Environment and Climate Change Canada
Environnement et Changement climatique Canada

ENVIRONMENT AND CLIMATE CHANGE CANADA'S FINAL SUBMISSION TO THE NUNAVUT IMPACT REVIEW BOARD

RESPECTING THE MARY RIVER PROJECT – PHASE 2 PROPOSAL (08MN053) BY BAFFINLAND IRON MINES CORPORATION

January 18, 2021

Canada

Executive Summary

Baffinland Iron Mines Corporation (the Proponent) is proposing an expansion to its existing Mary River Project (the Project), known as the Phase 2 Proposal. The Phase 2 Proposal is located on Baffin Island, Nunavut, and includes an increase in iron ore production along the northern transportation corridor from the currently approved 6.0 million tonnes per year (Mtpa) to 12 Mtpa. To accommodate this increase, the Proponent proposes to construct and operate a 110 km railway from the Mine Site up to the port facilities at Milne Inlet, as well as expand the port facilities to accommodate cape size vessels and expand the mine camp. The Phase 2 Proposal is a tiered approach, where the proposed increase in production to 12 Mtpa via the northern transportation corridor would eventually lead into the development of the southern transportation corridor via Steensby Inlet (including railway and port construction), which is currently approved for an iron ore production of 18 Mtpa. Once both parts of the Phase 2 Proposal are operational, the total authorized production of the Project will be 30 Mtpa.

Environment and Climate Change Canada (ECCC) has participated in all phases of the review process for the Phase 2 Proposal thus far, providing information requests (IRs) and technical comments to the Nunavut Impact Review Board (NIRB). ECCC also attended the initial Technical Meetings held in Iqaluit from April 8 to 10, 2019 and June 17 to 19, 2019, an initial Final Hearing in November 2019, and subsequent Technical Meetings held via teleconference September 14 to 18, 2020. ECCC submitted an initial Final Submission September 23, 2019. Over the fourteen months since the initial Final Hearing, aspects of the Project have been altered, resolved, and added; thus, ECCC is continuing its participation through this additional Final Submission.

The Final Submission summarizes the results of ECCC's technical review of information provided throughout the process, including commitments made by, and additional information provided by, the Proponent, and ongoing discussions with the Proponent.

ECCC is providing the following technical comments pertaining to the Phase 2 Proposal and its potential impacts on air quality and water quality. More specifically, ECCC comments and recommendations pertain to the following:

- Although Baffinland submitted an updated Phase 1 Waste Rock Management Plan (WRMP), ECCC has completed a review and identified outstanding Acid Rock Drainage and Metal Leaching concerns. ECCC and Baffinland have agreed to address this item through the water license application with the Nunavut Water Board.
- Baffinland has committed to completing an investigation on additional measures to mitigate the black carbon emissions associated with Project-related shipping. ECCC does not agree with the position put forward by Baffinland in their written materials that using distillate fuel in their vessels is not a technically feasible mitigation measure. ECCC recommends Baffinland use <0.1% Sulphur Marine Gas Oil (a common type of distillate fuel frequently used by ships) or equivalent-performing alternatives in their ore-shipping vessels to effectively reduce black carbon emissions.

List of Abbreviations

AMAP	Arctic Monitoring and Assessment Programme
AQNAMP	Air Quality and Noise Abatement Management Plan
ARD	Acid Rock Drainage
BAU	Business-as-usual
CAC	Criteria Air Contaminants
CEPA	*Canadian Environmental Protection Act*
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
DFO	Fisheries and Oceans Canada
ECA	Emission Control Area
ECCC	Environment and Climate Change Canada
EEZ	Exclusive Economic Zone
ERP	Early Revenue Phase
FEIS	Final Environmental Impact Statement
GHG	Greenhouse Gases
HFO	Heavy Fuel Oil
IMO	International Maritime Organizations
IR	Information Request
LNG	Liquefied Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MBCA	*Migratory Birds Convention Act*
MDMER	*Metal and Diamond Mining Effluent Regulations*
MGO	Marine Gas Oil
ML	Metal Leaching
Mtpa	Million Tonnes per Year
NIRB	Nunavut Impact Review Board
NO_2	Nitrogen Dioxide

PAG	Potentially Acid Generating
QIA	Qikiqtani Inuit Association
SARA	*Species at Risk Act*
SO_2	Sulphur Dioxide
t/y	Tonnes Per Year
VLSFO	Very Low Sulphur Fuel Oil
WRMP	Waste Rock Management Plan

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1.0 Introduction

Baffinland Iron Mines Corporation (the Proponent) is proposing an expansion to its existing Mary River Project (the Project) located on Baffin Island, Nunavut, near the community on Pond Inlet, known as the Phase 2 Proposal. The Phase 2 Proposal consists of an expansion of the Project infrastructure as well as an increase in iron ore production and transportation along the northern transportation corridor to Milne Port. The proposed increase would see the mine's production go up from the currently approved 6.0 million tonnes per year (Mtpa) to 12 Mtpa. The Phase 2 Proposal is also a tiered approach, where the proposed increase in production to 12 Mtpa and transportation via the northern transportation corridor would eventually lead to the development of the southern transportation corridor via Steensby Inlet, which is currently approved for an iron ore production of 18 Mtpa. Once both parts of the Phase 2 Proposal are operational, the total authorized production of the mine would be of 30 Mtpa.

