MEMORANDUM

TO Sandra Pouliot; Canadian Malartic Corporation **DATE** August 25, 2017

CC Sean Capstick, Ken De Vos; Golder Associates Ltd.

FROM Adam Auckland **PROJECT NO.** 1656263.1000.1004

PROVINCIAL INFORMATION REQUEST EAB11-NEW –
COMPILED RESPONSE DOCUMENTS AND RELEVANT COMMUNICATIONS

Following submission of the Version 2 Hammond Reef Gold Project Environmental Impact Statement/Environmental Assessment (EIS/EA), the Ontario Ministry of Environment and Climate Change (MOECC) Environmental Approval Branch (EAB) requested additional information in Information Request EAB11-NEW regarding climate change. This response package includes all documentation submitted by CMC in response, and relevant communication with MOECC. The following are included in this document package:

- Technical Memorandum – Detailed Qualitative Climate Change Assessment - Hammond Reef Gold Project. August 29, 2016
- MOECC Memorandum – Hammond Reef Gold Mine EA – Comment on the Technical Memorandum “Detailed Qualitative Climate Change Assessment – Hammond Reef Project”. December 23, 2016
- Technical Memorandum – Responses to Comments on Qualitative Climate Change Assessment – Hammond Reef Gold Project. March 20, 2017
- MOECC Letter from Sasha McLeod. April 28, 2017.

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Technical Memorandum

Detailed Qualitative Climate Change Assessment – Hammond Reef Gold Project
August 29, 2016

TECHNICAL MEMORANDUM

DATE August 29, 2016

PROJECT No. 1656263 (1000/1004)

DOC NO. 003 (Rev 0)

TO Sandra Pouliot
Canadian Malartic Corporation

CC Adam Auckland

FROM Allison Barrett and Sean Capstick

EMAIL Allison_Barrett@golder.com

DETAILED QUALITATIVE CLIMATE CHANGE ASSESSMENT – HAMMOND REEF GOLD PROJECT

The Atmospheric Environment Technical Support Document (TSD) (Golder, 2013) prepared as part of the Hammond Reef Gold Project (the Project) Environmental Impact Statement/Environmental Assessment (EIS/EA) provides an assessment of the impacts of the Project on climate, (i.e. the GHG emissions from the Project) and a qualitative assessment of the impacts of a changing climate on the Project. This report concludes that the emissions from the Project are insignificant contributors to global climate change, and the impacts from a potentially changing climate will not significantly affect the Project. A new comment [EAB11-NEW] has been raised by the Government Review Team (GRT) that requests an assessment of how the project interrelates with climate change over time, including the integration of climate change considerations with respect to design, mitigation and adaptation. This is based on the analysis of historic and future climate trends, presented in the Atmospheric Environment TSD (Golder, 2013).

Originally, the projections incorporated in the Atmospheric Environment TSD (Golder 2013) were taken from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4, IPCC 2007). In 2013, after the EIS/EA was submitted, the IPCC published the Fifth Assessment Report (AR5, IPCC 2013) with updated models, emission scenarios and modelled projections. AR5 represents the most current complete synthesis of information regarding climate change. The AR5 is consistent with the AR4, but benefits from better observations and improved models; conclusions from previous assessments completed based on AR4 are not likely to be impacted by moving to AR5, therefore additional work to use the updated AR5 projections is not required.

This memorandum presents a more detailed qualitative assessment of the potential effects of climate change on the Project.

Work Completed to Date

The Atmospheric Environment TSD (Golder, 2013) provides a comprehensive assessment of the historic and projected future climate trends for the Project area, based on Environment Canada historic data for nearby weather stations, and future climate trends published by the IPCC. The report concludes that both average temperature and average precipitation are likely to increase in the Project area but, that over the relatively short operational life of the Project (11 years), the effects of a potentially changing climate on the Project are not significant. In order to address the new comment from the GRT, additional information regarding how a changing climate may affect the different project phases, and adaptive management over the life of the mine has been compiled, including:

- A climate change assessment matrix with discussion of adaptive management planning over the life of the Project; and
- A discussion on the design basis for surface water management infrastructure as it relates to climate change.

In addition, this memo also provides an updated discussion on the climate trends identified in the Atmospheric Environment TSD including recent literature on the various climate factor trends.

Climate Factor Trends

The Global Climate Models (GCM) data discussed in Section 6.0 of the Atmospheric Environment TSD is provided on a monthly basis and represents the mean temperature and total precipitation. Information on extreme values is not directly available and cannot be inferred from such a broad time scale. For this reason, the climate factor trends must be developed to fully assess the impacts of the projected climate on the Project infrastructure components.

The climate factors assessed include changes to rainfall, temperature and extreme events (e.g., storms). These factors are further subdivided into specific event type factors that describe long term changes such as increasing winter temperatures or extreme events such as increased drought. These climate factors are a combination of the general trends of the GCM data and qualitative assessments from literature.

Current climate factors are based on the historical climate analysed in Section 5.0 of the TSD, which provides historical trends. The future trends of the climate factors were analysed using the climate model projections in Section 6.0 of the TSD. If climate projections were not available from Section 6.0, trends from literature were referenced to discuss the projected change in climate.

The justification for the direction of each of the future climate factor trends is given in the following table, which is an update to Table 6-9 of the original TSD. This table has been updated to provide additional qualitative discussion of the trends, including new references.

