0213**
November	0.0283	**0.0019**	**0.0021**	**0.0202**	**0.0021**	**0.0202**
December	0.0231	**0.0005**	**0.0008**	**0.0188**	**0.0008**	**0.0188**

NOTES:

1. Bolded numbers indicate the predicted flow is below the baseline environmental flow

The MMFs in watershed 102 are predicted to be below the baseline environmental flows for every month during construction, operation, and closure scenario 2 phases of mine life. During closure scenario 1 and post-closure, the MMFs are not expected to be below environmental flows for January, February, or August.

Table 6.7: Summary of Environmental Flows and Mean Monthly Flows for Watershed 103

Month	Watershed 103				
	Baseline Environmental Flow	Construction	Operation	Closure Scenario 1	Closure Scenario 2
	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
January	0.0054	**0.0002**	**0.0003**	0.0073	**0.0004**
February	0.0042	**0.0001**	**0.0003**	0.0073	**0.0003**
March	0.0127	**0.0007**	**0.0009**	**0.0079**	**0.0009**
April	0.0303	**0.0040**	**0.0042**	**0.0112**	**0.0042**
May	0.0412	**0.0047**	**0.0049**	**0.0119**	**0.0049**
June	0.0127	**0.0009**	**0.0011**	**0.0081**	**0.0011**
July	0.0127	**0.0005**	**0.0007**	**0.0077**	**0.0007**
August	0.0089	**0.0003**	**0.0005**	**0.0070**	**0.0005**
September	0.0127	**0.0012**	**0.0013**	**0.0083**	**0.0014**
October	0.0225	**0.0030**	**0.0032**	**0.0102**	**0.0032**
November	0.0158	**0.0019**	**0.0020**	**0.0091**	**0.0021**
December	0.0127	**0.0005**	**0.0007**	**0.0077**	**0.0007**

NOTES:

1. Bolded numbers indicate the predicted flow is below the baseline environmental flow
2. During post-closure, the MAF does not exceed the 10% change screening threshold and therefore the post-closure period is not assessed.

The MMF in watershed 103 is predicted to be below the baseline environmental flows for every month during construction, operation, and closure scenario 2 phases of mine life. During closure scenario 1, MMFs are expected to be above baseline environmental flows during January and February.

Table 6.8: Summary of Environmental Flows and Mean Monthly Flows for Watershed 106

Month	Watershed 106			
	Baseline Environmental Flow	**Construction**	**Operation**	**Closure Scenario 2**
	m³/s	**m³/s**	**m³/s**	**m³/s**
January	0.0338	**0.0205**	**0.0258**	**0.025836**
February	0.0257	**0.0156**	**0.0210**	**0.02101**
March	0.0650	**0.0424**	**0.0478**	**0.04774**
April	0.1422	0.2324	0.3294	0.237577
May	0.2092	0.3346	0.4317	0.339735
June	0.0657	0.0949	0.1919	0.100203
July	0.0657	**0.0540**	0.1510	**0.059327**
August	0.0529	**0.0324**	0.1295	**0.037805**
September	0.0657	0.0765	0.1735	0.081834
October	0.1048	0.1717	0.2688	0.177007
November	0.0786	0.1264	0.2235	0.131709
December	0.0657	**0.0490**	**0.0544**	**0.054341**

NOTE:
when the PSMF commences discharge to 106, the 10% screening threshold is no longer exceeded and is therefore not assessed

The MMF in watershed 106 is predicted to be below the baseline environmental flows for January, February, March, July, August, and December during construction and closure (Scenario 2) of mine life. Flows during operation are expected to be below baseline environmental flows for January, February, March, and December.

6.5 COMPARISON OF FLOOD FLOWS TO BASELINE CONDITIONS

Q100 flows developed during the hydrology baseline update are compared to baseline conditions for each watershed determined in Section 6.3 to have an increase in MAF of 10% or greater compared to baseline conditions. The results of the comparison are presented in Table 6.9 below for watersheds 103, 105, and 112.

Table 6.9 Summary of Flood Flows and Baseline Flows for Watershed 103, Watershed 105, and Watershed 112

Watershed	Baseline Q100	Q100			Maximum % Change
		Operation	Closure	Post-Closure	
	m³/s	m³/s	m³/s	m³/s	
103	1.611	-	-	3.026	88%
105	20.025	19.748	-	-	-1%
112	0.177	0.178	0.178	0.178	1%

NOTE:
Presented Q100 flows are for mine phases that exceed the 10% screening threshold

The Q100 in watersheds 105 and 112 are not expected to have an increase in flow greater than 10% compared to baseline Q100 conditions as a result of project activities. The watershed 105 Q100 during operations is expected to be less than baseline conditions due to the reduction in watershed area, which the constant discharge rate does not compensate for.