To accommodate this increase, the Proponent proposes to construct and operate a 110 km railway from the Mine Site to the port facilities at Milne Inlet via the northern transportation corridor. Further, the increase in production requires an expansion of the port facilities which would include the construction of a second dock with the ability to receive Cape Size vessels. The shipping season would be extended from July 1 to November 15. The mine camp would also be expanded in order to accommodate a peak of 1050 workers during the construction period of the Phase 2 Proposal.

The Phase 2 Proposal builds upon the Early Revenue Phase (ERP) and "original" Mary River Project. The Mary River Project was approved in 2012 and consisted of a southern transportation corridor (including a railway) to transport up to 18 Mtpa of iron ore through Steensby Inlet with year-round shipping (the Approved Project). In 2014, the ERP was approved to permit the production of up to 4.2 Mtpa of iron ore that would be transported from the Mine Site via the Tote road and shipped via Milne Inlet. The ERP was approved in October 2018 to temporarily increase the iron ore production to 6.0 Mtpa (renewed June 18, 2020, until December 2022).

On October 12, 2018, the Nunavut Impact Review Board (NIRB) initiated the technical review of the Final Environmental Impact Statement (FEIS) Addendum for the Phase 2 Proposal. Environment and Climate Change Canada (ECCC) has participated in the review for all phases of the Mary River Project. ECCC has participated in the Information Request (IR) Phase via the ECCC IRs provided to the NIRB on November 23, 2018. ECCC participated in the technical review phase via the ECCC Technical Review Submission, provided to NIRB on March 7, 2019. ECCC also attended the Technical Meetings from April 8 to 10, 2019, June 17 to 19, 2019, and September 14 to 18, 2020. ECCC is providing this Final Submission, taking into account the discussions with the Proponent at and following the Technical Meetings.

A summary of ECCC's mandate and legislation is provided in Section 2.0. ECCC technical comments and recommendations are provided in Section 3.0 and are based on ECCC's technical review of Proponent's information provided to date, including commitments made by the Proponent throughout the review process, additional information provided by the Proponent after the Technical Meetings and ongoing discussions with the Proponent throughout the review process.

2.0 Environment and Climate Change Canada's Mandate, Roles and Responsibilities

The mandate of ECCC is determined by the statutes and regulations under the responsibility of the Minister of Environment and Climate Change. ECCC's mandate covers matters such as the preservation and enhancement of the quality of the natural environment (including water, air and soil quality and the coordination of the relevant policies and programs of the Government of Canada), renewable resources (including migratory birds and other non-domestic flora and fauna), meteorology, and the enforcement of rules and regulations. ECCC's specialist advice is provided in the context of the Canadian Environmental Protection Act (CEPA), the pollution prevention provisions of the *Fisheries Act*, *the Species at Risk Act* (SARA), and *the Migratory Birds Convention Act* (MBCA).

ECCC administers the pollution prevention provisions of the *Fisheries Act*, which prohibits the deposit of a deleterious substance into fish-bearing waters. ECCC also participates in the regulation of toxic chemicals and the development and implementation of environmental quality guidelines pursuant to CEPA.

ECCC is responsible for protecting and conserving migratory bird populations and individuals under the MBCA. ECCC also administers SARA in cooperation with Fisheries and Oceans Canada (DFO) and the Parks Canada Agency to prevent wildlife species from becoming extirpated or extinct, provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming threatened, endangered or extirpated.

Additional information on ECCC's mandate can be found at: https://www.canada.ca/en/environment-climate-change/corporate/mandate.html.

3.0 Environment and Climate Change Canada's Technical Review Comments

This Final Submission summarizes the results of ECCC's technical review of information provided to date, including additional information provided by the Proponent following the Technical Meetings held in Iqaluit from April 8 to 10, 2019, June 17 to 19, 2019, and September 14 to 18, 2020, as well as information provided during and after meetings between ECCC, other federal departments and the Proponent on April 3, 2019 (Air Quality), April 4, 2019 (Acid Rock Drainage and Metal Leaching [ARD/ML]), June 7, 2019 (Air Quality), June 11, 2019 (Air quality, water quality, fuel spill modelling, ARD/ML), July 23, 2019 (Air Quality), September 9, 2019 (Air Quality), April 1, 2020 (Black Carbon), August 19, 2020 (ARD/ML), and January 11, 2021 (Black Carbon).

Section 3.1 outlines the current status of ECCC's technical comments, identifying technical comments that have been resolved and those that remain outstanding.