Table 1: Climate risk Matrix (TSD Table 6-9 Updated)

Climate Factor	Trend	Justification	Other Comments on Future Trends
Frequency of Drought	Qualitative		An increase in drought is projected to be likely (Warren and Lemmen, 2014)
Freeze-Thaw Cycles	Increasing	Slight increase based on increasing winter precipitation and average temperatures	Freeze-thaw events are projected to increase for much of Canada (Kertland and Warren, 2014)
High Humidity Periods	Increasing	Slight increase based on increasing precipitation from analysis of all models, and increase in temperatures	Projected changes in temperature and precipitation will increase evaporation (Bush et al., 2014)
Frequency of Extreme Temperatures	Unknown	Possible increase in extreme temperatures but strength of trend is unknown	An increase in heat waves is considered to be very likely, with an increased number, intensity and duration (Bush et al., 2014)
Frequency of Rainfall	Unknown	Trend is unclear due to unknown distribution of rain events in future projections	An increase in drought is projected to be likely (Warren and Lemmen, 2014)
Heavy Rain	Increasing	Slight increase based on higher rainfall volume in the summer season	An increase is projected for the amount of rain (Warren and Lemmen, 2014) Total annual precipitation will increase but precipitation in the key seasons may decrease and the intensity of rain may increase (Warren and Lemmen, 2014)
Total Rainfall	Increasing	Increase of ~50 mm annually above historic baseline by 2050	An increase is projected for the amount of rain (Warren and Lemmen, 2014) Total annual precipitation will increase but precipitation in the key seasons may decrease and the intensity of rain may increase (Warren and Lemmen, 2014)
Freezing Rain	Increasing	Slight increase in temperature will create a vertical profile that is conducive to freezing rain events	The frequency and duration of freezing rain events are projected to increase in Ontario, with a stronger trend in Eastern Ontario (Berry et al, 2014)
Rain on Snow Events	Increasing	Slight increase in temperature will create a vertical profile that is conducive to rain or snow events	Warmer winter temperatures may lead to more winter rainfall events (Canadian Council of Ministers of the Environment, 2003)
Flash Freeze Event (Rain/Freeze-Thaw)	Qualitative	Further assessment of trend is required due to unknown distribution of rain events in future projections	Freeze-thaw events are projected to increase for much of Canada (Kertland and Warren, 2014)

Climate Factor	Trend	Justification	Other Comments on Future Trends
Snow Accumulation	Qualitative	Further assessment of trend is required due to unknown distribution of precipitation events in future projections	Southern Canada will have a greater percentage of precipitation falling as rain and a lower percentage as snow (Bush et al., 2014)
Snowmelt	Qualitative	Further assessment of trend is required due to unknown distribution of precipitation events in future projections	Reduced snow cover is expected with the largest changes in maritime mountain regions (Warren and Lemmen, 2014)
Sunny Days	Qualitative	Further assessment of trend is required due to lack of information on future dynamics (cloud cover)	
Extreme Heat	Increasing	Slight increase based on increase in average summer temperatures	An increase in heat waves is considered to be very likely, with an increased number, intensity and duration (Bush et al., 2014)
Extreme Cold	Decreasing	Slight decrease based on increase in average winter temperatures	An increasing trend in warmer winters is projected (Bush et al., 2014)
Cooling Degree Days	Increasing	Slight increase based on increase in average summer temperatures	Increases in cooling degree days have been smaller and less widespread than the decreases in heating degree days (Canadian Council of Ministers of the Environment, 2003)
Heating Degree Days	Decreasing	Slight decrease based on increase in average winter temperatures	Warmer winters are projected (Bush et al., 2014)) Over the past century, heating degree days have declined significantly in most of Canada (Canadian Council of Ministers of the Environment, 2003)
Average Temperature	Increasing	Analysis of all models indicates an average increase of ~3°C above historic baseline by 2050	Most warming will take place in the winter (Warren and Lemmen, 2014)

Potential Climate Infrastructure Interactions

In keeping with the Federal-Provincial Guidance for Considering Climate Change in Environmental Assessments (FPTCCCEA 2003), Canadian Malartic Corporation (CMC) has examined the potential effects of a changing climate on the Project. Potential climate-infrastructure interactions have been identified below, and these interactions have been analyzed for significance. The potential future climate is described using climate factors that are based on potential changes to climate normals and extreme events for temperature, rain, snow, wind and mixed precipitation events that have the greatest potential to impact the Project.

The effects of climate change on infrastructure are typically noticed over a climate normal period (typically 30 years), if not longer. With the exception of the infrastructure that will remain on site and require long term management during the closure and post-closure phases (e.g., the waste rock stockpile, open pit, and tailings management facility (TMF)), most facilities and infrastructure in the Project area have an operational lifetime of 11 years, therefore, climate change is likely not to have significant effect on infrastructure during the operational life of the Project. Through closure planning and design, the remaining infrastructure will be stabilized such that effects due to climate change will not be significant.

The detailed design of the on-site infrastructure and facilities will be based on established guidelines, standard engineering practice and will consider extreme meteorological events. For example, the TMF Reclaim Pond is designed to accommodate a 1-in-10,000 year storm event without overtopping. It is not anticipated that any additional measures or adjustments will be required to address predicted climate change in the next 20 years. Over periods of less than 20 years, the inter-seasonal variability in weather is much greater than the decadal shifts in temperature, precipitation trends, or likely extreme weather events. Due to the short time frame of both the construction and operations phases, the potential effects of climate change on infrastructure during these phases are considered to be negligible.

A qualitative assessment of potential climate-facility/infrastructure interactions that may affect the effectiveness/performance of a specific facility/infrastructure is provided in the following table for four general climate factors (temperature, rain, snow, and mixed events). In this table, interactions that require further assessment for the infrastructure component are indicated by boxes containing a “Y”. All other interactions are not discussed further.

Table 2: Climate Matrix

Infrastructure Component	Temperature	Rain	Snow	Mixed Events (e.g., storms)
Construction				
Open Pit	N	N	N	N
Roads	N	N	N	N
Buildings	N	N	N	N
Operations				
Water Management Ponds and Collection Ditches	N	N	N	N
Freshwater Intake Pipeline	N	N	N	N
Industrial Water Treatment	N	N	N	N
Effluent Treatment and Discharge	N	N	N	N
Tailings Management Facility	N	N	N	N
Overburden and Waste Rock Stockpile	N	N	N	N
Open Pit	N	N	N	N
Roads	N	N	N	N
Buildings	N	N	N	N
Closure				
Biodiversity/revegetation	Y	Y	Y	N
Waste Rock Stockpile	N	Y	Y	N
Tailings Management Facility	N	Y	Y	N
Pit Filling	Y	Y	Y	N

Climate/infrastructure interactions during closure have more potential to be significant as long-term trends may start to influence planned closure facilities and activities such as pit filling, revegetation and biodiversity, and site rehabilitation. These potential interactions have been considered by water management and mine closure experts, to assess the potential impact and if additional mitigation or design may be required.