The expected Q100 for watershed 103 shows an increase greater than 10% compared to the baseline conditions. Prior to completion of pit filling, the stream 3 catch basin will be breached and removed. The stream 3 watercourse will be armoured with riverstone or a suitable substitute and will be engineered to minimize potential erosion resulting from a Q100 event.

6.6 MONITORING

A reduction in hydrological flows in local watersheds as a result of centralized Project water management, infrastructure and activities is expected throughout most of the watersheds within the SSA, with a lesser overall reduction in flow during the closure phase of mine life. The dominant factors in the reduction in flow include: the permanent sequestration of water into submerged tailings pore spaces and tailings water covers; the overprinting of watershed area and headwaters of streams for Project infrastructure; the capture and relocation of runoff and seepage via the catch basins, water collection ponds, SWM pond, and seepage collection ponds; and the dewatering from the open pits.

A monitoring plan will be implemented during all phases of the project to monitor the effects of the Project on the local hydrology to compare the assessment of change in hydrology presented in Section 6.3 to field observations. The monitoring plan for hydrology will be developed based on regulatory requirements for water quantity and to confirm the predictions presented herein.

The monitoring program will comprise the following elements:

- Weather monitoring at a weather station installed at the mine site to understand current weather events, track seasonal trends and snowpack accumulation as well as weather forecast monitoring to anticipate the onset of dry weather conditions.
- Water level stations at select locations within ponds and/or lakes to monitor water levels and volumes during construction, operation, and closure.
- Pump flow monitoring to Hare Lake, from the open pit, mine stormwater pond, catch basins and water management ponds.
- Flow monitoring stations at select locations within watercourses to monitor flow during construction, operation, and closure; cross-sections of the watercourse at the flow monitoring stations will be taken at regular intervals to develop and/or expand upon rating curves for stations within the LSA.

The full extent of the monitoring program will be determined based on federal and provincial guidelines as well as consultation with government agencies and applicable stakeholders. Surface water hydrological stations will be reviewed at regular intervals to add or remove monitoring stations from the monitoring program in accordance with their utility in monitoring the effects of the Project on the environment. Monitoring locations identified as part of a regulatory approval will be removed from the monitoring program once the required amendments are approved.

7.0 SUMMARY AND CONCLUSIONS

Changes to the watershed areas for the seventeen identified watersheds (Figure 2) were determined for construction, operation, closure, and post-closure phases of mine life. Associated changes to the MAF were calculated based on regression equations previously identified in the Baseline Hydrology Report update (CIAR #722) with changes to the groundwater regime detailed in the Hydrogeology Effects Assessment (Appendix D4 of the EIS Addendum [VOL 2]) and Project operation discharges included in the total flow.

Net changes to watershed areas are expected to be greater than 10% in five of the seventeen watersheds during construction and operation (watersheds 101, 102, 103, 105, 106), three watersheds during closure (watersheds 102, 103, and 106), and two watersheds during post-closure (watersheds 102 and 103).

Reductions in the MAF greater than the 10% threshold were predicted for watersheds 101, 102, 103, and 106. In watershed 101, six months of the year during construction and two months of the year during operations do not maintain environmental flows but flows recover to less than the 10% threshold for MAF during closure and post-closure. Watershed 102 is expected to undergo permanent changes commencing in construction and extending to post-closure. When the pit overflows and watershed 102 discharges to the Pic River, the permanent reductions in catchment area result in permanent reductions in flow. Watershed 103 is predicted to have MMFs that do maintain environmental flows during the construction, operation, and closure (scenario 2) periods until the pit is filled and overflow commences. MMFs during closure scenario 1 when the MRSA catchment area contributes to flow are not expected to maintain environmental flows for two months of the year. When the pit overflows in post-closure, net flow through stream 3 in watershed 103 will increase. In watershed 106, during winter and sometimes during summer, lower flow periods extending from construction to the time in post-closure where the PSMF commences discharge to watershed 106, MMFs do not maintain environmental flows. However, when the PSMF commences discharge to watershed 106, flows will recover and be less than the 10% MAF screening threshold.

Increases to the MAF greater than the 10% threshold were predicted for watersheds 103, 105, and 112. The analysis of flood flows (Q100) resulted in watersheds 105 and 112 having a maximum flood flow increase of -1% and 1% compared to baseline flood flow estimates. Watershed 103, due to a net increase in watershed size, was found to have a Q100 with an 88% increase compared to baseline conditions.

Minor changes (<5%) to Hare Lake water levels are expected to occur during construction and operations with a decrease of 0.25 cm during construction and an increase of 1.16 cm during operation, while under closure and post-closure conditions, Hare Lake is expected to normalize back to baseline conditions with a 0.2 cm decrease in water level.

Effectively no changes are anticipated to Pic River flows (<1%) throughout during construction, operation, closure, or post-closure phases of mine life.