3.1 Current Status of ECCC Technical Comments

ECCC's Technical Review Submission was submitted to the NIRB on March 7, 2019. A portion of ECCC's technical issues were addressed in the Proponents Technical Comments Responses submitted to the NIRB on March 25, 2019. Remaining issues were discussed during the Technical Meetings held in April and June, 2019 and September 2020. ECCC did not submit a new Technical Comments submission prior to the September 2020 Technical Meeting. Following the Technical Meetings and bilateral discussions, the Proponent made a number of commitments to resolve issues identified by ECCC. Information regarding the Proponent's commitments and/or resolutions was provided to the NIRB by the Proponent on July 4, 2019, and updated following the September 2020 Technical Meeting. Table 1 provides the current status of technical comments submitted by ECCC during the technical review stage.

Table 1. Current status of ECCC's Technical Comments submitted to the NIRB on March 7, 2019.

ECCC No.	Topic	Current Status	Notes
ECCC 3.1	Open-Water and Shoulder Season	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.2	Sea ice Trends and Projected Changes	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.3	Migratory Birds and Avian Species at Risk Effect Assessment and Mitigation Measures	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.4	Calculation of Total Greenhouse Gas Emissions	Resolved	Response and information provided by the Proponent in their Responses to

			ECCC Technical Submission was sufficient.
ECCC 3.5	Greenhouse Gas Emissions from Marine Diesel Consumption	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.6	Greenhouse Gas Emissions from Ore Carriers, Sealift Vessels and Tankers	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.7	Greenhouse Gas Emissions from Locomotives	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.8 / ECCC-FC1	Black Carbon Emitted from Ore Carriers, Sealift Vessels and Tankers	Outstanding	This comment is discussed in detail in Section 3.2.1.
ECCC 3.9	Criteria Air Contaminants from Marine Shipping	Resolved	Resolved after the second Technical Meeting in June 2019, with the additional information that was sent May 1st. Recommendation for Black Carbon (3.2.4) also applies.
ECCC 3.10	Comparison of Modelled NO_2, SO_2 and Dustfall to Measured Concentrations	Resolved	Resolved with the information provided after Technical Meetings
ECCC 3.11	Nitrogen Dioxide Concentrations (predictions)	Resolved	ECCC has no additional questions on this technical comment.
ECCC 3.12	Mitigation of Criteria Air Contaminants	Resolved	ECCC has no additional questions on this technical comment.
ECCC 3.13	Continuous Particulate Monitoring	Resolved	ECCC has no additional questions on this technical comment.
ECCC 3.14	Wind Turbines	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.15	Changes in Extreme Precipitation Events	Resolved	Response and information provided by the Proponent in their Responses to ECCC Technical Submission was sufficient.
ECCC 3.16	Sedimentation to Water Bodies along the Transportation Corridor	Resolved	Proponent provided the Tote Monitoring Program in revision 7 of the Roads Management Plan and was considered by ECCC as sufficient.
ECCC 3.17	Milne Port Effluent Discharge	Resolved	Proponent provided Milne Inlet Effluent Loadings Memo for review on May 1st 2019. Memo was considered by ECCC as sufficient.
ECCC 3.18	Marine Water Quality Monitoring	Resolved	Proponent provided 2019 Marine Environment Effect Management Plan study design for review on June 10,

			2019 as part of the Marine Monitoring Plan. Study design was considered by ECCC as sufficient.
ECCC 3.19 / ECCC-FC2	Acid Rock Drainage and Metal Leaching at the Waste Rock Facility	Resolution to be pursued during the Water Licensing Phase of the Project application	ECCC and Baffinland discussed outstanding comments on August 19, 2020. ECCC is confident the issue can be resolved during the water licensing phase.
ECCC 3.20 / ECCC-FC2	Acid Rock Drainage and Metal Leaching at Rail Line Rock Cuts and Quarries	Resolution to be pursued during the Water Licensing Phase of the Project application	ECCC and Baffinland discussed outstanding comments on August 19, 2020. ECCC is confident the issue can be resolved during the water licensing phase.
ECCC 3.21	Site Specific Tactical Response Plans for Bridges	Resolved	ECCC considers this technical comment resolved, but will review the site-specific response plans that will be developed by the Proponent and incorporated into their Spill Contingency Plan prior to railway operations (Railway Emergency Response Plan, May 13 2019).
ECCC 3.22	Arctic Diesel Fuel Spill Modelling	Resolved	ECCC has no additional questions on this technical comment.

3.2 Outstanding Technical Comments

The technical comments outlined in this section are currently considered outstanding. A detailed discussion of these issues, along with ECCC's recommendation is included below.

