AGNICO EAGLE

MELIADINE DIVISION

Meliadine Mine – Meliadine Extension FEIS Addendum

APRIL 2022

ᑐᑭᓯᓇᑦᑎᐊᕐᓗᓂ ᐅᖃᐅᓯᖅ ᓇᐃᓈᖅᓯᒪᔪᖅ / PLAIN LANGUAGE SUMMARY

ᑐᑭᓯᓐᓇᖅᑐᒃᑯᑦ ᐅᖃᐅᓯᕿᒥᒃ ᐊᑐᕐᓗᑎᒃ ᓇᐃᓇᖅᓯᒪᔪᒥᒃ ᐃᓚᐅᔪᖅ ᐃᖕᒥᒃᑰᖕᒐᑉᓗᓂ ᐃᓄᒃᑎᑑᖅ ᐊᒻᒪᓗ ᖃᑉᓗᓈᑎᑑᖅ.

The plain language summary is provided as a standalone Inuktitut file and English file.

ᐊᐅᓚᑦᑎᔨᓂᖖᒑᖅᑐᑦ ᓇᐃᓈᖅᓯᔪᑦ

ᐊᒡᓃᑯᒃᑯᑦ ᐃᓱᒪᓕᐅᖅᓯᒪᖕᒪᑕ ᐃᓚᓯᒃᑲᓐᓂᕈᒪᑉᓗᑎᒃ (ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑕᐅᓂᖃᖅᑕᐅᔪᖅ) ᐅᔭᖃᒃᑕᕆᐊᖓᓐᓂ ᐅᖓᓯᖕᓂᖅᑯᒥᒃ 25 ᑭᓚᒥᑐᒥᒃ ᑲᖏᖅᓂᐅᑉ ᑲᓇᖕᓇᖓᓂ, ᐊᒻᒪ 80 ᑭᓛᒥᑐ ᓂᒡᒋᐊᓂ ᐃᒃᓗᓕᒑᕐᔫᖅ ᑭᕙᓪᓕᕐᒥ ᓄᓇᕗᒻᒥ. ᓄᓇᕗᒻᒥ ᐊᒃᑐᖅᓯᓂᕐᒥᑦ ᕿᒥᕐᕈᔾᔨᒃᑯᑦ (ᐊᕙᑎᓕᕆᔾᔨᒃᑯᑦ) ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᖅ ᓈᓴᐅᑎ 006 ᑐᓂᔭᐅᓚᐅᖅᑐᖅ 2015-ᒥᑦ ᐊᒻᒪᓗ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᐃᓂᖅ ᑕᓯᕐᔪᐊᕐᒥᑦ ᐅᔭᖃᒃᑕᕆᐊᕐᒧᑦ, ᑐᓂᔭᐅᔾᔪᑎᖅᑲᕈᑎᖓ ᐱᓕᕆᐊᕐᒧᑦ ᓇᓗᓇᐃᒃᑯᑕᕐᒥᑦ ᓈᓴᐅᑎ 006-ᒥᑦ 2015-ᒥᑦ, ᐃᓚᐅᔪᑦ ᓈᓪᒪᒋᔭᐅᓂᖏᑦ ᐊᕕᒃᓯᒪᑉᓗᒋᑦ ᐱᕙᓪᓕᐊᓂᕆᔭᖕᖓᑦ, ᐃᓚᐅᑉᓗᑎᒃ ᐅᔭᖃᒃᑕᖅᑕᐅᓂᖓ ᑎᑎᕋᓂᐊᕐᒥᑦ ᐱᑕᓕᒃ ᓄᓇᒥᑦ ᐅᒃᑯᐃᖕᖓᔫᒃᑯᑦ ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᖃᒃᑕᕐᓂᒃᑯᑦ ᐊᒻᒪᓗ ᐅᔭᖃᒃᑕᖅᑕᐅᓂᖕᒋᑦ ᐸᒻᑉ (Pump), F ᐃᓂᐅᔪᖅ (F zone), ᑎᒃᑲᕗᑕ (Discovery) ᐊᒻᒪᓗ ᐅᐊᔅᒥᐊᒡ (Wesmeg) ᐱᑕᖃᑦ ᓄᓇᒥᑦ ᐅᒃᑯᐃᖕᖓᔫᒃᑯᑦ ᐊᑐᕐᓗᑎᒃ. ᖃᓄᐃᑑᓂᖓ A ᐃᒥᐅᑉ ᓚᐃᓴᖓ 2AM-MEL1631 ᑐᓂᔭᐅᓚᐅᖅᑐᖅ 2016–ᒥ ᑎᑎᕋᓂᐊᑉ ᐅᔭᖃᒃᑕᕆᐊᕐᕕᖕᖓᓄᑦ ᐊᒻᒪ ᒪᑭᒪᔪᑎᖏᓐᓄᑦ ᐃᓚᐅᑉᓗᑎᒃ ᓯᖃᓪᓕᑎᕈᑎᖓ, ᐱᓕᕆᕝᕕᖓ, ᓯᖃᓪᓕᑎᕐᓂᒃᑯᑦ ᓯᕐᓗᐊᖓ ᐊᒻᒪ ᓯᖃᓪᓕᑎᖅᑕᐅᓂᖕᖓᓄᑦ ᐊᑐᕆᐊᖃᖅᑐᑦ.

ᑕᓯᕐᔪᐊᕐᒥᑦ ᐅᐃᒍᕆᐊᖅᓯᓂᖅ ᐃᓚᐅᓇᔭᖅᑐᑦ ᓄᓇᐅᑉ ᐃᓗᐊᓂᑦ ᐅᔭᖃᒃᑕᕐᓂᖅ ᐊᒻᒪᓗ ᑕᓇᐅᓕᒃ ᐃᒪᕐᒥᒃ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐱᕐᑰᑦ ᐸᒻᑉ-ᒥᑦ (Pump), F ᐃᓂᐅᔫᒥᑦ (F zone), ᑎᒃᑲᕗᑕᒥᑦ (Discovery) ᐱᑕᓕᖕᓂᑦ, ᐱᕙᓪᓕᐊᓗᑎᒃ ᓄᓇᐅᑉ ᐃᓗᐊᓄᐊᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᐃᓚᒋᔭᐅᔪᑦ ᐱᕐᑰᑦ ᑎᑎᕋᓂᐊᕐᒥᑦ-Wolf ᖃᓂᖓᓂᑦ, ᓴᓇᕙᓪᓕᐊᓂᖅ ᐊᒻᒪᓗ ᐊᐅᖀᖅᑎᑦᑎᓂᖅ ᐊᓄᑕᒥᑦ ᐆᒻᒥᖅᑯᑎᓕᐅᕈᑎᒥᑦ, ᐊᒻᒪᓗ ᐊᑐᕐᓗᑎᒃ ᐃᓗᑦᑎᖅᓯᒪᔪᓂᒃ ᐊᒻᒪᓗ ᓄᓇᐃᔭᐃᓂᕐᓂᑦ. ᐊᖏᖅᑕᐅᓯᒪᔪᑦ ᒪᑭᒪᔾᔪᑕᐅᓂᐊᖅᑐᑦ ᐅᑯᐊᑎᑐᑦ ᐱᓕᕆᕝᕖᑦ, ᐃᕐᒥᒡᕕᒃ ᐅᔭᖓᓂᒃ, ᐃᒥᑉ ᒥᐊᓂᕆᔭᐅᓂᖓ, ᐅᒃᑳᓕᐅᕈᑎᑦ, ᓯᖃᓕᑎᕐᓂᒃᑯᑦ ᐃᓂᖃᕐᕕᖓᑦ, ᐅᔭᖃᒃᑕᕆᐊᑦ ᐊᐸᕐᑯᑎᖓᑦ, ᐃᒥᖃᕐᕖᑦ ᓴᓗᒻᒪᖅᑕᐅᑎᓪᓗ ᐊᑐᖅᑕᐅᑐᐃᓐᓇᕐᓂᐊᕐᒪᑕ. ᐊᓯᐊᖑᖅᑐᖃᓚᖏᑦᑐᖅ ᐊᑐᖅᑕᐅᔪᓂᒃ ᑲᖏᖅᓂᕐᒥ. ᐊᐅᓛᕐᓂᖓ ᐅᔭᖃᒃᑕᐊᖅ ᐃᓚᓯᒃᑲᓐᓂᕐᓂᖃᖃᔭᖅᑐᖅ 11 ᐅᑭᐅᓂᑦ ᑎᑭᓪᓗᒍ 2043-ᒧᑦ, ᐅᒃᑯᐊᖅᐸᓪᓕᐊᓗᑎᒃ 2044-ᒥᑦ 2050-ᒧᑦ, ᐊᒻᒪᓗ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍ 2051-ᒥᑦ 2060-ᒧᑦ.

ᐊᑐᖅᑕᐅᖕᒑᕈᖕᓇᖅᑐᑦ ᑐᒃᓯᕋᐅᑕᐅᖕᒥᔪᑦ ᐃᓚᒋᔭᐅᑉᓗᑎᒃ ᑕᓯᕐᔪᐊᕐᒥᑦ ᐅᐃᒍᕆᐊᖅᓯᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓴ ᓇᕙᓪᓕᐊᓇᔭᖅᑐᑦ ᒥᑦᑕᕐᕕᖕᒥᑦ ᐊᒻᒪᓗ ᐊᐅᖀᖅᑎᓪᓗᒍ, ᐊᒻᒪᓗ ᐊᑐᖅᑕᐅᓗᑎᒃ ᐃᓗᑏᕈᑎᔪᑦ ᓄᓇᒥᑦ ᐃᓗᑦᑐᖅᓯᒪᔪᑦ ᕿᒪᒃᑎᑦᑐᓂᒃ ᐃᓕᐅᖅᑲᐃᕝᕕᒋᓂᐊᕐᓗᒋᑦ ᐊᒻᒪᓗ ᐊᒃᑕᑰᖅᑕᐅᔪᑦ ᐅᔭᖅᑲᓂᒃ.

ᑐᖓᕕᐅᔪᑦ ᐃᓚᒋᐊᕈᑎᖓᑯᑦ ᐅᔭᖃᒃᑕᕆᐊᑦ ᐊᒻᒪ ᐊᓄᑕᒧᑦ ᑲᐃᑉᔮᖅᑎᑕᐅᑉ, ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔩᑦ ᑲᑎᒪᔨᖏᑦ ᑲᔪᓯᔫᓪᓗᐊᕐᓂᐊᕐᓕᕐᒪᑕ ᐃᓱᒪᒃᓴᖅᓯᐅᑲᓂᕐᓗᑎᒃ ᐱᓕᕆᐊᑉ ᐊᔪᖏᔪᑎᖓᓂᒃ. ᐋᒡᓃᑯᒃᑯᑦ ᑐᑭᓯᐊᕗᑦ ᐱᓕᕆᐊᖑᔪᒥᒃ ᑖᑉᓯᒥᖓ ᐊᒻᒪ ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔩᑦ ᑲᑎᒪᔨᖏᑦ ᖃᓄᐃᓕᐅᕈᑎᒃᓴᖃᕐᒪᑕ ᐱᓕᕚᓪᓗᐊᕐᓂᖕᖓᓂᒃ. ᐃᓱᒪᒋᔭᐅᑉᓗᓂ ᐊᒥᒎᓗᐊᖕᒋᒪᑕ ᑐᖃᒐᐅᓂᐊᖅᑐᑦ ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔨᖏᑦᑕ ᐃᓱᒪᒋᔭᖏᑦ ᑐᖄᖓᓗᑎᒃ ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᒻᒧᑦ ᐊᒻᒪ ᑎᑎᖅᑲᖏᑦ ᑐᖄᒐᖅᑦᑎᐊᓕᕐᓗᑎᒃ ᐅᑯᓄᖓ ᓄᓇᕗᒻᒥ ᐃᒪᓕᕆᔩᑦ ᑲᑎᒪᔨᖏᑕ (NWB) ᖃᓄᐃᑑᓂᖓᓗ A ᐃᒥᐅᑉ ᓚᐃᓴᖓᑕ ᐃᓚᒋᐊᕈᑎᖏᓐᓄᑦ ᐱᓕᕆᐊᕐᒧᑦ. ᐊᒡᓃᑯᒃᑯᑦ ᓇᓗᓇᐃᕈᐊᕐᒪᑕ ᐊᔾᔨᖅᓴᑦ ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑎᐅᑉ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒪᑕ ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔾᔪᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ ᐃᓗᐊᓂ 2014 ᐃᓚᐅᔭᕆᐊᖃᖏᓚᓪᓗ ᑐᖄᒐᐅᔪᓂᒃ ᓇᓕᐊᖕᓂᒥᐊᖅ ᐊᕙᑎᓕᕆᔩᑦ ᐃᓱᒪᓕᐊᓇᑲᓐᓂᖏᓐᓂ . ᐊᒻᒪ ᓱᓕ, ᓇᓗᓇᐃᖅᓯᓚᐅᕐᒥᑦᑐᒧᑦ ᑎᑎᖅᑲᓂᒃ ᒪᓕᒐᕐᓂᒡᓗ ᐱᓕᕆᐊᕐᒧᑦ ᐊᔪᖏᔪᒥ 006 ᓄᑖᖑᕆᐊᖃᖅᑐᓂᒃ ᑲᔪᓯᓂᐊᖅᑐᓂᒃ ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑎᐅᑉ ᐃᓗᓕᖏᓐᓂ. ᒥᐊᓂᕆᔭᐅᓂᖓᓄᑦ ᐸᕐᓇᐅᑎᑦ ᓄᑖᖑᖅᑎᑕᐅᓯᒪᔪᑦ ᑐᖄᖓᑉᓗᑎᒃ ᑕᓯᕐᔪᐊᑉ ᐃᓚᒋᐊᕈᑎᖓᑕ ᐱᓕᕆᐊᖏᓐᓄᑦ.

ᐊᒡᓃᑯᒃᑯᑦ ᐋᕿᑭᐊᕐᓂᓚᐅᕐᒪᑕ ᖃᓄᐃᓘᓂᖓ A ᐃᒥᐅᑉ ᓚᐃᓴᖓᓂ 2AM-MEL1631 ᐊᓯᖏᓐᓂᒃ;ᓚᐃᓴᓐᓂᒃ ᐃᓚᐅᑉᓗᓂ ᑕᓯᕐᔪᐊᑉ ᑐᒡᓕᐊᓂᒃ ᐱᓕᕆᐊᖓᓂᒃ ᐊᒻᒪ ᐃᓚᒋᐊᕈᑎᖓᑕ ᐱᓕᕆᐊᖏᓐᓂᒃ.

ᑕᐃᒪᖓᑦ 2015, ᐊᓃᑯᒃᑯᑦ ᖃᐅᔨᓴᐃᓐᓇᕐᒪᑕ ᒪᓕᒐᕐᓂᒃ, ᐃᓚᐅᓕᖅᑎᑕᐅᑉᓗᑎᒃ ᓄᑕᑖ ᐊᕙᑎᐅᑉ ᖃᐅᔨᓴᕐᓂᖏᓐᓄᑦ ᐊᒃᑐᐃᓂᖅᑲᖕᖑᑖ ᐊᕙᑎᒥᒃ ᐊᒻᒪ ᐃᓅᓯᕐᒥᒃ ᑕᓯᕐᔪᐊᑉ ᐃᓚᒋᐊᕈᑎᖓᓂᑦ. ᖃᐅᔨᓴᕐᓂᑯᓂᒃ ᑲᑎᖅᓱᐃᓂᖅ ᓄᓇᐅᑉ ᐊᕙᑎᖓᓂᑦ (ᓄᓇᒥᒃ ᐃᐸᔪᕐᒥᒃ, ᓄᓇᐅᑉ ᕿᕿᓂᖓᓂᒃ, ᓂᐱᖅᑯᖅᑐᓂᖓᓂᒃ ᐊᒻᒪ ᐃᒥᐅᑉ ᖃᓄᐃᓂᖓᓂ) ᓄᓇᐅᑉ ᐃᓕᕐᑯᓯᖓᓂᒃ (ᐱᕈᖅᑐᓂᒃ, ᓄᓇᒥᐅᑕᓂᒃ ᓂᕐᔪᑎᓂᒃ, ᑎᖕᒥᐊᕈᓯᕐᓂᒃ, ᐃᖃᓗᖕᓂᒃ ᓂᕿᖏᓐᓂᓪᓗ ᐃᒪᕐᒥᐅᑕᓂᒃ ᑕᕆᐅᕐᒥᐅᓂᓪᓗ ᓂᕐᔪᑎᓂᒃ) ᐊᒻᒪ ᐃᓕᕐᑯᓯᐅᑉ ᐱᕚᓪᓕᐊᓂᐅᑉᓗ ᐃᓕᕐᑯᓯᖓᓐᓂᒃ (ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᖏᑦ, ᐃᓄᐃᑦ ᐱᕐᑐᑎᕕᓂᖏᑦ ᐊᒻᒪ ᐃᓅᓯᖅ ᐱᕙᓕᐊᔪᓂᓪᓗ). ᖃᐅᔨᓴᕐᓂᑯᑦ ᐊᕙᑎᒥᒃ ᐊᓯᖏᓐᓂᒃ ᐊᒃᑐᐃᑕᐃᓕᔭᑕᐅᓂᐊᖅᑐᑦ, ᑕᓯᕐᔪᐊᑉ ᐃᓚᒋᐊᕈᑎᖓᓂ ᓈᒻᒪᖏᑐᓂᒃ ᐊᒃᑐᐃᓂᖃᓚᖏᓚᑦ ᐊᑯᓂ ᓴᓇᓂᐊᕐᓂᖓᓄᑦ, ᐊᐅᓚᑕᐅᓂᖓᓄᑦ ᐊᒻᒪ ᐅᑯᐊᖅᐸᓕᐊᓂᖓᓄᑦ.

ᐋᒡᓃᑯᒃᑯᑦ ᐋᕿᒃᓯᓚᐅᕐᒪᑕ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐊᒻᒪ ᒥᐊᓂᖅᓯᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᕐᓂᒃ ᐊᓯᖏᓐᓂᒃ ᐊᒃᑐᐃᑕᐃᓕᔾᔪᑎᒃᓴᓂᒃ, ᖃᐅᔨᓴᕐᓂᖏᓐᓂᒃ ᐊᒻᒪ ᐅᖃᐅᓯᐅᓗᑎᒃ ᐊᕙᑎᐅᑉ ᖃᓄᐃᑕᐅᓂᖓᓂᒃ ᓚᐃᓴᓕᕆᔾᔪᓄᑦ ᐃᓗᐊᓂ ᑕᓯᕐᔪᐊᕐᒥ ᐅᔭᕋᒃᑕᕆᐊᑦ, ᓚᐃᓴᑦ ᐊᑐᖅᑕᐅᔪᓪᓗ ᐱᕐᑯᔭᖏᓪᓗ ᓄᓇᕗᑦ ᐃᓗᐊᓂ. ᐊᕿᐅᒪᓂᖓ ᐊᕙᑎᐅᑉ ᐊᒃᑐᐃᓂᖏᓐᓄᑦ ᐃᓯᒪᓕᐅᕐᓂᐅᑉ ᐊᒻᒪ ᑲᔪᓯᓂᐊᕐᓂᖓ ᐊᓯᖏᓐᓄᑦ ᐊᒃᑐᐃᑕᐃᓕᔾᔪᑎᓄᒃ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓐᓂᕐᓂᐊᖅᐳᑦ ᐅᖃᐅᓯᐅᓗᑎᒃ ᐊᒻᒪ ᐊᕋᒍᑕᓖᑦ ᐅᓂᑉᑳᕆᓪᓗᑎᒃ. ᓂᕈᐅᖕᓇᖏᑦᑐᑦ ᓯᕗᓂᕐᒥ ᐊᕙᑎᐅᑉ ᐊᒃᑐᐃᓂᖏᑦ ᖃᐅᔨᔭᐅᓐᓂᖅᐸᑦ, ᐋᕿᑭᐊᖅᑕᐅᓂᐊᕐᒪᑕ ᓯᕗᓪᓕᕐᒥᒃ ᐊᑐᖅᑕᐅᓕᕐᓗᑎᒃ. ᐊᑐᓕᖅᑎᑕᐅᓂᖓᓂ ᒥᐊᓂᕆᔭᐅᓂᐅᑉ, ᐊᑐᖅᑕᐅᔪᖅ ᒥᐊᓂᖅᓯᕐᓂᕐᒧᑦ ᐸᕐᓇᐅᑦ ᐊᒻᒪ ᐊᕙᑎᐅᑉ ᒥᐊᓂᕆᔭᐅᓂᖓ ᐸᕐᓇᐅᑦ, ᐊᓯᖏᓐᓂᒃ ᐊᒃᑐᐃᑕᐃᓕᓂᕐᒧᑦ ᒥᐊᓂᖅᓯᔾᔪᑦ ᐋᕿᒃᑕᐅᓂᐊᕐᒪᓂᒃ ᐊᑐᓕᖅᑎᑕᐅᓗᑎᓪᓗ ᐱᔭᕆᐊᖅᖄᐸᑦ.

ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑦ ᐱᕙᓪᓕᕐᓇᕐᑐᓐᓂᒃ ᓴᕿᑦᑎᓇᔭᖅᐳᖅ ᐅᑭᐅᓄᑦ ᐊᒥᓲᓄᑦ ᐅᔭᕋᒃᑕᕆᐊᑦ ᐅᑯᐃᖅᓯᒪᓂᖓᓂ. ᐱᕙᓪᓕᐊᓂᕐᒧᑦ ᐊᒃᑐᖅᑕᐅᓃᑦ ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᒻᒥ ᐱᕙᓪᓕᕐᓇᖅᑐᒥᒃ ᓴᕿᑦᑎᓇᔭᖅᐳᑦ ᑭᕙᓪᓕᕐᒥᐅᓄᑦ. ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑦ ᓂᕈᐅᖕᓇᖅᑐᖅ ᓴᕿᑎᑦᓯᓇᔭᕐᓂᖓᓐᓂᒃ 205 ᓄᑖᓂᒃ ᐱᓕᕆᔨᓂᒃ ᐅᑭᐅᑉ ᐃᓗᐊᓂ ᐃᖏᕐᕋᓂᖓᓂ ᐅᔭᕋᒃᑕᕆᐊᑉ ᐊᒻᒪ ᐱᓕᕇᓐᓇᕐᓗᑎᒃ ᐅᑭᐅᖅ ᑎᑭᓪᓗᒍ 2043. ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑕᐅᔪᖅ ᓈᒻᒪᒃᑐᒻᒥᒃ ᐊᒃᑐᐃᓂᖃᕐᓂᐊᕐᒪᑦ ᓄᓇᓕᖕᓂᒃ ᐅᑭᐅᓂ, ᐊᒻᒪ ᐃᓚᕌᓂᒃ ᑮᓇᐅᔭᓕᐅᖅᑎᑦᓯᓗᓂ ᓈᒻᒪᑎᐊᖅᑐᓂᒃ ᓂᕆᔭᒃᓴᖃᕐᑯᑉᓗᕆᑦ, ᕿᑎᒃᑕᕐᓗᑎᒃ, ᐃᓕᓂᐊᖅᑕᕐᓗᑎᒃ ᐊᒻᒪ ᐱᕐᑯᑎᖃᖅᑕᕐᓗᑎᒃ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᖏᓐᓂᒃ ᐊᑐᖅᑕᖅᑐᐃᓐᓇᕐᓗᑎᒃ. ᐊᔾᔨᕐᓚᖓᓂᒃ ᑕᓯᕐᔪᐊᕐᒥ ᐃᓚᒋᐊᕈᑎᖓ ᑲᔪᓯᓂᐊᕐᒪᑦ ᐃᑲᔪᖅᑐᐃᓂᕐᒥᒃ ᓄᓇᓕᐅᑉ ᐱᓕᕆᐊᖏᓐᓂᒃ ᐊᒻᒪ ᐃᓕᓐᓂᐊᕐᓂᕐᒥᒃ ᐊᒻᒪ ᐃᓄᐃᑦ ᐊᒃᑐᖅᑕᐅᓂᐊᕐᓂᖏᓐᓄᑦ ᐃᑲᔫᓯᐊᖅᑖᕈᓐᓇᐅᑎᖏᓐᓄᓪᓗ ᐊᖏᕈᑎᑦ ᐊᒥᐊᒃᑯᖏᓐᓂᒃ ᐊᒻᒪ ᐊᖏᕈᑕᐅᔪᓂᒃ.

ᐊᐅᓚᑕᐅᓂᖓᓂ ᑕᓯᕐᔪᐊᕐᒥ ᐅᔭᕋᒃᑕᕆᐊᑦ, ᐊᒡᓃᑯᒃᑯᑦ ᑐᓴᐅᒪᑎᑦᓯᑦᑕᕐᒪᑕ ᐅᑭᐅᑕᒫᑦ ᓄᓇᓕᖕᓂᑦ ᐱᖃᖅᑕᐅᔪᓂᓪᓗ ᑭᕙᓪᓕᕐᒥ, ᓚᐃᓴᓕᕆᔨᓂᒃ ᐊᒻᒪ ᐱᓕᕆᔨᒥᖕᓂᒃ. ᑕᐃᒪᓐᓇ ᑐᑭᓯᐊᓂᖅᓴᖅᓯᐅᑎᑦᑎᔪᖅ ᐱᔪᖕᓇᐅᑎᓂᒃ, ᐱᔪᒪᓂᖅᑲᖅᓯᐅᔪᓂᒃ, ᐱᒻᒪᕆᐅᕆᔭᐅᔪᓂᒃ, ᓂᕆᐅᕆᔭᐅᔪᓂᒃ, ᐊᒻᒪᓗ ᐃᓱᒫᓘᑕᐅᔪᓂᒃ ᐊᒃᑐᖅᓯᓂᖃᖅᑐᑦ ᐃᓚᐅᖃᑕᐅᔪᓂᒃ, ᐱᑐᐊᖅᑐᒥᑦ ᐱᔾᔪᑎᒋᐸᓗᒍ ᑲᖏᖅᖠᓂᖅ. ᐅᖃᖃᑎᖃᖃᑦᑕᕐᓂᒃᑯᑦ, ᐊᒡᓃᑯᒃᑯᑦ ᐋᖅᑭᒃᓯᓚᐅᖅᑐᑦ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒧᑦ ᐱᖅᑯᓯᕆᔭᐅᔪᒥᒃ ᐃᓕᑕᖅᓯᔪᖅ ᐊᒻᒪᓗ ᐃᒃᐱᒍᓱᒻᕕᖅᖢᓂ ᐱᔪᒪᓂᕆᔭᐅᔪᓂᒃ ᐸᕐᓇᐃᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐱᓕᕆᐊᖃᕆᐊᖅᑎᓪᓗᒋᑦ. ᐊᒡᓃᑯᒃᑯᑦ ᑐᓴᐅᒪᑎᑦᓯᖕᒪᑕ ᐱᓕᕆᐊᖃᖃᑕᐅᔪᓂᒃ ᐊᒻᒪ ᓚᐃᓴᓕᕆᔨᖏᓐᓂᒃ ᑲᔪᓯᔪᒥᒃ ᑕᓯᕐᔪᐊᕐᒥ ᐅᔭᕋᒃᑕᕆᐊᓂᒃ ᐊᒻᒪ ᐃᓱᒪᒋᔭᐅᓯᒪᔪᒥᒃ ᑕᓯᕐᔪᐊᑉ ᐃᓚᒋᐊᕈᑎᖓᓂᒃ. ᑐᓴᐅᒪᑎᑦᓯᓂᖅ ᐊᒻᒪ ᐃᓚᐅᑎᑦᓯᓂᖅ ᐅᖃᐅᓯᐅᔪᓂᒃ ᐃᓱᒪᒋᔭᐅᓯᒪᔫᖅ ᐃᓚᒋᔭᐅᓂᐊᕐᓗᓂ ᐊᓯᐊᒍᑦ ᐱᓕᕆᐊᕆᐅᓂᐊᖅᑐᓂᒃ.

EXECUTIVE SUMMARY

Agnico Eagle is proposing an extension (referred to as the Meliadine Extension) to the Approved Meliadine Mine located approximately 25 kilometres north of Rankin Inlet, and 80 kilometres southwest of Chesterfield Inlet in the Kivalliq region of Nunavut. Nunavut Impact Review Board (NIRB) Project Certificate No.006 was issued in 2015 and the environmental assessment of the Meliadine Mine, resulting in the issuance of Project Certificate No.006 in 2015, included approval of a multi-phase approach to development, including mining of Tiriganiaq deposit using open pit and underground mining methods and mining of the Pump, F Zone, Discovery and Wesmeg deposits using open pit methods. Type A Water Licence 2AM-MEL1631 issued in 2016 was primarily for the Tiriganiaq deposit and associated infrastructure including, process plant, camp, tailings storage facility and waste rock storage facilities.

The Meliadine Extension proposes to include underground mining and associated saline water management infrastructures at the Pump, F Zone, and Discovery deposits, development of a new portal and associated infrastructures in the Tiriganiaq-Wolf mining area, construction and operation of a windfarm and use of additional borrow pits and quarries. Approved infrastructure, such as the camp, mill, water management infrastructures, power plant, tailings storage facility, All-weather Access Road, freshwater intakes and treatment plants would continue to be used. No changes are proposed to the Rankin Inlet facilities. The life of the mine would be extended by an additional 11 years until 2043, closure will occur from 2044 to 2050, and post-closure from 2051 to 2060.

Options/alternatives are also proposed as part of the Meliadine Extension and include construction and operation of an on-site airstrip, and use of exhausted open pits to store tailings and waste rock.

Agnico Eagle understands that the NIRB could decide to proceed with a reconsideration of the Project Certificate in relation to some components of the Meliadine Extension, and has considerable flexibility on how the process may proceed. It is anticipated that only limited scope NIRB consideration will be required in relation to Meliadine Extension and that the file will be subject to more detailed focus at the Nunavut Water Board (NWB) Type A Water Licence amendment phase. Agnico Eagle wishes to emphasize that the vast majority of the component of the Meliadine Extension was previously assessed by NIRB in 2014 and should not be included within the scope of any NIRB reconsideration. Further, we have not identified any terms and conditions of Project Certificate No.006 which require updating to proceed with the Meliadine Extension components. Existing management plans have been updated to reflect proposed Meliadine Extension activities.

Agnico Eagle will also amend its Type A Water Licence 2AM-MEL1631 and other required permits and/or approvals to include Meliadine Mine Phase 2 and Extension activities.

Since 2015, Agnico Eagle has continued to collect baseline and existing conditions data, which has been incorporated into the updated environmental assessment to identify and assess potential environmental and social effects resulting from the Meliadine Extension activities. Data collection included physical environment (e.g., terrain and soils, permafrost, geochemistry, noise, and surface water quantity and quality, marine water quality), biological environment (e.g., vegetation, terrestrial wildlife, birds and bird habitat, and fish and other aquatic organisms, and marine wildlife), and the socio-economic environment (e.g., Inuit Qaujimaningit, archaeology, and socio-economics). The results of the environmental assessment found that with mitigation, the Meliadine Extension will not cause long-term significant negative effects resulting from proposed construction, operations, and closure.

Agnico Eagle has developed monitoring and management programs required to mitigate, monitor, and report on its environmental performance against the regulatory requirements contained within its Meliadine operating authorizations, permits, licenses, and leases consistent with the legal requirements of applicable Acts and Regulations in Nunavut. The accuracy of the environmental impact predictions and the effectiveness of the mitigation measures will be verified through monitoring and annual reporting. If unusual or unforeseen adverse environmental impacts are noticed, corrective action will be put in place. Through the adaptive management process, the existing Adaptive Management Plan and the existing Environmental Management and Protection Plan, the existing mitigation measures are effective however will be adjusted or new mitigation measures implemented if necessary.

The Meliadine Extension represents the continuation of economic benefits into years beyond the end of mining of the existing life of mine. The economic effects of the Meliadine Extension are substantial and are expected to be of significant benefit to the territory. The Meliadine Extension is expected to generate 205 new employment opportunities during the peak year of operation incremental to those created by the existing life of mine, and extend employment and incomes until 2043. The Meliadine Extension will continue to have positive effects in communities for an extended period, in terms of household incomes and associated access to nutritious food, recreation, education, and resources with which to conduct traditional activities. Similarly, the Meliadine Extension will continue support for community programming and educational initiatives, as well as IIBAs royalties and commitments.