8.0 REFERENCES

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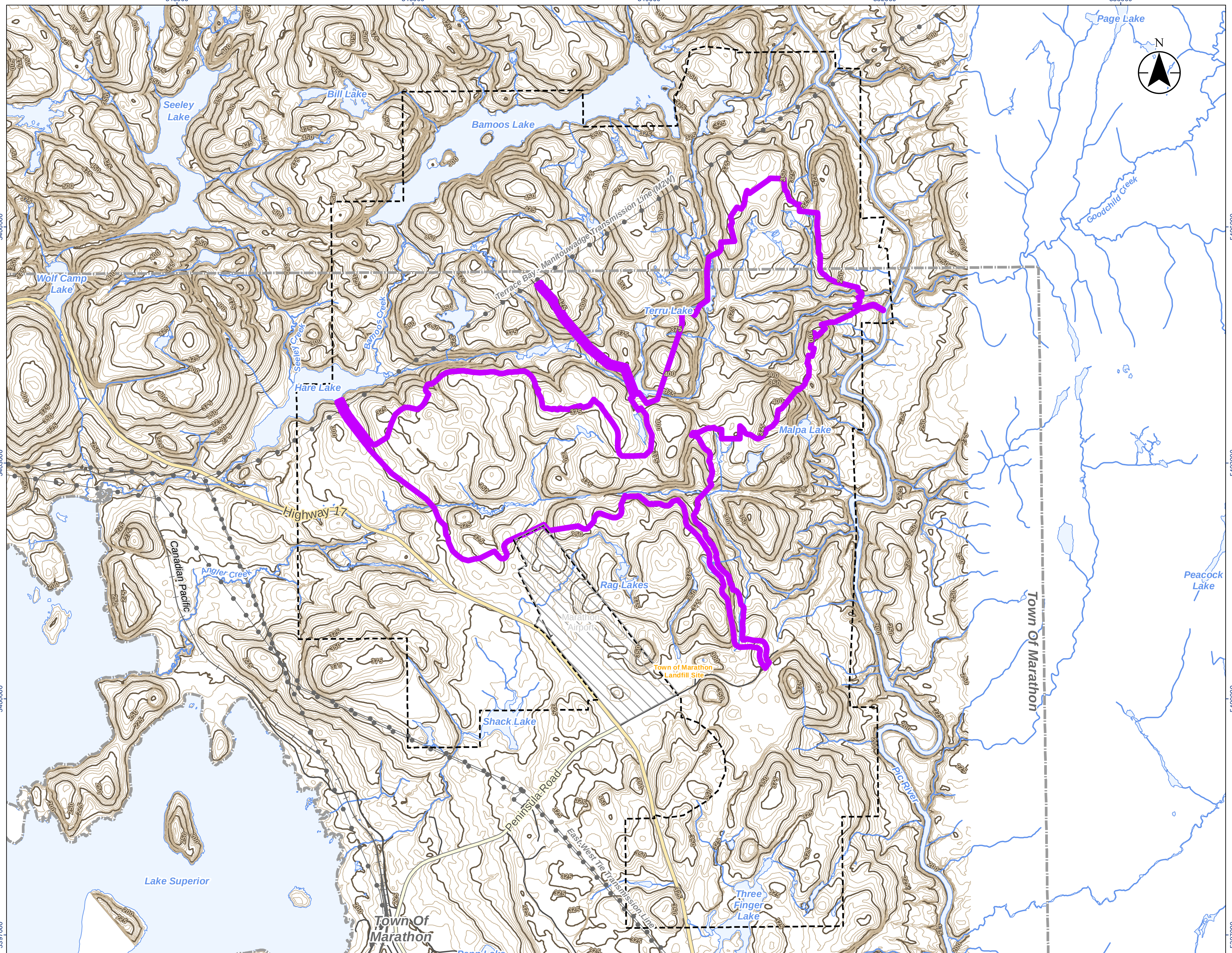
APPENDIX A
Figures



Stantec

Legend

- Project Boundary (MLAS, MENDM Changed 2017)
- Site Study Area Boundary
- Topographic Contour (5 m Intervals)
- Topographic Contour (25 m Intervals)
- Highway
- Major Road
- Minor Road
- Hydro Line
- Railway
- Watercourse
- Airport
- Municipal Boundary, Lower Tier
- Waterbody

0 1 2 km

1:50,000 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.