The Conceptual Closure and Rehabilitation Plan submitted as part of the Project's EIS/EA calls for:

- Lowering the TMF Reclaim Pond emergency spillway and removal of other water management ponds with release of water to the environment once water quality has been determined to be suitable for discharge;
- Re-vegetation of the tailings; and,
- Flooding of the open pits over an estimated duration of 218 years (based on average hydrological conditions).

The closure plan at the current stage of the Project is conceptual. Detailed closure planning and design will be undertaken closer to the mine end-of-life. A summary of the current future climate infrastructure assessment is provided in Table 3.

Table 3: Climate Resilience Assessment

Climate Factor	Project Resilience Assessment
Temperature	■ Drought-resistant species will be selected for closure re-vegetation activities (to be determined during detailed closure planning). ■ Increasing temperatures may increase evaporation rate of water, slightly changing the anticipated pit flooding time, but the effect on projected refill times is currently unknown.
Rain and Snow	■ The TMF Reclaim Pond will maintain sufficient storage above the maximum operating water level to contain the Environmental Design Flood (100-year rainfall and snowmelt event with a duration of 30 days) prior to activation of the emergency spillway. ■ The TMF Reclaim Pond emergency spillway is incorporated into the dam design to protect the dams against overtopping, and is designed to safely route a storm with a recurrence interval of 10,000 years. ■ Other site water management ponds (e.g., the Processing Plant Collection Pond and seepage collection ponds) will be designed and operated to contain the 100-year rainfall for 24-hours without discharge during operations ■ Drought-resistant species will be used for re-vegetation activities (to be determined during detailed closure planning). ■ Increased precipitation may expedite the filling of the open pits. The current projection is for the pits to flood in 218 years under average hydrologic conditions, increased precipitation in the future may shorten this time estimate. ■ After water quality has been determined through monitoring to be suitable for discharge, the invert elevation of the TMF Reclaim Pond emergency spillway will be lowered, significantly reducing the volume of water ponded within the TMF and increasing the flow capacity of the outlet such that failure of the dams through overtopping due to increased precipitation during extreme events will be even less likely. ■ After water quality has been determined through monitoring to be suitable for discharge, other site water management ponds (e.g., the Processing Plant Collection Pond and seepage collection ponds) will be removed and runoff will be either directed to the open pit or released to the environment. ■ Any ditches constructed for closure water management will be sized during detailed engineering with consideration of the potential for increase precipitation due to climate change.

Conclusion

The climate trends for the region indicate that, in general, the future will be warmer and wetter. Temperatures are increasing annually and seasonally. Precipitation is also increasing, and the trend is moving toward more precipitation falling as rain rather than as snow. In the future less frequent but more intense events (compared to current conditions) are reasonably expected.

During the construction and operations phases of the Project, climate facility/infrastructure interactions do not require further consideration of the potential effects of a changing climate, due to the short timelines for these phases. The climate/infrastructure interactions where a changing climate may require further consideration are projected to take place during the closure and post closure phase. Changes in climate may affect the growth of vegetation in the area, potentially impacting closure re-vegetation. This will be addressed during the detailed closure planning by selection of appropriate vegetation species. The pit flooding duration will depend on precipitation and temperature trends and therefore may be affect by long-term climate change, however, given the long filling duration, relatively small projected changes in annual average precipitation and temperature and the consideration that the projected impacts of changes in these climate factors will tend to offset each other (i.e., increase evaporation due to higher temperatures will increase filling time while increase precipitation will decrease filling time), the significance of climate change on the pit flooding duration is not considered to be significant.

Based on this assessment it can be concluded that the effects of a potentially changing climate on the Project are unlikely to be significant.

<Original signed by>

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MOECC Memorandum

Hammond Reef Gold Mine EA – Comment on the Technical Memorandum "Detailed Qualitative Climate Change Assessment – Hammond Reef Project." December 23, 2016

Ministry of the Environment and Climate Change

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December 23, 2016

MEMORANDUM

TO: Sandra Pouliot
Project Manager
Canadian Malartic Corporation (CMC)

FROM: Jessica Rosenberg
Special Project Officer
Environmental Approvals Branch

RE: Hammond Reef Gold Mine EA – Comments on the Technical Memorandum, "Detailed Qualitative Climate Change Assessment – Hammond Reef Project"

EA FILE NO. EA-03-05-01 / EAIMS 11031

The Ministry of the Environment and Climate Change staff from the Environmental Assessment Services (EAS) Section have reviewed the Technical Memorandum entitled "Detailed Qualitative Climate Change Assessment – Hammond Reef Project" (Technical Memo). We provide the following comments:

1. **Intergovernmental Panel on Climate Change (IPCC) Assessment Report data**
    a) On p. 1 of the Technical Memo, you indicate that IPCC Fifth Assessment Report benefits from better observations and improved models, but you conclude that assessments based on IPCC Fourth Assessment Report are not likely to be

impacted by using data from the more recent report. **Please explain this reasoning.**

2. **Mitigation (i.e. effects of the project on climate change)**
    a) As per EAS' comment from August 2015, the potential effects of the project on climate change (i.e. mitigation) should be discussed. The Technical Memo, in its current form, only discusses adaptation. **Please include a consideration of mitigation in the Technical Memo.**
    b) **Please evaluate anticipated GHG emissions from the Project, on an annual basis.** The assessment should include direct emissions from sources owned/controlled by CMC (eg. fuel from vehicles, boilers, furnaces, etc.), indirect emissions from generation of purchased electricity, heat or steam, as well as impacts related to the removal of carbon sinks (eg. total area of vegetation cleared for the project).
    c) **Please describe how the Project will be designed to minimize the potential for greenhouse gas emissions in the Technical Memo. Also, will there be a monitoring plan to minimize the project effects on climate change? If not, please provide rationale.**
    d) **Has CMC considered the use of electric vehicles for its Project? If not, please provide rationale.**