Since operations of the Meliadine Mine began, Agnico Eagle has continued public consultation by annually meeting with the community and local stakeholders within the Kivalliq region, regulatory agencies, and local employees. This has allowed a better general understanding of the rights, interests, values, aspirations, and concerns of the potentially affected stakeholders, with particular reference to Rankin Inlet. Through this continued consultation, Agnico Eagle has developed an operational culture that recognizes and respects these relevant interests in the planning and executing processes. Agnico Eagle has consulted with local stakeholders and regulators regarding ongoing operations of the Meliadine mine, as well as proposed Meliadine Extension. Consultation and regulatory engagement discussions were also considered as part of the alternatives assessment.

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ACRONYMS

Acronym	Definition
ABA	Acid base accounting
AEMP	Aquatic Effects Monitoring Program
Agnico Eagle	Agnico Eagle Mines Limited
AHCCD	Adjusted and Homogenized Canadian Climate Data
AMP	Adaptive Management Plan
AP	Acid Potential
ARD	Acid Rock Drainage
ATV	All Terrain Vehicle
AWAR	All Weather Access Road
CAAQS	Canadian Ambient Air Quality Standards
CCDS	Canadian Climate Data and Scenarios
CCME	Canadian Council of Ministers of the Environment
CESA	Caribou Effects Study Area
CIRNA	Crown-Indigenous Relations and Northern Affairs Canada
COPC	Chemical of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSM	Conceptual Site Model
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
ELC	Ecological Land Classification
EWTP	Effluent Water Treatment Plant
FEIS	Final Environmental Impact Statement
2014 FEIS	2014 Final Environmental Impact Statement; when referring to the original Application submitted in 2014 for the Meliadine Mine
2018 FEIS Addendum	2018 Final Environmental Impact Statement Addendum; when referring to the Addendum submitted in 2018 to truck saline effluent for discharge to sea
2020 FEIS Addendum	2020 Final Environmental Impact Statement Addendum; when referring to the addendum submitted in 2020 for the waterline
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GHGRP	Greenhouse Gas Emissions Reporting Program
GIS	Geographic Information System
GN	Government of Nunavut
HHERA	Human Health and Ecological Risk Assessment
HHS	Hunter Harvest Survey

Acronym	Definition
HTO	Hunters and Trappers Organization
ICRP	Interim Closure and Reclamation Plan
IIBA	Inuit Impact and Benefit Agreement
IPCC	Intergovernmental Panel on Climate Change
IQ	Inuit Qaujimaningit and Inuit Qaujimajatuqangit
ISQG	Interim Sediment Quality Guidelines
KHTO	Kangiqliniq Hunters and Trappers Organization
KivIA	Kivalliq Inuit Association
LDP	Leadership Development Program
LOM	Life of Mine
LSA	Local Study Area
MAA	Multiple Accounts Analysis
MAC	Maximum Average Concentration
MDMER	Metal and Diamond Mining Effluent Regulations
Meliadine Extension	Part of the Approved 2014 FEIS
Meliadine Mine site	Meliadine Gold mine site (site of the Meliadine Gold Project)
ML	Metal Leaching
MMSO	Marine Mammal and Seabird Observer
NAAQS	Nunavut Ambient Air Quality Standards
NAG	Net Acid Generation
NIRB	Nunavut Impact Review Board
NP	Neutralization Potential
NPAG	Non-Potentially Acid Generating
NPC	Nunavut Planning Commission
NPOR	Noise Point(s) of Reception
NTI	Nunavut Tunngavik Incorporated
NTLU	Non-traditional Land Use
NuPPAA	*Nunavut Planning and Project Assessment Act*
NWB	Nunavut Water Board
PAG	Potentially Acid Generating
PRISM	Program for Regional and International Shorebird Monitoring
PSU	Practical Salinity Units
Project Certificate No.006	NIRB Project Certificate [No.:006] Amendment 001 (February 26, 2019) and Amendment 002 (March 2, 2022)
RCP	Representative Concentration Pathway
RFFD	Reasonably Foreseeable Future Developments
RISE	Rapid Inuit Specific Education
RSA	Regional Study Area
SARA	*Species At Risk Act*

Acronym	Definition
SD	Supporting Document
SEMC	Socio-economic Monitoring Committee
SEMP	Socio-Economic Monitoring Program
SEMR	Socio-Economic Monitoring Report
SETP	Saline Effluent Treatment Plant
SFE	Shake Flask Extraction
SRES	Special Report on Emission Scenarios
SSA	Site Study Area
SSWQO	Site-specific Water Quality Objective
STP	Sewage Treatment Plant
2-D	Two-dimensional
3-D	Three-dimensional
T&C ##	Term and Condition Number ## (from NIRB Project Certificate [No.:006])
TAG	Terrestrial Advisory Group
TDS	Total Dissolved Solids
TEMMP	Terrestrial Environment Management and Monitoring Plan
TK	Traditional Knowledge
TSF	Tailings Storage Facility
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
VEC	Valued Ecosystem Component
VMR	Virtual Meeting Room
VSEC	Valued Socio-Economic Component
Water Licence	Type A Water Licence 2AM-MEL1631
WRSF	Waste Rock Storage Facility
ZOI	Zone of Influence

1 PROJECT DESCRIPTION

1.1 Introduction

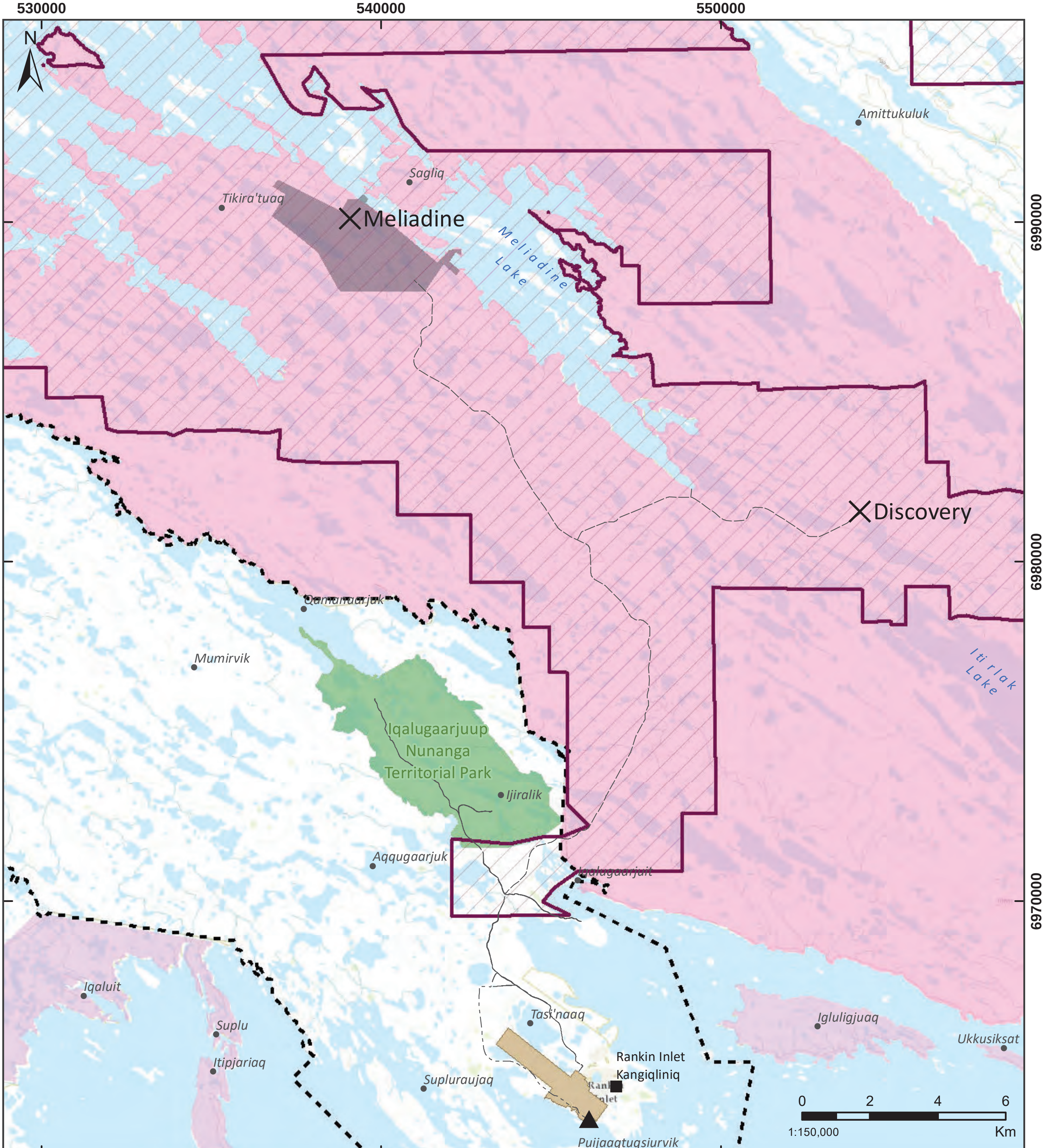
Agnico Eagle Mines Limited (Agnico Eagle) is operating the Meliadine Mine, located approximately 25 km north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. Figure 1.1-1 presents the Meliadine Mine location and leases; Figure 1.1-2 presents the Meliadine Mine location and claim blocks.

On October 10, 2014, the Nunavut Impact Review Board (NIRB) provided the Minister with the Final Hearing Report and recommended Terms and Conditions for the Meliadine Project. The Minister accepted the NIRB's recommendation on January 27, 2015 and Project Certificate No.006 was issued on February 26, 2015. This included the approval of the Tiriganiaq deposit and the F Zone, Wesmeg, Pump, and Discovery deposits of the Meliadine Mine and the associated infrastructure.

On May 19, 2016, the Minister approved the Type A Water Licence 2AM-MEL1631 to begin construction and operation of the Meliadine Mine. At that time, Agnico Eagle only applied for the Type A Water Licence required to proceed with the Tiriganiaq deposit. As indicated at that time, amendments are required to proceed with the other deposits, as part of this application (Meliadine Extension) included in Project Certificate No.006.

Since the Project Certificate was issued, the Meliadine Mine has been subject to two reconsiderations by NIRB. On February 26, 2019 the NIRB provided a positive decision to amend the Project Certificate to include discharge of saline effluent to the marine environment via diffuser at Itivia Harbour and to convey via truck saline effluent along the All Weather Access Road (AWAR) to Itivia Harbour (i.e., Melvin Bay). On January 31, 2022 the Minister provided a positive decision to amend the Project Certificate to include the conveyance of saline effluent via a waterline along the AWAR (instead of via truck), to accommodate an increased volume of discharge at Itivia Harbour.

On June 23, 2021, the Minister approved the Type A Water Licence 2AM-MEL1631 Amendment which included updated total dissolved solids (TDS) thresholds to Meliadine Lake, increase of annual freshwater consumption, additional laydown area, additional landfarm, updated waste management strategy, construction of access roads, and an updated Interim Closure and Reclamation Plan (ICRP).



Meliadine Project

Project Description - Leases

Date: 10/6/2021
Map Number: MEL-005
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

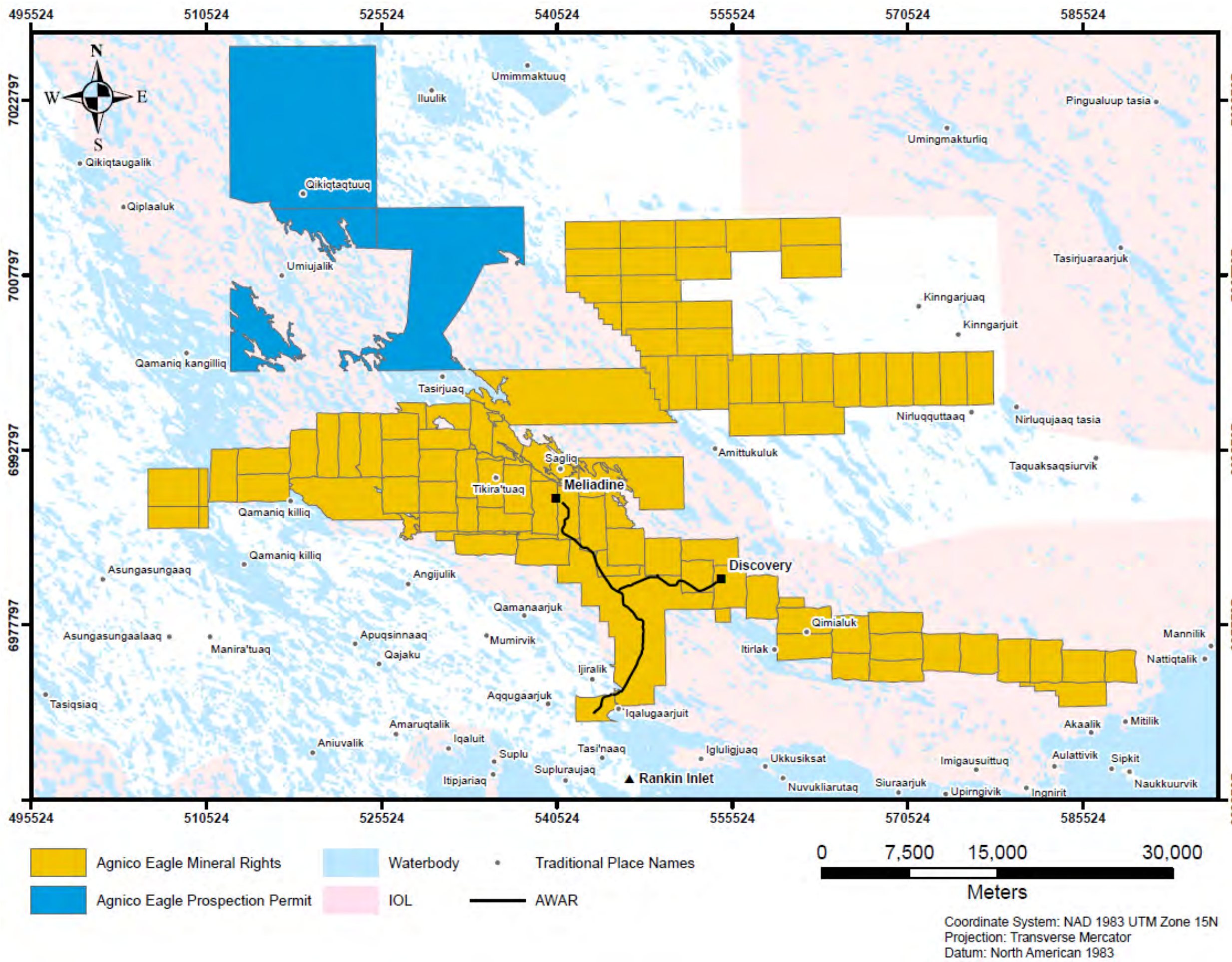
AGNICO EAGLE
ECOLOGIC

- Itivia Laydown
- Traditional Place Names
- Bypass Road
- AWAR
- Municipal Road
- Meliadine Claim Blocks
- Production Lease
- Municipal Boundary
- Nunavut Airport Boundary

Inuit Owned Lands

- Surface
- Surface-Subsurface
- Territorial Park

Figure 1.1-2: Site Location and Claim Blocks



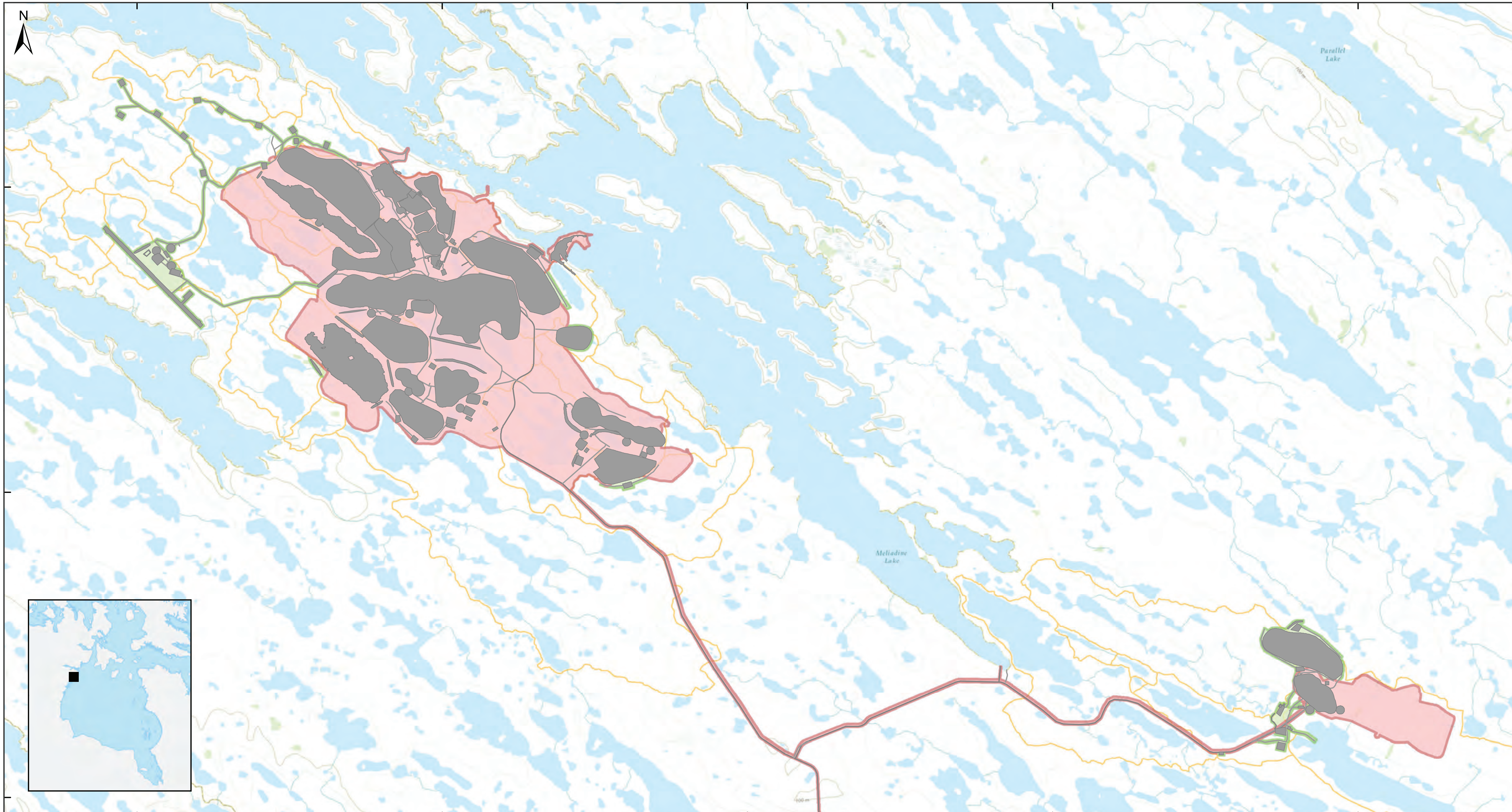
At this time, Agnico Eagle is seeking approvals and permits required to proceed with mining of the deposits that were not included in the Water Licence (Meliadine Extension) and associated approved activities. As mentioned above, Project Certificate No.006, including the Meliadine Extension deposits, has been issued in 2015. Based on additional geological investigations conducted, lessons learned since NIRB approval in 2015, and to continue developing the Meliadine Mine in a sustainable way, Agnico Eagle is seeking approval to add the following activities:

- underground mining and associated saline water management infrastructures at the Pump, F Zone, and Discovery deposits that were previously assessed and approved for open pit mining activities by NIRB;
- development of a new portal and associated infrastructures in the Tiriganiaq-Wolf area to improve access to and expand the existing Tiriganiaq underground mine;
- construction and operation of a windfarm to reduce greenhouse gas (GHG) emissions (NIRB Project Certificate No.006 Term and Condition [T&C] 9);
- use of additional borrow pits and quarries to replace depleted sources and build a road to the windfarm, Tiriganiaq-Wolf portal, airstrip, road to Discovery and other deposits; and
- extension of the operation phase (i.e., mine life) by 11 years to 2043.

Agnico Eagle is also seeking approval for the following options/alternatives should it be required:

- construction and operation of an on-site airstrip to increase site access flexibility;
- use of exhausted pits to store tailings to complement the current waste management strategy; and
- use of exhausted pits to store waste rock to complement the current waste management strategy.

Collectively, this is referred to as Meliadine Extension. Proposed changes to the approved footprint are illustrated on Figure 1.1-3.



Meliadine Extension

Site Overview

0 1 2 3
1:60,000 Km

Date: 4/10/2022
Map Number: MEL-032
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

- NIRB Approved Project Footprint
- Meliadine Extension Footprint
- Mine Infrastructure
- Catchment Boundary Line

AGNICO EAGLE ECOLOGIC

Agnico Eagle understands that the NIRB could decide to proceed with a reconsideration of the Project Certificate in relation to some components of the Meliadine Extension, and has considerable flexibility on how the process may proceed.

Should the NIRB determine that it will proceed with a reconsideration process in relation to the Meliadine Extension, the NIRB should take great care in the scoping of activities to be considered in the reconsideration process. The vast majority of the components of the Meliadine Extension were previously assessed (2014) and approved (2015) by the NIRB and should not be included within the scope of any NIRB reconsideration process. Further, Agnico Eagle has not identified any terms and conditions of Project Certificate No.006 which require amendment to proceed with the Meliadine Extension components. Monitoring required for the Meliadine Extension can continue to be addressed under the existing and robust monitoring and management plans described in the Project Certificate and Type A Water Licence. Based on the components of the Meliadine Extension, which are generally focused primarily on items relating to management of water and waste, it is anticipated that limited scope for NIRB consideration will be required in relation to Meliadine Extension and that the file will be subject to more detailed focus at the NWB Type A Water Licence amendment phase.

In support of any reconsideration required by NIRB Agnico Eagle has provided this stand-alone Final Environmental Impact Statement (FEIS) Addendum to guide the review process. This Application has been developed to conform to the *Guidelines for the Preparation of an Environmental Impact Statement for Agnico-Eagle Mines Ltd's Meliadine Project* (NIRB 2012), as well as recent guidance (*Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet*; NIRB 2020a) issued by the NIRB to Agnico Eagle for completion of the 2020 FEIS Addendum.

Agnico Eagle received a positive conformity determination from Nunavut Planning Commission (NPC) for Meliadine Extension activities on April 1, 2022.

1.1.1 Scope of Meliadine Extension Components and Activities

Table 1.1-1 provides a summary of Meliadine Extension components as a comparison to the approved 2014 FEIS and the 2018 and 2020 FEIS Addenda. Figure 1-1.4 and Figure 1.1-5 provides an overview of the Meliadine Extension site layout for the main site and Discovery deposit, respectfully.

Table 1.1-1: Definition of Scope

	Meliadine Mine – Phase 1&2	Meliadine Extension
Permits and Approvals	NIRB Project Certificate No.006, approval received in 2015 NIRB Project Certificate No.006, Amendment 001 NIRB Project Certificate No.006, Amendment 002 NWB Type A Water Licence 2AM-MEL1631 NWB Type A Water Licence 2AM-MEL1631 Emergency Amendment NWB Type A Water Licence 2AM-MEL1631 Amendment 001 KivIA Production Lease KVPL11D01 KivIA Quarry Permit KVCA07Q08 KivIA Quarry Permit KVCA11Q01 KivIA Road Lease KVRW11F02 Nunavut Airports Laydown Area Lease LE-03-320-0036 Nunavut Airports Bypass Road Lease 102893 GN-CGS Bypass Road Lease L-51808T GN-CGS AWAR Road Lease L-51809T CIRNAC Diffuser Lease 55K/16-42-2 DFO Letter of Advice 11-HCAA-CA7-00014	Reconsideration Project Certificate No.006 (anticipated – to be determined by NIRB) Amendment NWB Type A Water Licence 2AM-MEL1631 Amendment to KivIA Production Lease KVPL11D01 Amendment to KivIA Quarry Permit KVCA07Q08 Amendment to KivIA Quarry Permit KVCA11Q01 DFO Authorization Schedule 2
Inuit Agreements	Inuit Impact and Benefit Agreement	Subject to discussions with KivIA
Location / Land Tenure	The Meliadine Mine is located approximately 25 km north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. Claim block is presented in Figures 1.1-1 and 1.1-2.	No change.
Life of Mine	The Meliadine Mine resources will be extracted over an approximate 13-year period from 2019 to 2032.	Extension activities will extend the Life of Mine by 11 years and postpone mine closure to 2043 instead of 2032. In total, the Meliadine Life of Mine will be 24 years.
Site Access	Meliadine Mine is accessed by the All Weather Access Road (AWAR) and bypass road, and marine barging where applicable. Use Rankin Inlet's airstrip for transportation of "fly-in/fly-out" employees.	No change. There is a potential that in future, as an option/alternative Agnico Eagle will construct and operate an on-site airstrip near the Tiriganiaq-Wolf mining area.

	Meliadine Mine – Phase 1&2	Meliadine Extension
Rankin Inlet Infrastructure – Fuel Storage, Port Facility, Laydown	A spud barge (floating dock) to serve as a dock for offloading containers, materials, and equipment from barges. A fuel tank farm to store up to 80 million litres of diesel fuel in 8 x 10-million litre tanks. A laydown yard area (14 hectares) to store incoming and outgoing containers, materials, and equipment pending truck delivery to the Project site by road. A saline effluent diffuser to allow discharge at Itivia Harbour.	No change.
Domestic Waste Management	On-site facilities include: landfill incorporated within waste rock storage facility, incinerator, landfarms	Some changes as described below (note that these changes are not considered "significant" under the Project Certificate but it is anticipated they will require consideration as part of the Type A Water Licence amendment process): • Addition of landfarms at the Wesmeg and Discovery deposits. • Change in soil reclamation criteria for landfarm soil. • Inclusion of a landfill at the Discovery deposit and located within the WRSF. • Inclusion of a second smaller capacity incinerator to accommodate increased number of workers and support during planned maintenance on the primary incinerator. • Addition of a composter to divert away organic matter from the incinerator.
Hazardous Waste Management	Material is segregated at site and shipped to an approved disposal location in the south.	No change.
Power	Power plant is diesel-fuel generated.	No change to power plant. New: • Construction of a windfarm composed of 11 turbines. The purpose is to provide general power, reduce reliance on diesel fuel, and reduce Greenhouse Gas emissions. This will provide a sustainable, long-term, "green" energy supply to the Life of Mine during operations and closure.

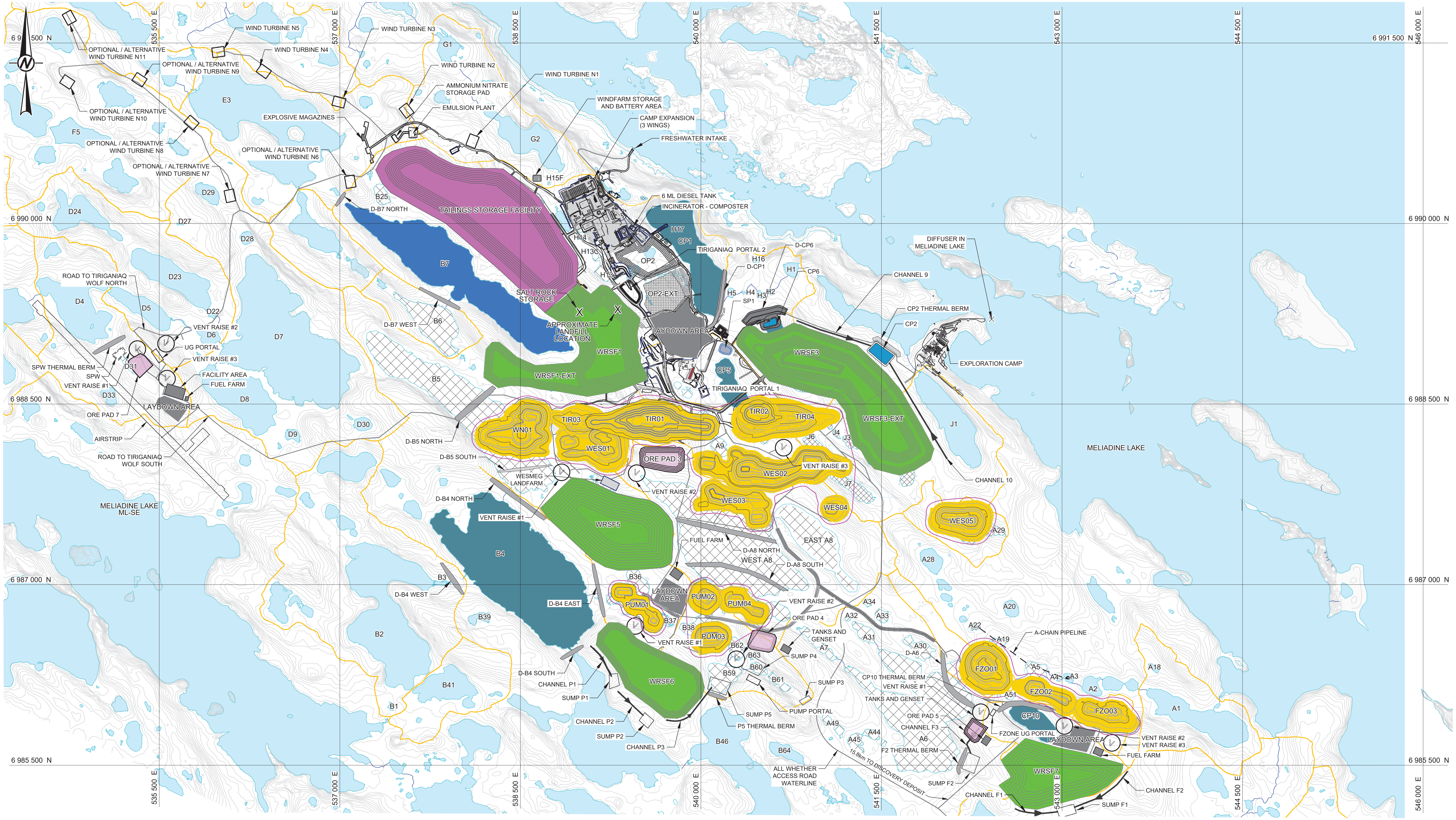
	Meliadine Mine – Phase 1&2	Meliadine Extension
Mine Infrastructure	Open pit mining assessed: Tiriganiaq, Wesmeg, Pump, F Zone, and Discovery. Although all five pits were assessed, only Tiriganiaq has advanced mining activity. Underground mining assessed: Tiriganiaq. Phase 1 included the assessment of access roads to Discovery, Pump, F Zone, and Wes-Normeg deposits; and was included with the Type A Water Licence Amendment as the access roads are within the previously assessed footprint of the FEIS.	New: • Extension of existing deposit; Tiriganiaq-Wolf (underground mining). • Underground mining at Pump, F Zone, and Discovery. No change except for additional small (i.e., approx. 10 km) access roads to the Tiriganiaq-Wolf area and to the windfarm.
Ore Processing	Ore processing, handling, treatment, and disposal will continue at the Meliadine Mill and tailings will be stored in the footprint of the existing approved Tailings Storage Facility. Operations for the approved Tailings Storage Facility is addressed under Type A Water Licence 2AM-MEL1631. Mill rate of approximately 8,500 tonnes per day.	No change. No change.
Tailings	Final tailings will be transported directly to an impoundment area as a pumped slurry through a pipeline. Although slurry was assessed in the original application (FEIS 2014), the Type A Water Licence issued in 2016 includes dry stack tailings.	No change to tailings management method. Note the dry stack Tailings Storage Facility area envisioned for Meliadine Extension will likely be smaller than slurry Tailings Storage Facility considered in the original application. New alternative: • Use of pits to store tailings as an option/alternative to the current waste management strategy, should Agnico Eagle identify the need for this in future.
Ore Stockpile	Ore pads located near the crusher to temporarily store ore before being fed to the mill.	New: • Ore will be stockpiled in a series of temporary stockpiles located adjacent to the pits and underground portals. Ore will then be brought to the approved ore stockpiles located near the crusher.