Project Location
Marathon

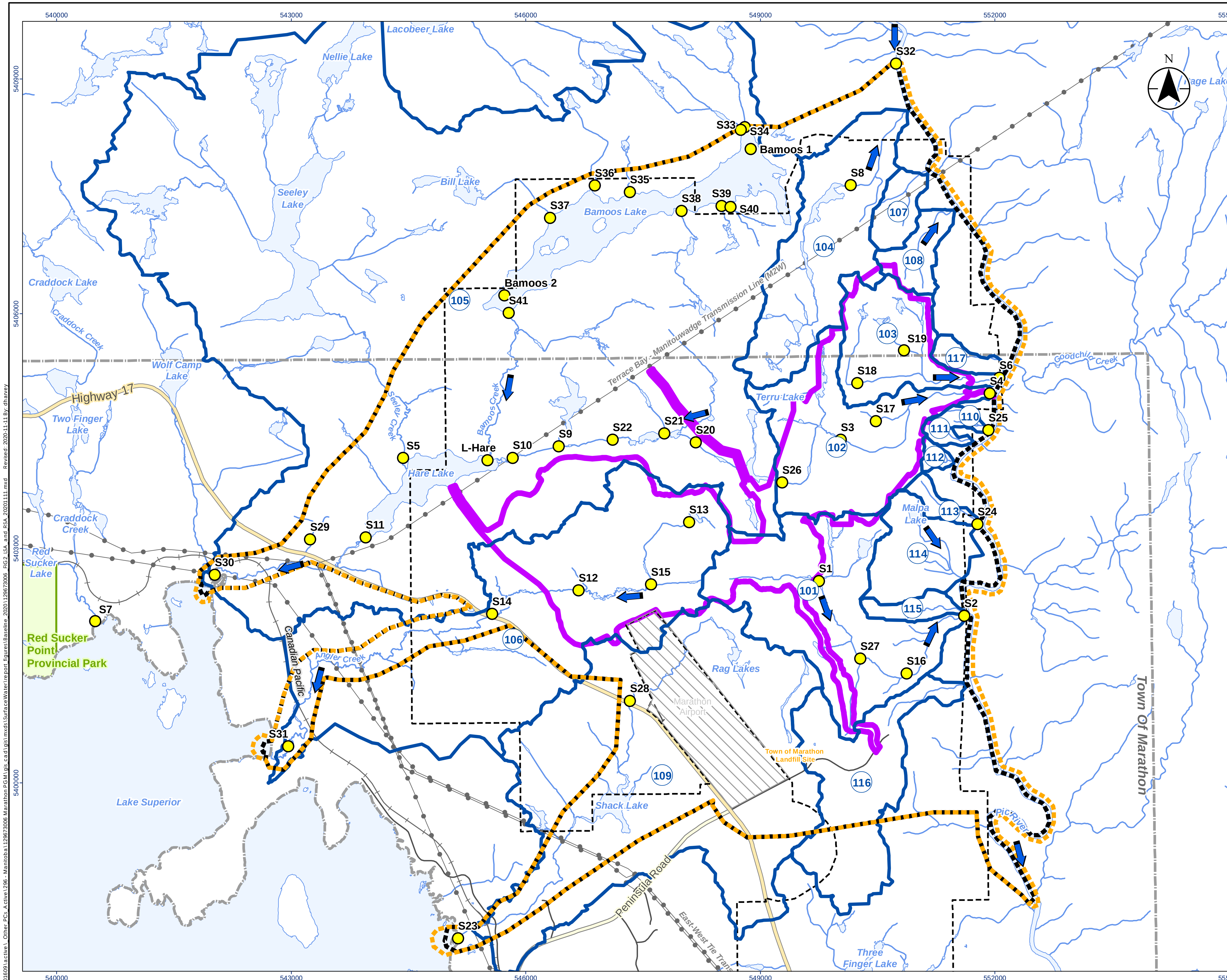
129673006 REVA
Prepared by SW on 2020-11-13
Technical Review by DH on 2020-09-16
Independent Review by ABC on yyyy-mm-dd

Client/Project
GENERATION PGM INC.
MARATHON PALLADIUM PROJECT

Figure No.
1

Title
Site Study Area

V:\01609\active_Other_PC_Active\1296...\Marathon\129673006 Marathon PGM\gis_cad\gis\mxds\Noise\report_figures\Baseline_2020\129673006_Fig1_Site_Location.mxd Revised: 2020-11-13 By: dharvey



Stantec

Legend

Type

- Local Study Area
- Regional Study Area
- Approximate Limit of Surface Rights (current and/ or planned)
- Site Study Area Boundary
- Surfacewater Quantity Sampling Station
- Surface Water Flow Direction
- Highway
- Major Road
- Minor Road
- Hydro Line
- Railway
- Watercourse
- Airport
- Municipal Boundary, Lower Tier
- Provincial Park
- Waterbody
- Watershed Boundary