3. **Methodology for "Table 2: Climate Matrix," p. 6**
    a) It is not clear, on its face, how the facility/infrastructure and climate interactions meriting further assessment were selected, as outlined in Table 2 on p. 6. **Please describe the methodology used to determine the interactions requiring further assessment.**

4. **"Table 3: Climate Resilience Assessment" on p. 7**
    a) The Ministry specified in its August 2015 comments that it was interested in seeing designs or mitigation to meet extreme weather events, specifically 1:500 year storm events. Table 3, entitled "Climate Resilience Assessment" on p. 7 discussed the 100-year rainfall event for the design of the Processing Plant Collection Pond and the seepage collection ponds. **Please consider the 1:500 year storm event.**
    b) **Please describe how climate factors with unknown trends will be incorporated into project design.** Specifically, will there be a monitoring plan in place to support adaptation to unpredictable weather events?

Finally, please consider the Ministry of the Environment and Climate Change's guidance document, "Guide: Consideration of Climate Change in Environmental Assessment in Ontario," which I have attached.

If you have any questions or need further clarification on the comments above, feel free to contact me.

<Original signed by>

Jessica Rosenberg

c: Adam Auckland, Golder Associates Ltd

Attached: Guide: Consideration of Climate Change in Environmental Assessment in Ontario

Technical Memorandum

Responses to Comments on Qualitative Climate Change Assessment – Hammond Reef Gold Project March 20, 2017

TECHNICAL MEMORANDUM

DATE March 20, 2017

PROJECT No. 1656263 (1000/1004)

DOC NO. 008 (Rev 0)

TO Sandra Pouliot
Canadian Malartic Corporation

CC Adam Auckland

FROM Allison Barrett and Sean Capstick

EMAIL Allison_Barrett@golder.com

RESPONSE TO COMMENTS ON QUALITATIVE CLIMATE CHANGE TECHNICAL ASSESSMENT - HAMMOND REEF GOLD PROJECT

Golder Associates Ltd. (Golder) has prepared the following response to the Ministry of Environment and Climate Change (MOECC) comments related to the August 29, 2016 memorandum entitled "Detailed Qualitative Climate Change Assessment – Hammond Reef Gold Project" (herein referred to as the Technical Memo), issued in response to the MOECC Environmental Approval Branch (EAB) comment EAB11-NEW. The comments addressed in this memorandum were received by Canadian Malartic Corporation (CMC) in a letter from the MOECC dated December 23, 2016.

MOECC Comment 1:

On p. 1 of the Technical Memo, you indicate that IPCC Fifth Assessment Report benefits from better observations and improved models, but you conclude that assessments based on IPCC Fourth Assessment Report and not likely to be impacted by using data from the more recent report. Please explain this reasoning.

CMC Response 1:

The original assessment for this Project was completed in 2013, was based on data available in IPCC's AR4 (the Fourth Assessment Report). In late 2013, the Intergovernmental Panel on Climate Change (IPCC) published the Fifth Assessment Report (AR5; IPCC 2013) with updated models, emission scenarios and modelled projections. This response provides a comparison of AR4 and AR5, along with a discussion of the implications of AR5 on the previous climate projections and the differences that may result from the update to AR5 emissions scenarios, new third-party models, and current recommended approaches to future climate projections.

Global climate models require extensive inputs in order to characterize the physical processes and social development paths that could alter climate in the future. The most notable changes between AR4 and AR5 are the emissions scenarios used to drive the projected changes in climate.

In AR4, the IPCC established a series of socio-economic scenarios that help define the future levels of global GHG emissions. The IPCC identifies many scenarios but the assessment completed for the Hammond Reef Project and presented in the Atmospheric Environment Technical Supporting Document (TSD), focuses on three, namely, A1B, B1, A2. The A1B and A2 scenarios represent a focus on economic growth while the B1 scenario represents a shift towards more environmentally conscious solutions to growth. Both scenarios A1B and B1 include a shift towards global solutions while the A2 scenario includes growth based on regional models. These three socio-economic scenarios have been described more fully by the IPCC in their Special Report on Emission Scenarios (SRES) (Nakicenovic and Swart, 2000).

In order to represent the wide range of the inputs possible to global climate models in AR5, the IPCC has introduced a series of representative concentration pathways (RCPS) that help define the future levels of radiative forcing of the atmosphere. The IPCC identifies four scenarios but the current focus is on the three RCPs currently available from Canadian Climate Data and Scenarios (CCDS), namely, RCP 2.6, RCP 4.5 and RCP 8.5. The pathways are named after the radiative forcing projected to occur by 2100. These three RCPs have been described more fully by van Vuuren et. al. (2011) in their paper "The representative concentration pathways: an overview" and are summarized in Table 1, below.

Table 1: Characterization of Representative Concentration Pathways

Name	Radiative Forcing in 2100	Characterization
RCP 8.5	8.5 W/m²	Increasing greenhouse gas emissions over time, with no stabilization, representative of scenarios leading to high greenhouse gas concentration levels.
RCP 4.5	4.5 W/m²	Total radiative forcing is stabilized shortly after 2100, without overshoot. This is achieved through a reduction in greenhouse gases over time through climate policy.
RCP 2.6	2.6 W/m²	"Peak and decline" scenario where the radiative forcing first reaches 3.1 W/m² by mid-century and returns to 2.6 W/m² by 2100. This is achieved through a substantial reduction in greenhouse gases over time through stringent climate policy.

Note: summarized from van Vuuren et. al 2011

By describing the RCPs according to radiative forcing, each scenario represents a range of socio-economic changes which in total are characterized as described in Table 1. The SRES scenarios, used in AR4, are storylines describing specific socio-economic conditions and offer limited flexibility in representing socio-economic changes, while the RCPs, used in AR5, represent specific radiative forcing scenarios (without the accompanying economic storyline from AR4). AR5 is less of an economic description, and focuses instead on the actual amount of radiative forcing over time. The change in the emission scenarios between AR4 and AR5 represents a completely new approach to emission scenarios, making a direct comparison between assessment results challenging as the AR4 scenarios are not accompanied by associated radiative forcing endpoints, but rather describe a range of economic possibilities. Figure 1 (taken from van Ypersele, 2010) provides a graphical comparison of the projected CO_2 concentrations over time for selected SRES emission scenarios (from AR4) and the RCPs (AR5). The RCPs describe a wider range of possible CO_2 outcomes extending beyond the 2100 timeline.