	Meliadine Mine – Phase 1&2	Meliadine Extension
Waste Rock	Waste rock and overburden generated will be placed in one of five Waste Rock Storage Facilities assessed: • B7 WRSF (East, South and West) located in a U-shape around the Tailings Storage Facility, north of the Tiriganiaq deposit (WRSF1 and WRSF2 as approved under Water Licence 2AM-MEL1631). • WRSF3 approved under Water Licence 2AM-MEL1631 and located east of Tiriganiaq Pit 2. • B4 WRSF located west of the Wesmeg and Pump deposits. • A45 WRSF located south of the F Zone deposit. • The Discovery WRSF located east of the Discovery deposit. NPAG cover will be placed should monitoring during operations shows that waste rock contains PAG material.	Waste rock and overburden generated from open pit activities will be placed in one of the Waste Rock Storage Facilities (WRSF) as originally assessed. Overall, it is anticipated the total WRSF surface area will be half the size of the original application. The details of WRSFs and comparison with the 2014 application are below: • WRSF1 and WRSF1_ext located within the footprint of the approved B7 WRSF. • WRSF3 is increased to the south with the addition of WRSF3_extension. • WRSF5. Located within the approved footprint in close proximity to the approved B4 WRSF footprint. • WRSF6. Located within the footprint of approved B4 WRSF. The area is smaller than the original application. • WRSF7. Located within the footprint of approved A45 WRSF. • WRSF 9. Located northwest of the Discovery pit, outside of the approved footprint. New: • Underground waste rock will be temporarily stored in salt waste rock piles before being brought back underground when stoping is completed. F Zone, Pump, Tiriganiaq-Wolf, and Discovery will have associated temporary salt rock piles. New alternative: • Use of open pits to store waste rock as an option/alternative to the current waste management strategy.
Freshwater	Freshwater sourced from Meliadine Lake. Freshwater for dust suppression sourced from small lakes and ponds close to the road and/or Meliadine River. Freshwater needs assessed at 2,168,100 m^3/year (including a 25% contingency).	No change to sources of water used. No additional freshwater required.

	Meliadine Mine – Phase 1&2	Meliadine Extension
Water Management	**Infrastructures:** Water management structures will be built (e.g., dikes/berms, and diversion channels) as needed to manage water from areas within the mine site. Surface contact water and saline water are managed separately. **Contact Water:** Contact water originating from developed areas (e.g., pits, WRSF, TSF) will be intercepted and conveyed to the various collection ponds for temporary storage. All contact water will eventually be conveyed to Collection Pond 1 (CP1). Contact water collected within CP1 will be used to satisfy mill process water make-up requirements, with any excess water treated using the Effluent Water Treatment Plant, if required, and discharged to Meliadine Lake. **Saline Water:** Use of saline ponds to collect underground water. After treatment, water is conveyed to Itivia Harbour for discharge into the receiving environment. **Treatment:** Effluent Water Treatment Plant (TSS), Sewage Treatment Plant (BOD, TSS, bacteria), Saline Effluent Treatment Plant (TSS, ammonia) and Reverse Osmosis (TDS) Plant are used to treat water.	No material changes. Additional water management structures will be built as needed to manage water from areas within the mine site. **Surface Contact and Saline Water:** No change to overall water management strategy. Surface contact water and saline water from the underground mines will be separated. Water management at site will be optimized by using the waterline to minimize discharge to Meliadine Lake. Water collected at the Discovery site will be conveyed through a waterline to the SETP, where it will be treated and discharged into the receiving environment (Itivia Harbour) using the approved waterline. Addition of saline ponds at F Zone, Tiriganiaq-Wolf, Pump and Discovery to collect water originating from underground mine activities. As proposed during Amendment No. 002 to the Project Certificate No.006, saline water will be eventually conveyed to the SETP, where it will be treated and discharged to the receiving environment (Itivia Harbour). Capacity of the Sewage Treatment Plant will be increased to accommodate increased number of employees.
Borrow Pits and Quarries	Borrow pit (gravel material) and quarry material (blasted rock material) needed to build the following infrastructure, but not restricted to: • AWAR • Haul/service roads • Storage/operation pad(s) Quarries and borrow pit selection consist of: • Quarries: R5, R14, and R19	New: • As additional material will be required for the airstrip and access roads, and as there is a need for additional material to meet current requirements, new borrow pits/quarries are required.

	Meliadine Mine – Phase 1&2	Meliadine Extension
	• Borrow Pits: B5, B6A, B6West, B10, B11A, B12, B13, and B15, Meliadine esker, Tiriganiaq esker, Wesmeg esker, and Emulsion esker • Most of these sources have been depleted and areas reclaimed. Material from the open pits will also be used for construction.	
On-site Fuel	Approximately 122 million liters of diesel fuel per year for use at the Meliadine Mine. Current fuel tanks on site: • One 6 ML tank, one 3 ML tank and a number of storage tanks with capacities varying between 1,000 and 250,000 L. Total diesel fuel storage capacity is in the range of 9.7 million L.	No change to overall fuel needs at the Meliadine Mine is required. Some changes as described below (note that these changes are not considered "significant" under the Project Certificate but it is anticipated they will require consideration as part of the Type A Water Licence amendment process): • Addition of fuel storage tanks at Pump, F Zone, Tiriganiaq-Wolf, and Discovery will be needed. Each site will consist of four 75,000 L and one 50,000 L tanks for a total of 350,000 L per site. • A new 6,000,000 L tank will be added adjacent to the existing industrial pad fuel tank. • Combined total of 7,400,000 L added to what has already been approved. Total diesel fuel storage capacity (Approved and Extension) would be in the range of 17.1 ML.
Marine Shipping	A total of 4-6 vessels annually deliver dry goods, and 4 to 6 tankers annually deliver diesel fuel for the Meliadine Mine. All shipping is carried out during the open water season (typically from early August to late October) and follows established shipping lanes that are presently in use for the annual sealift to Rankin Inlet and other communities. There is no ice breaking to extend the shipping season. Ships are not serviced in Rankin Inlet and arrive with enough fuel for the return voyage south.	No change.
Closure	Reclamation work begins as soon as an area's operation is complete. Most removal or demolition of buildings and infrastructure will occur at the end of operations phase, though, and would be done in the first two years of decommissioning. Reclamation work should be completed within 3 to 4 years of the closure. The filling of open pits with water would extend for several years.	No change (note if option to store waste rock and tailings is exercised in future, this would be addressed as part of the Closure Plan).

	Meliadine Mine – Phase 1&2	Meliadine Extension
Employment	The total workforce during operations was assessed at 700 employees.	The total workforce during operations will be expanded to a maximum of 905 employees. Additional employment at Meliadine will gradually ramp up from 2024 to 2031. 2031 will be the peak employment year due to mining activities occurring simultaneously at various deposits. Employment will remain above the 2014 FEIS workforce until 2040 and will then gradually decrease until closure.
Camp	A total of 680 beds was proposed for the camp complex.	Three wings will be added to accommodate the increase in the number of employees.



LEGEND

EXISTING GROUND	WATER
ROAD	DEWATERED
CATCHMENT BOUNDARY LINE	OPEN PITS
MINING AREA	TAILINGS STORAGE FACILITY
DIVERSION CHANNEL	WASTE ROCK STORAGE FACILITY
CONTACT WATER POND	
SALINE POND	

NOTE

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.

REFERENCE

1. REFERENCE BASE DRAWING FROM CLIENT "PLOM2021_MEL_ENG_edits_V1-Base.dwg".
2. MINE INFRASTRUCTURE FROM AGNICO EAGLE MINES LTD. "LineWork for WMI PLOM to Jenyfer 09012021.dwg" PROVIDED ON SEPT. 1, 2021.

NOT FOR CONSTRUCTION

0 500 1,000
1:15,000 METRES

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER
MEMBER OF WSP

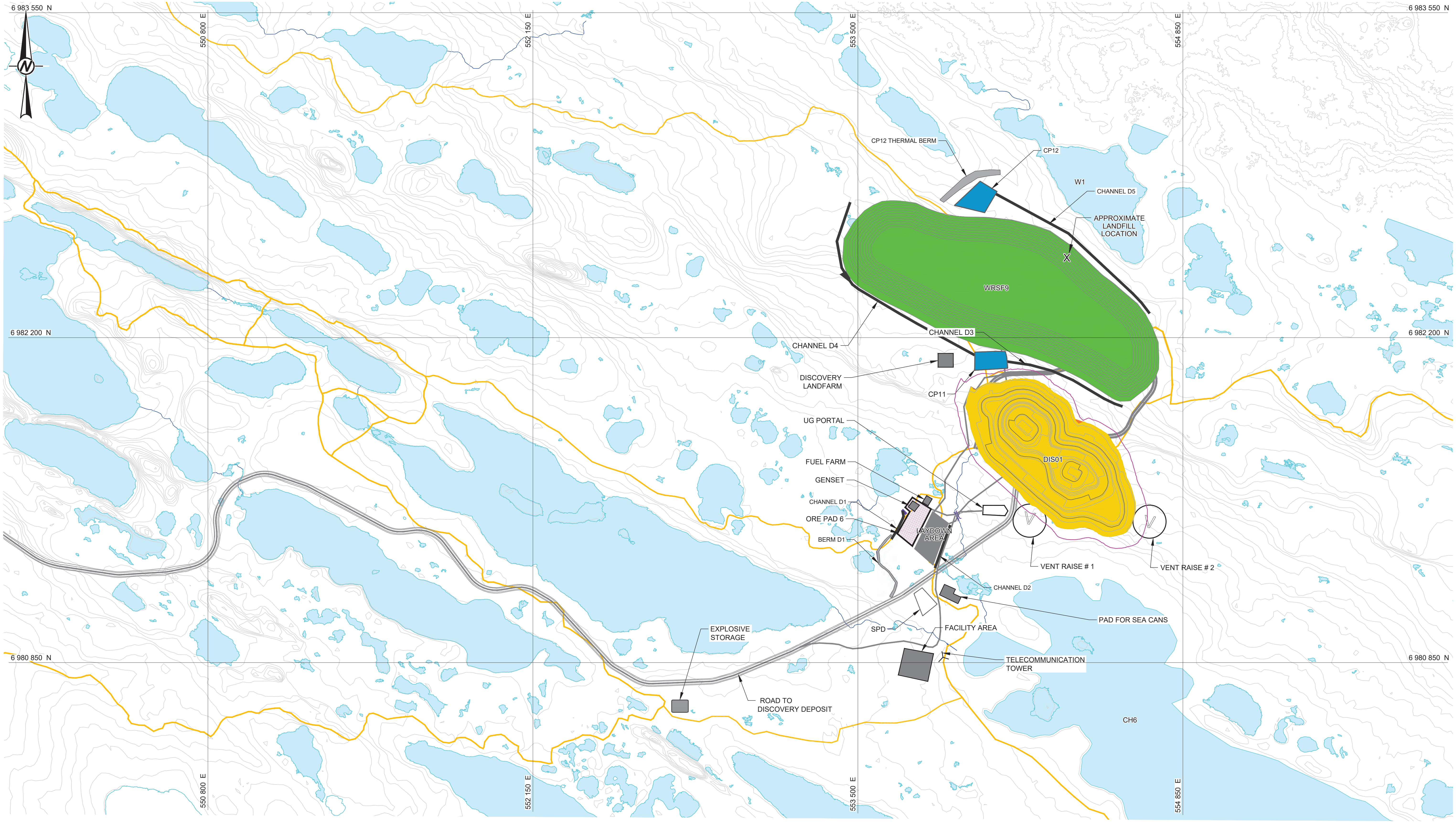
YYYY-MM-DD	2021-10-20
DESIGNED	JR
PREPARED	AK
REVIEWED	JK
APPROVED	LY

PROJECT
MELIADINE MINE EXTENSION

TITLE
2043 YEAR SITE LAYOUT

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
21482774	2000/2002	0	14

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



LEGEND

- EXISTING GROUND
- ROAD
- CATCHMENT BOUNDARY LINE
- MINING AREA
- DIVERSION CHANNEL
- CONTACT WATER POND
- SALINE POND
- WATER
- DEWATERED
- OPEN PITS
- TAILINGS STORAGE FACILITY
- WASTE ROCK STORAGE FACILITY

NOTE

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.

NOT FOR CONSTRUCTION

REFERENCE

1. REFERENCE BASE DRAWING FROM CLIENT "PLOM2021_MEL_ENG_edits_V1-Base.dwg".
2. MINE INFRASTRUCTURE FROM AGNICO EAGLE MINES LTD. "LineWork for WMI PLOM to Jenyfer 09012021.dwg" PROVIDED ON SEPT. 1, 2021.

0 250 500
1:7,500 METRES

CLIENT
AGNICO EAGLE MINES LIMITED

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-20
DESIGNED	JR
PREPARED	AK
REVIEWED	JK
APPROVED	LY

PROJECT
MELIADINE MINE EXTENSION

TITLE
2043 YEAR SITE LAYOUT - DISCOVERY

PROJECT NO.	PHASE/TASK/DOC.	REV.	FIGURE
21482774	2000/2002	0	1.1-5

1.1.2 The Proponent

The Meliadine property is owned and managed by Agnico Eagle Mines Limited (NYSE: AEM, TSX: AEM), a Canadian publicly traded mining company listed on the Toronto and New York Stock Exchange, trading symbol AEM, with the head office in Toronto, Ontario.

Agnico Eagle is a long established, Canadian headquartered, gold producer with underground and open-pit operations located in Canada, Finland, and Mexico, and exploration and development activities in Canada, Finland, Sweden, Mexico, and the United States. Agnico Eagle is the sole owner of the Meliadine Mine. In Canada, Agnico Eagle also owns and operates the LaRonde Complex, Goldex, Hope Bay, and Meadowbank Complex mines. It also has 50% of ownership in the Canadian Malartic Mine.

A summary of Agnico Eagle's 2020 annual report is available on-line (here) and more information about the company can be found here.

1.1.3 Sustainable Development, the Precautionary Principle, and Adaptive Management

1.1.3.1 Sustainable Development

Agnico Eagle is committed to creating value for their shareholders by operating in a safe, socially, and environmentally responsible manner, while contributing to the prosperity of our employees, their families, and the communities in which we operate. This is imbedded into the four fundamental values that make up the keystones of Agnico Eagle's Sustainable Development Policy: Operate a Safe and Healthy Workplace, Protect the Environment, and treat Employees and Communities with Respect.

1.1.3.2 Application of the Precautionary Principle

As understood by Agnico Eagle, the "precautionary principle" or precautionary approach is as follows: "[w]here there are threats of serious or irreversible damage; lack of full scientific certainty must not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UNCED 1992). When the precautionary principle applies, it is the Proponent who bears the burden of proof to show that despite this uncertainty, the potential for adverse environmental impacts can be mitigated or reversed.

1.1.3.3 Adaptive Management

Agnico Eagle uses adaptive management as part of the precautionary approach. Adaptive management is a part of decision-making processes, including those around environmental effects. Agnico Eagle's approach can be summarized as follows:

- Priority 1 – Collect the scientific data required to allow scientific consensus to be achieved and consult with local stakeholders to incorporate Inuit Qaujimaningit and Inuit Qaujimajatuqangit (IQ), Traditional Knowledge (TK), and Community Knowledge collected into our data to help reach consensus.
- Priority 2 – Design all facilities and activities with adaptive management in mind. In cases where

uncertainty remains, Agnico Eagle has looked for applicable data from similar settings elsewhere so that others' experiences can be brought into consideration. Agnico Eagle has also built in appropriate safety factors in the design of the facility or in the proposed action. In each case, Agnico Eagle has incorporated flexibility so that the activity or design can be actively adapted to accommodate possible future change.

- Priority 3 – Design and implement monitoring programs to address all areas of uncertainty so that data are being generated to a) allow for scientific consensus to be achieved, and b) to allow activities where some uncertainty exists to be adaptively managed in a timely manner.

As a result of Agnico Eagle's Amendment to the Water Licence (Agnico Eagle 2020b) and addendum to Project Certificate (Agnico Eagle 2020a) an Adaptive Management Plan (AMP; Agnico Eagle 2021a) for water management at Meliadine was created based on the priorities above. The primary objective of the AMP is to document specific management actions and mitigation measures to be taken when specified thresholds are exceeded. Mitigation measures may include special studies, operational changes, revised or new water and waste management systems, new or expanded conveyance systems, structures and/or facilities, or implementing mitigation activities to prevent, stabilize or reverse a change in environmental conditions or to otherwise protect the receiving environment. The AMP was developed in collaboration and with inputs from Kivalliq Inuit Association (KivIA), Crown-Indigenous Relations and Northern Affairs Canada (CIRNA), and Environment and Climate Change Canada (ECCC).

1.1.4 Regional Context

The Meliadine Mine falls within the boundaries of the Keewatin Regional Land Use Plan (NPC 2000) administered by the NPC (see Figure 1.1-1). The Meliadine Mine has received positive conformity determinations in June 2011 (Meliadine Mine proposal), January 2018 (saline discharge proposal), and March 2020 (waterline proposal). All activities for the Meliadine Extension Proposal are within the same area.

The issues considered in the 2014 FEIS and subsequent FEIS Addenda within a regional context remain unchanged because of the Meliadine Extension Proposal. Baseline reports representing new data collected since the filing of the 2014 FEIS and existing conditions reports representing new data collected since construction of the Meliadine Mine are appended to the appropriate Application sections.

1.1.5 Land Tenure

Consistent with the Meliadine Mine, Meliadine Extension is primarily situated on Inuit Owned Lands (see Figure 1.1-1) and administered by the KivIA (surface rights) on behalf of the Inuit Beneficiaries as designated under the Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada (Nunavut Agreement; GC 1993b). As part of Meliadine Extension activities, Agnico Eagle currently anticipates potential amendments with the KivIA to the current Production Lease, as well as to the existing Quarry Permits (KVCA07Q08 and KVCA11Q01).

The southern portion of the AWAR (i.e., South of the Char River bridge), the Rankin Inlet Bypass Road, and the Rankin Inlet Infrastructure – Fuel Storage, Port Facility, Laydown are located on Commissioner's Lands (managed by either the Government of Nunavut [GN] Departments of Community and Government Services or Nunavut Airports).

Table 1.1-2 provides a current list of surface tenures issued by KivIA, Crown, and Municipality.

Table 1.1-2: Surface Tenures

Ownership	Lease	Purpose
KivIA	KVPL11D01	Production Lease
KivIA	KVCA07Q08	Quarry Permit (on-site)
KivIA	KVCA11Q01	Quarry Permit (along AWAR)
KivIA	KVRW11F02	Road Lease
Nunavut Airports	LE-03-320-0036	Itivia Laydown Area
Nunavut Airports	102893	Bypass Road Lease
GN-CGS	L-51808T	Bypass Road
GN-CGS	L-51809T	AWAR
CIRNAC	55K/16-42-2	Diffuser Lease

1.1.5.1 Regulatory Regime

The Meliadine Mine is located within the Nunavut Territory and is subject to the regulatory approvals established under the applicable laws and regulations of Canada and Nunavut. Agnico Eagle will adhere to the existing conditions and/or mitigations outlined by regulatory agencies or applicable licence requirements. While the existing authorizations will continue in effect for the Meliadine Mine, Agnico Eagle currently anticipates it will need the following amendments or new approvals for Meliadine Extension activities:

- New Fisheries and Oceans' (DFO) Authorization
- Metal and Diamond Mining Effluent Regulations (MDMER) Schedule 2 Listing (Multiple Accounts Analysis [MAA]). Note this watershed was included in the 2014 FEIS and therefore was already fully assessed by NIRB, but Agnico Eagle had not commenced the Schedule 2 process following NIRB Project Certificate No.006 issuance
- Transport Canada and NAV Canada notifications
- Amendment to NWB Type A Water Licence 2AM-MEL1631

Nunavut Planning Commission

All project proposals in the Keewatin Planning Region that require amendment to a licence or authorization from a land use authorizing agency must be submitted to NPC who is responsible for determining conformity with the Keewatin Regional Land Use Plan (NPC 2000).

Agnico Eagle submitted an application to NPC on March 28, 2022. On April 1, 2022 the NPC determined that the proposed amendment conforms with the Keewatin Regional Land Use Plan and referred the file to NIRB.

Nunavut Impact Review Board

As outlined in the Project Description (Section 2), that the NIRB may determine that the Meliadine Extension will require a reconsideration of Project Certificate No.006 under Part 5 of the *Nunavut Planning and Project Assessment Act* (NuPPAA). Agnico Eagle also anticipates that the Water Licence will require amendment under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. Should the NIRB proceed with a reconsideration, Agnico Eagle requests the NIRB scope the reconsideration in consideration of the fact that many key components of the Meliadine Extension have already completed a NIRB assessment in 2014. Agnico Eagle has provided this stand-alone Application to help guide the process.

The Application for the Meliadine Extension applies an ecosystem-based approach by describing the ecological function of each ecosystem component or valued ecosystem component (VEC) and valued socio-economic component (VSEC), indicating the ecological and cultural pathways of the potential impacts that are predicted, and updating mitigation and monitoring plans to deal with those impacts consistent with the approach applied for development of the 2014 FEIS, which conformed to the Guidelines for the Preparation of an Environmental Impact Statement (NIRB 2012). Refer to Appendix A for the concordance completion of Meliadine Extension against the 2014 FEIS Guidelines. This Application also considers recent direction provided by NIRB for amendment/reconsideration applications (NIRB 2020a,b).

The legislation and Terms and Conditions contained in the Project Certificate No.006 are achieving their purpose, are robust and adequate to address the proposed changes and in Agnico Eagle's view no additional Terms and Conditions or amendments to existing Project Certificate No.006 Terms and Conditions are required. The additional or revised project components are integrally linked to the original Project and therefore assessment as a stand-alone project would not be appropriate or supported by NIRB policy.

It is Agnico Eagle's position that all Terms and Conditions will be complied with and that changes will be managed and monitored through Management Plans in place for the Meliadine Mine.

There is precedent for NIRB proceeding with a reconsideration process that ultimately did not result in any amendments to the existing Project Certificate. As described in Section 2.5 of the Project Description, Agnico Eagle is considering implementing the future option/alternative of in-pit disposal at Meliadine as part of Meliadine Extension. Agnico Eagle was previously approved by NIRB to proceed with in-pit tailings disposal at the Meadowbank Mine. Agnico Eagle notes that at the conclusion of the NIRB reconsideration process, the NIRB determined the existing Terms and Conditions were sufficient (Project Certificate No.004-Amendment 003) and ultimately referred the application to the NWB. Based on the decision of the NIRB in relation to in-pit disposal at Meadowbank, Agnico Eagle suggests that in-pit disposal should not be included within the scope of any reconsideration process that the NIRB determines is required in relation to the Meliadine Extension, and that aspect of the Meliadine Extension should be referred directly to NWB for detailed consideration as part of the Water Licence amendment process.

Similarly, not every Meliadine Extension component would require terms and conditions, as they are part of standard mine infrastructure present at other mines in Nunavut. The future option/alternative on-site airstrip is acknowledged to be a change to the Meliadine Mine. Dedicated mine site airstrips are common to all other production mines in Nunavut, including Agnico Eagle's Meadowbank Mine. Agnico Eagle notes that Project Certificate No. 004-Amendment 003 for the Meadowbank Mine does not have a specific T&C related to the airstrip; consequently, would propose that a specific T&C would similarly not be required in Project Certificate No.006. The airstrip and related activities would be managed through appropriate monitoring and management plans[1].

Agnico Eagle believes a staggered or partially coordinated approach for the review of the NIRB Addendum to Project Certificate No.006 and NWB Type A Water Licence 2AM-MEL1631 Amendment Application is the most efficient and effective review process for the Meliadine Extension, given that most of the changes proposed are primarily within the jurisdiction of the NWB. Agnico Eagle will submit an amendment application to the NWB in the second half of 2022.

Agnico Eagle will continue to implement an environmental management system consistent with operations for the Meliadine Mine. Agnico Eagle has amended existing management, mitigation, and monitoring plans for the Meliadine operations based on the activities of the Meliadine Extension (refer to Section 12).

1.1.6 Analysis of Need and Purpose of Meliadine Extension

As part of the 2014 FEIS, it was presented that the Kivalliq region of Nunavut offers limited, and usually seasonal, employment opportunities. The population is predominately young with a high level of unemployment. Elders have stated that the young must find jobs in the wage economy as they will not be able to live off the land as Inuit did in the past. Many of the policies and strategies for Nunavut speak to self-reliance and improved quality of life as drivers for economic development that requires both the protection and use of renewable resources balanced with the development of non-renewable resources.

Construction of the Meliadine Mine commenced in 2016 and commercial production began in 2019. Incorporating lessons learned during construction and the first years of operation, resource, and project assessment have been refined. In parallel, the resources have continued to be explored through ongoing exploration activities and geological studies. Through these, economic extensions, mainly underground, have furthered the Life of Mine (LOM). Other components included in Meliadine Extension are a windfarm to address NIRB Project Certificate No.006 T&C 9, and an option/alternative to build and operate an onsite airstrip.

The continued mine life of Meliadine Extension will support the vision and contribute to the goals of persons enrolled under the Nunavut Agreement (Inuit as expressed by Nunavut Tunngavik Incorporated [NTI] and KivIA). Benefits will accrue to Kivalliq Inuit from the Inuit Impact and Benefit Agreement (IIBA),

[1] The Meadowbank Project Certificate does include language for cruising altitudes (610 m) and 1,000 m vertical and 1,500 m horizontal distance from observed concentrations of migratory birds, which are also included in the Meliadine Project Certificate No.006 (T&C 69).

employment and business opportunities. Extending the LOM will ensure employment stability and continued business opportunities. Skills learned will continue to be used for an additional decade.

Agnico Eagle will continue exploration activities with the objective to extend the LOM beyond 2043. Inuit employment opportunities will be maximized throughout the LOM.

Meliadine Extension improves the overall project by adding jobs and by expanding jobs and business opportunities with the addition of 11 years to the LOM.

2 MELIADINE EXTENSION COMPONENTS AND ACTIVITIES

2.1 Meliadine Extension Design

The Meliadine Extension primarily consists of amending the Water Licence 2AM-MEL1631 to include the mining of Pump, F Zone, Wesmeg, and Discovery deposits that were previously assessed and approved for open pit mining activities by NIRB. Based on the additional geological information collected since the 2014 FEIS, Agnico Eagle refined the open pit and underground mine designs and reviewed the infrastructure required to support mining activities.

As part of this Application, Agnico Eagle is proposing the following changes:

- underground mining and associated saline water management infrastructures at the Pump, F Zone, and Discovery deposits that were previously assessed and approved for open pit mining activities by NIRB;
- development of a new portal and associated infrastructures in the Tiriganiaq-Wolf area to improve access to and expand the existing Tiriganiaq underground mine;
- construction and operation of a windfarm to reduce GHG emissions (Project Certificate No.006 T&C 9);
- use of additional borrow pits and quarries to replace depleted sources and build a road to the windfarm, Tiriganiaq-Wolf portal, airstrip, road to Discovery and other deposits; and
- extension of the operation phase (LOM) by 11 years to 2043.

Agnico Eagle is also seeking approval for the following options/alternatives should it be required:

- construction and operation of an on-site airstrip to increase site access flexibility; and
- use of exhausted pits to store tailings and waste rock to complement the current waste management strategy.

The Meliadine Extension, other than the proposed alternatives, was previously assessed by NIRB in the 2014 FEIS and should not be included within the scope of any NIRB reconsideration. Updates to the mine plan triggers inclusion of water and waste management infrastructures, which is reviewed as part of the Water Licence Amendment process. As part of Meliadine Extension, Agnico Eagle will continue to conduct design studies with both the cold northern climate and remote location as the principal engineering considerations for successful design, construction, and operations. Consistent with the 2014 FEIS, and other Agnico Eagle mines in Nunavut, the planned activities to Meliadine Extension as described in the 2014 FEIS were designed to minimize the areas of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to a post-mining use for traditional pursuits and wildlife habitat.

In designing the Meliadine Extension activities, Agnico Eagle has worked to optimize the overall footprint of its proposed operation and its associated facilities.

The most current concepts have been selected for Meliadine Extension design and are an extension of current practices (i.e., mining, processing, and effluent treatment). The technologies are considered state-of-the-art, and the Meliadine project team have adapted to difficult climatic conditions and have designed infrastructure accordingly and used up-to-date technology to solve problems.

Agnico Eagle intends to continue using familiar, proven approaches seen at many mining operations in production today and will be continually addressing problems using proven newest technologies to improve mining efficiency, production efficiency, reduce fuel consumption, and ultimately reduce emissions.

2.2 Meliadine Extension Phases

The initial construction phase for the Meliadine Extension will commence in 2024 upon reception of permits and approvals. Construction will continue through the operation phase to prepare for mining of new deposits. The mine development sequence and life of mine summary for all deposits are presented in Table 2.2-1 and Table 2.2-2.

The NIRB approved Meliadine Mine was scheduled to be completed in 2032. With the Meliadine Extension, it is proposed to extend the LOM (i.e., operation phase) until 2043. Agnico Eagle will continue exploration activities with the objective to extend mine life beyond 2043.

Closure will extend for 7 years as pits are being re-flooded, from 2044 to 2050. Similar to the 2014 FEIS, most removal or demolition of buildings and infrastructure will occur at the end of the operation phase, and would be done in the first two years of decommissioning. Reclamation work should be completed within 3 to 4 years of the closure. The filling of open pits with water would extend until the end of the closure phase. During closure, all saline water will be pumped to the underground and surface contact water, as well as local runoff and precipitation will be stored in the pits to enhance reflooding activities. Active reflooding will be conducted with water to be pumped from Meliadine Lake. There will be no discharge into Meliadine Lake or to Itivia Harbour during this phase.

Post-closure will be initiated when flooded pits are reconnected to the surrounding environment and will last 10 years, from 2051 to 2060. For additional details regarding closure and post-closure, please refer to the Conceptual Closure and Reclamation Plan (Appendix D-18).

Table 2.2-1: Meliadine Extension Mine Development Sequence

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047-2050	2051-2060
Approved Mining																													
Tiriganiaq Deposit	■	■	■	■	■																								
Construction																													
Infrastructure					■	■	■	■	■	■	■	■	■																
Dewatering & Fish out					■	■	■	■	■	■																			
Tiriganiaq Deposit																													
Open Pit					■	■	■	■										■	■	■	■	■	■	■					
Underground					■	■	■	■	■	■	■	■	■	■	■	■	■	■											
Wesmeg Deposit																													
Open Pit					■		■	■	■	■	■							■	■	■	■	■	■						
Pump Deposit																													
Open Pit									■	■	■	■	■	■	■	■	■												
Underground										■	■	■	■	■	■	■													
F Zone Deposit																													
Open Pit											■	■	■	■	■	■	■												
Underground														■	■	■	■	■	■	■									
Discovery Deposit																													
Open Pit												■	■	■	■	■	■												
Underground							■	■	■	■	■	■																	
Tiriganiaq-Wolf Mining Area																													
Underground															■	■	■	■	■	■	■	■	■	■					
Closure																													
Infrastructure																									■	■	■		
Flooding																									■	■	■	■	
Post-Closure																													
Monitoring																													■

Table 2.2-2: Life of Mine Summary for All Deposits

Year	Total Ore Open Pit (t)	Total Waste Rock Open Pit (t)	Total Ore Underground (t)	Total Waste Rock Underground (t)	Total Saline WRSF (t)	Total Tailings Stored in TSF (t)	Total Overburden (t)
2020	201,105	2,424,133	1,722,231	832,179	-	857,637	693,226
2021	209,456	1,506,696	1,853,757	708,224	-	1,043,775	3,349,130
2022	805,698	2,593,910	1,795,949	668,700	-	1,036,149	1,221,917
2023	522,170	4,268,265	1,784,634	791,648	-	1,258,243	1,194,525
2024	1,162,317	4,680,005	1,914,255	836,442	-	1,439,030	623,602
2025	1,335,751	5,333,152	1,875,054	872,577	113,528	1,446,644	787,056
2026	1,682,088	3,062,755	1,830,249	979,387	161,238	2,354,955	2,225,166
2027	869,780	6,916,269	2,021,221	1,174,276	389,231	2,334,117	2,087,886
2028	777,060	9,286,915	2,509,795	1,125,163	55,128	2,273,527	1,918,261
2029	919,527	10,669,542	2,621,861	1,067,906	(191,571)	2,319,689	350,370
2030	1,227,191	8,313,774	2,304,465	1,209,051	178,681	2,339,819	2,432,426
2031	788,971	9,470,241	2,193,953	1,108,828	171,541	2,290,915	1,716,222
2032	741,908	9,583,821	2,391,155	1,006,758	111,522	2,338,642	1,655,221
2033	613,935	10,383,475	2,226,433	677,785	215,335	2,333,300	989,498
2034	793,675	11,206,325	2,167,472	512,589	112,344	2,350,769	-
2035	695,610	8,978,764	2,265,949	601,856	171,049	2,361,679	2,217,665
2036	1,479,607	8,636,056	2,479,570	521,334	58,783	2,366,867	1,818,870
2037	567,985	5,949,811	2,390,134	587,040	(111,623)	2,541,827	5,373,987
2038	1,252,010	10,728,043	1,335,433	297,488	(560,472)	3,102,500	19,947
2039	1,676,609	10,323,391	1,171,605	96,872	(523,102)	3,102,500	-
2040	1,727,495	7,379,533	546,805	153,786	-	3,102,500	2,790,454
2041	670,280	10,152,255	540,649	41,862	-	3,102,500	1,171,814
2042	1,098,670	10,791,759	419,008	-	-	3,093,632	-
2043	631,021	1,936,032	176,847	-	-	808,256	-
Total (t)	**22,449,918**	**174,574,923**	**42,538,482**	**15,871,751**	**351,609**	**51,599,471**	**34,637,243**
Total (Mt)	**22.4**	**174.6**	**42.5**	**15.9**	**1.1**	**51.6**	**34.6**
2014 FEIS Total (Mt)	**27.0**	**373.3**	**11.1**	**5.3**	**0**		**57.0**

2.3 Detailed Meliadine Extension Proposal Description

The facilities already assessed under NIRB Project Certificate No.006 and included in the scope of permit under Type A Water Licence 2AM-MEL1631 include: a power plant, mill, camp, heli-pad, maintenance shop, laydown areas, Meliadine and Rankin Inlet tank farm, Waste Rock Storage Facilities (WRSFs), Tailings Storage Facility (TSF), an ore stockpile, landfill, incinerator, landfarm, emulsion plant, a potable water and sewage collection and treatment system, contact and saline treatment system, water intake, diffuser, quarries and borrow pits, AWAR and bypass road, access roads, water management infrastructure (e.g., saline and contact water collection ponds, channels, dikes, berms, jetties, pump systems and pipelines, and culverts), and Tiriganiaq open pits and underground.