0 1 2 km

1:50,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
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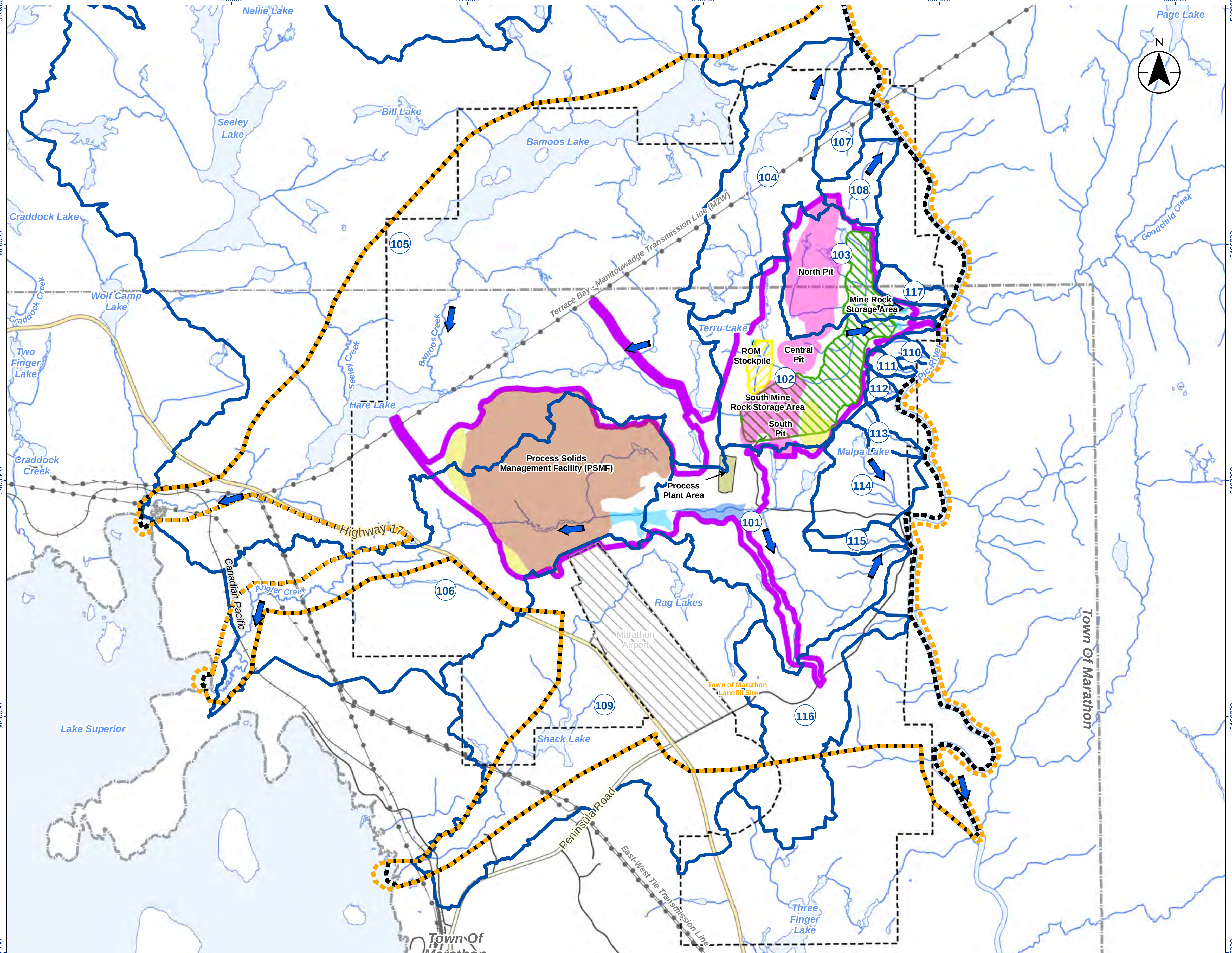
Project Location
Marathon

129673006 REVA
Prepared by DH on 2020-11-11
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
GENERATION MINING LTD.
MARATHON PALLADIUM PROJECT

Figure No.
2

Title
Local and Regional Study Area



Stantec

Legend

- Local Study Area
- Regional Study Area
- Approximate Limit of Surface Rights (current and/ or planned)
- Site Study Area Boundary
- Surface Water Flow Direction
- Highway
- Major Road
- Minor Road
- Hydro Line
- Railway
- Watercourse
- Airport
- Municipal Boundary, Lower Tier
- Waterbody
- Watershed Boundary (Operation)

Mine Plan Polygons

- Stormwater Management Pond
- Open Pit
- Overburden Stockpile
- Process Soilds Management Facility (PSMF)
- Water Management Pond
- Mine Rock Storage Area (MRSA)
- Process Plant Area
- ROM Stockpile