3.2.1 ECCC-FC1: Black Carbon Emissions

Introduction and Importance of the Topic to Impact Assessment

Black carbon, as a short-lived climate pollutant, contributes to warming in the atmosphere due to increased absorption of radiation, and also contributes to Arctic warming due to ice-albedo effect and may accelerate snow and ice melting (Bond *et al.*, 2013; Flanner *et al.*, 2007). A report prepared by Arctic Council's Arctic Monitoring and Assessment Program (AMAP) concluded that a mass of black carbon emitted within the Arctic is likely to warm the Arctic several times more than the same mass of black carbon emitted outside the Arctic (AMAP, 2015). A study found that black carbon emitted within the Arctic has an almost five times larger Arctic surface temperature response (per unit of emitted mass) compared to emissions at mid-latitudes (Sand *et al.*, 2013). A recent study by ECCC scientists (Gong *et al.*, 2018) has shown that marine shipping emissions in 2010 had a local to regional impact on black carbon levels and this impact would increase significantly under a 2030 business-as-usual (BAU) projection for shipping in the region (e.g., black carbon deposition to ice/snow roughly doubles in the 2030 BAU scenario from 2010 levels). This study factored in some increase in shipping in the Arctic as part of the BAU projection, but does not specifically account for the increase from this particular product. In particular, the study found that, in the 2030 BAU scenario, contribution to the black carbon loading from shipping could

represent up to 15% locally over Baffin Bay, and that contribution to the black carbon deposition from shipping could exceed 30% locally over the east coast of Baffin Island. As a result, marine shipping is expected to have an important (and increasing) contribution to black carbon deposition to the region. Unlike greenhouse gas (GHG) emissions – which act globally to influence climate – black carbon emissions that occur within the Arctic have a much greater impact in the Arctic than emissions of this pollutant occurring at southern latitudes.

Reference(s):

- AMAP Assessment. 2015. Black carbon and ozone as Arctic climate forcers. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. vii + 116 pp.
- Baffinland Iron Mines Corporation. 2019. Draft Air Quality and Noise Abatement Management Plan – Revision 7.
- Baffinland Iron Mines Corporation. 2019. Technical Comment Responses Phase 2 Proposal – Mary River Project, Response to ECCC 3.08.
- Baffinland Iron Mines Corporation. 2019. Technical Memo – Black Carbon Emissions for the Phase 2 Project (August 22, 2019).
- Baffinland Iron Mines Corporation. 2020. Technical Memo - Review of Mitigation Options for Reducing Black Carbon Emissions from Shipping (October 1, 2020).
- Bond, T. C., Doherty, S.J., Fahey, D.W., Forster, P.M., Berntsen, T., DeAngelo, B.J., Flanner, M.G., Ghan, S., Karcher, B., Koch, D., Kinne, S., Kondo, Y., Quinn, P.K., Sarofim, M.C., Schultz, M.G., Schulz, M., Venkataraman, C., Zhang, H., Zhang, S., Bellouin, N., Guttikunda, S.K., Hopke, P.K., Jacobson, M.Z., Kaiser, J.W., Klimon, Z., Lohmann, U., Schwarz, J.P., Shindell, D., Storelvmo, T., Warren, S.G., and Zender, C. 2013. Bounding the role of black carbon in the climate system: A scientific assessment, J. Geophys. Res. Atmos., 118, 5380–5552, doi:10.1002/jgrd.50171.
- Comer, B., Georgeff, E., Osipova, L., International Council on Clean Transportation (ICCT). Air emissions and water pollution discharges from ships with scrubbers. 2020(a). https://theicct.org/publications/air-water-pollution-scrubbers-2020
- Comer, B., Osipova, L., Mao, X. International Council on Clean Transportation (ICCT). Arctic Heavy Fuel Oil Ban: Fuel and Voyage Cost Effects on Bulk Carriers used in Canadian Arctic Mining Operations. 2020(b).
- Flanner, M.G., C.S. Zender, J.T. Randerson and P.J. Rasch. 2007. Present day climate forcing and response from black carbon in snow. Journal of Geophysical Research: Atmospheres, 112:D11202, doi:10.1029/2006JD008003.
- Gong, W., Beagley, S. R., Cousineau, S., Sassi, M., Munoz-Alpizar, R., Ménard, S., Racine, J., Zhang, J., Chen, J., Morrison, H., Sharma, S., Huang, L., Bellavance, P., Ly, J., Izdebski, P., Lyons, L., and Holt, R. 2018. Assessing the impact of shipping emissions on air pollution in the Canadian Arctic and northern regions: current and future modelled scenarios, Atmos. Chem. Phys., 18, 16653-16687, https://doi.org/10.5194/acp-18-16653-2018, 2018.
- IHS Markit. Sea Web Vessel Search. https://ihsmarkit.com/products/sea-web-vessel-search html.
- International Maritime Organization – Fourth IMO GHG Study 2020 – Final Report. (July 29, 2020).

- Lack, 2017 – An Update to Investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping (BLG17/INF.7), submitted by Canada to the IMO's Pollution Prevention and Response Subcommittee – 5th meeting, document number PPR 5-INF.7.
- Sand, M., T. K. Berntsen, Ø. Seland, and J. E. Kristjánsson. 2013. Arctic surface temperature change to emissions of black carbon within Arctic or midlatitudes, J. Geophys. Res. Atmos., 118, 7788–7798, doi:10.1002/jgrd.50613.