The Meliadine Extension comparative to the approved Meliadine Mine activities is defined in Table 1.1-1 and shown in Figure 1.1-3. The general mine site layout of this Application is provided in Figure 1.1-4 and Figure 1.1-5. A list of updated engineering figures is provided in Appendix C.

2.3.1 Ore Deposits and Mining

The mining methods used for the open pits and underground mines will follow similar extraction methods as per the 2014 FEIS which consist of a conventional truck/shovel method for the open pits, and long hole mining with some mechanized cut and fill in flat areas for underground. The configuration will be a mix of transverse and longitudinal stoping. Scoop and truck equipment will be used to extract material which will be transported the ore stockpiles. Stopes will be backfilled with rock fill, cemented rock fill and/or paste fill.

Mining method includes the segregation of waste rocks coming from the underground mines and open pits. Dedicated waste rock facilities will be built to facilitate management of material coming from underground portions to keep it separate from open pit materials.

The combined total tonnages of all deposits throughout the life of the mine for Meliadine Extension include:

- 65 Mt of ore (22.4 Mt open pit and 42.5 Mt underground)
- 191.6 Mt of waste rock (174.6 Mt open pit, 15.9 Mt underground, and 1.1 Mt saline WRSF)
- 34.6 Mt of overburden

In comparison, the 2014 FEIS included the following:

- 38 Mt of ore (27 Mt open pit and 11 Mt underground)
- 378.6 Mt of waste rock (373.3 open pit, 5.3 Mt underground)
- 57 Mt of overburden

Table 2.2-2 provides a summary of the total tonnages of all the deposits over the LOM, as well as a comparison to the totals provided in the 2014 FEIS. The mining plan, including the sequence of development of the different deposits, is provided in more detail in Section 2.2. A summary is provided in Table 2.2-1.

Geology and Geochemistry of the orebodies is described in Section 6.2 of this Application.

2.3.2 Ore Stockpile Facilities, Processing, and Tailings Management

The originally proposed locations for ore storage at Meliadine (2014 FEIS) were two large pads to the southeast of the Industrial Pad, encompassing numerous waterbodies in watersheds H and J. For the 2015 application for the Type A Water Licence, the locations of the proposed ore storage facilities had moved closer to the Industrial Pad and primary crusher, with three smaller ore storage pads proposed instead of two large pads. Multiple changes were made to the configuration of various infrastructures within the Industrial Pad footprint since the 2015 application. As the general location of OP2 did not change, it was decided during detailed design of the facility to expand this originally planned footprint to incorporate the available remaining footprint of the previously planned OP1 and maximize the storage space next to the crusher during detailed design. For Meliadine Extension, this area will continue to be used.

For this Application, there will be new temporary ore stockpiles adjacent to the pits and portals at Pump, F Zone, Tiriganiaq-Wolf, and Discovery (Figure 1.1-4 and Figure 1.1-5). The stockpiles are being added to facilitate ore handling and increases productivity of mine fleet which allows for more efficient equipment to transport the ore on a long distance (e.g., specific site to mill). Ore will be segregated by provenance and by ore grade. The ore will either be transported directly to the Approved mill and crusher for processing or will be temporally stockpiled at OP2.

Contact water from the stockpiled ore material will be captured and redirected to the proper Attenuation Ponds.

Agnico Eagle will continue to adhere to management practices in accordance with the Ore Storage Management Plan (Appendix D-27).

The upper milling rate is not expected to change from the current 8,500 tpd rate but will extend in time until the new proposed end of LOM.

Tailings will continue to be deposited in the approved TSF, authorized under Project Certificate No.006 and Type A Water Licence 2AM-MEL1631. The dry-stack TSF will be extended to accommodate additional tailings produced by the extension of the LOM. The footprint of the dry-stack will remain within the assessed and approved footprint of the original 2014 FEIS.

2.3.3 Overburden and Waste Rock Management

As per Table 2.2-2, amount of overburden and waste rock to be generated by open pit and underground mining activities during the Meliadine Extension mine life are within the scope of the 2014 FEIS.

Waste rock and overburden generated from open pits activities will be placed in one of the WRSF assessed. Overall, the total WRSF surface area will be half the size of the original application and will mostly be within the 2014 FEIS footprint (Agnico Eagle 2014). Most of the material will be stored within one of the following WRSFs (Figure 1.1-4 and Figure 1.1-5):

- **WRSF1 and WRSF1_Ext:** located within the footprint of the approved B7 WRSF. The area is within the 2014 FEIS footprint.
- **WRSF3 and WRSF3_Ext:** WRSF3 is increased to the south with the addition of WRSF3_ext.
- **WRSF5:** Located near approved B4 WRSF. The area is within the 2014 FEIS footprint.
- **WRSF6:** Located within the footprint of approved B4 WRSF. The area is within the 2014 FEIS

footprint.

- **WRSF7:** Located within the footprint of approved A45 WRSF. The area is within the 2014 FEIS footprint.
- **WRSF9**: Located northwest of the Discovery pit. The location has changed from that presented in the 2014 FEIS, but the area is smaller than in the 2014 FEIS.

Per the 2014 FEIS, the piles will be designed and operated to minimize the impact on the environment and considering geotechnical stability and geochemical considerations. The material will be generally transported by truck and end-dumped, following a sequence developed for the operation. Waste rock and overburden will be managed within the same area.

Discovery WRSF (i.e., WRSF9) contains rock with potential for acid generation or potential to leach metals and will require a thermal cover to reduce potential impacts on the environment.

Although not required for the management of metal leaching and acid rock drainage (ARD) potential, waste rock and overburden will be disposed on land and in a manner that encourages total freezing. Based on experience, it is expected that the material within each pile will freeze within two years of placement, but this needs to be confirmed with thermal analyses. Several thermistors will be placed during operation to confirm the rate of freezing for the various material cells and modify the management if required.

Waste rock generated from the underground mining activities will be separated from the open pit waste rock and stored in a separate WRSF. The underground waste rock will be temporarily stored in a saline WRSF on surface before being brought back underground throughout the mine life. All saline WRSFs will be removed at closure. The four saline WRSF are:

- Pump (Saline WRSF 1)
- F Zone (Saline WRSF 2)
- Discovery (Saline WRSF 3)
- Tiriganiaq-Wolf (Saline WRSF 4)

Agnico Eagle will continue to adhere to management practices outlined in the Mine Waste Management Plan (Appendix D-21).

2.3.4 Water Management

No change to the water management strategy is anticipated based on the current state of the Meliadine Mine, Meliadine Extension, and related Water Licence and amendments. Water management proposed for Meliadine Extension is consistent with approved approaches.

The general water management strategy is to limit surface flow entering the mine footprint and restrict uncontrolled surface contact water releases from the mine footprint to the environment to limit impacts on the receiving environment. In developing the water management plan, the following guiding principles were followed:

- segregate water as much as possible (non-contact, contact, and saline water);
- control and minimize contact water through diversion and containment;
- minimize or eliminate surface contact water discharges to Meliadine Lake as per Exhibit 23 of waterline hearing (NIRB Public Registry ID. 335793; KivIA 2021) and reflected in Term and Condition 25 per Project Certificate Amendment 002; however, the opportunity to minimize discharge to Meliadine Lake can only occur if the waterline is operational and conditions at the site are within the Normal Operating Conditions as defined in the Adaptive Management Plan (Appendix D-01). Normal operating conditions refer to:
  - Saline water capacity at site is less than 70% (open-water), <5% pre-freeze up, and <15% pre-freshet.
    - The pre-freeze up period starts no earlier than September 15.
  - The dual waterline is operational and the capacity is 6,000 to 12,000 m^3/day of saline water and up to 8,000 m^3/day of surface contact water, for a total capacity of 20,000 m^3/day.
    - The regular operational window for the waterline is open-water conditions from approximately late June to mid-October (or until consistent sub-zero temperatures are observed).
  - Surface contact water capacity at site is less than 81% (open-water), less than 14% pre-freeze up, and less than 22% pre-freshet.
  - End-of-pipe concentrations (CP1) for TDS are less than the maximum average concentration as defined in Water Licence 2AM-MEL1631.
- avoid placing collection ponds within overburden, site collection ponds within bedrock, or in lakes;
- minimize freshwater consumption by recycling and reusing the contact and process water wherever feasible; and
- meet discharge criteria before any site contact water is released to the receiving environment.

Please refer to the updated Water Management Plan (Appendix D-35), Groundwater Management Plan (provided as an appendix in Appendix D-35), Adaptive Management Plan (Appendix D-01) for additional details.

2.3.4.1 Water Management Infrastructure

As per the 2014 FEIS, infrastructures will include saline and contact water collection ponds, dikes, berms, culverts, channels, and sumps.

Additional saline ponds will be built at F Zone, Tiriganiaq-Wolf, Pump, and Discovery to collect and segregate water originating from underground mines. This water will continue to be managed via the waterline.

Additional culverts will be required along the new proposed access roads to Tiriganiaq-Wolf.

For further information refer to the updated Water Management Plan found in Appendix D-35.

2.3.5 Water Supply & Water Treatment Facilities

2.3.5.1 Water Supply

Freshwater and potable water use will extend for operations until 2043 and Meliadine Lake will continue to be the intake. Freshwater for dust suppression will continue to be sourced from small lakes and ponds proximal to the road and/or to Meliadine River.

Through the 2014 FEIS (Volume 2, Table 2-27; Agnico Eagle 2014), freshwater consumption needs were assessed at 2,168,100 m^3/year (including a 25% contingency). Agnico Eagle does not propose changes to the overall authorized total consumption from Meliadine Lake as part of Meliadine Extension.

2.3.5.2 Water Treatment Complex

Contact water will be treated for total suspended solids (TSS) in the Effluent Water Treatment Plant (EWTP) if required and discharged into Meliadine Lake.

Saline water will be treated for ammonia (NH3) and TSS if required in the Saline Effluent Treatment Plant (SETP). A pre-treatment plant could be installed to complement the Saline Effluent Treatment Plant if required. Treated water will be conveyed to Rankin Inlet via waterline and discharged at Itivia Harbour through a diffuser. Discharge will be done in accordance with MDMER applicable limits.

Saline water will be treated through the SETP prior to being discharged at Itivia Harbour.

A Reverse Osmosis Plant is also in place to treat TDS from CP5. As per the Adaptive Management Plan, normal operation consists of discharging water from CP5 to Itivia Harbour with the Waterline. If concentration are above TDS discharge criteria in Meliadine Lake and the Waterline is not available, Reverse Osmosis Plant could be used

For Discovery, contact water will be conveyed via the waterline along the Discovery Road to the SETP and discharged at Itivia Harbour using the existing waterline.

Sewage water will be treated in the Sewage Treatment Plant (STP) for Biological Oxygen Demand, TSS and bacteria prior to be conveyed to CP1. An additional plant will be required to accommodate the increased number of employees for Meliadine Extension.

2.3.6 Lakes and Ponds Dewatering, Fishout, and Reflooding

Agnico Eagle will complete the fishout and dewatering of some ponds and lakes within the mine's footprint. This activity will require DFO authorization and/or MDMER Schedule 2 listing. As part of the 2014 FEIS, 77 lakes and ponds were to be impacted. A total of 33 of these were reviewed and included in DFO's 2015 Letter of Advice (DFO 2015).

Since the 2014 FEIS and DFO's 2015 Letter of Advice, the *Fisheries Act* was amended to include protection of small-bodied fish and their habitat in addition to protection of large-bodied fish and their habitat. As such, a request for review including 46 waterbodies not already approved by the 2015 Letter of Advice will be submitted to DFO (Table 2.3-1) and 12 waterbodies will be included in the regulatory amendment application to MDMER Schedule 2 (Table 2.3-2). Please refer to the Conceptual Fish Offsetting Plan (Appendix D-26) for additional details.

Table 2.3-1: Fish and Fish Habitat Lost through Project Infrastructure (Section 35)

A Watershed		B Watershed		H Watershed
Lake A6	Pond A3	Lake B7	Pond B39	Pond H15e
Lake A8	Pond A4	Pond B30	Pond B34	**I Watershed**
Pond A37	Pond A5	Pond B31	Pond B36	Pond I1
Pond A35	Pond A32	Pond B32	Pond B37	**J Watershed**
Pond A7	Pond A34	Lake B4	Pond B38	Pond J2
Pond A44	Pond A50	Lake B5	Pond B59	Pond J3
Pond A45	Pond A51	Lake B6	Pond B60	Pond J7
Pond A49	Pond A52	Pond B19	Pond B61	Pond J8
Pond A2	Pond A19	Pond B22	Pond B62	
Pond A2A	Pond A53	Pond B25	Pond B63	

Table 2.3-2: Fish and Fish Habitat Lost by Deposit of Mine Waste (Section 36)

A Watershed	B Watershed		J Watershed
Pond A52	Lake B4	Pond B32	Pond J2
D Watershed	Lake B7	Pond B60	Pond J3
Pond D31	Pond B25	Pond B61	Pond J8
	Lake B34		

As per the 2014 FEIS, following completion of mining, the underground mines (Wesmeg, Pump, F Zone, Tiriganiaq-Wolf, and Discovery) and the pits (Wesmeg, Pump, F Zone, Discovery) will be flooded by a combination of natural runoff and contact water from the site. Flooding will commence at the beginning of closure and will last 7 years.

During the closure and post-closure phases, the water management infrastructure will be decommissioned when the water quality monitoring results meet discharge criteria to allow water to passively flow to the natural environment.

2.3.7 Rankin Inlet Infrastructure – Fuel Storage, Port Facility, Laydown Area, and Marine Discharge

There are no proposed changes from the approved 2014 FEIS activities for the Rankin Inlet Infrastructure. Containers, materials and equipment from barges will continue to be offloaded at the beach. A laydown yard area will continue to store incoming and outgoing containers, materials, and equipment pending truck delivery to the Meliadine Extension site by road. There are no proposed changes to the upper fuel storage limit of 80 ML.

Agnico Eagle will continue to adhere with the management practices outlined in the Spill Contingency Plan, Oil Pollution Emergency Plan, and Bulk Fuel Storage Facility: Environmental Performance Monitoring Plan (Appendix D-33, D-25, and D-09, respectively).

The 2014 FEIS did not include the assessment of discharge to Itivia Harbour; however, Agnico Eagle has since completed two FEIS Addenda (Agnico Eagle 2018a, 2020a) to evaluate the impacts to discharging to the marine environment. Subsequently, these Addenda were both approved by the Minister and are included in Project Certificate No.006, Amendment 001 and 002, respectively.

Agnico Eagle completed an assessment to discharge to Itivia Harbour at 6,000 to 12,000 m^3/day, and as an alternative, up to 20,000 m^3/day in the 2020 FEIS Addendum (Agnico Eagle 2020a). This included a discharge of a blend of saline and surface contact water.

Subsequently, as part of Meliadine Extension, Agnico Eagle completed an assessment to continue discharge at a rate of 20,000 m^3/d through the waterline until 2043. There are no proposed changes to the discharge of water at Itivia for Meliadine Extension and it is consistent with Exhibit 23 of waterline hearing (NIRB Public Registry ID. 335793; KivIA 2021) and reflected in Term and Condition 25 per Project Certificate Amendment 002. Please refer to the Adaptive Management Plan for further details (Appendix D-01).

Water, which will be tested and analyzed prior and during discharge, will be conveyed via the waterline that runs from the Meliadine Mine site along the AWAR, Discovery road and bypass road, ending at the Rankin Inlet Infrastructure – Fuel Storage Facility. The diffuser is located at a depth of about 20 m at Itivia Harbour.

Agnico Eagle will continue to adhere to the management practices outlined in the Ocean Discharge Monitoring Plan (Appendix D-24).

2.3.8 Waste (Domestic and Hazardous) Management

2.3.8.1 Landfill

Consistent with the 2014 FEIS, Agnico Eagle does not propose changes to the on-site landfill located within WRSF1, and will continue to progressively fill in an orderly manner. An exact waste volume is not a critical parameter in the design because of the flexibility of design to accommodate extensions (larger to accept more waste) or contractions (smaller to accept less waste) within WRSF1. A landfill will also be built within the Discovery WRSF (i.e., WRSF9).

Agnico Eagle will continue to adhere to management practices in accordance with the Landfill and Waste Management Plan (Appendix D-20).

2.3.8.2 Hazardous Waste

Consistent with the 2014 FEIS, Agnico Eagle does not propose changes to the approved handling and disposal of hazardous waste. Hazardous material is segregated at site and will continue to be shipped to an approved disposal location in the south. Hazardous management will be implemented in accordance with the approved Hazardous Material Management Plan (Appendix D-15).

2.3.8.3 Incineration

Consistent with the 2014 FEIS, Agnico Eagle does not propose changes to the incinerator currently in place, which were selected based on ECCCs *Technical Document for Batch Waste Incineration*. The incinerators are in their own buildings on the south end of the industrial pad, down-wind of other mine infrastructure.

Agnico Eagle will continue to adhere to management practices in accordance with the Incineration and Composter Waste Management Plan (Appendix D-16).

2.3.8.4 Composter

Agnico Eagle is proposing to add one composter at the Meliadine site to improve waste management. Organic material including food, paper and cardboard, and dead animal (small sized only) would be diverted from the incinerator to the composter. The composter will be located in the same building as the incinerator. Further details are provided in the Incinerator and Composter Waste Management Plan (Appendix D-16).

2.3.8.5 Landfarm

Consistent with the 2014 FEIS, Agnico Eagle does not propose changes to the three currently approved landfarms; however, two additional landfarms will be added at the Wesmeg and Discovery deposits (Figure 1.1-4 and Figure 1.1-5) which will also be designed to receive soils, rock, snow, and ice contaminated with petroleum hydrocarbons (includes light hydrocarbons such as diesel and gasoline). The locations of the landfarms were chosen to minimize the footprint of the site and the transport distance of contaminated material from potential spill locations.

Agnico Eagle is also proposing to change the soil remediation criteria used for the Abandoned Military Site Reclamation Protocol guidelines for the protection of human health and the management limit These are more appropriate for the Meliadine site.

Agnico Eagle will continue to adhere to management practices in accordance with the Landfarm Management Plan (Appendix D-19).

2.3.9 Site Access, Access Roads, and Associated Water Crossings

Consistent with the 2014 FEIS, no changes are proposed to the AWAR and bypass road as approved under the 2014 FEIS. The AWAR and bypass road will continue to provide year-round access to the Meliadine Mine.

The Rankin Inlet airstrip will continue to be used to transport workers and cargo.

The 2014 FEIS assessment included the evaluation of access roads to Discovery, Pump, F Zone, and Wes-Wesmeg-North deposits; however, these access roads were not constructed as only the Tiriganiaq deposit was advanced per the Type A Water Licence 2AM-MEL161. Subsequently in August 2020, the Type A Water Licence Amendment (Agnico Eagle 2020b) included the construction of the access roads to Discovery, Pump, F Zone, and Wesmeg deposits as they are within the previously assessed footprint of the FEIS (Agnico Eagle 2014). This Minister approved this amendment on June 23, 2021. There are no changes proposed to these access roads as part of Meliadine Extension.

However, new access roads to the Tiriganiaq-Wolf mining area, airstrip, and to wind turbine locations will be constructed. It is anticipated that two roads will be constructed to the Tiriganiaq-Wolf deposit, one to the north of Lake D7 and one to the south. The road north of Lake D7 will have a few watercourse crossings (D6 to D22, and D6 to D5). The access roads will be constructed using waste rock or aggregates from quarry and borrow pit sites, and top-dressed with esker, quarry material or crushed open pit waste rock (see Section 2.3.11).

Agnico Eagle will continue to adhere to the management practices outlined in the Roads Management Plan (Appendix D-30) and Terrestrial Environment Management and Monitoring Plan (TEMMP; Appendix D-34).

2.3.10 Marine Shipping

There are no changes to the shipping methods and practices. All shipping is carried out during the open water season (typically from early August to late October) and follows established shipping lanes that are presently in use for the annual sealift to Rankin Inlet and other communities. There is no ice breaking to extend the shipping season. Ships are not serviced in Rankin Inlet and arrive with enough fuel for the return voyage south.

Agnico Eagle has made commitments in the past through the Whale Tail Project to avoid travel between Southampton and Coats Island. Marine shipping activities are to stay south of Coats Island to avoid sensitive wildlife habitat and species along the shipping route, subject to vessel and human safety considerations. Agnico Eagle will continue to adhere to the shipping route as committed to as reasonably practical.

Agnico Eagle will continue to adhere the management practices outlined in the Shipping Management Plan (Appendix D-31).

2.3.11 Borrow Pits and Quarry Sites

For the 2014 FEIS Assessment, construction of the AWAR, access roads, and storage/operation pad(s), Agnico Eagle utilized a series of quarry/borrow pit sites, which are included in Table 2.3-3, along with the status.

Table 2.3-3: Approved Quarries / Eskers for Meliadine

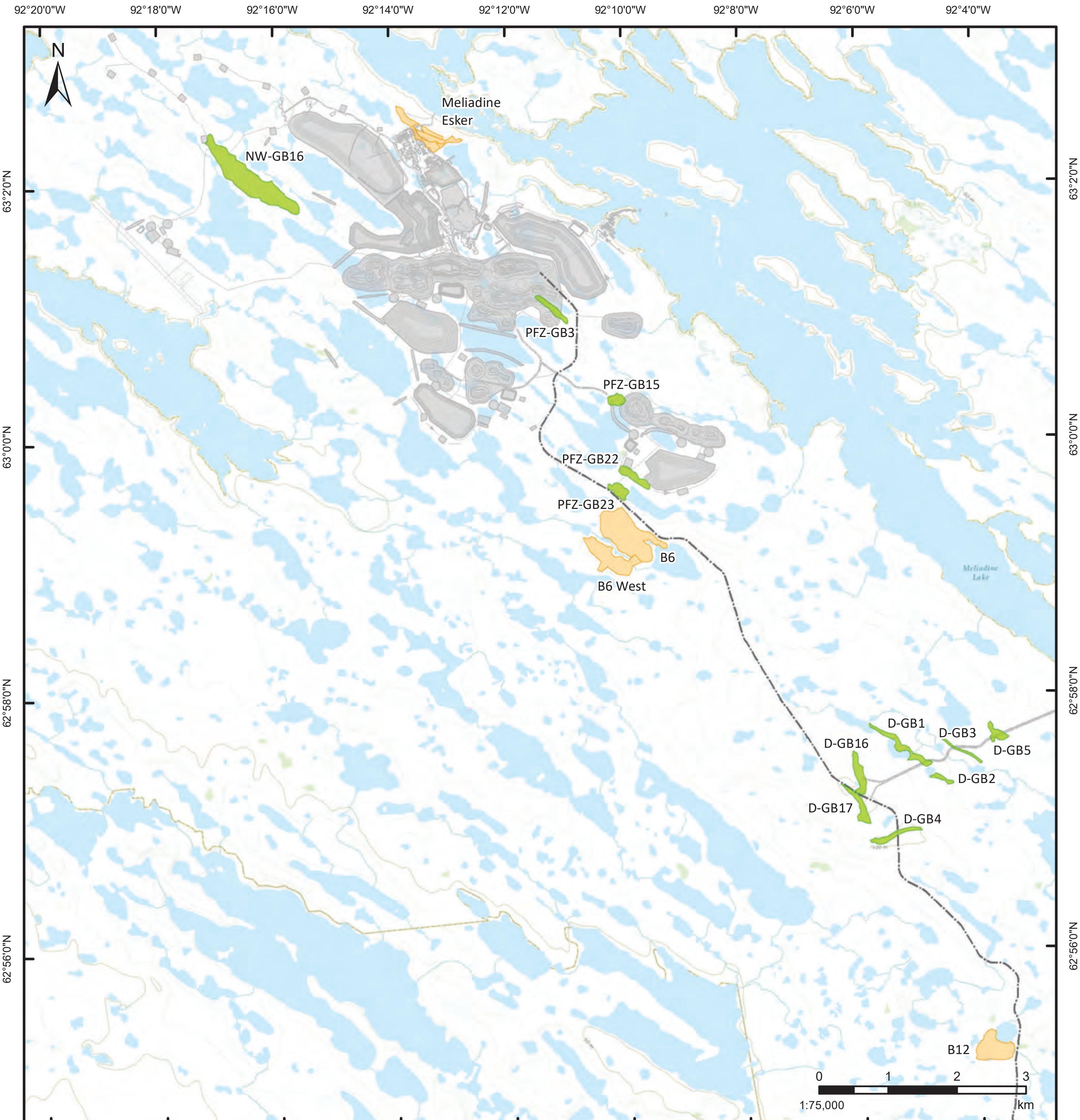
Quarry/ Borrow Pit	Status
R5	Never used and not planned to be used in future
R14	Depleted and rehabilitated, not planned to be used in the future
R19	Never used and not planned to be used in future
B5	Depleted and rehabilitated, not planned to be used in the future
B6A	Depleted and rehabilitated, not planned to be used in the future
B6 West	Still has material
B10	Depleted and rehabilitated, not planned to be used in the future
B11A	Depleted and rehabilitated, not planned to be used in the future
B12	Still has material, partially rehabilitated
B13	Depleted and rehabilitated, not planned to be used in the future
B15	Depleted and rehabilitated, not planned to be used in the future
Emulsion Esker	Depleted and rehabilitated, not planned to be used in the future
Westmeg Esker	Depleted and rehabilitated, not planned to be used in the future
Meliadine Esker	Still has minimal amount of material, partially rehabilitated

As with the 2014 FEIS, Agnico Eagle will look for opportunities to use clean open pit waste rock material for construction requirements on top of the borrow pits and/or quarry sites. For this Application, Agnico Eagle has assumed additional material will be needed to complete the construction of the access roads, laydown areas, water management structures, and the airstrip. Potential sites are presented in Table 2.3-4 and Figure 2.3-1. Agnico Eagle does not intend on using all these borrow pits/quarry sites, rather an upper limit of 530,095 m^2 will be disturbed for material excavation. Once that surface area has been reached, other borrow pits/quarries will not be used. An additional amount of 1.6 Mm^3 of waste rock will also be used for construction purposes.

Management, mitigation, and monitoring of borrow pits and quarry material will be implemented in accordance with the Borrow Pits and Quarries Management Plan (Appendix D-08).

Table 2.3-4: Proposed Borrow Pits for Meliadine Extension

Borrow Pit	
NW-GB16	D-GB1
PFZ-GB3	D-GB2
PFZ-GB15	D-GB3
PFZ-GB22	D-GB4
PFZ-GB23	D-GB5
	D-GB16
	D-GB17



Meliadine Extension

Location of Borrow Pits and Quarries

Date: 3/8/2022
Map Number: MEL-015
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

- Approved Borrow Pit Sources
- Potential Borrow Pit Sources for Meliadine Extension
- Meliadine Extension
- All-Weather Access Road (AWAR)

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2.3.12 Power Generation

Consistent with the 2014 FEIS, Agnico Eagle does not anticipate any changes to the existing and approved Power Plant, which will continue to be operated as a diesel generated facility. However, to evaluate long-term objectives of displacing high carbon emissions from diesel generators with lower carbon emissions from wind turbines, Agnico Eagle completed an assessment to include a windfarm as part of this Application.

In addition, this fulfills the requirement of Project Certificate No.006 T&C 9, which states the following:

> *"Prior to the commencement of operation, the Proponent shall develop a Greenhouse Gas Emissions (GHG) Reduction Plan which includes, but is not limited to:*
>
> a. *An estimate of the Project's GHG baseline emissions;*
> b. *A description of monitoring measures to be undertaken, including the methods, frequency, parameters and a description of data analysis; and,*
> c. *A description of mitigative and adaptive strategies planned, and taken, toward reducing the Project-related emission of greenhouse gases over the Project's life."*

To build and operate the windfarm, Agnico Eagle could partner with the community or use internal resources. Other objectives for the windfarm include:

- providing solutions to reduce the reliance on conventional fuels for power needs; and
- reducing the risk and impact to the environment of fuel transportation, handling, and burning.

A windfarm is a standalone feature that could be placed at the Meliadine Mine site that would have the smallest footprint compared to the other alternatives considered (refer to Section 2.5.5), as an economically and technically viable alternative for the Arctic in consideration of similar projects north of 60 degrees in Canada (e.g., windfarms at the Diavik Diamond Mine in Lac de Gras, Northwest Territories, Raglan Mine renewable electricity smart-grid in Nunavik, Northern Quebec).

The windfarm location was selected based on proximity with mine site infrastructures and maximum wind-power generation (refer to Figure 2.3-2). The sites for wind turbine placement and associated access roads were selected by studying the wind resource maps, location of the proposed on-site airstrip, archaeology sites, land use, wildlife and vegetation baselines, and cost of infrastructure around the Meliadine Mine site. An unobstructed exposure to north-western prevailing winds in the area was a critical factor in determining the proposed layout for turbine placements. Terrain conditions were also considered to ensure easy access to the sites and erecting the wind turbines.

Meliadine Extension

0 1 2 3
1:60,000 km

Legend

Wind Turbine

Meliadine Extension

All-Weather Access Road (AWAR)

Date: 12/8/2021

Map Number: MEL-007

Coordinate System: NAD 1983 UTM Zone 15N

Projection: Transverse Mercator

Datum: North American 1983

AGNICO EAGLE

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The windfarm is planned to be built in a phased approached; whereby wind turbines will be constructed based on needs and other economic factors. It is anticipated that wind turbines N1 to N5 (Figure 2.3-2) would be constructed during a first phase. The AWAR (including the bypass road to Itivia Harbour) and the Rankin Inlet barge landing area will be able to receive and allow transportation of the wind turbine components to the Meliadine Mine site without requiring modifications. Heavy-equipment from the Meliadine Mine will be used where feasible, and extra equipment will be rented and barged in and out of the site via Rankin Inlet, as required.

Details of the preliminary design are provided in Appendix C.

It is anticipated that the proposed wind turbines will operate for the duration of the Meliadine Mine life but may be extended as exploration continues.

Agnico Eagle will adhere to management practices in accordance with the Windfarm Management Plan and Greenhouse Gas Reduction Plan (Appendix D-36 and Appendix D-14, respectively).

2.3.13 Fuel and Explosives Facilities

2.3.13.1 On-site

Consistent with the 2014 FEIS, Agnico Eagle anticipates approximately 122 ML of diesel fuel per year for use at the Meliadine Mine and there is no change with Meliadine Extension.

For this Application Agnico Eagle anticipates that additional fuel storage at Pump, F Zone, and Discovery deposits will be needed. Each site will consist of four 75,000 L and one 50,000 L tanks for a total of 350,000 L per site (i.e., Pump, F Zone, and Discovery); for a combined total of 1,050,000 L. An additional 6 ML tank will be added adjacent to the existing fuel tanks on-site in the industrial pad area.