0 1 2 km

1:50,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
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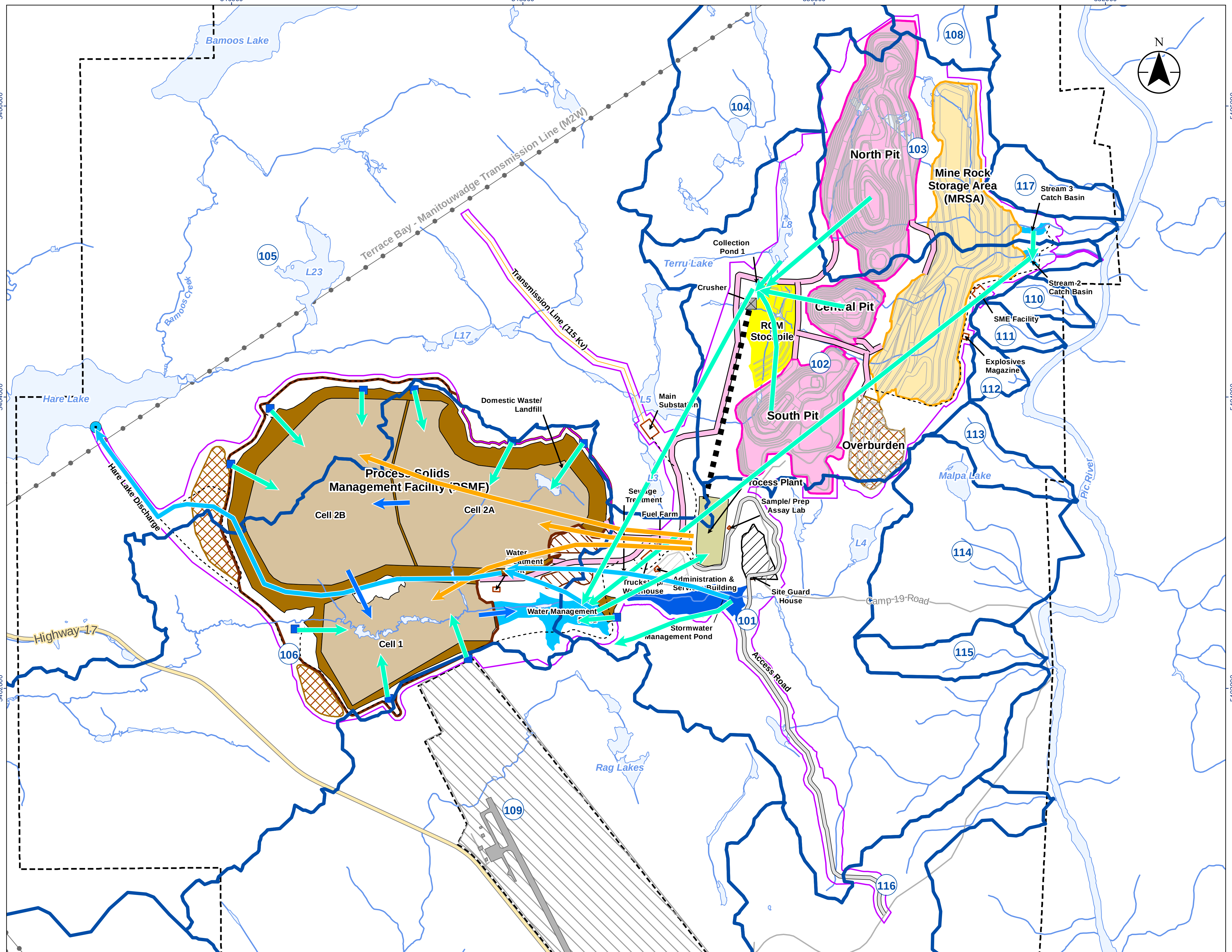
Project Location
Marathon

129673006 REVA
Prepared by DH on 2021-01-22

Client/Project
GENERATION PGM INC.
MARATHON PALLADIUM PROJECT

Figure No.
3

Title
Construction and Operation Watersheds



Stantec

Legend

- Excess Water Discharge Pipeline
- Gravity Overflow
- Process Soils Pipeline
- Water Transfer Pipeline
- Watershed Boundary (Closure)
- Site Study Area Boundary
- Project Boundary (MLAS, MENDM Changed 2017)
- Highway
- Hydro Line
- Watercourse
- Airport (Property Boundary)
- Airport Infrastructure
- Waterbody

Proposed Project Components

- Crusher
- Discharge Location
- Seepage Collection Basin
- Access Road
- Conveyor
- Haul Road
- Site Road
- Transmission Line (115 Kv)

Aggregate Site (Aggregate Plant, Concrete Batch Plant, Diesel Generator)

- Building/ Facility Footprint
- Stormwater Management Pond
- Laydown Area
- Mine Rock Storage Area (MRSA)
- Open Pit
- Overburden Stockpile
- Process Soilds Manadement Facility (PSMF)
- PSMF Cell
- PSMF Embankment

Process Plant Area (Bulk Reagent Storage, Live Ore Stockpile, Process Plant, Propane Storage Area, Concentrate Storage Building, Diesel Generators)

- ROM Stockpile
- Soil Stockpile
- Water Management Pond

0 0.5 1 km

Notes 1:27,001 (At original document size of 11x17)