Proponent's Conclusion(s):

In Technical Comment ECCC 3.08, ECCC requested the Proponent provide a quantification of black carbon emissions from shipping activities. In response, the Proponent provided a memorandum outlining the black carbon emission estimates associated with shipping from the Project. During the second Technical Meeting in June 2019, the Proponent stated that there was an error in the emission estimates and new estimates would be provided. The Proponent provided new black carbon estimates and a conference call was held between the Proponent and ECCC on July 23, 2019 to discuss the updated emissions. Based on ECCC's recommendations, the Proponent committed to update the emissions again using different assumptions.

On August 22, 2019 the Proponent submitted further updated black carbon estimates using the agreed upon fraction of 0.5 black carbon to $PM_{2.5}$. The Proponent estimated the black carbon emissions for the maximum shipping scenario of 30 Mtpa of iron ore, occurring from 2025 to 2035. The results of the calculation showed that the total black carbon emissions for the maximum shipping scenario are 65.2 t/y. The Proponent concluded that the "*estimated total of black carbon emissions after maximum shipping is reached would increase the 2017 Canadian North black carbon by 11%*" (Page 6). In this case "Canadian North" is defined as the total black carbon emissions for all sources in Nunavut, Northwest Territories, and Yukon. The August 22, 2019 memo also lists the Proponent's proposed mitigations for black carbon emissions. These are:

- Use of shipping route evaluation criteria to design the shortest, most efficient route feasible while also considering safety and other environmental impacts (e.g., avoidance of whales/sensitive marine life).
- Reduce power demand while idling by turning off equipment.
- Reduce power demand while stationary by anchoring over drifting, considering it is safe to do so.
- Equipment is maintained in good working order. Crews monitor and maintain equipment as part of their existing daily tasks.
- Shipping contractors have the necessary training programs for their employees on optimal equipment use methods, such as proper driving/piloting techniques to reduce fuel consumption and required maintenance activities.
- Compliance with the International Marine Organization's 2011 Guidelines for the Control and Management of Ships' Biofouling, reducing potential drag on a vessel while in transit.
- Ships being used by the Proponent will comply with all applicable shipping regulations, including those established to reduce emissions. As of January 1, 2020 the International Maritime Organizations (IMO) Global Sulphur Cap 2020, vessels will no longer be able to use fuels with greater than .5% Sulphur without scrubbers.

Additionally, Section 4.3.5 of the draft AQNAMP states that "*Baffinland will investigate and implement mitigation to reduce CAC [Criteria Air Contaminants] emissions from large vessels, including use of alternative fuels and higher emission standards, but there is a limited ability to control the types of vessels and fuels used in shipping to and from the site*" (Page 33).

Following the June 2019 Technical Meeting with ECCC and others, Baffinland produced a memorandum, dated October 1, 2020, exploring the feasibility of further black carbon mitigation options, including using alternative fuels such as marine gas oil (distillates). Non-fuel-type mitigation options included operational and technological options that were considered to provide additional black carbon mitigation. Baffinland noted that some of these measures were already in place or planned. Fuel treatments such as water-in-fuel emulsion were considered as a mitigation option that is available for newer (Tier 3) vessels.

Exhaust treatment was another potential avenue of mitigation (precipitators, filters, catalysts, and scrubbers) explored by the proponent. Baffinland considered scrubbers to have a potential to reduce black carbon emissions by up to 55%, and notes that scrubbers are partially employed by the Project's vessels. Baffinland also notes that scrubbers are only useful with heavy fuel oil, and produce toxic wastewater that is discharged to the marine environment.

The final option for black carbon mitigation proposed by Baffinland relates to alternative fuels. The memo provided a rationale for the infeasibility of using alternative fuels, as summarized below:

- Biodiesel is not commercially available
- Liquid natural gas would require an engine retrofit and sufficient fuel supply at ports
- Methanol powered ships are not currently available
- Nuclear powered ships are not currently available
- Distillate fuel use would require a second fuel tank, fuel is not sufficiently available, it would be a large cost for the shippers to switch fuels, and is not shown to reduce black carbon emissions.

Additionally, at the third Technical Meeting (September 2020), Baffinland agreed to provide a more detailed assessment of black carbon mitigation measures as part of their 2021 Annual Report for the project.

ECCC's Conclusion(s):

Black carbon emissions from ships burning 0.5% Sulphur fuel (known as very low sulphur fuel oil; VLSFO), is expected to result in equivalent black carbon emissions as current higher-sulphur heavy fuel oil (HFO). While overall particulate matter emissions would be lower with the VLSFO, this is due to reduction in sulphate particles and not black carbon. Therefore, the ratio of black carbon to total particulate mass is expected to be much higher with the VLSFO when compared to current HFO with higher Sulphur levels. This is an important consideration when calculating the black carbon emissions from the Project. ECCC has reviewed the Proponent's August 22, 2019 memo on black carbon and concurs with the assumptions, methodology, and total emission estimates that arrive at a total annual black carbon emission of 65.2 tonnes, representing an 11% increase in black carbon emissions in the Canadian North (the Territories). ECCC agrees with the Proponent's assessment of the quantity of black carbon emitted as a result of this project's marine shipping. ECCC further notes that this also represents a 157% increase in shipping related black carbon emissions in the Canadian North.