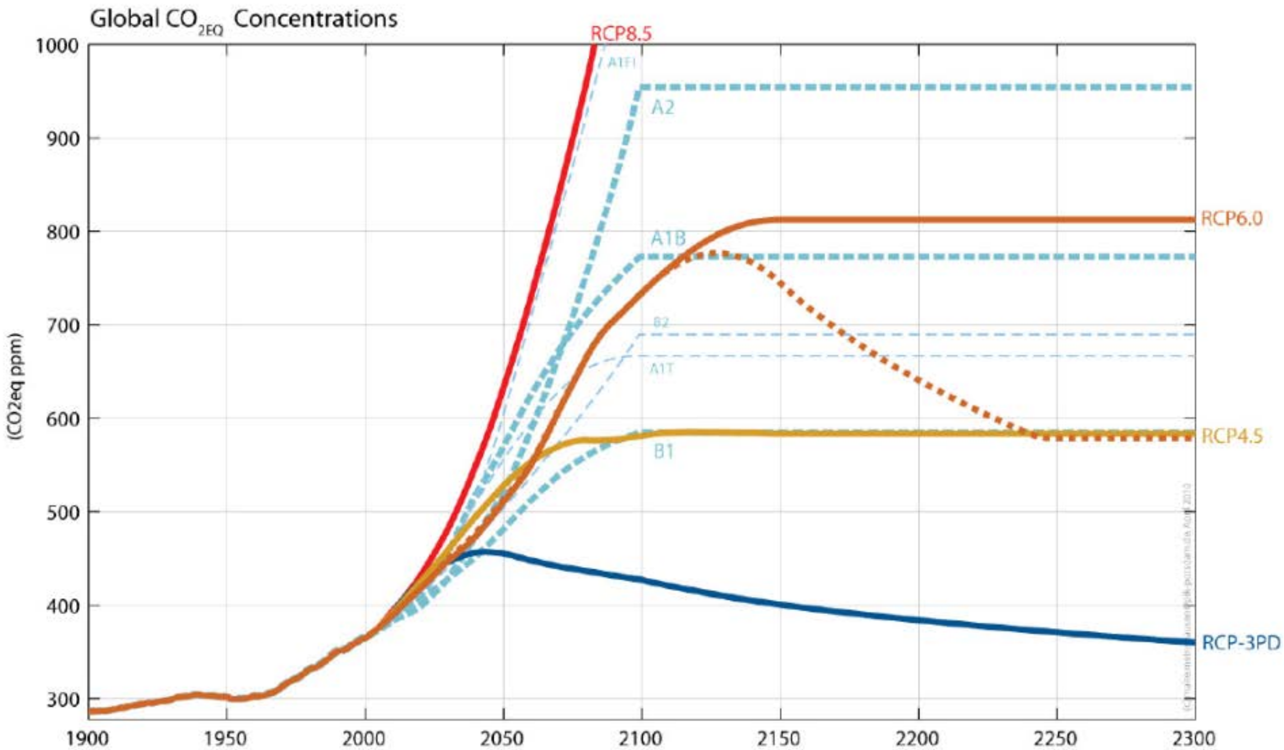

Figure 1: Comparison of Projected CO_2 concentrations over time from SRES and RCPs (van Ypersele, 2010).

Despite the changes in the emission scenarios between AR4 and AR5, the projected changes in climate are comparable for most regions across the globe. Looking at the following figure, the patterns of projected temperature and precipitation from CMIP3 (representative of AR4) and CMIP5 (representative of AR5) are very similar.