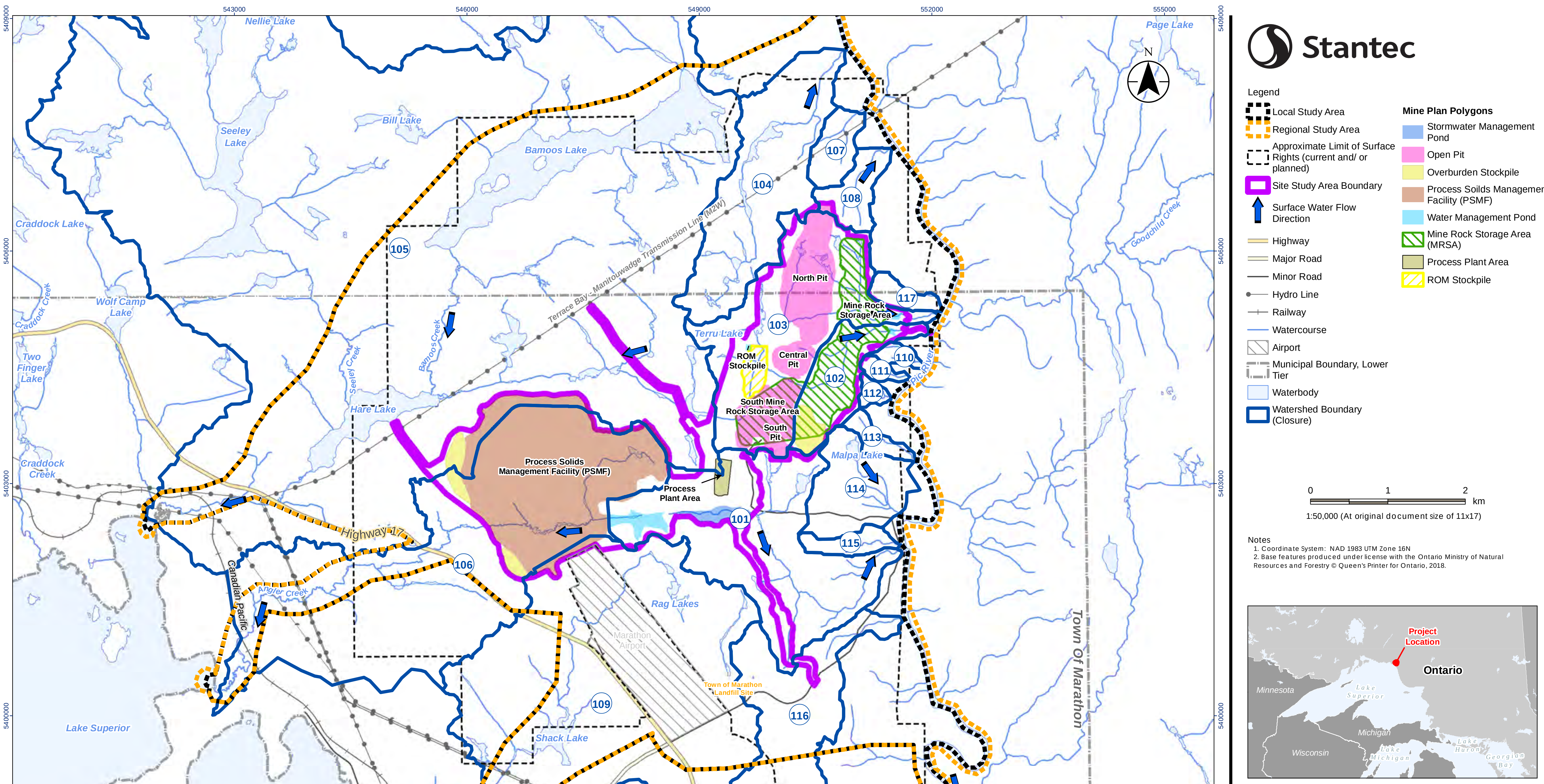
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3, Mine plan as illustrated on this drawing is approximate and for illustrative purposes. Design details were provided by G Mining and Knight Piesold.