Consistent with Agnico Eagle best management practices, the storage tanks will be double walled and the whole area will be surrounded by impermeable berms to prevent a spill should the double wall leak. A fueling station will be in front of the fuel farm to allow fueling of mobile equipment. This station, as well as the equipment being refuelled, will also be sitting on a lined pad.

From Rankin Inlet, fuel will continue to be transported on a year-round basis by highway class tanker trucks to the Meliadine site via the bypass road and AWAR.

Agnico Eagle will continue to adhere the management practices outlined in the Spill Contingency Plan and the Bulk Fuel Storage Facility: Environmental Performance Monitoring Plan (Appendix D-33 and Appendix D-09, respectively).

2.3.13.2 Explosives Production and Storage Sites

Consistent with the 2014 FEIS, the total quantity of explosives needed is estimated at about 12,000 tons of emulsion per year (full production years) and there is no change with Meliadine Extension.

The existing emulsion plant and storage magazine located near the Meliadine Mine will be maintained for Meliadine Extension. A storage magazine will be added at the Discovery deposit. All explosives will be shipped to the Meliadine Mine site by the annual sealift and will be packaged and transported in accordance with Canadian regulations for the transport and storage of explosives. Consistent with the 2014 FEIS, waste water generated by the emulsion plant will be re-used within the plant when feasible and any excess used water will be evaporated (remaining solids will be disposed in the same manner as unusable emulsion). Any unusable emulsion waste will be taken to the mine blast patterns for disposal down the boreholes.

Agnico Eagle will continue to adhere to explosive management and blasting practices outlined in the Ammonia Management Plan and Explosives Management Plan (Appendix D-04 and Appendix D-13, respectively).

2.3.14 Maintenance, Warehouse, Laydown

Consistent with the 2014 FEIS activities, primary maintenance will occur using existing infrastructure at Meliadine Mine. The vehicle wash bay is equipped with an oil/water separation unit to allow residual hydrocarbons to be removed from the dirty wash water generated by washing of the vehicles. There are no changes proposed for Meliadine Extension activities.

In addition, there are no changes proposed for Meliadine Extension activities for the warehouse, which is designed to store small and medium-sized maintenance spares for the process plant, mine equipment, and plant support vehicles and equipment, including related consumables. A separate contained area inside the warehouse will be dedicated to the storage of special lubricants and greases. Large-sized process equipment spares will be stored in a dedicated laydown area on the east side of the process plant. The warehouse is also an open space area where numerous sea cans are stored.

2.4 Potential Future Developments

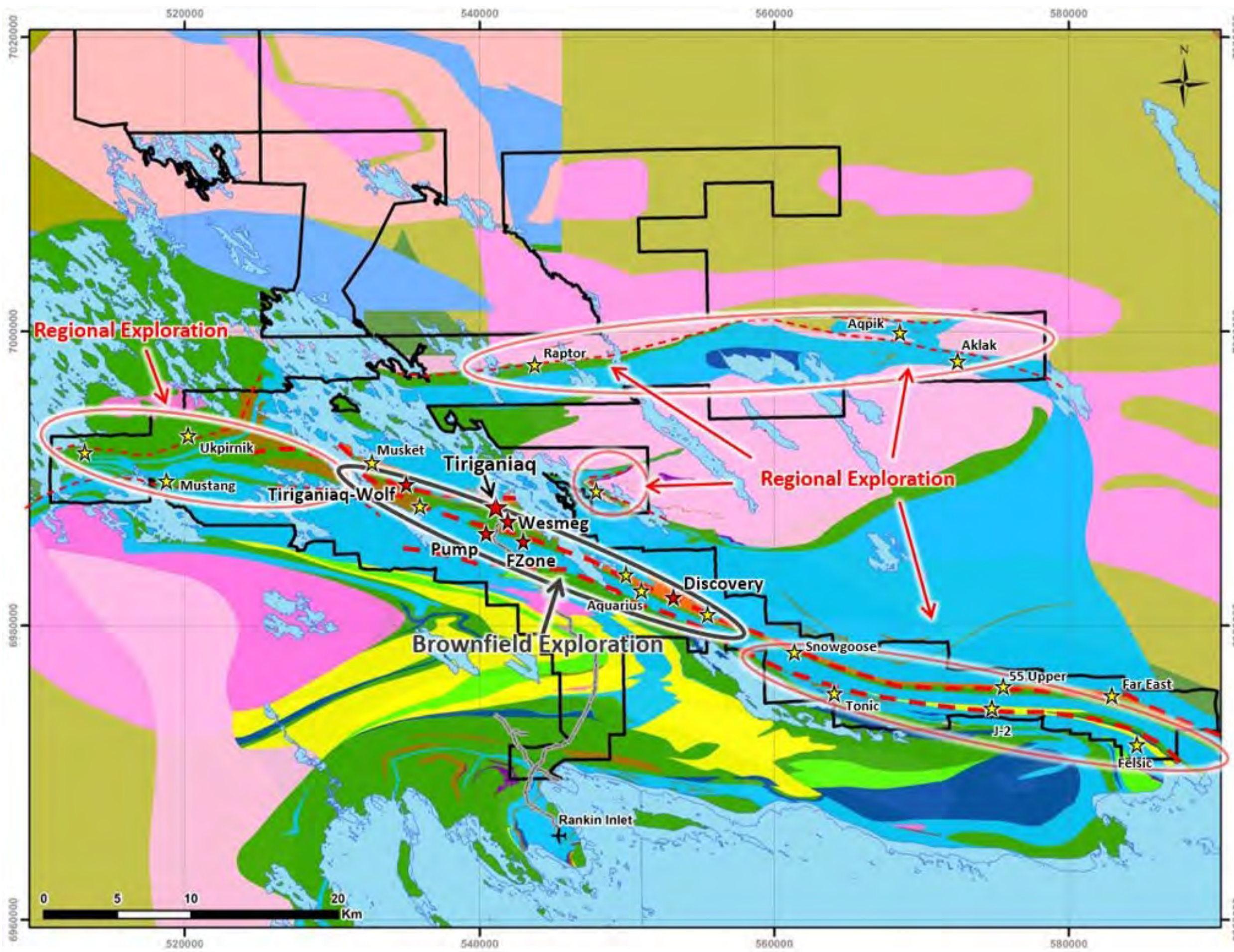
Agnico Eagle plans to be in Nunavut on a long-term basis and to remain a key contributor to the Kivalliq region by supporting local communities in a sustainable way. As such, exploration activities are undertaken on the Meliadine property with the objective to extend Meliadine Mine life beyond 2043. These ongoing exploration activities and potential mine life extension are part of the scope of the Meliadine Mine. The property is large and thus represents an extensive prospective land package to be explored. The scope of existing rights for the project includes all mineral tenures listed in this document as well as all previously issued and current regulatory approvals.

The current Meliadine project has many areas of interest, and as such form a good portion of the future of the Meliadine operation. The current orebodies of Tiriganiaq, Wesmeg, Pump, F Zone, and Discovery are a great platform from which Agnico Eagle intends to develop the area further. Development and site exploration will be concentrated in the zone containing the known orebodies and constitute great brownfield exploration potential (Figure 2.4-1).

Agnico Eagle will also continue regional exploration in the areas circled in red and this work could develop some additional mineral potential, which are part of the scope of this Application. Further, any and all access to such areas is included in the scope of such future development and are part of Agnico Eagle's existing rights, subject to the need to acquire any required surface access approvals from KivIA or the Crown.

As with all current development, Agnico Eagle intends to continue all its potential development efforts responsibly and following all regulations and Inuit landowner requirements as to the development of future properties.

Figure 2.4-1: Potential Future Developments included in scope of Application



2.5 Options/Alternatives to Meliadine Extension

Alternatives were considered during all stages of Meliadine Extension design. Consultation and regulatory engagement discussions have been considered as part of the alternatives assessment. In general, consistent with the 2014 FEIS, Meliadine Extension alternatives were evaluated according to the following criteria:

- Environmental – potential impacts to the environment, project footprint, reclamation;
- Engineering and Viability – best engineering practices, technology, permitting, risk, and flexibility;
- Economy – cost implications, construction capital, operating costs, maintenance cost for reclamation; and
- Society – community acceptance or preference, IQ and TK, health and safety, quality of life, employment, and socio-economic effects.

The following sections describe options/alternatives that shaped Meliadine Extension. For clarity, these two options are part of this Application as they may be pursued in the future.

2.5.1 Use of Exhausted Pits to Store Tailings

Agnico Eagle currently places all tailings at the Meliadine Mine in a TSF, where tailings have been deposited as dry stack. To ensure appropriate long-term planning to optimize the site footprint, Agnico Eagle is assessing the potential for in-pit slurry tailings deposition as an alternative to the dry stacking method currently employed. In-pit disposal would improve the current economics and mine planning, reduce overall freshwater consumption during closure reflooding, while using existing Meliadine Mill for ore processing facilities, within an area that has previously been impacted. Moreover, in-pit disposal would reduce the surface area impacted by the project by reducing the footprint of the TSF. During operations, Agnico Eagle would continue to use existing facilities and continue monitoring the mine operations, water use and water quality in accordance with Type A Water Licence 2AM-MEL1631 requirements as previously approved by NWB.

Agnico Eagle is approved for in-pit disposal at the Meadowbank Mine and has proven success with this method. As part of the Meadowbank in-pit tailings assessment, the Meadowbank Mine Dike Review Board supported the use of early in-pit tailings disposal as it has advantages with respect to health and safety, quality of life, water, air, capital cost, technology, natural hazards, and adaptability.

Agnico Eagle is evaluating locations for in-pit tailings deposition. Current open pits assessed (i.e., WES01, WES04, WES05, WN01, PUM01, PUM03) are shown on Figure 2.5-1. Refinements will be further assessed as part of the Type A Water Licence amendment with the NWB.

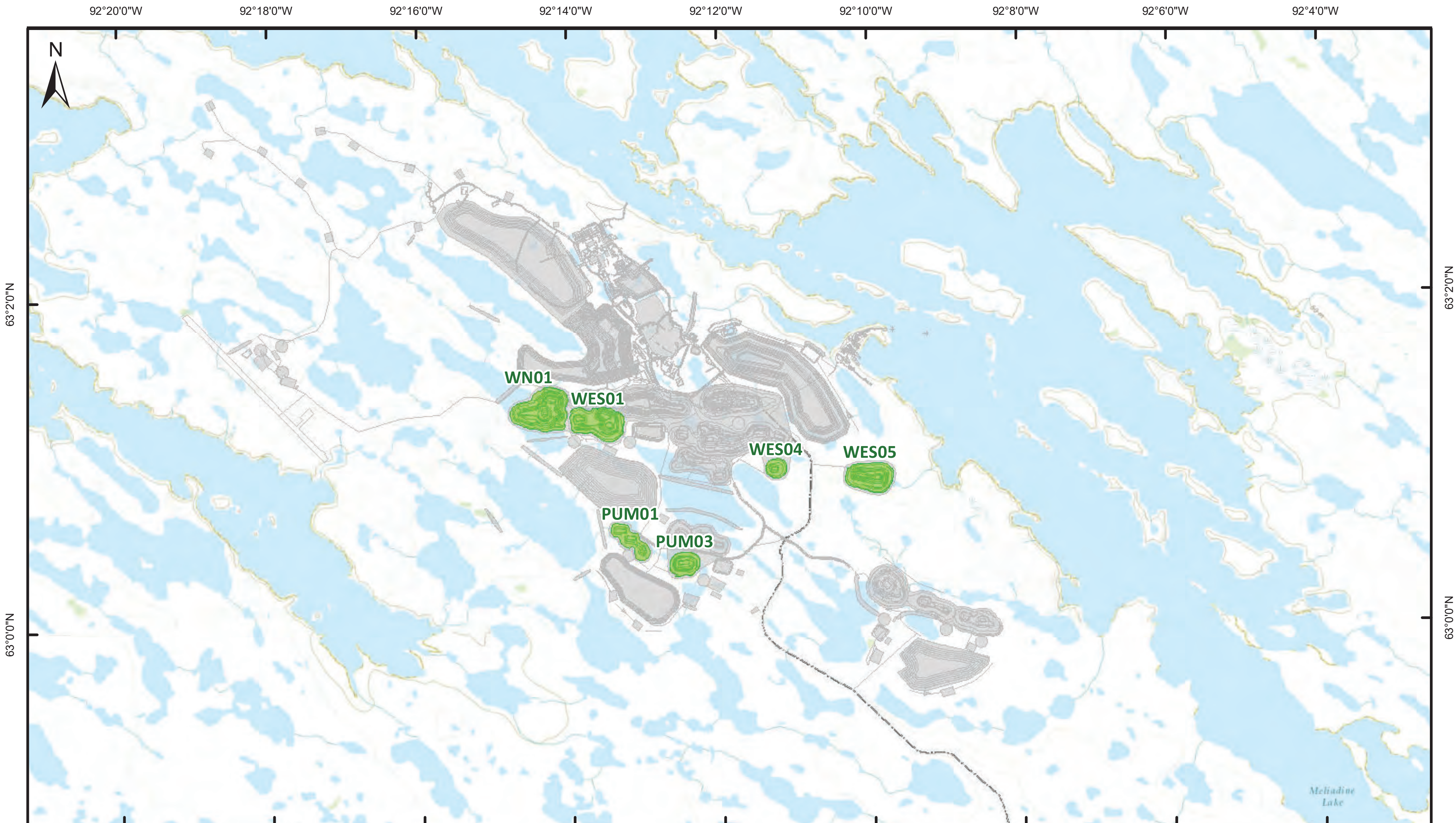
2.5.2 Use of Exhausted Pits to Store Waste Rock

Agnico Eagle is also looking at placing waste rock in mined out (exhausted) pits. In-pit disposal would improve the current economics and mine planning and reduce overall freshwater consumption during closure reflooding. Moreover, in-pit disposal would reduce the surface area impacted by the project by reducing the footprint of the WRSF. The use of exhausted pits to store waste rock is also link the primary offsetting strategy of the Meliadine Extension.

Agnico Eagle is evaluating locations for in-pit waste rock deposition. Current open pits assessed (i.e., TIR01, TIR02, TIR03, TIR04, WES02, WES03, PUM02, PUM04, FZO01, FZ02, FZ03, DIS01) are shown on Figure 2.5-2. Refinements will be further assessed as part of the Type A Water Licence amendment with the NWB. Agnico Eagle is approved for waste rock in-pit disposal at the Meadowbank Mine and has proven success with this method.

2.5.3 Temporary Storage of Saline and Surface Contact Water into Pits

Should there be more water than we can handle, an alternative to current water management strategies would be to store it into pits. Agnico Eagle is evaluating locations for in-pit water storage. Current open pits assessed (i.e., TIR02, WES04, WES05) are shown on Figure 2.5-3.



0 1 2 3
1:60,000 km

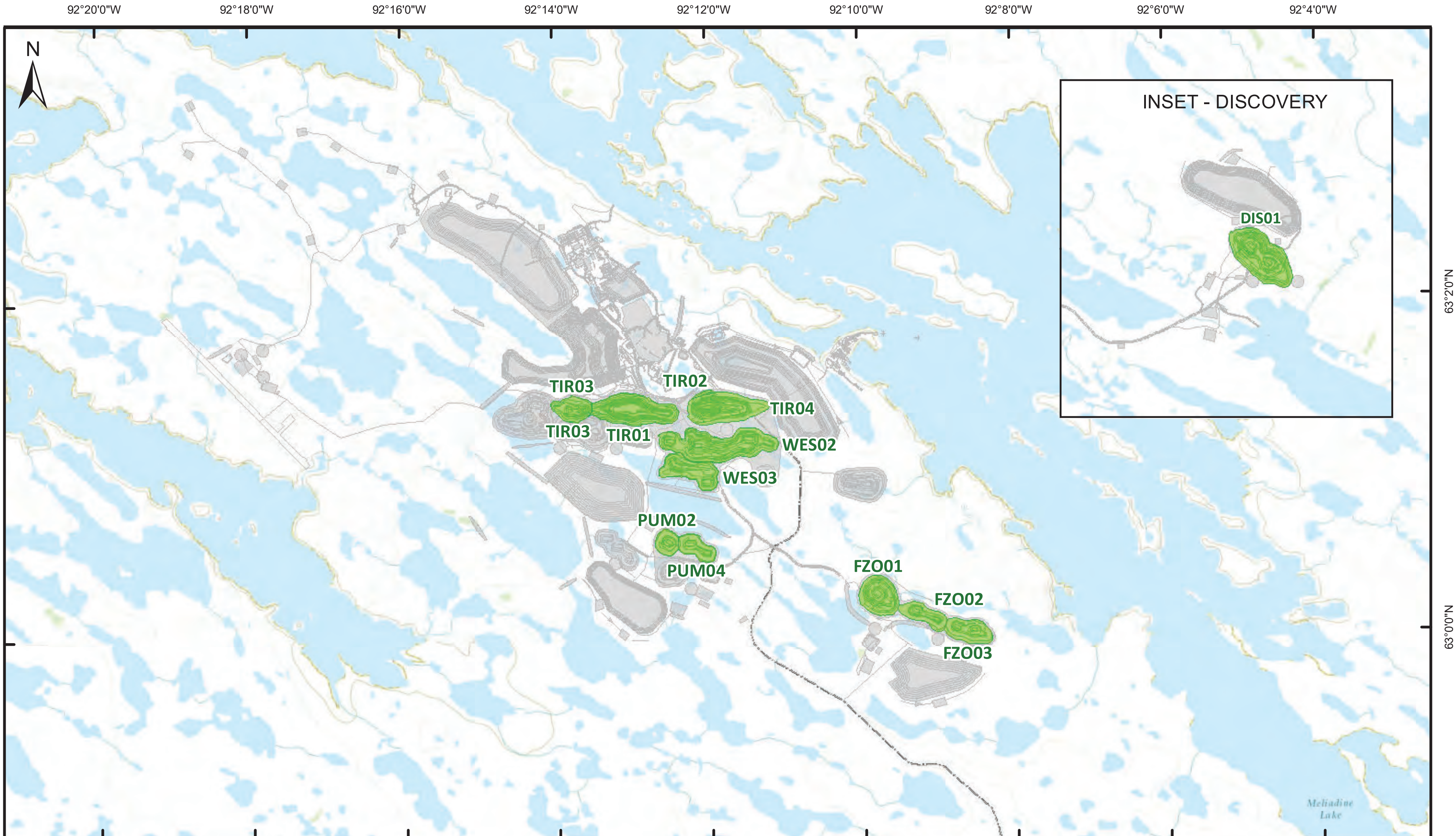
Meliadine Extension

Alternative – Exhausted Pits for Tailings Storage

Date: 10/28/2021
Map Number: MEL-012
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

Legend
- Exhausted Pits for Tailings Storage
- Meliadine Extension
- All-Weather Access Road (AWAR)

AGNICO EAGLE ECOLOGIC



Meliadine Extension

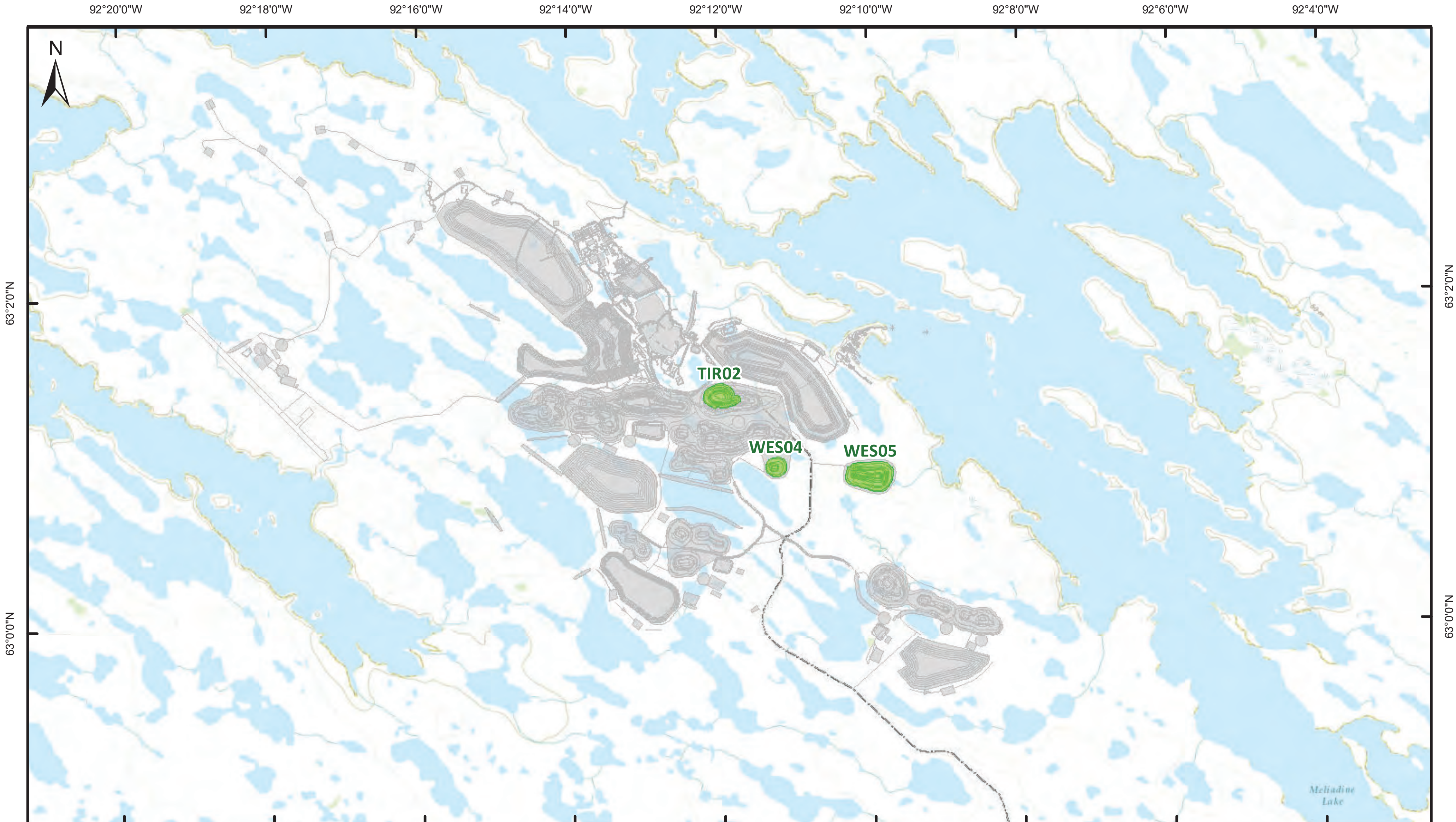
Alternative – Exhausted Pits for Waste Rock Storage

Date: 10/27/2021
Map Number: MEL-013
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

Legend

- Exhausted Pits for Waste Rock Storage
- Meliadine Extension
- All-Weather Access Road (AWAR)

AGNICO EAGLE ECOLOGIC



0 1 2 3
1:60,000 km

Meliadine Extension

Alternative – Exhausted Pits for Saline and Surface Contact Water Storage

Date: 10/27/2021
Map Number: MEL-014
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

Legend
- Exhausted Pits for Saline and Surface Contact Water Storage
- Meliadine Extension
- All-Weather Access Road (AWAR)

AGNICO EAGLE ECOLOGIC

2.5.4 Construction and Operation of an On-site Airstrip

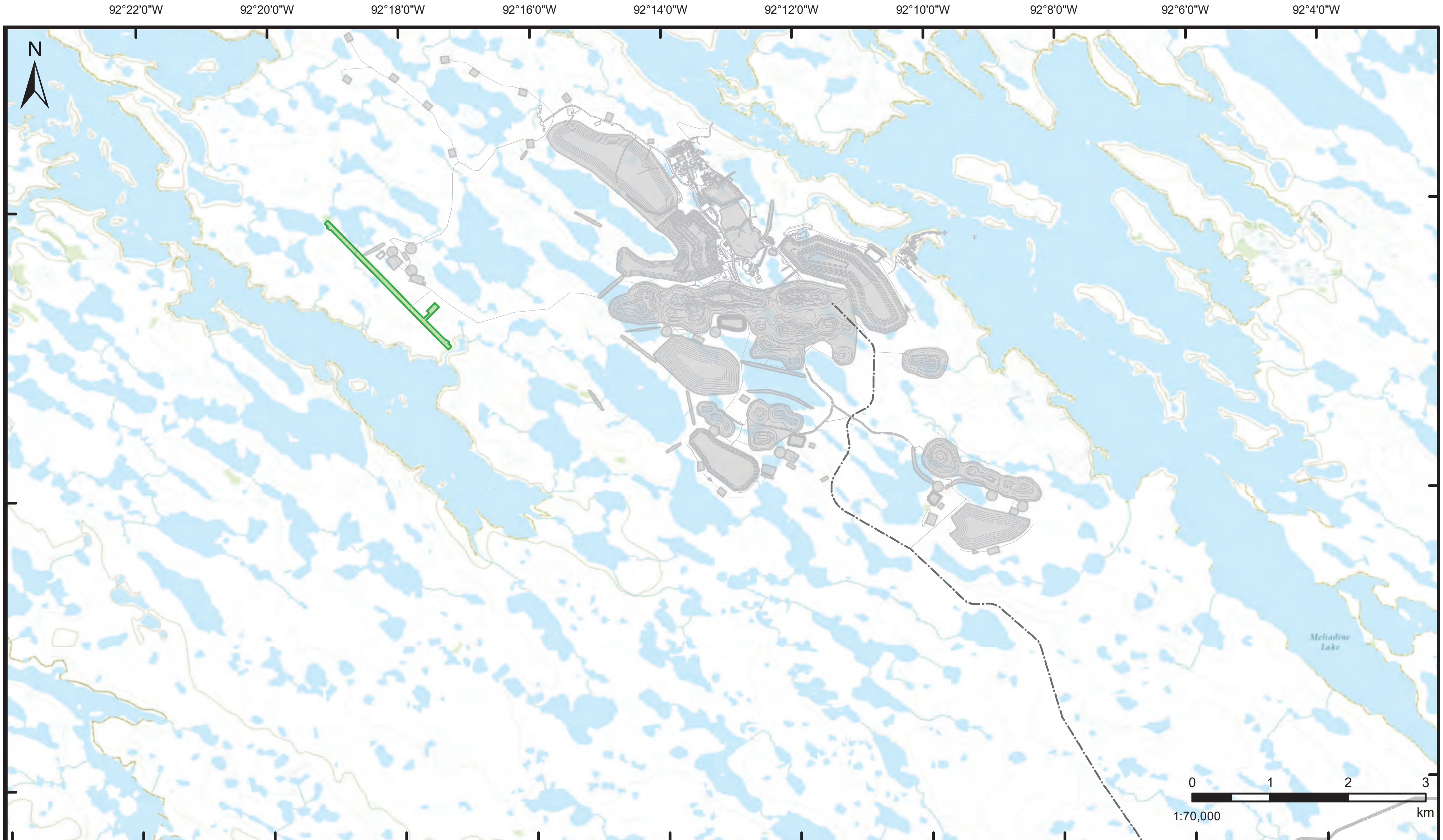
In Supporting Document (SD) 2-1 Project Alternatives of the 2014 FEIS (Agnico Eagle 2014), Agnico Eagle considered building an on-site airstrip; however, at the time of consultation for the proposed mine, community members were not in favor of an on-site airstrip as opportunities would be removed for local business, a gravel airstrip could not accommodate certain aircrafts, and there would be land impacts that would need to be reclaimed. Therefore, the 2014 FEIS included using Rankin Inlet's airstrip for all airplane traffic.

In light of lessons learned following years of constructing and operating the Meliadine Mine, Agnico Eagle is proposing the development of an on-site airstrip as an alternative to the Rankin Inlet airstrip to support year-round access to site during operations, including regular scheduled crew changes, and some equipment and materials resupply. Agnico Eagle is not actively looking at building it in the short-term but this alternative has been included into this Application. Agnico Eagle would like to have the flexibility to build it should conditions change and the need arise as it plans to be in Nunavut for a long time.

Some of the benefits of an on-site airstrip include:

- Providing flexibility for the Mine during caribou migration (i.e., possibility to take off and land when caribou are close to AWAR and not the mine site).
- Reducing cargo and passenger traffic on the AWAR and the bypass road
- Reducing dust emissions along the AWAR.
- Reducing transportation time for mine employees.
- Reducing the number of flight cancellations by using different material for the airstrip runway (i.e., gravel opposed to paved which freezes). In 2020, more than 20 trips were delayed or postponed to the next day due to this reason.
- Providing flexibility for the Mine during bad weather (i.e., possibility to initiate take off and landing faster as passengers will be closer to the mine site).
- Providing an alternative location for flights to land in the event of an emergency.

The preferred location (Option 2a) of the airstrip (Figure 2.5-4) was selected for several reasons which considered potential impacts to wildlife and waterbodies, as well as noise impacts. Based on caribou collar data, the caribou migration path is less travelled at the proposed location over areas to the east of the site. The proposed airstrip runway is aligned well with the overall site which will lower overall noise emissions. In addition, the proposed location would allow for the potential to utilize infrastructure that would also be needed for the Tiriganiaq-Wolf mining area (e.g., garage, access road, pads).



Meliadine Extension

Date: 12/8/2021

Map Number: MEL-008

Coordinate System: NAD 1983 UTM Zone 15N

Projection: Transverse Mercator

Datum: North American 1983

Legend

Proposed airstrip location

Meliadine Extension

All-Weather Access Road (AWAR)

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The following specifications are anticipated for the airstrip:

- Will be all-weather and capable of servicing passenger and large cargo aircraft (e.g., 737-200 with gravel kit)
- Will only be accessible to chartered flights (i.e., no commercial flights)
- Will be up to 60 m x 2,134 m (200 ft x 7,000 ft)
- Anticipate 4-6 flights per week during operations and closure
- An operations center will be located at the airstrip.

For clarity, Agnico Eagle considers the airstrip alternative to be part of the scope of this Application. It is possible that the airstrip will not ultimately be built, but it is an important future contingency option.

2.5.5 Screened Out Alternatives

The alternatives shown in Table 2.5-1 were considered for Meliadine Extension, in addition to those presented in the SD 2-1 of the 2014 FEIS; however, are currently determined to not be viable options at this time but could be alternatives to the Meliadine Mine in the future.

Table 2.5-1: Screened Out Alternatives for Meliadine Extension

Project Component	Description and rationale for not including
Power generation	• Solar: This alternative was deemed impractical given the Mine's location at 63 degrees north. There is darkness that would limit production in the winter months and would require a large footprint to accommodate enough solar panels to meet power requirements for the Meliadine Mine. This alternative was also evaluated as part of the 2014 FEIS (Volume 2, SD 2-1, Agnico Eagle 2014). • Nuclear power and geothermal power: These are regulatory challenging options with high cost of implementation and return on investment prohibitive, with various environmental and technical considerations and long-term to permanent implications to the environment and communities. There is no geothermal source of energy at the Mine site or its surrounds. Geothermal energy was also evaluated as part of the 2014 FEIS (Volume 2, SD 2-1, Agnico Eagle 2014). • Hydropower: The cost of building dams and installing hydroelectric generators in Kivalliq are return on investment prohibitive, and potential environmental effects have not fully been assessed nor approved. Hydropower was also evaluated as part of the 2014 FEIS (Volume 2, SD 2-1, Agnico Eagle 2014). • Tidal power: Not feasible given the distance from the nearest coastline to the Meliadine Mine. Development of this option would require an extended linear footprint over land with associated facilities at the coast. Systems extending over such long distances do not carry the full power to its ultimate destination due to system resistance and energy expenditures. These limitations make this an inefficient, regulatory challenging and return on investment prohibitive option with long-term or permanent environmental implications. • Power grid connections: As the Mine site is remote/off-grid, there are currently no power lines from which electric or hydroelectric power could be purchased for the Mine. The KivIA is planning the development of a hydro-fiber link from Manitoba to the Kivalliq region. Baseline studies and feasibility study are currently ongoing. Should this project be permitted and built, Agnico Eagle will investigate the opportunity to build a power line from the mine to Rankin Inlet to connect it with the grid. This option would reduce greatly diesel fuel consumption. The proposed wind turbines are brought forward as a short-term solution and in case the hydro-fiber link does not get built. • Natural Gas: This alternative is not feasible as the Mine site, is remote/off-grid and there are no short- to medium-term future options of natural gas lines or bulk storage to tie in with the life of the Mine.