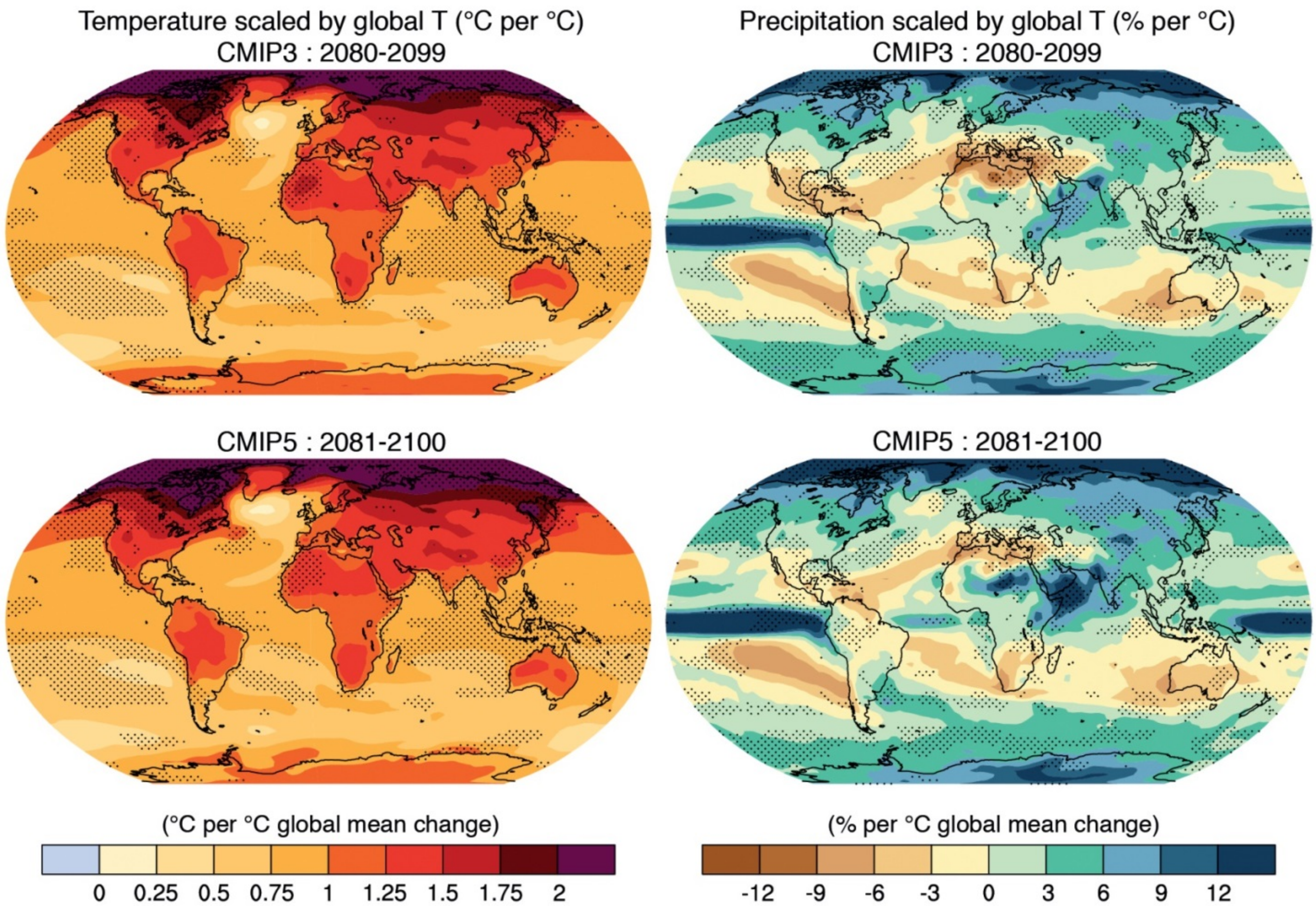

Figure 2: Comparison of Temperature and Precipitation from AR4 (CMIP3) and AR5 (CMIP5) (IPCC, 2013)

As the global comparison (Figure 2) indicates, the model projections from AR4 and AR5 show comparable results, especially when considered within the uncertainty of climate modelling. Generally, the conclusions from previous reports and assessments dependant on climate projections from AR4 are not likely to produce different conclusions using climate projections from AR5 over the 2050s and 2080s, the current standard time ranges for climate assessments (2041 to 2070 being represented as “the 2050s” and 2071 to 2100 being represented as “the 2080s”). Likewise, if any vulnerabilities were identified using the AR4 climate projections, they will continue to be vulnerable using the AR5 climate projections. Furthermore, the Hammond Reef Project is only anticipated to have an active lifespan of approximately 11 years, and will have been closed long before the 2080s. During the development of the closure plan, revegetation plans, projections of pit filling time, and other long-term planning aspects may be reviewed with respect to the latest climate projections, however the use of AR4 for the assessment of potential climate effects on the project during construction and operations is deemed to be sufficient.

MOECC Comment 2:

a) As per EAS' comment from August 2015, the potential effects of the project on climate change (i.e., mitigation) should be discussed. The Technical Memo, in its current form, only discusses adaptation. Please include a consideration of mitigation in the Technical Memo.
b) Please evaluate anticipated GHG emissions from the Project, on an annual basis. The assessment should include direct emissions from sources owned/controlled by CMC (e.g., fuel from vehicles, boilers, furnaces, etc.), indirect emissions from generation of purchased electricity, heat or steam, as well as impacts related to the removal of carbon sinks (e.g., total area of vegetation cleared for the project).
c) Please describe how the Project will be designed to minimize the potential for greenhouse gas emissions in the Technical Memo. Also, will there be a monitoring plan to minimize the project effects on climate change? If not, please provide rationale.
d) Has CMC considered the use of electric vehicles for its Project? If not, please provide rationale.

CMC Response 2:

Greenhouse gas (GHG) emissions calculations were included in Appendix 6.III of the Hammond Reef Gold Project Atmospheric Environment TSD. From the TSD, Table 7 is reproduced below (as Table 2), summarizing the emissions of GHGs from direct sources anticipated at the Project site, including the diesel mobile fleet, stationary fuel combustion (heating, process sources), and blasting. The estimated mobile emissions (included in the "All Sources" section) are based on conservative calculations assuming that the maximum vehicle fleet is in use at all times (24 hours per day, 365 days per year), and therefore represents an upper bound of the maximum annual GHG emission rate for these sources.

Table 2: Annual GHG Emissions for Maximum Operating Year by Emission Type

GHG	**Emissions (t)**	**Emissions (tCO_2e)**
Stationary and Process (no mobile)		
CH_4 (Methane)	0.391	8.207
N_2O (Nitrous Oxide)	1.742	540.003
CO_2 (Carbon Dioxide)	27,537	27,537
Total CO_2e		28,085
All Sources (Mobile, Stationary and Process)		
CH_4 (Methane)	7.186	150.9
N_2O (Nitrous Oxide)	11.07	3,432
CO_2 (Carbon Dioxide)	192,041	192,041
Total CO_2e		**195,624**

Indirect GHG emissions were not previously assessed for the Project as these emissions are not required under the O.Reg.452/09 Guideline or the Greenhouse Gas Reporting Program (GHGRP) Guideline. The loss of GHG sinks due to clearing of trees is a one-time activity and not comparable to the GHGs emitted annually over the life of the project. Based on the Project description presented in the EIS/EA (Golder, 2013) the anticipated electricity needs for the Project during operation is 120 MW. Using the very conservative assumption that the facility is using this amount of power 24 hours per day, 365 days per year, the annual energy usage would be 1,051,200 MWh/yr according to the following formula:

$$P(MWh) = 120\ MW\ \times 24\frac{h}{day} \times 365\frac{day}{yr}$$

Based on the latest data available for the Ontario electrical grid (2015 data), the GHG emission rate per MWh of power generated is 0.05 tonnes CO_2e/MWh, resulting in a maximum estimation of 52,560 t CO_2e/yr due to purchased electricity. Based on this calculation, Table 10 from Appendix 6.III of the Atmospheric Environment TSD, is reproduced below as Table 3, with the purchased electricity added to the Indirect Emissions line. Revised values are BOLDED for visibility. As identified in the TSD, the effect of the Project on climate can be considered to be negligible.