Project Location 129673006 REVA
Marathon Prepared by DH on 2021-03-05

Client/Project
GENERATION PGM INC.
MARATHON PALLADIUM PROJECT

Figure No.
4

Title
Construction and Operation Water Management



Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
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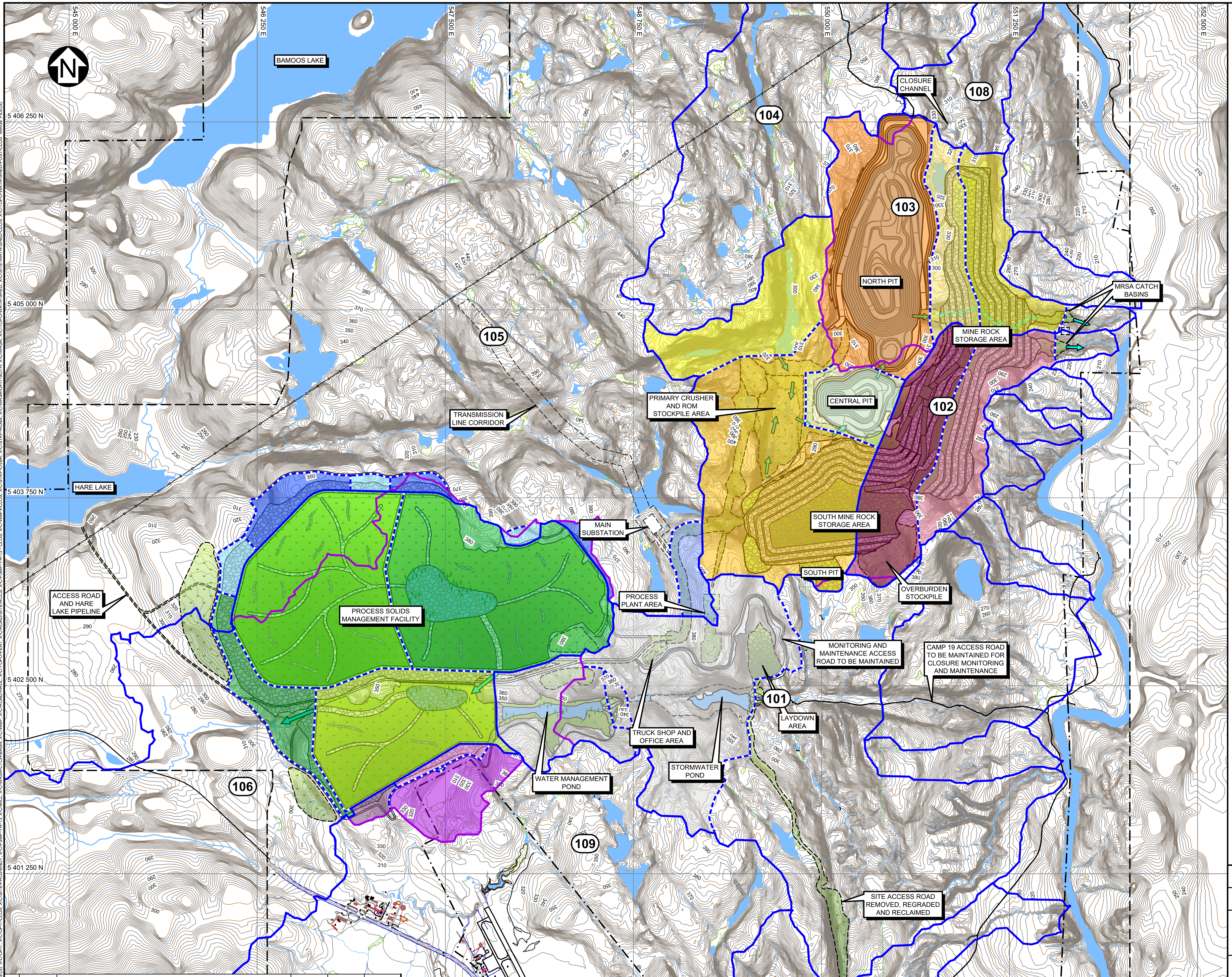
Project Location
Marathon

129673006 REVA
Prepared by DH on 2021-01-20

Client/Project
GENERATION PGM INC.
MARATHON PALLADIUM PROJECT

Figure No.
5

Title
Closure Watersheds



REPORTS TO SUB-WATERSHED 105:

REPORTS TO SUB-WATERSHED 106:

REPORTS TO SUB-WATERSHED 103:

REPORTS TO SUB-WATERSHED 109:

REPORTS TO SUB-WATERSHED 102:

REPORTS TO SUB-WATERSHED 101:

LEGEND:

- WATER
- WETLAND
- RECLAIMED ROCKFILL (CREST AND BENCHES)
- ROCKFILL SLOPE
- RECLAIMED AREA
- PROJECT BOUNDARY
- LIMIT OF DETAILED TOPOGRAPHY
- CLOSURE WATER FLOW DIRECTION
- ROCKFILL WIND BREAK
- CLOSURE SWALE AND WATER FLOW DIRECTION
- ACCESS ROAD - MAINTAINED
- ACCESS ROAD - RECLAIMED
- PRE DEVELOPMENT WATERSHED BOUNDARY
- POST CLOSURE WATERSHED BOUNDARY

NOTES:

1. COORDINATE GRID IS UTM (NAD27) ZONE 16 N AND IS IN METRES.
2. CONTOUR INTERVAL IS 2 METRES. DETAILED TOPOGRAPHY BASED ON NORDMIN PROJECT BASEMAP (JULY 4, 2011). REGIONAL CONTOURS ARE BASED ON LAND INFORMATION ONTARIO (OCTOBER, 2011).
3. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. PRE DEVELOPMENT WATERSHED PROVIDED BY STANTEC, (NOV 2, 2020).

SCALE A 250 125 0 250 500 750 1000 1250 m

GENERATION MINING

MARATHON PALLADIUM PROJECT

Closure and Post-Closure Water Management

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-446/10	NB21-00070

FIGURE 6 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22JAN'21	ISSUED WITH TRANSMITTAL	JAM	AS	CNH