In the October 1, 2020 feasibility memo, the Proponent listed multiple potential black carbon mitigation options, noting that some were already in place, specifically those based on improving fuel efficiency such as weather routing. It is ECCC's opinion that these mitigations are unlikely to meaningfully reduce the Project's black carbon emissions. The remaining mitigation measures explored in the memo were identified as technically infeasible or commercially unavailable by the Proponent.

In a follow-up conversation with the Proponent on January 11, 2021 ECCC reviewed with the mitigation measures the proponent had identified as technically unfeasible, particularly those related to the use of distillate fuels for project shipping. Specifically, the Proponent noted in their memo that using distillate would require ships to have two fuel tanks, which is impractical, and raised concerns regarding quantity of fuel to be carried. ECCC reviewed the list of ships employed by Baffinland in 2017 and 2018 (Panamax bulk carriers with 3-4 fuel tanks with a total fuel capacity of 2300 tonnes on average) (Comer et al. 2020(b)). These ships therefore have the capability to use MGO in Canadian Waters, and ships often do carry MGO as it is a standard practice for use in emission control areas (ECAs) such as those in Europe and North America. Based on ECCC's review of the proponents shipping operations and the published literature on these types of ships, ECCC disagreed with the Proponents conclusions. At the conclusion of this meeting the proponent agreed that vessels serving the mine will have the ability to run marine gas oil (MGO, distillate) in addition to the HFO used in open waters.

Based on the Proponent's calculation that 11% of a one-way voyage takes place in Canadian Waters (Canada's exclusive economic zone, or EEZ), and 8% in the North Sea ECA (Comer et al. 2020(b)), and the average fuel capacity of the Proponent's vessels (2300 tonnes), ECCC concludes that likely only one tank of MGO would be required to complete two round trips between Rotterdam (a major destination port) and Milne Port, using MGO in both Canada's EEZ and the North Sea ECA. The total volume of MGO required per trip would be about 143 tonnes and the average fuel tank capacity for these types of ships is 500-1000 tonnes (IHS Sea-web). These ships would already be expected to carry MGO aboard for use in the North Sea ECA. There is an exception provided by Regulation 4 of MARPOL Annex VI, however, where ships that use scrubbers in conjunction with HFO also comply with the low-Sulphur fuel requirements in the North Sea ECA. The Proponent noted during the meeting with ECCC on January 11, 2021 that their ships may use a variety of configurations to meet the sulphur emission requirements, including different types of scrubbers and fuels. There are no modifications, retrofits, or technical impediments for these ships to use MGO.

The Proponent also indicated that "very low sulphur fuel oils (VLSFOs) such as distillate" are not an effective mitigation measure for black carbon. ECCC notes that distillate fuel (marine gas oil), is distinct from VLSFO, based on viscosity and density. More than 90% of VLSFOs tested to date meet the accepted definition of an HFO. 0.1% sulphur marine gas oil (distillate fuel) has been shown to reduce black carbon emissions by 80%. VLSFO has not been shown to reduce black carbon emissions (IMO 2020). Other alternative fuels such as liquefied natural gas (LNG) reduce black carbon by an even greater proportion than MGO, but a switch to these alternatives involves much greater practical challenges, including lack of currently available vessels capable of using the fuels and lack of fuel supply for Arctic shipping routes.

The Proponent noted that scrubbers may be a potential mitigation measure for black carbon; however, ECCC disagrees with this conclusion. Recent studies show that scrubbers are not effective at mitigating black carbon emissions, particularly when compared to the mitigation provided by distillate fuel (Comer

et al., 2020(a)). The 2020 report, published by the International Council on Clean Transportation notes that "black carbon emissions are 81% higher using HFO with a scrubber than using MGO in a medium-speed diesel engine and more than 4.5 times higher than using MGO in a slow-speed diesel engine." Furthermore, as the Proponent also indicated in their October 2020 memo on mitigation feasibility, scrubbers also result in a waste product that is discharged to the marine environment and is toxic to wildlife (Comer, 2020).

ECCC notes that in order to reduce the risk of spills to wildlife, the IMO approved a ban on HFO in the Arctic that will come into force in 2024. Once this ban is implemented, use and carriage for the purpose of use of HFO will be prohibited for most vessels. However, double-walled vessels, such as those used for this Project, will be exempt from the ban until 2029. Although the IMO's HFO ban will result in changes in fuel use by vessels in the Arctic, some of these fuels (e.g. some VLSFO which does not meet the definition of HFO) are expected to have no improvement in black carbon emissions. Therefore, the ban will not ensure reduction in black carbon. As a result, it is ECCC's position that effective mitigation measures to reduce black carbon emissions from this project are needed.