Project Component	Description and rationale for not including
Contact Water Management	Different scenarios for dewatering of lakes and storage of contact water were evaluated. Various locations for dike positioning were also evaluated.
Saline Water Management	Inclusion of saltwater evaporators. Five saltwater evaporators were used at site between mid-2017 and 2019/2020 to reduce saline groundwater volumes stored in surface water ponds. There were some success with the evaporators but once the quantity of realized groundwater inflows to be managed became greater than long-term storage, discharge to the environment was required and they were decommissioned. However, as a short-term alternative, evaporators may be used.
Water Treatment	To reduce at the source ammonia loading and consequently the need for ammonia treatment, different strategies could be implemented, such as: • Training and housekeeping improvement in the explosive handling underground; • In situ ammonia treatment underground; • In pond ammonia treatment at the surface; • Alternative to break point chlorination for ammonia removal in the WTC building.
Waste Rock and Tailings Management	Storage of tailings into Lake B7. Not carried forward due to risks of depositing tailings into Lake B7 during operation and the long-term performance after closure. Various locations for storage of waste rock were looked at for Meliadine Extension. However, the objective is to stay within the approved 2014 FEIS footprint.

2.5.6 Project No-Go Decision

The Meliadine Extension is an opportunity made real by existing mining and milling facilities at Meliadine Mine and experience gained from the commencement of the operation. Agnico Eagle considers this extension of the LOM by 11 years, as an opportunity, to continue to develop business and growth in Nunavut, in partnership with its different stakeholders.

From the economic and societal view, the no-go alternative would result in a substantial lost opportunity. Continuation of benefits and revenue stream to Inuit, and from direct taxes paid to hamlet, territorial and federal governments would cease. Employment and business contracting opportunities to individuals and companies would be lost. Benefits to Inuit from the IIBA over the operating life of the mine would end.

Additionally, this Application represents an optimization of the NIRB 2014 FEIS. A no-go would mean that those improvements are not made to the project until the end of approved mine life in 2032. From an environmental perspective, the no-go alternative would mean no additional impacts from mining after 2032. Existing site facilities would be decommissioned, and the area disturbed would be restored within the terms of the existing project certificate and other approvals (including the Type A Water Licence, government and Inuit-issued surface tenures, and *Fisheries Act* Authorizations).

Mining is market driven, as such Agnico Eagle is continually aware that market conditions may yield no go scenarios. Options in such situations include not proceeding with construction as planned, placing the Meliadine Mine into temporary care and maintenance or commencing closure and reclamation activities earlier than projected.

3 CONSULTATION AND ENGAGEMENT

3.1 Principles and Goals

Agnico Eagle acquired the Meliadine Project in July 2010 from Comaplex Mineral Corporation. Since that time, Agnico Eagle has actively engaged and consulted stakeholders throughout the Kivalliq region and adjacent jurisdictions.

As per Project Certificate No.006, Agnico Eagle will continue to work in partnership with community members and Kivalliq Elders to establish a mutually beneficial, cooperative, and productive relationship. Our approach is characterized by effective two-way communication, consultation, and partnering.

Community and public engagement for the proposed changes were planned in accordance with community relations best practices. Agnico Eagle has aligned its practices with the guiding principles set forth by the NIRB (2020c).

- Consultation should be part of an ongoing relationship between the Proponent of a project proposal and the communities that will be potentially affected by the proposed project, where mutual trust and understanding builds over time through a continuing process of discussions, decisions, and follow-through. Importantly, consultation generally takes place before a project proposal is developed and decisions are made regarding the project.
- Consultation is a two-way communication process, in which all parties listen and contribute views, information and ideas. The Proponent should communicate back to participants to confirm understanding of the information and to indicate any resulting effects of shared views, information and ideas.
- Consultation leads to action. It is an opportunity for genuine and respectful listening. This does not necessarily mean that every suggestion made in a consultation is implemented, but that input will always be taken into account.

Agnico Eagle's public participation framework is driven by our Responsible Mining Management System which includes four phases: plan, do, check, and act.

- The planning phase is about policies, objectives, and rules and regulations.
- The doing phase covers taking care of documentation and directly engaging or communicating with communities.
- The checking phase is for performance, management, compliance, and monitoring.
- Lastly, acting phase, includes management reviews, implementation and reporting back to the communities.

Figure 3.1-1 outlines how Agnico Eagle's engagement process fits into the Responsible Mining Management System system.

Figure 3.1-1: Responsible Mining Management System Standard Engagement Process

3.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

As per the 2014 FEIS, this Application process is designed to be aligned with IQ guiding principles, including:

- **Fostering good spirit by being open, welcoming, and inclusive**: Agnico Eagle welcomes, and has sought, input to this Application through consultation and engagement with stakeholder groups in Rankin Inlet.
- **Decision-making through discussion and consensus**: Agnico Eagle facilitated discussion about this Application, and the balance of impacts and benefits, in consultation with stakeholders in Rankin Inlet. Ongoing discussions and dialogue are providing feedback to our mitigation and monitoring plans.
- **Working together for a common cause**: Through consultation with community stakeholders including Elders, land users, youth, women, and local government, Agnico Eagle has endeavored to work collaboratively with stakeholders to identify the best possible management plans.
- **Respect and care for the land, animals, and the environment**: Agnico Eagle is committed to developing Meliadine Extension in a way that will minimize impacts on land, animals, and the environment.

IQ encompasses not only TK about land and resources, but also the skills to apply this knowledge to livelihoods, and a value system that is founded upon respect, sharing, collaboration, collective decision-making, skills development, and the responsible use of resources.

3.3 Design and Implementation

3.3.1 Design

Consistent with the original 2014 FEIS, Agnico Eagle recognised two types of affected communities:

1) Communities that share ecosystem and socio-economic ties to and whose traditional land use is potentially affected by the Meliadine Extension; and
2) More distant communities outside this area.

As such, primarily Rankin Inlet was identified as Meliadine Extension-affected community for public engagement and consultation. That said, Agnico Eagle at the same time is not losing sight that some effects, if they are not mitigated, could extend outside the local area. Therefore, Agnico Eagle selected the entire Kivalliq region and its seven communities (Naujaat, Coral Harbour, Baker Lake, Chesterfield Inlet, Rankin Inlet, Whale Cove, and Arviat) as the consultation outreach area for public engagement and consultation.

Agnico Eagle is proactive in adopting a robust IQ methodology. Supporting this IQ methodology are two full-time Agnico Eagle TK and IQ advisors whose roles are to lead the collection of IQ and ensure culturally relevant consultation methods that incorporate community and TK are used. Moreover, the adopted IQ methodology allows a consistent format to collect, validate, and integrate IQ and TK into Agnico Eagle project phases.

IQ and TK are collected and validated through multiple engagement channels with Kivalliq individuals, communities, and community groups. Engagement channels regroup one-on-one conversations, focus groups, public consultations and open house with field experts and knowledge holders. Another source of collection and validation in a self-participation mode is also done via Agnico Eagle's Virtual Meeting Room (VMR).

The interpretation process consists of reviewing IQ and TK collected to confirm it and ensure validation of past collected IQ and TK when needed. All interpretation is done via knowledge holders and supporting staff.

IQ and TK collected and validated through multiple engagement activities in regard to the Meliadine Extension have been incorporated to the design, where applicable, and documented in their respective component of this Application.

3.3.2 Implementation

Community information sessions and consultations made possible through in-person meetings have long been the standard for Agnico Eagle Nunavut's project development and operations teams. When the pandemic made these existing communication methods more challenging, by the instauration of travel restrictions, public health guidelines and southern employees required to quarantines, innovative thinking led the way towards identifying an alternative option to reach a broad audience during those changing times.

In March 2020, Agnico Eagle presented during Focus Group Meetings a pilot VMR to members of the community to get feedback on the website. Subsequently, adjustments were made to the room, such as addition of information on the protective and monitoring measures for wildlife and vegetation (refer to Appendix E-2).

As such, the Meliadine Extension VMR, was created to foster an open, transparent, and respectful dialogue with all communities of interest, which went live to the public on June 28, 2021 (https://meliadinevmr.agnicoeagle.com/). The website is completely accessible in both English and Inuktitut and has a wide variety of engagement material from videos to interactive maps, storymaps, infographics, and texts.

The VMR allows meaningful information sharing, as well as to get feedback. Information is available on the Meliadine Extension, how we have engaged with the communities, how we ensure wildlife protection, our plans for water management, the protective measures that we implemented to protect aquatic life, and our efforts to introduce TK and IQ in our operations. A feedback form and questionnaires were designed into the VMR to gather comments or questions on the different topics presented in the room.

The VMR was used for public consultation on the Meliadine Extension via public meetings and Focus Group meetings between June 18 and June 25, 2021. This innovative way of engaging allows participants to have access to additional information after the engagement sessions and to provide additional comments, answer surveys or simply browse through the content once again at their own pace.

During the June 2021 public meetings, Agnico Eagle heard from some participants that information presented as reading material was not accessible to everyone due to reading proficiency or eyesight. As such, the VMR was updated with a reader option and summary section to reach a broader audience.

The VMR will be used as part of engagement activities to communicate, gather feedback, and provide updates on the Meliadine Extension, in addition to in-person meetings, and will be continually updated and accessible 24/7.

In addition to the VMR, Agnico Eagle has taken several actions to maintain an open, honest, and transparent process that includes the public in decisions about project activities and to assist both the communities and the Proponent to understand what effects the project will have on potentially-affected communities. These included:

- Prioritizing focused consultations with community groups to respect public gathering restrictions.
- Leveraging local Agnico Eagle employees to hold in-person meetings as much as possible, while respecting public health guidelines.
- Ensuring key messages and information are understood by communities by using plain language summaries in all communications.
- Campaign on social media and Radio for the VMR.
- Installation of a tent at Km 15 of the AWAR open to all members of the public to follow public health guidelines (Figure 3.3-1).

Figure 3.3-1: Kilometer 15 (AWAR) Public Meeting of June 21, 2021

After June's engagement activities, an event was organized on September 22, 2021 with the Rankin Inlet Women's Group in collaboration with a community member from Baker Lake who was involved in Baker Lake fish out to answer questions and concerns raised from Rankin Inlet community members regarding fish outs.

Subsequently, an open house was organized to present what Agnico Eagle heard from the communities to date regarding the Meliadine Extension and answer questions about the Meliadine Extension between December 7 and 8, 2021. An updated version of the VMR, including the following information, was used during the open house and publicly launch on December 7, 2021:

- summary of engagement activities related to the Extension;
- main themes of comments and concerns;
- Agnico Eagle response; and
- TK and IQ validated and collected

In 2021, Agnico Eagle hosted various public meetings, focus groups, and meetings with stakeholders (Table 3.3-1). More details of those engagement activities, interest group, method and dates are provided in Appendix E-1. The purpose of these consultation activities is twofold; provide the communities with Meliadine Extension information and answer their questions; and identify their concerns and feedback with regards to the Meliadine Extension.

Table 3.3-1: Meliadine Extension 2021 Engagement and Consultation Program[(a)]

Event	Time and Location
Community road show, announcements, and meetings	o Rankin Inlet Public Meeting at km 15 of the AWAR. Out of the 5 sessions planned there were attendees to 4 of them (June 21 to 23, 2021) o In-person (local staff) and Virtual Public Session with Baker Lake, Arviat, and Chesterfield Inlet (June 22, 23, and 25, 2021) o Public Launch of the Meliadine Extension Virtual Meeting Room (Facebook post, June 28, 2021) o Virtual Public session with Naujaat and Coral Harbour (August 31, 2021) o Open House for Rankin Inlet Residents (November 2, 2021) o Open House for Rankin Inlet Residents (December 7 and 8, 2021)
Focus Groups	o Rankin Inlet Women Elders (March 17, 2021) o Rankin Inlet Elder's Group (March 19-24, 2021) o Rankin Inlet Hunters and Trappers Organization (March 23, 2021) o Kivalliq Inuit Association (March 18, 23, and 24, 2021) o Rankin Inlet Youth Group (March 25, 2021) o Elders' Advisory Committee (June 18 and 19, 2021) o Rankin Inlet Women's Group (September 22, 2021) o Inaugural Itivia/Tasirjuaq Cabin Owners Committee Forum (November 3, 2021)
Meetings	o Kivalliq Inuit Association (June 18, 2021)

(a) Refer to Appendix E-1

3.4 Ongoing Stakeholder Consultation

To ensure an effective and ongoing engagement process, we have implemented a variety of mechanisms and activities that occur throughout the year. These help us keep in touch with the communities and make sure they have the opportunity to give us feedback on a regular basis. The complete record of engagement activities from August 2020 (after waterline application submission) to March 2021, outside of Meliadine Extension can be found in Appendix E-3. The following examples are activities that occur on a yearly basis:

- Socio-Economic program, the Socio-Economic Report and Socio-Economic Committee
- Exploration and Shipping Consultation with the concerned communities (Hamlets and Hunters and Trappers Organizations [HTO])
- Meeting with HTOs, Hamlets, Royal Canadian Mounted Police, Fire Department and Community clinics in person to give information about cyanide transportation, the AWAR use and various other topics as per commitments made and NIRB Project Certificate Terms and Conditions, or on an as needed basis.
- Meeting with IIBA Committees, such as the Business Opportunities Committee, the Employment and Culture Committee and the Implementation Committee.

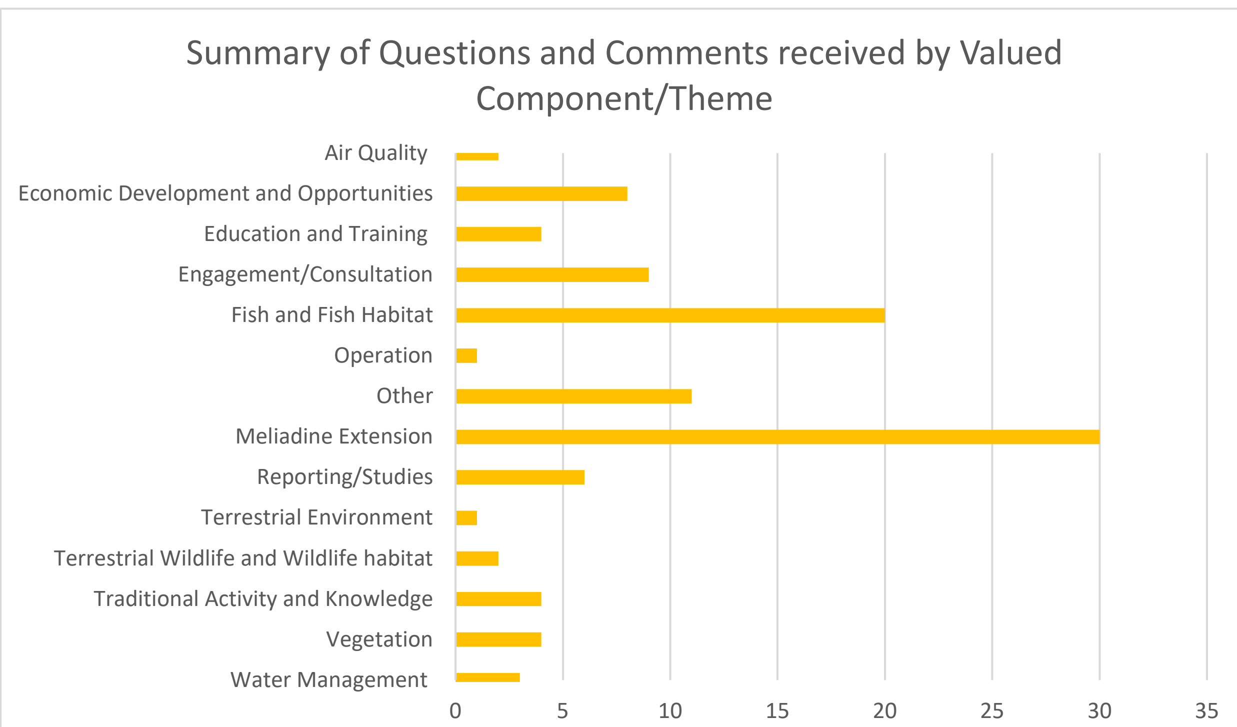
Throughout the year, Community Liaison Officers are involved in consultations and focus group activities, Hamlet meetings with community groups and members, support Family days and Christmas Feast. They also play an important role in the Community Liaison Committee to discuss Agnico Eagle's operations general project updates, AWAR, community initiatives, traditional knowledge and IQ and a set list of recommendations to bring the community's voice to Agnico Eagle on specific Community Liaison Committee matters.

Aiming to continuously improve on integrating IQ and TK to our operations, Agnico Eagle IQ and TK Advisors are responsible to advise Agnico Eagle's operations, service, and exploration teams on meaningful engagement which includes regular updates, advice, and suggestions. The IQ and TK Advisors play an active role and ensures plain language information is shared with community members. The IQ and TK Advisors also consult with groups of Elders, Women, Hunters, and other wildlife organizations to gather feedback that can be integrated in our operations and projects.

3.5 Outcome of Consultation and Engagement Activities

The extensive list of comments and questions received for the consultations in 2021 are provided in Appendix E-2. Figure 3.5-1 below, is a summary of the valued component and theme that were discussed during those engagement activities. Table 3.5-1 summarizes specific outcomes resulting from Meliadine Extension consultation activities.

Figure 3.5-1: Summary of Meliadine Extension Questions and Comments Received by Valued Component/Theme



Note: As of December 14, 2021

Table 3.5-1: Specific Outcomes Following Consultations on Meliadine Extension[(a)]

Valued Component/ Theme	Concerns	Outcome
Fish and Fish Habitat	Concerns were raised on what happens to fish during fish out (behavior and feeding)	An event was organized on September 22, 2021 with the Rankin Inlet Women's Group in collaboration with a community member from Baker Lake who was involved in Baker Lake fish out to answer questions and concerns from Rankin Inlet community members.
Virtual Meeting Room	Information was requested to be added to the Virtual Meeting, as well as modifications to the design	Listed below are examples of changes made to the Virtual Meeting following comments made by the community: - Consultation records were added - Plain language summaries, videos and audio reader added - Addition of banners (i.e., information on vegetation surveys in the Terrestrial Environment) - Inuktitut Place Name added on the maps

(a) Refer to Appendix E-2

3.6 Traditional Knowledge and IQ Identification and Validation

As part of the Meliadine Extension engagement activities, traditional land use statements collected in the past for the Meliadine Mine were shared with the participants and through guided questions in the VMR, they were invited to confirm if those statements were still accurate. As such, Agnico Eagle was able to validate the following information on traditional land use.

- *We heard from the community that Inuit caribou hunting is an important activity. People from Rankin Inlet hunt caribou in the Meliadine area and elsewhere. They also hunt along the coast by boat (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).*
- *We heard from community consultation that the lower Meliadine was an important caribou hunting area. We learned that the herds migrated along the coast. Sometimes, large herds migrate through the area and many people hunt when caribou are present (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).*
- *We heard from the community that caribou are important. Consultation told us that there are caribou bones on the land, some grown into the moss of the tundra. We heard that this area still is a major caribou hunting area. Caribou, including many cows and calves, migrate through this area (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015)*
- *We learned from the community that fishing for both Arctic char and grayling are important to people. There are remains of stone fishing weirs near the mouth of the Meliadine River, and stone drying racks scattered through the valley. ""Iqalugaarjuk"" translates as ""the river of little fishes,"" which refers to the grayling. Rectangular stone ""caches"" were used to store frozen char for winter use (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015)."*
- *We heard from the community that Meliadine Lake is a good fishing spot in the late winter and springtime. Many people follow the winter road toward the Meliadine Camp and then follow snowmobile trails to the southeast end of the lake. There are many ice fishing holes made in Meliadine Lake in the*

spring (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).

- *We heard from the community that thousands of snow geese, Canada geese, and white-fronted geese stop in the lower Meliadine lakes to rest and feed during both spring and fall migrations. People hunted there in the past and continue to do so now. Many still use the old taluit as blinds (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).*
- *We learned from the community that Lingonberry grows almost everywhere on the tundra around Rankin Inlet. It has red berries that ripen in August, and are food to humans and wildlife. The berries are eaten by geese, ptarmigan, gulls, sik siks, foxes, and bears. The berries are eaten in the fall and in the spring, after spending the winter under the snow (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).*
- *We learned from community consultation that people tend to pick berries in Iqalugaarjuup Nunanga Territorial Park, near Second Landing Lake, and along the Diana River Trail. Sometimes, people cross the river to pick berries, mostly while hunting caribou or geese (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).*
- *We heard from community consultation that Meliadine Lake is an important area (Elder's Group Meeting, March 2021).*

Additionally, we heard from the participants that berry harvesting is practiced from Km 12 to Km 27 of the AWAR. Berries used to be picked all the way up to the Meliadine Lake. During the spring, when there is light all day long, people would walk from Rankin to the area near Diana River to pick berries. Participants shared worries about the area now being too dusty.

Mining exploration has been part of the region for a long time and participants were not surprised that Agnico Eagle found new gold. Guiding began in 1928-1929, in the coastal areas between Baker Lake and Chester. In the 1970s, they started staking [of mineral claims] near Pistol Bay, in the coastal area past Whale Cove for a Russian company.

We heard that Josephine River Falls was named after Bob Hickes. His Inuit name was Apualuktut, which is Josephine River Falls local name. Apualuktut means “red hair” (Hickes was non-inuit). There are many Char at this location. Char had difficulty going upstream in the past. The falls resemble a fountain, and the cliff is an obstacle. There is a big lake upstream from Pistol Bay Falls that is used for fish derbies. Josephine Falls site is used for many things, including survival. This location is still being used every year. Travel occurs to Josephine Falls [and everywhere else] by snow machine and by all- terrain vehicle (ATV). In the past, people walked or used dog sleds. Community residents travel to these sites by ocean, using kayaks and canoes. Fox skins were used in boat construction. The “Itirlak” area is close to cabins.

There are a lot of fish at Landing Lake. There is first Landing Lake and second Landing Lake. It’s called Landing Lake because float planes landed there. Fish species at this site include: Trout, Arctic Char, and Landlocked Char (half breed fish, does not go downstream). Meeting participants called Landlocked Char the beauty and the beast fish. Landlocked Char, fish that resembles an eel (the liver is a delicacy, and the meat makes a good broth), white fish (that do not go up/downstream), grayling. The food fish eat affects the colour of their flesh. As Arctic Char go up (upstream), they lose their red colour, as they stop eating shrimp.

Women did, and still do, most of the fishing in the communities. Community members used to walk from Rankin Inlet to the area near Diana River to fish on the surrounding lakes. It would take all day. All fish at Meliadine go upstream to Peter Lake, and then go downstream to the ocean via Diana River.

The seasons are changing, and the streams are getting lower having an impact on fish. Some years are dry, and the water is low. Some years, the water is high when there is more rain. Fish have different sizes depending on the size of rocks in the streams and their location; they change accordingly. When the water becomes dirty, fish move somewhere else. The community fish using fishnets, and they have seen different species of fish they have not seen before.

The daily diet still consists of various traditional foods. We heard from participants that especially caribou and fish meat regularly supplement their diet. Fish and caribou meat are part of the weekly diet. Arctic char is stocked up during the summer and ice freeze up with gill net in the ocean or lakes. Fish is stored in catches for personal consumption and to feed dog team. Much of the caribou meat is grounded in order to cook meals. Participant indicated that they share all their catches with anyone that needs traditional meat and fish. Traditional food sources are preferred over store bought and processed food for health and cost reasons. It is critical that they maintain a healthy stock of traditional foods in order to eat healthy and to save money.

Inuit learn quickly by seeing things. Elders shared that they need to think about the future of their grandchildren and education.

3.7 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement into the Design and Environmental Assessment

3.7.1 Meliadine Extension Design

Throughout engagement activities it was shared that respect and care for the land, animals, and the environment is crucial to members of the community and that it is an intrinsic part of the Inuit societal values. As such, the Meliadine Extension was designed to stay within a similar area as previously assessed for the 2014 FEIS.

Furthermore, we heard concerns from community members that Agnico Eagle was not using Traditional Place names into its map. As such, Traditional Place names were added to our maps for people to better relate to general areas compared to Meliadine Extension footprint.

Additionally, consideration of comments received from the engagement sessions were factored into the design, including but not limited to the following:

Marine Environment

Following discussions with the community of Coral Harbour and to reduce potential impacts of shipping activities on marine mammals and traditional land use activities in Coral Harbour, an additional shipping corridor has been added south of Coats Island for the past years (Figure 8.1-2). This is now the primary one used by shipping companies. The shipping corridor north of Coats Island continues to be available should shipping conditions south of Coats Island prevent safe navigation. The local study area (LSA) has been modified to account for this change.

As requested during the last pre-sealift season meetings, traditional place names are also included on Figure 8.1-2.

Socio-Economic Environment

Elders shared throughout engagement activities that educational development and employment, especially for the younger generation, are important for the members of the community.

Agnico Eagle has several training programs and initiatives that contributes positively to educational achievement and employment perspectives. Section 9.4 of this Application provides an overview of some of those programs and the complete list of monitoring program and mitigation measures in place are available in Appendix G-08 of this Application.

Climate Change

Concerns regarding climate and meteorology include reference to low water levels same as for the 2014 FEIS. Agnico Eagle incorporates the start and end of the open water season in their design for effluent discharge every year to ensure that water levels and the consumptive flows from approved water bodies are always within the approved limits and do not impact the water levels of the lake at any given moment or season of the year.

Fish and Fish Habitat

Throughout engagement with community members, we heard that Itirlak Lake was an important fishing location. Meliadine Extension will not impact Itirlak Lake.

Concerns were raised that fish being moved from one lake to another might not be able to survive due to vegetation in the receiving environment being different. As part of fish out design Agnico Eagle ensures that fish are moved into a lake with similar characteristics.

Terrestrial Environment

Concerns were raised that caribou might be disrupted when helicopters and planes are nearby, and move away. Agnico Eagle will continue to comply with the TEMMP which includes measures to reduce impact from planes and helicopters on caribou. Additionally, an Airstrip Management Plan and Windfarm Management Plan was developed as part of Meliadine Extension Application.

Air Quality

Agnico Eagle heard concerns about dust being present along the AWAR, impacting berry picking harvesting activities. Agnico Eagle will continue to comply with the Dust Management Plan and the Air Quality Monitoring Plan. Mitigations measures, such as speed limits and use of dust suppressants when required, will continue to be employed.

3.7.2 Environmental Assessment

As described in the 2014 FEIS the IQ collected on the Meliadine Extension included knowledge on the existing condition, concerns on the various project impacts, and recommendations for the Meliadine Extension. Knowledge of the existing conditions is included in baseline reports or environmental setting portions of the 2014 FEIS. Identification and validation of TK and IQ during Meliadine Extension consultations were included in the Environmental Assessment (EA) respective VECs or VSECs.

4 IMPACT ASSESSMENT METHODOLOGY

4.1 Introduction

The EA methods used in this Application for Meliadine Extension and presented herein are consistent with the EA methods used in the 2014 FEIS and the 2018 and 2020 FEIS Addenda, and are in alignment with the Meliadine Project Guidance document (NIRB 2012, Public Registry ID 286775). It is assumed and reasonable that the EA methods used in 2014, 2018, and 2020 applications are appropriate for this Application and NIRB's approach to making a determination regarding conformity and going forward it is anticipated that the NIRB will follow the Guidelines for the Preparation of an Environmental Impact Statement for Agnico-Eagle Mines Ltd.'s Meliadine Project (NIRB File No. 11MN034), issued by the NIRB February 20, 2012 [NIRB 2012, Public Registry ID 286775], which states, "*Guideline conformity review is a presence or absence analysis rather than an evaluation of the quality of the information presented*".

Agnico Eagle has maintained consistency with the assessment approach between all Meliadine applications that have been before NIRB (i.e., 2014 FEIS, 2018 and 2020 FEIS Addenda) and continues to apply to this Application. The methods and approach are described below; however, a summary of the changes is noted in the Table 4.1-1. The objective of this Application is to focus on the changes from the 2014 FEIS (Agnico Eagle 2014) and new pathways triggered by the changes of Meliadine Extension.

Table 4.1-1: Summary of Change

Topic	No Change	Change
VEC / VSECs	No change to the VEC / VSECs as established for the 2014 FEIS.	
Assessment endpoints	No change to the endpoints established for the 2014 FEIS.	
Spatial boundaries	No change to LSAs for the following VEC/VSEC: • atmospheric environment (air and noise) • hydrogeology / groundwater • freshwater environment (hydrology, surface water quality, fisheries) • socio-economics No change to RSAs for the following VEC/VSEC: • atmospheric environment (noise) • terrestrial environment (soil and terrain, vegetation, wildlife, and birds) • hydrogeology / groundwater • freshwater environment (hydrology, surface water quality, fisheries) • traditional activity and knowledge • cultural, archaeological, and paleontological resources • socio-economics	Change to mine site SSA to account for a minor adjustment to include the extended footprint (i.e., wind turbine locations): • atmospheric environment (air and noise) Change to LSA for the following VEC/VSEC to account for a minor adjustment to include the extended footprint (i.e., wind turbine locations and the WRSF at the Discovery deposit): • terrestrial (soil and terrain, vegetation, wildlife, and birds) • traditional activity and knowledge • cultural, archaeological, and paleontological resources Change to LSA and RSA for the following VEC to account for a change to the shipping corridor: • marine environment and wildlife Change to RSA for the following VEC to expand the area in which predicted concentrations are available for assessing potential impacts: • air quality
Temporal boundaries		Increase of 11 years of mine life
Pathway analysis	No new primary pathways were identified for the following VEC/VSEC: • permafrost, geology, geochemistry • hydrogeology / groundwater • terrestrial- soil and terrain, vegetation, wildlife • freshwater environment (hydrology, surface water quality, fisheries) • marine environment and wildlife • traditional activity and knowledge • socio-economics • cultural, archaeological, and paleontological resources	New primary pathways were identified for the following VEC/VSEC: • air (to assess the windfarm) • noise (to assess the windfarm and airstrip) • terrestrial birds (to assess the windfarm)

Topic	No Change	Change
Residual effects analysis and classification	No change; there are no residual impacts for the following VEC/VSEC: • atmospheric environment (air and noise) • terrestrial environment (soil and terrain, vegetation, wildlife, birds) • freshwater environment (hydrology, surface water quality, fisheries) • marine environment and wildlife • traditional activity and knowledge • socio-economics • cultural, archaeological, and paleontological resources	
Cumulative effects	No change to the boundary.	Updated to reflect current conditions.
Uncertainty	No change as uncertainty is remains part of science; however, existing conditions are more certain than at the development of the 2014 FEIS.	
Monitoring and follow-up	The Management and Monitoring Plans are robust enough to carry forward for Meliadine Extension, additional updates were made where applicable.	Three new plans were developed based on Meliadine Extension additions.

4.2 Use of Existing Information and Baseline Information Collection

For this Application it is important to distinguish between baseline information and existing environment and how it was used in the assessment. **Baseline** is defined as previously collected data which was used in the 2014 FEIS; thus, has been previously assessed. **Existing conditions** is defined as data collected post commencement of construction of the Meliadine Mine. The data from supplemental studies (i.e., existing conditions) conducted by Agnico Eagle since 2014 has been incorporated into the Meliadine Extension design and this Application. A summary of baseline data reports (as provided in the 2014 FEIS) describe conditions pre-construction of the Meliadine Mine, are listed in Appendix F of this Application. Appendix G provides existing conditions reports used to support this Application. Technical studies and modelling reports completed to support this Application are provided in Appendix H.

Baseline data presented in the 2014 FEIS and the 2018 and 2020 FEIS Addenda have been subject to review through the assessment processes and through review of annual monitoring reports. As the documents listed in Appendix F have been previously reviewed by regulatory agencies and communities, it is not anticipated that detailed consideration of these baseline data will be required as part of this process. Consistent with 2018 and 2020 FEIS Addenda approach, a summary of key points relevant to Meliadine Extension are provided within each section of this Application.