Table 3: Comparison of Project GHG Emissions to Canadian Emissions

Source	Annual GHG Emissions (kg CO_2e/yr)	Project Total as a Relative Percentage
Direct Project Emissions	195.624	100%
Indirect Emissions	**52.560**	
Project Total	**248.184**	
Ontario (2010)	171,300	**0.1448%**
Canada (2010)	692,000	**0.0359%**

GHG reporting will be undertaken by the Facility as mandated under the Provincial and Federal GHG reporting programs. Currently, GHG emissions over 25 kt/year are required to be reported under the Provincial program, and GHG emissions over 50 kt/year are required to be reported under the Federal program. CMC will also participate in the Ontario GHG cap-and-trade program, if the facility is deemed eligible.

GHG mitigation for the Project was also discussed briefly in the Atmospheric Environment TSD and Appendix 6.III of the TSD:

> *Given the nature of Facility operations, Scope 1 and 2 emissions will be the most significant, and will provide the best opportunity for mitigation. Accordingly, these categories will be the primary focus of the GHG inventory.*

Environment Canada's Environmental Code of Practice for Metal Mines (Environment Canada 2009) identifies and recommends best practices in order to facilitate and encourage continual improvement in the environmental performance of mining facilities throughout the mine life cycle. It is Canadian Malartic's intent to follow these recommended best practices during all phases of the Project's life cycle. In following these best practices, Project aspects that will be examined for opportunities to implement measures to control GHG emissions may include, but are not limited to the following:

- corporate strategies;
- project design (e.g., decreasing vehicle travel distances to reduce fuel use);
- operational practices;
- employee engagement (e.g., encouraging carpooling to reduce Scope 3 GHG emissions);
- use of alternative energy sources (e.g., "green" power);
- procurement protocols (e.g., use of fuel efficient equipment);

- vegetation recovery (e.g., revegetating areas as operations cease allowing for the renewal of GHG sinks); and
- research and development options.

CMC will consider the feasibility of electric or other alternative power equipment during detailed project planning. The state of the science for heavy-duty electric vehicles is still in early stages, and vehicle reliability and suitability for the Northern Ontario environment, and active mining operations, is still being assessed.

Following the best practices and recommendations put forth in the Environmental Code of Practice for Metal Mines, as well as ongoing consideration of measures to control GHG emissions in all Project aspects can result in a responsible and effective program for minimizing GHG releases from the Project.

MOECC Comment 3:

a) It is not clear, on its face, how the facility/infrastructure and climate interactions meriting further assessment were selected, as outlined in Table 2 on p.6. Please describe the methodology used to determine the interactions requiring further assessment.

CMC Response 3:

The previous Technical Memo stated:

> *The effects of climate change on infrastructure are typically noticed over a climate normal period (typically 30 years), if not longer. With the exception of the infrastructure that will remain on site, and require long term management during the closure and post-closure phases (e.g., the waste rock stockpile, open pit, and tailings management facility (TMF), most facilities and infrastructure in the Project area have an operational lifetime of 11 years, therefore, climate change is likely not to have significant effect on infrastructure during the operational life of the Project.*

Due to the short duration of construction and operational activities, and the short lifespan of operational facilities, and infrastructure, these components are unlikely to be significantly affected by predicted climate change in the next 10-20 years. Closure and post-closure activities (such as pit filling, revegetation) are more likely to be impacted by the potential effects of climate change.

Table 2 from the previous Technical Memo has been reproduced below as Table 3. In this table, interactions that require further assessment for the infrastructure component are indicated by boxes containing a “Y”. Construction and operational facilities, operations, and infrastructure are highlighted in grey. It was determined that these components will not be significantly affected by the long-term effects of climate change, due to their short duration, and were therefore eliminated from further consideration.

The closure activities and infrastructure, left in white at the bottom of the table, are likely to be present or will occur after the Project has ceased operations. For these activities and infrastructure components, there is a possibility that future climate change may have some effects. Mixed events (rain/snow mixed storms, ice storms, etc.) are not likely to have a significant effect on those infrastructure components or activities because current design requirements already take total precipitation into account. Total precipitation (rain and snow), were elements identified to be considered in the planning of the revegetation program, the closure design of the waste rock stockpile and the TMF, and may affect the time required for the pits to fill. Temperature was not found to be an important design element for the waste rock stockpile or the TMF because the existing range of temperatures throughout the year (summer vs. winter) is already significantly greater than the projected temperature increases in the future. Temperature changes can, however, affect biodiversity and revegetation, and pit filling (the latter through changes in potential evaporation).

Table 3: Climate-Infrastructure Interaction Matrix

Infrastructure Component	Temperature	Rain	Snow	Mixed Events (e.g., storms)
Construction				
Open Pit	N	N	N	N
Roads	N	N	N	N
Buildings	N	N	N	N
Operations				
Water Management Ponds and Collection Ditches	N	N	N	N
Freshwater Intake Pipeline	N	N	N	N
Industrial Water Treatment	N	N	N	N
Effluent Treatment and Discharge	N	N	N	N
Tailings Management Facility	N	N	N	N
Overburden and Waste Rock Stockpile	N	N	N	N
Open Pit	N	N	N	N
Roads	N	N	N	N
Buildings	N	N	N	N
Closure				
Biodiversity/revegetation	Y	Y	Y	N
Waste Rock Stockpile	N	Y	Y	N
Tailings Management Facility	N	Y	Y	N
Pit Filling	Y	Y	Y	N

MOECC Comment 4:

a) The Ministry specified in its August 2015 comments that it was interested in seeing designs or mitigation to meet extreme weather events, specifically 1:500 year storm events. Table 3, entitled “Climate Resilience Assessment” on p.7 discussed the 100-year rainfall event for the design of the Processing Plant Collection Pond and the seepage collection ponds. Please consider the 1:500 year storm event.
b) Please describe how climate factors with unknown trends will be incorporated into project design. Specifically, will there be a monitoring plan in place to support adaptation to unpredictable weather events?