ECCC's Recommendation(s):

Given the large predicted increase in black carbon emissions as a result of this project, coupled with the sensitive nature of the Arctic, ECCC recommends that Baffinland, through the contracting of their shippers, require the use of 0.1% S MGO (distillate fuel), or equivalent-performing alternatives, for the journey through Canadian waters (Exclusive Economic Zone; 200 nautical miles from shore). Alternative methods of reducing black carbon emissions may be used in lieu of distillate fuel, provided the methods employed are supported by peer-reviewed research to achieve at least the same level of mitigation shown to be provided by distillate fuel.

The level of mitigation from "equivalently performing alternatives" should be 80%, based on the performance of MGO. Performance of alternative fuels should be based on a consensus-based internationally recognized scientific report such as the 4th IMO Greenhouse Gas Study, Arctic Monitoring and Assessment Programme under the Arctic Council, or the United Nations Framework Convention on Climate Change. ECCC does not consider the use of scrubbers to be an effective measure to mitigate black carbon.

3.2.2 ECCC-FC2: Acid Rock Drainage and Metal Leaching at the Waste Rock Pile, Quarries and Rail Line Rock Cuts

Introduction and Importance of the Topic to Impact Assessment

Acid Rock Drainage and Metal Leaching (ARD/ML) is a naturally occurring oxidation process when sulfide minerals are exposed to water and oxygen (air). When sulphides are exposed to water and the oxygen from air, they oxidize to form acid. This oxidation of sulphides minerals can also produce acid with low pH. If streams or other natural watercourses carry this acid, it is called acid rock drainage (ARD). Metals and metalloid can dissolve and leach from the surrounding rock into water in acidic environment producing high amounts of dissolved metals in water.

Most mining projects contain rocks with varying amounts of sulfide minerals in their waste rock and in the tailings. ARD/ML can have negative impact on the environment if mine waste (waste rock and tailings) are not characterized and managed properly. When ARD/ML starts, it lasts a long time and is very difficult and expensive to manage. ARD/ML in addition to mine waste (tailings & waste rock) management is known to be one of the largest environmental liability facing the mining industry, therefore preventing the initiation of ARD/ML is key to control the on set of ARD/ML.

Reference(s):

- Baffinland Iron Mines Corporation. 2019. Technical Comment Responses Phase 2 Proposal – Mary River Project, Responses to 3.19 and 3.20.
- Environment and Climate Change Canada. 2019. Environment and Climate Change Canada's Technical Submission to the Nunavut Impact Review Board Respecting Mary River Project – Phase 2 Proposal by Baffinland Iron Mines Corporation, ECCC 3.19 and ECCC 3.20.
- Baffinland Iron Mines Corporation. 2019. Memo: Outstanding questions related to ECCC 3.19, May 1, 2019.
- Baffinland Iron Mines Corporation. 2019. Memo: Statement on Waste Rock and ARD, July 3, 2019.

Proponent's Conclusion(s):

On March 7, 2019, ECCC submitted two technical comments to the NIRB regarding concerns and questions on ARD/ML rock mitigation and management as part of ECCC's Technical Review Submission (ECCC 3.19 and ECCC 3.20). ECCC 3.19 provided recommendations regarding the waste rock pile, whilst ECCC 3.20 provided recommendations regarding quarries and rail line rock cuts. On March 25, 2019 the Proponent provided the following in response to ECCC's technical comments 3.19 and 3.20:

> "…*management strategies are continually updated to mitigate observed issues and evaluate the effectiveness of the management practices. Baffinland continues to investigate the source of the observed ARD at the WRF, and has retained expert engineering support to evaluate the effectiveness of the current management strategy and update the thermal model.*
>
> *The waste rock management plan continues to be updated on an as-needed basis, with an interim update scheduled for 31 March 2019 and a full update of the management plan in December 2019 following the collection and assessment of monitoring data to be completed in 2019. Baffinland continues to evaluate how waste rock is characterized and to monitor the geochemical data from blast hole data for waste rock characterization. Information will continue to be provided to CIRNAC [Crown-Indigenous Relations and Northern Affairs Canada], ECCC, QIA [Qikiqtani Inuit Association] as required under the terms and conditions of the existing Type A Water Licence and through MDMER [Metal and Diamond Mining Effluent Regulations] reporting*" (Page 54).

In response to concerns raised by ECCC and CIRNAC, the Proponent issued two technical memos (May 1 and May 14, 2019) providing a description of work underway, commitments to provide an updated Waste Rock Management Plan (WRMP) by Dec. 31, 2019 and an explanation of the proposed mitigation and management for the Phase 2 Proposal developments. These concerns were further discussed with the Proponent and CIRNAC during the June 18-19, 2019 Technical Meeting.