4.3 Valued Ecosystem and Socio-Economic Components, Assessment Endpoints, Measurement Indicators

4.3.1 Identification of Valued Ecosystem Components and/or Valued Socio-Economic Components

VECs and VSECs to assess Meliadine Extension related effects, based on their role in the ecosystem and value placed on them by humans for traditional use and cultural purposes, are consistent with those presented in the 2014 FEIS. For the 2018 and 2020 FEIS Addenda, VECs and VSECs applicable to the proposed activities of those applications also followed the VECs and VSECs established for the 2014 FEIS. The VECs and VSECs for this Application include the following:

VEC / VSEC		VSECs
Air Quality/Emissions	Hydrogeology and Groundwater Quality	Population Demographics
Climate and Meteorology	Hydrology	Traditional Activities and Knowledge
Noise	Freshwater quality and sediment quality	Economic Development and Opportunities
Soils and Terrain	Freshwater Fish and Fish Habitat	Education and Training
Vegetation	Freshwater plankton and benthos	Individual and Community Wellness
Wildlife (focus on caribou)	Marine Environment	Community Infrastructure and Public Services
Upland Birds	Marine Wildlife	Governance and Leadership
Raptors	Ecological Health	Non-traditional Land and Resource Use
		Public and Worker Safety
		Cultural, Archaeological, and Paleontological Resources

4.3.2 Assessment Endpoints and Measurement Indicators

Assessment endpoints and measurement indicators in the 2014 FEIS (Volume 4, Section 4.2.3 of Agnico Eagle 2014, Public Registry ID 287486) were used for this Application, and is provided herein.

Assessment endpoints represent the key properties of the VEC or VSEC that should be protected for their use by future human generations. Assessment endpoints are general statements about what is being protected. For example, protection of water supply and water quality; maintenance of population abundance, assemblages and distribution of wildlife; and continued opportunities for traditional and non-traditional use of these ecological resources may be assessment endpoints for groundwater, surface water, wildlife, and traditional and non-traditional land use.

Measurement endpoints are defined as quantifiable (i.e., measurable) expressions of changes to assessment endpoints as compared to baseline (i.e., pre-2014 FEIS and previously assessed) and existing conditions (e.g., changes to chemical concentrations, rates, habitat quantity and quality, and number and distribution of organisms). For example, measurement endpoints for assessing the protection of surface water quality may include Meliadine Extension-related changes to physical and chemical properties of water. Measurement endpoints also provide the primary factors for discussions concerning the uncertainty of impacts to VECs and VSECs, and subsequently, are the key variables for study in monitoring and follow-up programs.

The overall determination of significance of impacts from Meliadine Extension on VECs and VSECs is then predicted by linking residual effects on measurement endpoints to the associated assessment endpoint. For example, changes to water quality were assessed by evaluating how changes in certain concentrations may influence the health of species; abundance and distribution of freshwater biota; continued opportunity for traditional and non-traditional use of fish. Valued components, assessment endpoints, and measurement endpoints used in this Application are presented in Table 4.3-1, and are consistent with the 2014 FEIS.

Table 4.3-1: Meliadine Extension Assessment and Measurement Endpoints

Valued Component (VEC or VSEC)	Assessment Endpoints	Measurement Endpoints
Atmospheric environment • Air quality • Noise	• Compliance with applicable ambient air quality criteria • Compliance with applicable noise standards • Contribution of greenhouse gas to climate change	• Greenhouse Gas emissions • Total suspended particulates • Carbon, sulphur, and nitrogen oxides • Particulate matter (e.g., dust) • Equivalent noise level
Soil	• Assessed through other components (i.e., maintenance of plant populations)	• Soil quality • Soil quantity and distribution • Reclamation suitability
Vegetation: • Plant populations and communities • Listed rare plants • Traditional plant use	• Maintenance of population abundance and distribution of plant populations and • communities • Continued opportunity for use of traditional plants • Maintenance of population abundance and	• Relative abundance and distribution of plant species • Presence of invasive species • Availability of plants for traditional use

Valued Component (VEC or VSEC)	Assessment Endpoints	Measurement Endpoints
	distribution of plant species at risk	
Wildlife: • Waterbirds • Upland birds; migratory birds • Raptors; • Caribou, caribou habitat and behaviour	• Maintenance of population abundance and distribution of the abundance and distribution of wildlife populations • Continued opportunity for traditional and non-traditional use of wildlife	• Habitat quantity and fragmentation • Habitat quality • Relative abundance and distribution of wildlife species • Survival and reproduction • Access to wildlife • Availability of wildlife
Species health: • Caribou, Arctic fox, key prey species for carnivores, raptors, migratory birds, waterbirds, fish, benthic invertebrates, plankton	• Changes to health of species	• Chemicals of potential concern • Exposure • Toxicity
Hydrogeology and Groundwater quality and quantity	• Assessed through other valued components (i.e., through the path to surface water and then fish habitat; continued opportunity for traditional and non-traditional use of fish)	• Groundwater flows and levels • Groundwater quality
Hydrology (including water quantity)	• Availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial ecosystems • Assessed through other valued components (i.e., abundance and distribution of freshwater biota; continued opportunity for traditional and non-traditional use of fish)	• Flow rate and the spatial and temporal distribution of water • Surface topography, drainage boundaries, waterbodies, and water pathways
Surface water quality (including sediment quality)	• Protection of surface water quality for aquatic and terrestrial ecosystems, and human use • Assessed through other valued components (i.e., changes to health of species; abundance and distribution of freshwater biota; continued opportunityfor traditional and non-traditional use of fish)	• Physical analytes (e.g., pH, conductivity, turbidity) • Major ions and nutrients • Total and dissolved metals • Organic compounds
Freshwater Aquatic Ecology: • Fish and fish habitat • Benthic invertebrates	• Habitat Units (as part of No-Net Loss plan) • Abundance and distribution • Continued opportunity for traditional and non-traditional use of fish	• Habitat units • Habitat quantity and fragmentation • Habitat quality, lower trophic levels • Fish health, including survival and reproduction • Access to fish
Marine Environment and Marine Wildlife	• Maintenance and population abundance and distribution of marine • biota, fish and wildlife • Maintenance and population abundance and distribution of Species at Risk • Continued opportunity for use of marine biota, fish and wildlife	• Habitat quantity • Habitat quality • Relative abundance and distribution of fish species • Survival and reproduction of marine wildlife • Availability of marine biota, fish, and wildlife • Access to marine biota, fish, and wildlife
• Population demographics • Education and training • Individual, family and community wellbeing • Community infrastructure and Public Services • Worker and Public Health and Safety • Governance and Leadership	• Maintenance of long-term social systems	• Demographic Changes • Migration • Education achievement and capacities • Family and community cohesion and function • Crime incidents • Physical and mental health • Addiction

Valued Component (VEC or VSEC)	Assessment Endpoints	Measurement Endpoints
		• Safety • Security • Community infrastructure • Public Service • Performance and capacity of governments
Traditional activity and knowledge	• Maintenance of traditional activity and knowledge	• Traditional and Commercial Harvesting • Land Use and Mobility • Food Security • Language
Employment and Business Opportunities	• Maintenance of long-term economic properties	• Employment • Gross Domestic Product and economic growth • Inflation and Consumer Price Index • Trade balance • Investment • Employment by industry • Economic infrastructure • Government fiscal situation • Business opportunities and contracting • Economic development • Income • Traditional economic activities
Non-traditional land use and resource use	• Maintenance of land use opportunities	• Hunting • Fishing • Tourism • Recreation • Parks and protected Areas • Wilderness character
Human Health • Workers • Public (Inuit and non-Inuit)	• Protection of air quality and noise with respect to human health • Continued opportunity for use of surface water, fish and country foods for traditional and non-traditional use	• Air quality • Soil quality • Country food quality • Water quality • Sediment Quality • Fish Quality • Noise
Heritage Resources / Cultural Impacts	• Protection of archaeological and paleontological resources • Maintenance of cultural resources	• Archaeological and sacred sites • Paleontological sites • Changes to the Cultural, Archaeological and Paleontological Record

4.4 Assessment Boundaries

For changes assessed in this Application, as part of the activities for the Meliadine Mine, the study area boundaries were developed based on the same criteria as the 2014 FEIS (Agnico Eagle 2014, Public Registry ID 287423 to 287614) and FEIS Addenda (Agnico Eagle 2018a, 2020a). The boundaries were set so that all potential residual effects (direct and indirect) of Meliadine Extension changes would fall within the study area boundaries. Refer to Figure 1.1-3 for a comparison of the approved and Meliadine Extension.

4.4.1 Spatial Boundaries

The LSA and Regional Study Areas (RSA) for all VEC and VSECs are mainly consistent with the 2014 FEIS (Agnico Eagle 2014, Public Registry ID 287423 to 287614) and are further described in Sections 5 to 9 of this Application. The methodology to determine the boundaries remain unchanged.

A summary of the 2014 FEIS boundaries in comparison to Meliadine Extension are provided in Table 4.4-1. Figures of the spatial boundaries for VEC/VSEC for Meliadine Extension are provided in Sections 5 to 9.

Selection of the boundary for effects study areas was based on the physical and biological properties of VEC and VSECs. In addition, effects assessment areas were designed to capture the maximum spatial extent of potential effects from Meliadine Extension and other past, present, and reasonably foreseeable future developments (RFFDs).

Table 4.4-1: Meliadine Extension Study Areas

Valued Component	Site Study Area (SSA)		Local Study Area (LSA)		Regional Study Area (RSA)	
	2014 FEIS	Meliadine Extension	2014 FEIS	Meliadine Extension	2014 FEIS	Meliadine Extension
Air Quality	A Site Study Area (SSA) was defined for the Mine Site (and associated infrastructure) that encompasses all of the operational areas, the open pits, and the interconnecting mine roads. This includes the direct area of physical disturbance associated with the construction and operation of the Project (disturbance footprint), and extends outward a distance of 500 m. This is the area where non-Project related activities would be restricted during the life of the Project, and public access to these areas would be limited. Site Study Areas were not defined for the AWAR, Rankin Inlet activities, or marine shipping.	The SSA is slightly changed to include new infrastructure presented in Meliadine Extension using the same methodology (500 m setback distance)	Mine Site: A rectangle 21×30 km in size, generally centered on the Mine Site activities. AWAR: A band 3 km in width, extending 1.5 km either side of the travel surface of the roadway. The AWAR LSA is considered to start at the edge of the mine LSA and extend south into Rankin Inlet. Rankin Inlet: The boundaries of the community of Rankin Inlet. LSA was not defined for Marine Shipping.	No change.	Defined for the mine site (and associated infrastructure), the AWAR, and Rankin Inlet activities. The RSA is 40×45 km in size, generally centered on the mine site, and includes the area where the dispersion modelling predictions were made. The areas where marine shipping activities occur, which includes the marine areas adjacent to Rankin Inlet and the off-shore areas within Canadian waters where these vessels would travel to and from Rankin Inlet, were considered to be "beyond the RSA".	Change to expand the area in which predicted concentrations are available for assessing potential impacts
Climate and Meteorology	Not defined	n/a	Not defined	n/a	Not explicitly defined. However, the areas that enclose the stations used for describing the existing climate and meteorology, as well the 50×50 km domain over which the dynamic (3-D) dispersion meteorology was generated, could be considered as the RSA for this discipline.	No change
Noise	A single SSA was defined to include the Mine Site (and associated infrastructure), the AWAR, and Rankin Inlet activities. Within the Mine Site area, the SSA encompasses the operational area of the Project; including the direct area of physical disturbance associated with the construction and operation of the Project (disturbance footprint), and extends outward a distance of 500 m. This is the area where non-Project related activities would be restricted during the life of the Project, and public access to these areas would be limited. Along the AWAR and in Rankin Inlet, the extent of the SSA is limited to the disturbance footprint. The SSA does not include marine shipping activities due to the relative distance of these activities to Point(s) of Reception (POR).	The SSA is slightly changed to include new infrastructure presented in Meliadine Extension using the same methodology (500 m setback distance)	Extends approximately 5 km from the SSA, and encompasses identified sensitive points of reception (PORs), and does not include marine shipping activities due to the large distance between these activities and identified PORs.	No change.	Not explicitly defined as the potential Project noise effects limited to the SSA and LSA. However, any noise effects that extend beyond the LSA are considered to extend into the RSA. Marine Shipping activities generally occur within the RSA.	No change.

Valued Component	Site Study Area (SSA)		Local Study Area (LSA)		Regional Study Area (RSA)	
	2014 FEIS	Meliadine Extension	2014 FEIS	Meliadine Extension	2014 FEIS	Meliadine Extension
Permafrost and Permafrost Terrain	Not defined	n/a	Not defined	n/a	Not defined	n/a
Soil	Not defined	n/a	Mine Site: 500 m buffer surrounding the mine footprint; where potential changes were greater than 500 m from the mine footprint, the LSA was expanded AWAR and Discovery Road: buffered by 1,000 m on either side Rankin Inlet: limited to the Project footprint within the hamlet boundary (i.e., the outward limit of Rankin Inlet infrastructure) and did not include a buffer. The total area of the LSA is 10,598 ha.	Mine Site: the 500 m buffer surrounding the mine footprint remains but is slightly adjusted to account for wind turbines. No change to AWAR and Discovery Road and Rankin Inlet	280,000 ha (i.e., radius of 28 km centered on the proposed mine site). The RSA extends an additional 14 km beyond the Zone of Influence so that effects from the mine can be assessed through wildlife monitoring. The RSA encompasses the entire Project footprint, including the AWAR and Rankin Inlet infrastructure.	No change.
Vegetation						
Terrestrial Wildlife and Wildlife Habitat	Caribou Effects Study Area (CESA): encompasses the entire spring migration, calving, post-calving, and summer ranges, as well as part of the rut, fall migration, and winter ranges of the Qamanirjuaq herd	No change.				
Birds and Bird Habitat	Not defined	n/a				
Groundwater and Hydrogeology	Not defined	n/a	Includes all the Project facilities, open pits and underground mine, buildings and infrastructure and the nearest lakes with open taliks.	No change.	Includes regional lakes with open taliks sufficient to define the regional groundwater flow directions	No change.
Hydrology, including Water Quantity			Mine site: includes watersheds under the direct mine footprint, including watersheds A, B, C, D, E, G, H, I, J, P, X, CH, and the Meliadine Lake watershed. AWAR: includes sections of watercourses crossed by the road corridor at the watercourse crossing locations.	No change.	Includes the Atulik, Char River, Dry Cove, Meliadine Lake, Meliadine River, Rankin Inlet, and Thompson watersheds.	No change.
Surface Water Quality			Mine site: LSA includes waterbodies and watercourses within watersheds on the Peninsula of Meliadine Lake (including Basins A, B, C, D, E, F, G, H, I, J, and P), the CH watershed, as well as Meliadine Lake itself AWAR: same as that defined for hydrology, and includes watercourses crossed by the Meliadine and Discovery road corridors and the area 100 m to either side of the centre line of the corridor at all watercourse crossings	No change.		No change.
Fish and Fish Habitat				No change.		No change
Marine Environment	Not defined	n/a	Includes all areas in Itivia Harbour designated for marine infrastructure (spud barge installation) and vessel activities, including the in-shore barge and small tanker route where delivery barges and small tankers transport offloaded materials and fuel from the cargo and tankers vessels anchored outside Melvin Bay, as well as the proposed offshore shipping corridor area extending west to east from Melvin Bay to Eastern Hudson Strait prior to entry into the western Labrador Sea.	No change at Itivia Harbour. A preferred shipping corridor has been added south of Coats Island	Includes a 5 km buffer area extending outside Melvin Bay and on either side of the marine shipping corridor, which is considered sufficient to encompass the potential regional extent of underwater noise effects from the Project.	No change at Itivia Harbour. A preferred shipping corridor has been added south of Coats Island
Marine Wildlife						

Valued Component	Site Study Area (SSA)		Local Study Area (LSA)		Regional Study Area (RSA)	
	2014 FEIS	Meliadine Extension	2014 FEIS	Meliadine Extension	2014 FEIS	Meliadine Extension
Traditional Activity and Knowledge	Not defined	n/a	Includes the study area for the mine, and the study area for the AWAR. The LSA includes the Project area, and a 500 m buffer surrounding the Project area.	The 500 m buffer surrounding the mine footprint remains but is slightly adjusted to account for wind turbines.	Includes the Project Development Area, AWAR, the communities of Rankin Inlet, Chesterfield Inlet, and Whale Cove; and the caribou study area.	No change
Non-traditional Land Use	Not defined	n/a	Where effects are anticipated at a local level only, the terrestrial resources LSA, with a boundary modification to include the entire municipality of Rankin Inlet, has been used to discuss Project effects on NTLU.	No change	The caribou RSA will be used to discuss regional effects to NTLU, with the inclusion of Chesterfield Inlet and the surrounding lands bounded by the coast and the south shore of the inlet.	No change
Socio-economics	Not defined	n/a	Includes the Kivalliq Region and the five communities of Arviat, Baker Lake, Chesterfield Inlet, Rankin Inlet, and Whale Cove make up the Project LSA	No change	Nunavut Territory	No change
Cultural, Archaeological and Paleontological Resources	Not defined	n/a	Based on the anticipated spatial extent of the immediate direct impacts (e.g., Project footprint) and a buffer of 500 m surrounding the footprint. For the Rankin Inlet, the footprint was limited to the Project footprint within the hamlet boundary (i.e., the outward limit of Rankin Inlet infrastructure) only and did not include a buffer, beyond the legislated 30 m protections zone	The 500 m buffer surrounding the mine footprint remains but is slightly adjusted to account for wind turbines. No change to the Rankin Inlet footprint.	Includes the Agnico Eagle Lease area plus a 7 km buffer; which includes the Iqalugaarjuup Nunanga Territorial Par	No change

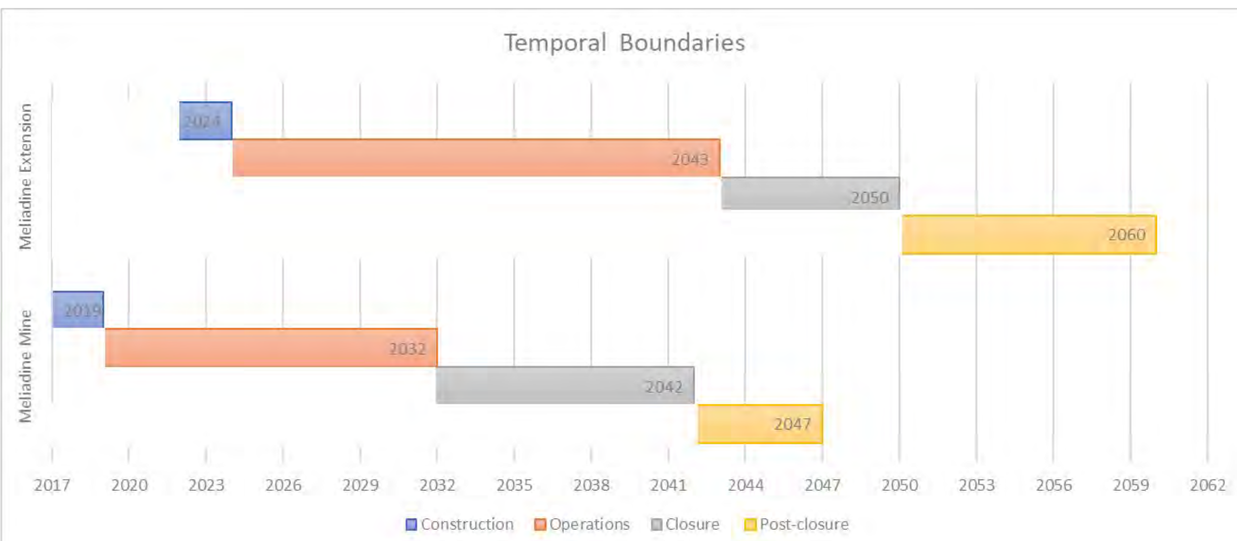
4.4.2 Temporal Boundaries

The approach used to determine the temporal boundaries of potential effects was similar to the approach used to define spatial boundaries and are linked to two concepts:

- the development phases (i.e., construction, operation, and closure), focused on Meliadine Extension changes
- the predicted duration of effects from Meliadine Extension changes on a VEC or VSEC, which may extend beyond closure (i.e., post-closure)

The Meliadine Mine has a current LOM of 13 years, with operations that commenced in 2019 running to 2032. Meliadine Extension will extend the LOM for an additional 11 years to 2043. Closure will extend for 7 years (i.e., to 2050) as pits are being re-flooded. Post-closure will be initiated when flooded pits are reconnected to the surrounding environment, and will last 10 years until 2060. Refer to Figure 4.4-1 for an overview of temporal boundaries.

Figure 4.4-1: Temporal Boundaries – Approved and Meliadine Extension



Notes:

- Construction will continue through operations to prepare for mining of new deposits
- Post-closure duration is consistent with the Meliadine ICRP Update 2020 (SNC 2021) submitted as part of the Type A Water Licence 2AM-MEL1631 Amendment and includes the waterline

4.5 Impact Assessment Approach and Impact Prediction

4.5.1 Pathway Analysis

Pathway analysis identifies and assesses the linkages between Meliadine Extension components or activities, and the correspondent potential residual effects to VEC or VSECs. A detailed description of the methods for the pathway analysis are provided in Volume 4, Section 4.3 of the 2014 FEIS (Agnico Eagle 2014, Public Registry ID 287486).

The analyses of residual effects from Meliadine Extension activities were quantitative and qualitative based on the size and scope of the extension and available information. The assessment included professional judgement and/or experienced opinion supported by data from field studies, scientific literature, monitoring programs, government publications, and personal communications. IQ and community information were incorporated, where available.

Given that Meliadine Extension remains generally within previously assessed areas, many of the 2014 FEIS predicted effects will remain unchanged, and are primarily focused at the Meliadine Mine site. Mitigation measures described in the 2014 FEIS will continue to be applied, as appropriate.

For each of the VECs and VSECs, all reasonable interactions between the proposed activities under Meliadine Extension were identified as:

- Construction, operation, and closure of the wind turbines
- Construction, operation, and closure of the airstrip
- Construction, operation, and closure of additional underground mining and infrastructure
- Construction, operation, and closure of the Tiriganiaq-Wolf mining area

For this Application, the incremental change from what is currently approved (i.e., already assessed) for Meliadine Mine to what is proposed for Meliadine Extension was assessed as part of the pathway analysis.

- **No linkage** – pathway is non-existent or is removed as it was previously assessed and the proposed activities under Meliadine Extension represent a negligible change, or is removed by environmental design features and mitigation so that the proposed activities result in no detectable environmental change and residual effects to VCs or the associated habitat relative to existing conditions or guideline values. Pathways with no linkage to VEC or VSEC are included in Appendix B-2 and will not be carried through the effects assessment.
- **Minor** – pathway could result in a minor environmental change but would have a negligible residual effect on VEC or VSEC or the associated habitat relative to existing conditions or guideline values. Pathways that are anticipated to be minor are included in Appendix B-2 and will not be carried through the effects assessment.
- **Primary** – pathway is likely to result in a measurable environmental change that could contribute to residual effects on VEC or VSEC or the associated habitat relative to existing conditions or guideline values. Primary pathways require further effects analysis to determine the environmental significance from Meliadine Extension activities on VEC or VSEC or the associated habitat. The primary pathways are presented in Sections 5 to 10, including rationale for the identified pathways.

The effects analysis considers all primary pathways that result in expected changes to a VEC or VSEC after implementing environmental design features and mitigation. Thus, the analysis is based on the residual effects from the proposed activities.

4.5.2 Residual Effects Analysis and Classification

An effects analysis follows the general approach to analyzing potential Meliadine Extension-specific and cumulative (where applicable) effects on a VEC or VSEC. The effects analysis for the VECs and VSECs followed the assessment methodology described in Volume 4 of the 2014 FEIS (Agnico Eagle 2014, Public Registry ID 287486).

Effects statements are used to focus the analysis of changes to VECs and VSECs that are associated with one or more primary pathways. Sections 5 to 10 of this Application presents a qualitative assessment for criteria such as magnitude, geographic extent, duration, and frequency for identified primary pathways. Pathways associated with each effects statement are classified using scales (categorical values such as negligible, low, or high) for each impact criterion (e.g., magnitude). The purpose of the residual effect classification is to describe the residual effects from Meliadine Extension on a VEC or VSEC using a scale of common words, rather than numbers or units.

The following criteria were used to assess the residual effects from Meliadine Extension, and are further described below:

- Direction or nature of the impacts
- Magnitude and complexity
- Geographic extent
- Frequency
- Duration
- Reversibility
- Likelihood or probability of effects

The term “effect”, used in the effects analyses and residual effects summary, is regarded an “impact” in the residual impact classification. Therefore, in the residual impact classification, all residual effects are discussed and classified in terms of impacts to VECs or VSECs with primary pathways.

Direction: Direction indicates whether the impact on the environment is negative (i.e., less favourable), positive (i.e., beneficial), or neutral (i.e., no change). While the focus of the impact assessment is to predict whether the development is likely to cause significant adverse impacts on the environment, the positive changes associated with Meliadine Extension also are reported. Neutral changes are not assessed.

Complexity and Magnitude: Complexity is the degree of intricacy relative to the existing condition. Complexity is a measure of the number of interconnected or interwoven components. Magnitude is a measure of the intensity of an impact, or the degree of change caused by Meliadine Extension relative to the 2014 FEIS conditions or a guideline value. The degree of complexity is incorporated within magnitude and is then classified into four scales: negligible, low, moderate, and high. Magnitude can relate to a percentage change (e.g., change from existing conditions), or to absolute changes that are above or below guidelines or thresholds. Where possible, magnitude is reported in absolute and relative terms.

Geographic Extent: Geographic extent refers to the area affected, and is categorized into four scales; local, regional, beyond regional, and transboundary. Local-scale impacts mostly represent changes that are directly related to the Meliadine Extension footprint and activities but may also include small-scale indirect impacts. Changes at the regional scale are largely associated with indirect impacts from the Meliadine Extension, and represent the maximum predicted spatial extent of impacts from the Meliadine Extension. Impacts beyond the regional scale are mostly associated with VECs (e.g., caribou) that have large spatial distributions and are influenced by cumulative effects from the Meliadine Extension and other developments.

Frequency: Frequency refers to how often an impact will occur and is expressed as isolated (confined to a discrete period), periodic (occurs intermittently, but repeatedly over the assessment period), or continuous (occurs continuously over the assessment period). Frequency is explained more fully by identifying when it occurs (e.g., once at the beginning of the Meliadine Extension). If the frequency is periodic, then the length of time between occurrences, and the seasonality of occurrences (if present) is discussed.

Duration: Duration is defined as the amount of time from the beginning of an impact to when the impact on a VEC or VSEC is reversed and is expressed relative to Meliadine Extension phases. Thus, duration is a function of the length of time that the VEC or VSEC is exposed to Meliadine Extension activities or phases (e.g., construction, operation, temporary closure, decommissioning and reclamation or permanent), and its' reversibility.

Reversibility: After removal of the stressor, reversibility is the likelihood and time required for a VEC or VSEC or system to return to a state that is similar to the state of systems of the same type, region, and time period that are not affected by the Meliadine Extension. This term usually has only one alternative: reversible or irreversible. The time frame is provided for reversibility (i.e., duration) if an impact is reversible. Permanent impacts are considered irreversible. Where appropriate, the evaluation identifies the resources that may be directed to facilitate recovery.

Likelihood or Probability of Effects: Likelihood is the probability of an impact occurring and is described in parallel with uncertainty. Four categories are used: unlikely (impact is likely to occur less than once in 100 years), possible (impact will occur at least once in 100 years), likely (impact will likely occur at least once in 10 years), and highly likely (impact has 100% chance of occurring within a year). The likelihood of an impact was determined based on the probability of the event occurring and the implementation of mitigation measures.

Although professional judgement is inevitable in some cases, an effort was made to classify impacts using scientific principles and supporting evidence where possible. The scale and definitions for the residual impact criteria for classifying effects from Meliadine Extension are provided in Table 4.5-1.

For VECs or VSECs with primary pathways, the assessment and classification of residual impacts was based on the predicted incremental and cumulative changes:

- Incremental impacts are based on changes from Meliadine Extension relative to existing conditions (i.e., 2014 FEIS)
- The magnitude for cumulative impacts involves changes from existing conditions through application of Meliadine Extension and into the future case

Cumulative impacts from Meliadine Extension and other RFFDs influence a population throughout its entire annual range (including migratory movements where applicable). In contrast, the geographic extent of incremental impacts from Meliadine Extension may have a local or regional influence on marine or terrestrial wildlife populations, for example.

Table 4.5-1: Definitions of Criteria Used in the Residual Impact Classification of Pathways

Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Negative: a less favourable relative to existing conditions **Positive:** an improvement over existing conditions or values	**Negligible:** no predicted detectable change from existing conditions **Low:** impact is predicted to be within the range of existing conditions **Moderate:** impact is predicted to be at or slightly exceeds the limits of existing conditions **High:** impact is predicted to be beyond the upper or lower limit of existing conditions so that there is likely a change of state from existing conditions	**Local:** small-scale direct and indirect impacts from the proposed amendment activities (e.g., footprint, and dustdeposition) **Regional:** the predicted maximum spatial extent of combined direct and indirect impacts from the Meliadine Extension that exceed local-scale effects (can include cumulative direct and indirect impacts from the Meliadine Extension and other developments at the regional scale) **Beyond Regional:** cumulative local and regional impacts from the proposed amendment activities and other RFFD extend beyond the regional scale	**Short-term:** impact is reversible at end of construction **Medium-term:** impact is reversible at end of closure **Long-term:** impact is reversible within a defined length of time beyond closure **Unknown**: Impact may be reversible; however, the length of time cannot be defined **Permanent**: impact will last into perpetuity	**Isolated:** impact confined to a specific discrete period **Periodic:** impact occurs intermittently but repeatedly over the assessment period **Continuous:** impact will occur continually over the assessment period	**Reversible:** Impact will not result in a permanent change of state ofthe population compared to "similar" environments not influenced by the proposed amendment activities **Irreversible:** impact is not reversible (i.e., duration of impact is unknown or permanent)	**Unlikely:** the impact is likely to occur less than oncein 100 years **Possible:** the impact will have at least one chanceof occurring in the next 100 years **Likely:** the impact will have at least one chanceof occurring in the next 10 years **Highly Likely:** the impact is very probable (100% chance) within a year

4.5.3 Approach to Cumulative Effects

The approach to cumulative effects follows the general approach as described in Volume 4, Section 4.5.2 of the 2014 FEIS (Agnico Eagle 2014, Public Registry ID 287486).

Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, cultural, and economic components of the environment through time and across space. Some changes may be human-related, such as increasing industrial development, and some changes may be associated with natural phenomenon, such as extreme rainfall events, and periodic harsh and mild winters. It is the goal of the cumulative effects assessment to estimate the contribution of these types of effects, in addition to Meliadine Extension effects, to the relative change in the VECs or VSECs.

Cumulative effects assessment requires identifying and predicting the likelihood and significance of potential cumulative effects, including direct, indirect, and residual impacts. Not every VEC or VSEC requires an analysis of cumulative effects. The key is to determine if the effects from the Meliadine Extension and one or more additional developments/activities overlap (or interact) with the temporal or spatial distribution of the VEC or VSEC. For some VECs, Meliadine Extension -specific effects are important and there is little or no potential for cumulative effects because there is little or no overlap with other developments (e.g., soils). For other VECs that are distributed, or travel over large areas and can be influenced by a number of developments (e.g., migratory birds, caribou), the analysis of cumulative effects can be necessary and important. Socio-economic components also must consider the potential cumulative effects of the Meliadine Extension and other developments and human activities, where there are residual effects.

In this Application, cumulative effects are identified, analyzed, and assessed within the Meliadine Extension-specific assessments for those VECs, where it is applicable. Similar to Meliadine Extension-specific effects, the analysis of cumulative effects involved pathway analysis and effects analyses, and the classification and determination of significance of residual impacts.

A list of projects (past, present, and future) used to assess cumulative effects are provided in Appendix B-1. Cumulative effects identified, analyzed, and assessed in consideration of the proposed activities of Meliadine Extension, relative to the 2014 FEIS, are summarized in Section 5 to 10, where applicable.

4.5.4 Prediction Confidence and Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted (i.e., underestimated). Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events)

- understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will impact migratory marine birds and mammals)
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts

Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and the current knowledge of the system. It is anticipated that the baseline and existing conditions data are moderately sufficient for understanding current conditions; therefore, there is a moderate level of understanding of Meliadine Extension-related impacts on the ecosystem.

Where appropriate, uncertainty may also be addressed by additional mitigation and in follow-up and monitoring programs. Sections 5 to 10 of this Application includes a discussion of sources of uncertainty and how uncertainty is addressed.

4.5.5 Monitoring and Follow-up

The approach for monitoring and follow-up is consistent with the 2014 FEIS (Agnico Eagle 2014, Public Registry ID 287486).