CMC Response 4:

The TMF Reclaim Pond will be designed to protect the dams against overtopping and safely route a storm with a recurrence interval of 10,000 years.

CMC will consider designing site water management ponds that will contain process affected water (i.e., water that has been used by the ore processing facility), including the TMF seepage collection ponds, and associated water conveyance infrastructure (e.g., ditches, pumps) to contain the 1:500 year storm event without uncontrolled discharge to the environment. The detailed design of these infrastructure components will be undertaken during the permitting phase of the project.

Water management ponds and infrastructure that will contain/convey only runoff and non-process affected seepage will be designed to contain the 1:100 year storm event. This level design is considered sufficient because the primary concern with respect to release of runoff and non-process affected seepage to the environment during such an event is increased concentration of total suspended solids (TSS). During an extreme event of this nature, naturally occurring erosion is increased and, as a result, natural streams and receiving water bodies will have elevated concentrations of TSS.

The facilities, activities, and infrastructure most likely to be affected by future climate change are those which will persist in the closure and post-closure phases of the project, including:

- Biodiversity/revegetation;
- Waste Rock Stockpile;
- Tailings Management Facility; and
- Pit Filling.

Through Canadian Malartic's commitments for undertaking closure, post-closure and rehabilitation of the site, the following monitoring activities have been identified:

- Visual assessment of areas undergoing revegetation by an ecologist until native vegetation communities become established and are considered to be thriving;
- The physical stability of all mine-related structures that remain in place at closure will be monitored as described in Section 5.1 of the Conceptual Closure and Rehabilitation Plans TSD.
- Pit water quality will be monitored during the filling period until a stable chemical condition is reached (as determined in consultation with the Ministry of Northern Development and Mines). After discharge, water quality will be monitored for a period of 5 years, pending water quality results (see response to Federal comment T(2)-03).

It is anticipated that these monitoring activities will identify potential concerns related to unpredictable weather events in the future.

<Original signed by> <Original signed by>

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MOECC Letter

Sasha McLeod

April 28, 2017

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April 28, 2017

Ms. Sandra Pouliot, Environment Project Leader
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Sent via email to spouliot@canadianmalartic.com

Dear Ms. Pouliot:

Staff from the Environmental Assessment Services section of the Ministry of the Environment and Climate Change (ministry) have reviewed the Technical Memo titled "Response to Comments on Qualitative Climate Change Technical Assessment – Hammond Reef Gold Project," provided by Canadian Malartic Corporation (CMC) and dated March 20, 2017. We provide the following comments.

1. RE: Response #2 Best Practices for Reduction of GHG Emissions

The ministry acknowledges CMC's intent to follow Environment Canada's Environmental Code of Practice for Metal Mines, specifically for controlling GHG emissions.

Request: The ministry requests that CMC commit – through a response to these comments – to review during project implementation the 'Towards Sustainable Mining' framework to scan for potential actions in order to minimize project-related GHG emissions. The TSM framework is a publication of the Mining Association of Canada, of which CMC's parent company Agnico Eagle is a member.

2. RE: Response #3 – Emergency Response During Construction and Operations

The memo indicates that climate change events are not expected to impact the project during construction or operations due to the relatively short (11 year) timespan for these project phases.

With this in mind, the ministry recognizes there is the potential for climate change events, such as extreme storms, which have occurred in recent years. As stated in the draft Guide: Consideration of Climate Change in Environmental Assessment in Ontario (August 2016), many jurisdictions are beginning to consider greater variation in future climate scenarios in their project planning, and the ministry considers this a prudent and diligent approach to project planning. As such, the ministry would like to ensure that CMC has plans in place to address the potential for climate change and extreme events during construction and operations.

The ministry notes that CMC's Emergency Preparedness and Response Plan (Chapter 8.2.4 of the December 2013 EA) speaks to certain environmental events – floods and droughts – as well as the corresponding mitigation & management methods to address these events. The Emergency Preparedness and Response Plan indicates that CMC will be developing a detailed environmental emergency plan following EA approval, if granted.

Request: The ministry requests that, when CMC prepares its detailed environmental emergency plan post-EA, CMC consider and include relevant climate change-related impacts and weather events, such as floods, droughts and extreme storms, in the detailed plan for construction and operations. The ministry further requests that CMC make a commitment in its Commitments Registry indicating the above.

3. RE: Response #3 – Consideration of Extreme Events at Post-Closure

The Technical Memo notes that CMC considered the impact that "mixed events (rain/snow mixed storms, ice storms, etc.)" may have on infrastructure during closure/post-closure.

It is unclear to the ministry how extreme events (not just mixed events) were considered, including extreme storms and extreme wind. CMC's August 29, 2016 memo, titled "Detailed Qualitative Climate Change Assessment – Hammond Reef Project," states that "the potential future climate is described using climate factors that are based on potential changes to climate normal and extreme events for temperature, rain, snow, wind and mixed precipitation events that have the greatest potential to impact the Project." However, neither the August 2016 nor March 2017 memos provide further details specifically on extreme storms or extreme wind, which may present more sudden risks to the project besides incremental temperature and precipitation increases.

Request: The ministry requests that CMC clarify – through a response to these comments – how extreme storms and extreme wind were considered in the EA, and if there are any related mitigation or adaptation measures. If additional factors and measures are determined to be needed, please provide an updated "Table 3: Climate Resilience Assessment" (found in the August 2016 memo) as part of CMC's response to these comments in order to provide the ministry with a complete listing of climate change-related factors (including but not limited to temperature, precipitation, extreme storms and wind, etc.) and associated mitigation and adaptation measures.

The ministry also requests that CMC add a commitment in the Commitments Registry that CMC will consider climate change, including related extreme weather events, in advance of and during the closure of the site. This is to ensure that the most up to date climate change information, including but not limited to forecasted changes in temperature, precipitation, mixed events and extreme weather events, are considered during detailed design of the closure and post-closure phases.

If you have any questions or need further clarification on the comments above, feel free to contact me.

<Original signed by>

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Sasha McLeod