In the May 1, 2019 technical memo, (as well as during discussions at the Technical Meetings) further clarification was provided by the Proponent on 2019 geochemical investigations being undertaken in order to determine soluble sulphate contents within the waste rock and potential impacts to seepage water quality. The geochemical testing program will provide insight on the need to re-assess the 0.2% total Sulphur content cut-off used to classify rock as Potentially Acid Generating (PAG) or non-PAG. The results of this investigation would allow the Proponent to better understand the cause of ARD/ML at their Waste Rock Pile and better inform mitigation measures to be used to manage ARD/ML and seepage issues.

In the May 14, 2019 technical memo, the Proponent provided clarification regarding the need to reassess their PAG/Non-PAG rock characterization protocol in order to avoid ARD/ML in future quarries and rail line rock cuts. The Proponent also provided clarification regarding mitigation measures that can be implemented if PAG rock is identified at quarries and rail line rock cuts. The Proponent mentions that, where possible, PAG rock would be avoided and would not be developed or exposed. In the event that PAG rock cannot be avoided, the Proponent will employ the following mitigations measures, "*diverting of runoff and seepage from exposed PAG rock cuts; re-sloping and covering PAG face with crushed carbon rich rock; and design of engineered covers such as shotcrete cover of exposed PAG rock cuts*" (Page 2). Further, surface water runoff from quarries will be monitored and should be able to inform if the mitigation measures are effective and if they are shown to be ineffective the Proponent states that possible treatment methods will be evaluated to manage the issue.

An updated Waste Rock Management Plan (Revision 2) was provided by the Proponent on December 31, 2019, and the Proponent responded to subsequent comments by Intervenors. A third revision was provided dated June 16, 2020, in which the Proponent provided clarification on some points. ECCC met with the Proponent on August 19, 2020 to discuss the outstanding comments and ECCC provided a letter to the NIRB outlining the outstanding concerns, dated September 4, 2020. In this letter ECCC also indicated concurrence with the Proponent's proposal to resolve the concerns during the water licensing process.

The Proponent provided a letter in response dated September 10, 2020, in which several commitments were described, and partially resolve ECCC's comments.

ECCC's Conclusion(s):

1. ECCC recommended that the Proponent assess all samples with Acid Base Accounting (ABA) and Shake Flask Extraction (SFE).

2. ECCC recommended that the Proponent assess a wide range of samples without relying on the 0.2 wt. % S cut off, in order to ensure that no PAG rock is misclassified as non-AG rock and that the Proponent adopt Golder's recommendation that all samples be submitted for ABA and SFE testing on an ongoing basis.

3. ECCC recommended that the proponent not use sulphide content as the only parameter to classify Potentially Acid Generation and non-Acid Generating rock.

4. ECCC recommended that the proponent verify whether there are layers of the lifts that are not frozen within the Waste Rock Facility.

Item 1 was partially resolved by the Proponent's March 13, 2020 Response to Intervenor Comments on the Waste Rock Management Plan Revision 2, and Revision 3, in which a commitment was made to implement the recommended testing on some but not all samples. The Proponent has committed to evaluate the use of 0.2 wt % sulphur as a cutoff threshold, but ECCC considers this item outstanding. The thermal assessment is still outstanding, although the Proponent has committed to continue the thermal monitoring program at the Waste Rock Facility throughout the life of the mine.

ECCC's Recommendation(s):

ECCC recommends, in agreement with the Proponent's proposal, that the outstanding comments listed above be further discussed and resolved during the water license application process through the Nunavut Water Board.

4.0 Summary of Recommendations

4.1 ECCC-FC1: Black Carbon Emissions

Given the large predicted increase in black carbon emissions as a result of this project, coupled with the sensitive nature of the Arctic, ECCC recommends that Baffinland, through the contracting of their shippers, require the use of 0.1% S MGO (distillate fuel), or equivalent-performing alternatives, for the journey through Canadian waters (Exclusive Economic Zone; 200 nautical miles from shore).

The level of mitigation from "equivalently performing alternatives" should be 80%, based on the performance of MGO. Performance of alternative fuels should be based on a consensus-based internationally recognized scientific report such as the 4th IMO Greenhouse Gas Study, Arctic Monitoring and Assessment Programme under the Arctic Council, or the United Nations Framework Convention on Climate Change. ECCC does not consider the use of scrubbers to be an effective measure to mitigate black carbon.

4.2 ECCC-FC2: Acid Rock Drainage and Metal Leaching at the Waste Rock Pile, Quarries and Rail Line Rock Cuts

ECCC recommends that the outstanding comments be further discussed and resolved during the water license application process through the Nunavut Water Board.

5.0 Acknowledgements

ECCC would like to thank the NIRB for this opportunity to provide input to the review process for the Mary River Project – Phase 2 Proposal (08MN053) and looks forward to continuing its participation in the review.

ECCC's comments and recommendations are not to be interpreted as any type of acknowledgement, compliance, permission, approval, authorization, or release of liability related to any requirements to comply with federal or territorial statutes and regulations.