Monitoring programs are proposed to deal with the uncertainties associated with the impact predictions and environmental design features. In general, monitoring is used to test (verify) impact predictions and determine the effectiveness of environmental design features (mitigation). Monitoring is also used to identify unanticipated effects and implement adaptive management where required. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Meliadine Extension:

- **Compliance monitoring and inspection**: monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and conditions of approval, and of Company commitments (e.g., inspecting the installation of a silt fence; monitoring mine water discharge quality and volumes).
- **Follow-up:** programs designed to test the accuracy of impact predictions, reduce uncertainty, determine the effectiveness of environmental design features, and provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices. Results from follow-up programs can be used to increase the certainty of impact predictions in future EAs. Where applicable, the results from follow-up programs completed at Meliadine Mine were considered in the assessment of Meliadine Extension.

These programs form part of the environmental management system for the Meliadine Mine. If monitoring or follow-up detects effects that are different from predicted effects, or the need for improved or modified design features, then adaptive management will be implemented by Agnico Eagle. This may include increased or decreased monitoring, changes in monitoring plans, or additional mitigation. Monitoring, mitigation, and management plans are further discussed in Section 12 of this Application.

5 ATMOSPHERIC ENVIRONMENT

5.1 Introduction

The purpose of Section 5 is to address updates to the 2014 FEIS and the 2018 and 2020 Addenda (Agnico Eagle 2014, 2018a, 2020a), in relation to the impacts of the changes made to the Meliadine Extension of the Meliadine Mine. This Application does not propose changes to traffic levels and type of traffic on the AWAR or to laydown and fuel farm activities in Rankin Inlet. At site, a windfarm, an airstrip as an alternative, and underground mines in already approved areas are the proposed changes as part of Meliadine Extension. The TSF and WRSF will have a smaller footprint than originally anticipated reducing particulate matter emissions. The LOM will be extended by 11 years, to 2043. No other changes are proposed at the Meliadine Mine.

5.1.1 Valued Ecosystem Components

The identification of VECs and factors considered in their selection are further described in Section 4.3 of this Application. The following VEC's for atmospheric environment have been identified for this Application, which are consistent with the 2014 FEIS:

- air quality
- climate and meteorology
- greenhouse gas emissions
- noise

5.1.2 Spatial Boundaries

5.1.2.1 Air Quality

As part of the 2014 FEIS, four areas were assessed: the Mine Site, AWAR, Rankin Inlet, and Marine shipping.

In the 2014 FEIS, no Site Study Area (SSA) was developed for the AWAR, Rankin Inlet and marine shipping. As part of Meliadine Extension, no changes were made to this spatial boundary as no changes are proposed for these activities. The Mine Site SSA has been expanded to the northwest compared to the 2014 FEIS to include the windfarm, airstrip and Tiriganiaq-Wolf mining area using the same outward distance of 500 m from infrastructures around the Mine site.

No change was required to the Mine Site, AWAR, and Rankin Inlet LSAs for Meliadine Extension as there are no proposed changes to these areas. No LSA was defined for the marine shipping activity in the 2014 FEIS and in this Application.

As part of the 2014 FEIS, a single RSA was developed for the mine site, AWAR and Rankin Inlet. Activities in the marine shipping area were considered to be "beyond the RSA". For Meliadine Extension, the RSA was extended primarily to the north to expand the area in which predicted concentrations are available for the purposes of assessing potential impacts. From the 35 km by 35 km RSA in the 2014 FEIS, the 2021 FEIS Addendum used a 43 km east-west by 48 km north-south RSA. In 2014, the northern boundary of the LSA and RSA were the same.

The spatial boundaries for air quality are provided in Figure 5.1-1.

5.1.2.2 Climate and Meteorology

The spatial boundary associated with the climate is the Kivalliq region of Nunavut, same as in the 2014 FEIS. The temporal boundary is the historic climate and meteorological records for Rankin Inlet.

5.1.2.3 Climate Change

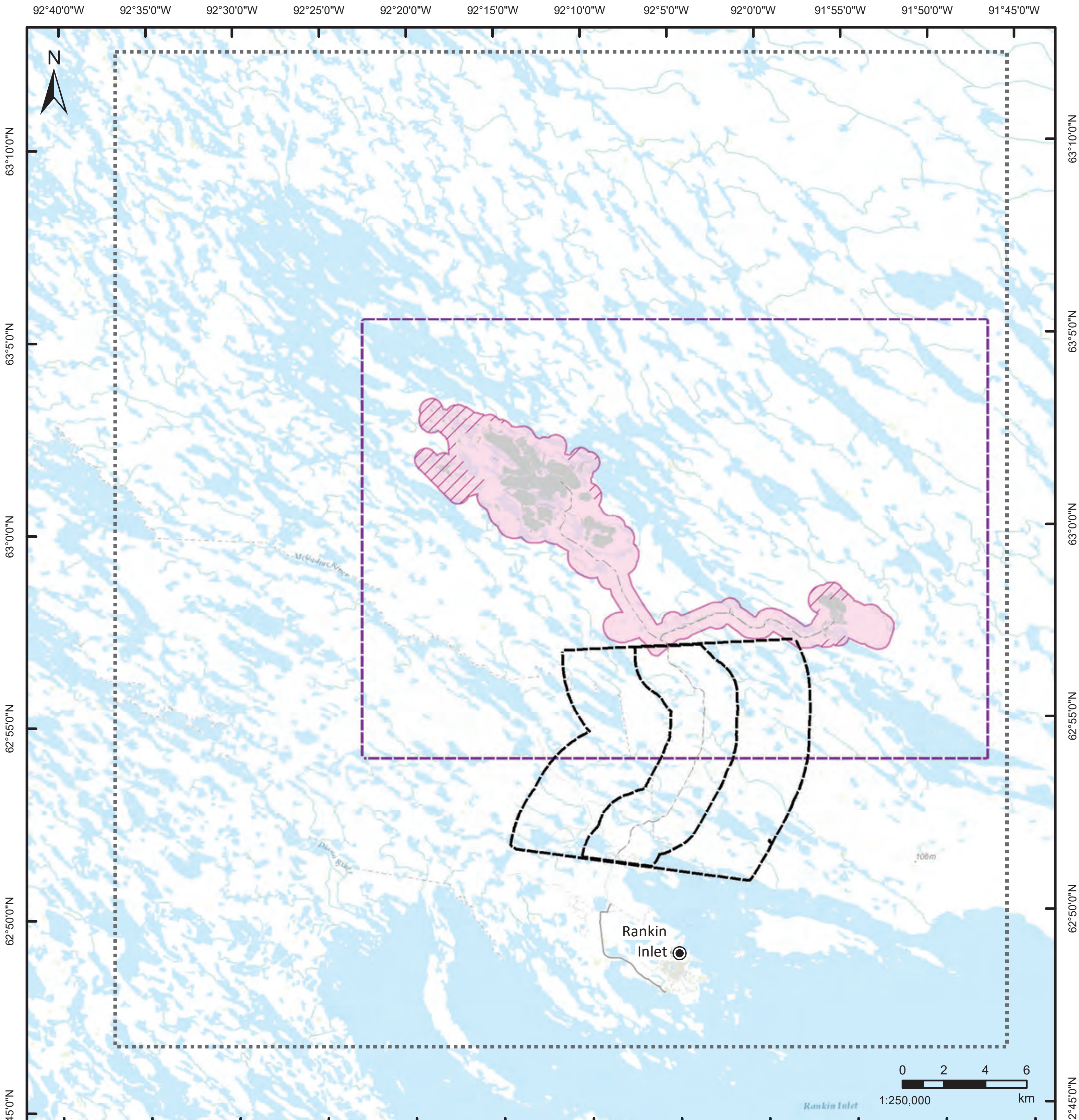
An SSA and LSA were not defined for climate change. In addition, no explicit RSA was defined for climate change. However, the areas that enclose the stations used for describing the historic climate trends (i.e., Baker Lake and Rankin Inlet), as well as the grid cells used for defining future climate trends, could be considered as the RSA for this discipline.

5.1.2.4 Noise

The spatial boundaries are identical to the 2014 FEIS, which included assessing the effects of noise associated with the spatially isolated elements of the Meliadine Extension (i.e., mine site and infrastructure, AWAR, Itivia Harbour activities, and marine shipping. In summary:

- A single SSA was defined to include the Meliadine Extension's infrastructure and AWAR activities with a 500-metre setback distance.
- The LSA was defined as a 5 km boundary that encompasses the identified sensitive points of reception (PORs).
- A RSA was not explicitly defined for noise as effects are expected to be limited to the SSA and LSA.

The spatial boundaries for noise are provided in Figure 5.1-2.



Meliadine Extension

Spatial Boundaries – Air Quality

Date: 11/25/2021

Map Number: MEL-016

Coordinate System:
NAD 1983 UTM Zone 15N

Projection: Transverse Mercator

Datum: North American 1983

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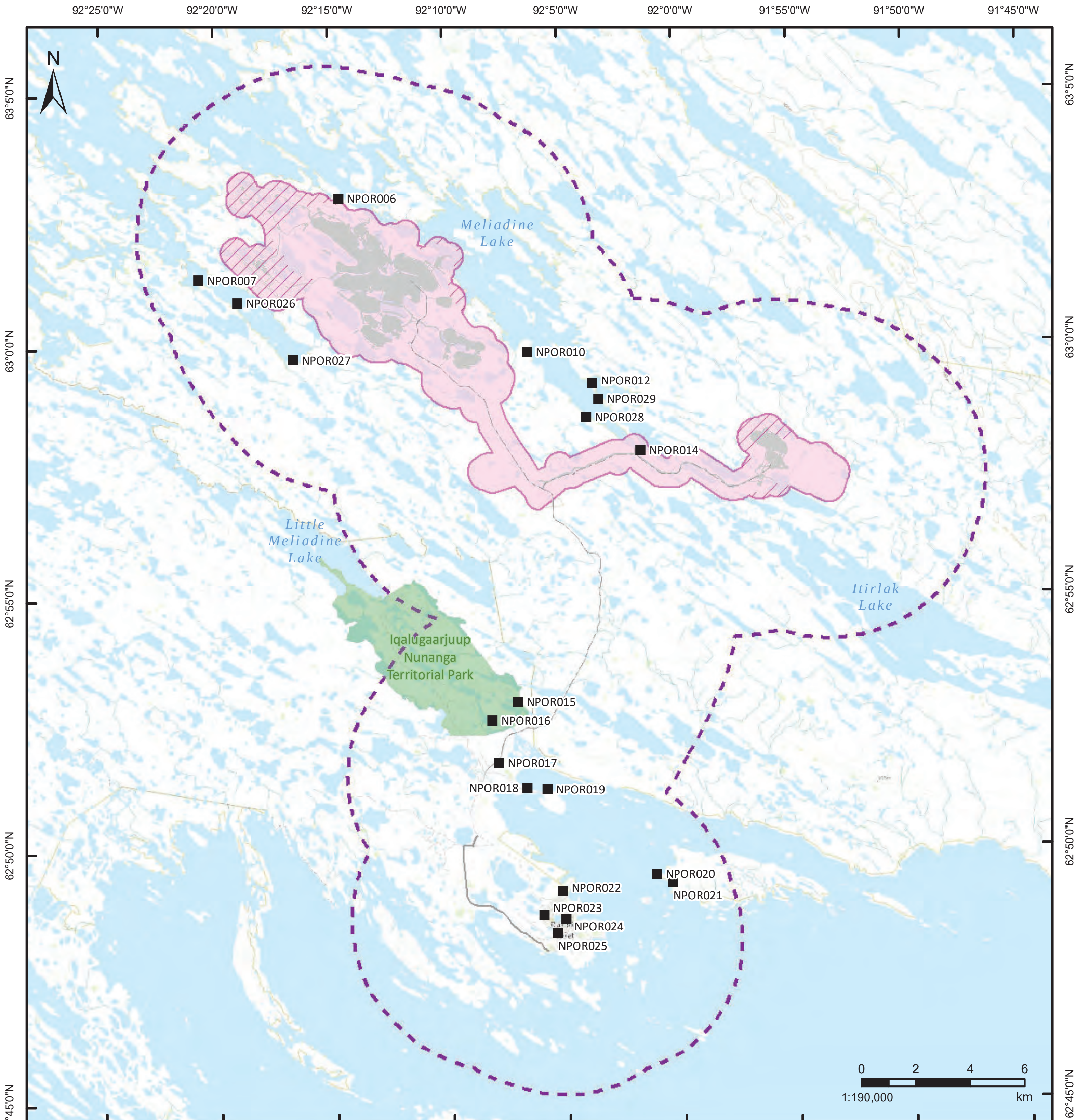
Legend

- Meliadine Extension
- Site Study Area (Mine Site)
- Extension Area
- Local Study Area (AWAR)
- Local Study Area (Mine Site)
- Regional Study Area
- All-Weather Access Road (AWAR)
- Bypass Rd.
- Existing Road



Meliadine Extension

Spatial Boundaries – Noise

Legend

- Noise Receptor
- Meliadine Extension
- Site Study Area (Mine Site)
- Extension Area
- Local Study Area
- Territorial Park
- All-Weather Access Road (AWAR)
- Bypass Road
- Existing Road

Date: 11/4/2021
Map Number: MEL-023
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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5.2 Air Quality

5.2.1 Abstract

There is one new primary pathway for Meliadine Extension. It is associated with operation of the windfarm that will reduce combustion emissions. For air quality, the predicted emissions from the mine site are below the 2020 and 2025 Canadian Ambient Air Quality Standards (CAAQS) limits for NO_2 and SO_2 at the SSA boundary. No changes are expected regarding particulate matter and dust emissions. Effects on air quality associated with Meliadine Extension are assessed as non-significant.

5.2.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ, TK, and concerns related to air quality were provided by community members and incorporated into the Meliadine Extension air quality assessment, which takes into account review of community engagement notes from focus group meetings, public consultations and the VMR and other consultation processes. The following IQ, TK, comments, and concerns have been expressed by community members related to effects of Meliadine Extension on air quality:

- Dust from the road can affect vegetation and activities, such as berry picking.

5.2.3 Existing Environment

Baseline air quality presented in the 2014 FEIS was obtained using ECCC National Air Pollution Surveillance Network. The air quality was representative of undisturbed natural area. Readings were very low and well below the given air quality standards.

Air quality monitoring is ongoing at the Meliadine Mine. Constituents monitored include NO_x, SO_2, total suspended particulates (TSP), PM_{10}, $PM_{2.5}$, and dust.

Calculated annual average concentrations of NO_2 and SO_2 were well below the Nunavut Ambient Air Quality Standards (NAAQS) and the 2014 FEIS maximum predicted values. 2020 was the fourth full year of monitoring for gaseous compounds.

Dustfall results are mostly within Alberta Environment’s Ambient Air Quality Guidelines for recreational and industrial areas (Air Quality Monitoring Report in Agnico Eagle 2021c). In 2020, one of 40 on-site samples exceeded the recreational guideline, and no sample exceeded the industrial guideline. Historically, an increase in measured dustfall rates has occurred since mid-2017 when the construction period began, as anticipated. Despite increasing site activity, levels of dustfall at site perimeter monitoring stations are generally well within Alberta recreational guidelines, with exceedances occurring in a maximum of 4% of total dustfall samples in any given year since that time. Along the AWAR, annual average rates of dustfall have only exceeded the Alberta recreational guideline at the 25-metre distance as expected in the 2014 FEIS.

Dust suppressant in the form of calcium chloride has been applied along the AWAR and road watering has been conducted around the site in previous years. Results of dustfall monitoring indicate that these best management practices are being effectively implemented to minimize emissions.

Suspended particulates (TSP, $PM_{2.5}$, and PM_{10}) monitoring results to date have been below maximum concentrations predicted in the 2014 FEIS and regulatory guidelines. Concentration of metals of concern to the Meliadine Mine in TSP (cadmium and iron) were less than 2014 FEIS-selected health-based screening values and 2014 FEIS maximum model predictions in all samples.

Incinerator stack testing has been ongoing since Project Certificate issuance in 2015 and all results to date have been below GN standards for mercury, dioxins, and furans.

Target concentrations published by the CAAQS were updated since the 2014 FEIS to include stricter targets for 2020 and 2025. The 2014 FEIS used the NAAQS as criteria. Agnico Eagle has included both the 2020 and 2025 CAAQS targets in its NO_2 and SO_2 predictive modelling. Table 5.2-1 summarizes CAAQS for NO_2 and SO_2.

Table 5.2-1: Ambient Air Quality Standards, Objectives and Guidelines for NO_2 and SO_2

Compound	Averaging Period	2014 FEIS (NAAQS)	2020 CAAQS	2025 CAAQS
NO_2 (µg/m^3)	1-hr	400	113[b]	79[b]
	24-hr	200	N/A	N/A
	Annual	60[a]	32[c]	22.5[c]
SO_2 (µg/m^3)	1-hr	450	183[d]	170[d]
	24-hr	150	N/A	N/A
	Annual	30[a]	13[e]	10.5[e]

(a) Arithmetic mean value

(b) Canadian Ambient Air Quality Standard is 113 µg/m^3 from December 2017 through December 2024 and 79 µg/m^3 as of January 2025 (Government of Canada 2017a); compliance based on a three-year average of the annual 98th percentile of the daily 1-hour maximum concentration (D1HM).

(c) Canadian Ambient Air Quality Standard is 32 µg/m^3 from December 2017 through December 2024 and 22.5 µg/m^3 as of January 2025 (Government of Canada 2017a); compliance based on a one-calendar-year average of all the 1-hour average concentrations.

(d) Canadian Ambient Air Quality Standard is 183 µg/m^3 from October 2017 through December 2024 and 170 µg/m^3 as of January 2025 (Government of Canada 2017b); compliance based on a three-year average of the annual 99th percentile of the daily-maximum 1-hour average concentrations.

(e) Canadian Ambient Air Quality Standard is 13 µg/m^3 from October 2017 through December 2024 and 10.5 µg/m^3 as of January 2025 (Government of Canada 2017b); compliance based on a one-calendar-year average of all the 1-hour average concentrations.

5.2.4 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the Application and air quality was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-1 of this Application and are also described in Volume 5, Section 5.2.5, Table 5.2-7 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC air quality as a result of

Meliadine Extension, there is no change from the previous assessment. Primary pathways identified for Meliadine Extension are further assessed below and presented in Table 5.2-2.

The following primary pathways were identified for Meliadine Extension for the air quality assessment:

- Mine Site (Operation):
  - Meliadine Extension activities will result in air emissions, which may cause changes in air concentrations and atmospheric deposition rates.
  - Fuel combustion will result in air emissions, which may contribute to territorial and national GHG emissions.
  - New: The windfarm will result in reduced diesel fuel consumption and a commensurate reduction in emissions of common air contaminants associated with diesel combustion, which is a positive effect.

Table 5.2-2: Potential Primary Pathways for Air Quality

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Mine Site (Operation)	Meliadine Extension activities will result in air emissions, which may cause changes in air concentrations and atmospheric deposition rates. Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions. NEW: The windfarm will result in reduced diesel fuel consumption and a commensurate reduction in emissions of common air contaminants associated with diesel combustion, which is a positive effect.	Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards. Use of ultra-low sulfur diesel will stay in place. The use of low-emissions explosives such as emulsion will continue to be preferred. Speed limits and dust suppressant (water of calcium chloride) will continue to be used when required to reduce dust emissions. Sources of particulate emissions at the processing facility are controlled through the use of baghouses. Enclosures are used to reduce fugitive emissions at the processing facility. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. Installation of incinerator that complies with Nunavut Environmental Protection Act standards for dioxin and furans.	Primary	Primary	Table 5.2-7 of 2014 FEIS	No change	Not Significant	No change	No changes in the mining rate is planned for the Meliadine Extension. The total tonnage of rock moved during the life of mine is smaller than what was predicted in the 2014 FEIS due to a refined mine plan. The windfarm will reduce NO_2 and SO_2 emissions. Predicted mine site emissions are under CAAQS guidance for 2020 and 2025. Mitigation and monitoring measures outlined in the 2014 FEIS will be carried forward through Meliadine Extension.

5.2.4.1 Mine Site (Operation)

The air quality emissions assessment was done with the refined mining for the Meliadine Extension.

Overall, no changes are expected in particulate matter emissions as the assessed production rate will remain the same at 8,500 tpd. The airstrip will likely increase fugitive emissions but the TSF and WRSFs will be smaller than originally anticipated balancing increased emissions from the newly added airstrip. Therefore, no particulate matter modelling was needed for the Mine Site as the 2014 FEIS modelling is considered to be a conservative assessment of effects.

Although no increase in emissions is predicted due to the production rate staying the same, SO_2 and NO_2 were reassessed because of the change in guidance from the CAAQS for those two constituents which have lower thresholds for 2020 and 2025. A conservative scenario was developed based on the busiest year in terms of total emissions. This was evaluated by the total tonnage being moved over the year. Scenarios for Meliadine Extension's alternatives, such as the windfarm and airstrip, are also assessed in terms of their impact on ambient air quality. The windfarm will reduce NO_2 and SO_2 emissions. Air quality modelling methods and results are presented in Appendix H-01.

Concentrations were assessed outside the mine's air quality SSA. This approach is consistent with the 2014 FEIS.

The goals of the modelling exercise were to evaluate the potential of air emissions and corresponding air quality effects, including:

- quantify emissions from the fuel combustion in mobile equipment, such as haul trucks and mining fleet;
- quantify emissions from stationary equipment, such as diesel generators and other combustion sources;
- predict the dispersion of emissions; and
- assess the predictions in light of the CAAQS guidance for 2020 and 2025.

Figures 5.2-1 shows the daily 1-hour maximum NO_2; and average annual NO_2 predicted concentrations respectively for the worst case scenario. The modeling results for the other scenarios assessed, including SO_2 predicted levels and the assessment of alternatives are presented in Appendix H-01. The predicted emissions from the mine site are below the 2020 and 2025 CAAQS limits for NO_2 and SO_2 at the SSA boundary (Table 5.2-3).

Table 5.2-3: Maximum Predicted NO_2 and SO_2 Concentrations in SSA

Compound	Averaging Period	Maximum Concentration	NAAQS	2025 CAAQS
NO_2	1-hour (µg/m^3)	76.9	400	79[a]
	Annual (µg/m^3)	13.3	60	22.5[b]
SO_2	1-hour (µg/m^3)	48.8	450	170[c]
	Annual (µg/m^3)	1.7	30	10.5[d]

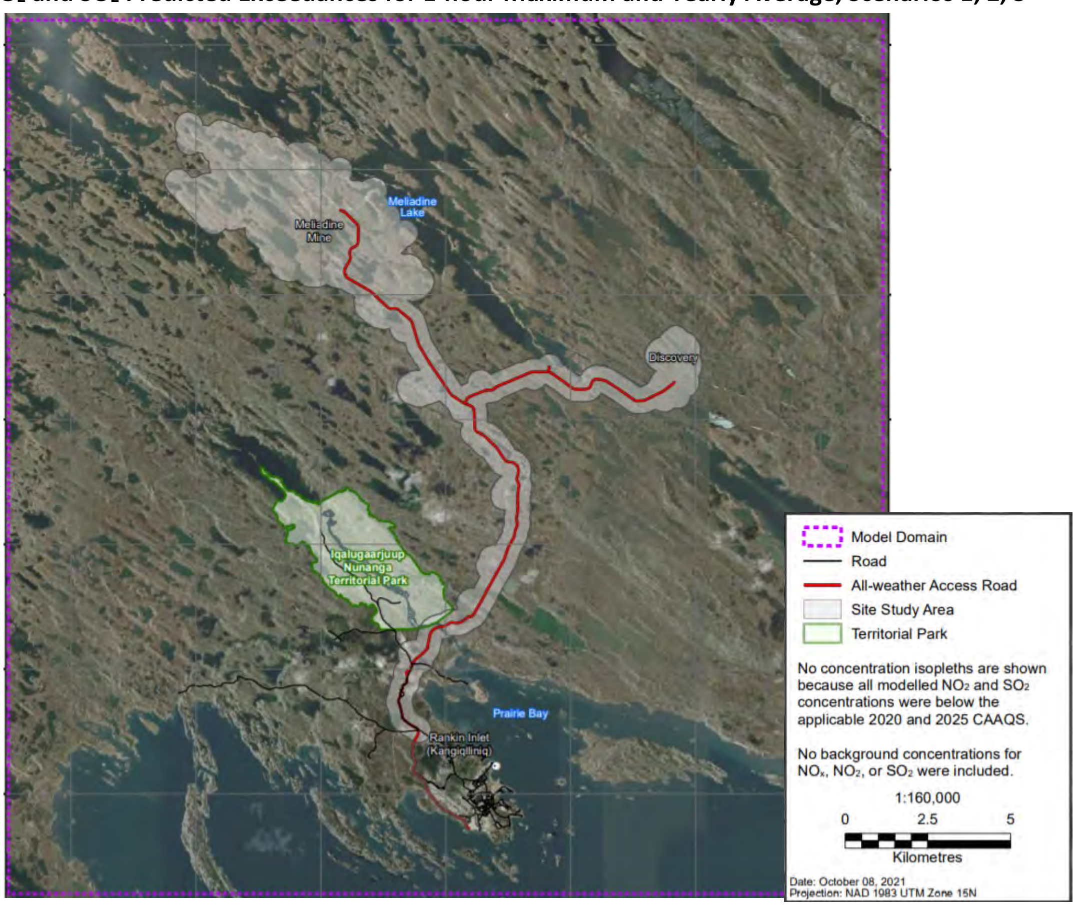
(a) Canadian Ambient Air Quality Standard is 113 µg/m^3 from December 2017 through December 2024 and 79 µg/m^3 as of January 2025 (Government of Canada 2017a); compliance based on a three-year average of the annual 98^{th} percentile of the daily 1-hour maximum concentration (D1HM).

(b) Canadian Ambient Air Quality Standard is 32 µg/m^3 from December 2017 through December 2024 and 22.5 µg/m^3 as of January 2025 (Government of Canada 2017a); compliance based on a one-calendar-year average of all the 1-hour average concentrations.

(c) Canadian Ambient Air Quality Standard is 183 µg/m^3 from October 2017 through December 2024 and 170 µg/m^3 as of January 2025 (Government of Canada 2017b); compliance based on a three-year average of the annual 99^{th} percentile of the daily-maximum 1-hour average concentrations.

(d) Canadian Ambient Air Quality Standard is 13 µg/m^3 from October 2017 through December 2024 and 10.5 µg/m^3 as of January 2025 (Government of Canada 2017b); compliance based on a one-calendar-year average of all the 1-hour average concentrations.

Figure 5.2-1: NO_2 and SO_2 Predicted Exceedances for 1-hour Maximum and Yearly Average, Scenarios 1, 2, 3



5.2.5 Residual Impact Classification

Although primary pathways have been identified for air quality, no residual impact classification are made because air quality does not have an assessment endpoint. Any potential effects associated with the primary pathways are captured in the assessment of potential effects to, and residual impact classifications for, other VCs (e.g., water quality, and human health).

5.2.6 Cumulative Effects Assessment

No projects are present in the vicinity of Meliadine Extension. Therefore, no cumulative effects are foreseeable for regional air quality. This is consistent with the 2014 FEIS.

The modelling results shows that the emission from anthropogenic activity at Meliadine Extension will not reach Rankin Inlet; therefore, any potential activity in the hamlet will most likely not have cumulative effects with Meliadine Extension. The assessment of air quality associated with the AWAR includes all expected activities, including those not related to the Meliadine Extension. In Rankin Inlet, air quality effects of the Meliadine Extension were shown to be negligible with respect to the existing sources within the community.

5.2.7 Uncertainty

Consistent with the 2014 FEIS, the air quality assessment relies on dispersion models in predicting the effect of the Meliadine Extension. Therefore, there is a potential for uncertainty within the results. Uncertainty in the predictions used in the air quality assessment of Meliadine Extension have been managed through a combination of the following:

- The CALPUFF model was used which is a widely accepted standard for such applications in Canada as well as internationally;
- Inputs for stationary equipment, mobile equipment, blasting and meteorology were carefully selected based on monitoring data, supplier specifications or conservative assumptions; and
- The modeled scenario represents the busiest year for total activity (2030), which is expected to produce the highest number of emissions over the operations phase of the Meliadine Extension.

NO_2 is being carried forward into the Human Health and Ecological Risk Assessment (HHERA) for further evaluation.

5.2.8 Monitoring and Follow-up

Agnico Eagle will continue to comply with the Air Quality Monitoring Plan, the Dust Management Plan, and the Greenhouse Gas Reduction Plan (Appendix D-02, D-11, and D-14, respectively).

Where applicable to Meliadine Extension, Agnico Eagle has updated the associated management plans as part of this addendum submission to NIRB.

Agnico Eagle considers that existing T&C 1, 2, 3, 4, and 5 of Project Certificate No.006 are sufficient to mitigate and monitor air quality impacts associated with the Meliadine Extension.

5.3 Climate and Meteorology

The purpose of this section is to address updates to climate and meteorology data presented in the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a), in relation to the Meliadine Extension.

For Meliadine Extension, the average annual temperature in Rankin Inlet during this period is -10.4 °C which is the same as the average mean temperature reported in the 2014 FEIS (Volume 5, Table 5.4-4; Agnico Eagle 2014). Temperatures are seen to increase. These trends are the same as observed in the 2014 FEIS. The annual precipitation for Meliadine Extension is 430 mm, distributed relatively evenly as snowfall and rainfall. According to the meteorological records, annual precipitation appears to be trending upward. Overall, the modelled wind data were comparable to the monitoring data from Rankin Inlet for the same period (Okane 2021) and agree with the CALMET Wind-Rose from the 2014 FEIS. Winds are moderate to strong and generally originate from the north-northwest and the north.

Consistent with the 2014 FEIS, climate and meteorology refer to historic observations regarding the expected weather conditions and the variability in those conditions, respectively.

5.3.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ and TK concerns regarding climate and meteorology include reference to low water level, same as for the 2014 FEIS. The IQ and TK observations generally match the historic trend analysis from climate trends presented in Section 5.4 of this Application. A general increase in precipitation is noted in the 39-year trend analyzed and project specific future climate databases. Temperatures are seen to increase, similar to what is indicated by TK in the 2014 FEIS consultation.

5.3.2 Air Dispersion Meteorology

There is no change in the Computer Aided Learning in Meteorology (CALMET) data used in the 2014 FEIS air dispersion modelling for the Meliadine Extension. The rationale for using the same meteorology data is that validation was done on the 2014 FEIS Fifth-Generation Penn State/NCAR Mesoscale Model (MM5) prognostic data and it was still representative of Meliadine Extension location and appropriate to use as inputs to the Computer Aided Lagrangian Puff (CALPUFF) air quality dispersion model. For more details on the CALMET meteorological data used for Meliadine Extension air dispersion modelling, refer to Volume 5, Section 5.3.3 of the 2014 FEIS.

5.3.3 Existing Conditions

Information on climate and meteorology baseline and existing conditions has been collected and summarized in a variety of documents since the issuance of the 2014 FEIS (Agnico Eagle 2014). The documents include the 2020 FEIS Addendum (Agnico Eagle 2020a), Meliadine Annual Reports, and several ECCC online datasets have also been utilized.

This section presents a summary of the climate conditions concerning temperature, precipitation, and wind speed considered for Meliadine Extension and as the base for climate change projections.

5.3.3.1 Temperature

The 39-years of modelled hourly temperature data are summarized monthly in Table 5.3-1 (Okane 2021). The coldest month, on average, over the period of 1981 through 2020, was January (-26.7 °C), whereas July had the highest average temperature (15.1 °C). These trends are the same as observed in the 2014 FEIS. The average annual temperature in Rankin Inlet during this period is -10.4 °C which is the same as the average mean temperature reported in the 2014 FEIS (Volume 5, Table 5.4-4; Agnico Eagle 2014).

Table 5.3-1: Climate Data (Existing Conditions based on Meliadine/Rankin Inlet Weather Station 1981 to 2020)

Month	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Average Temperature (°C)
January	-26.7	-33.9	-30.3
February	-26.4	-33.7	-30.1
March	-20.7	-29.2	-24.9
April	-11.4	-20.4	-15.9
May	-2.3	-8.9	-5.6
June	8.1	0.7	4.4
July	15.1	6.4	10.8
August	13.2	6.4	9.8
September	6.4	1.4	3.9
October	-1.8	-7.1	-4.5
November	-13.0	-20.7	-16.9
December	-21.7	-29.1	-25.3
Annual	**15.1**	**-33.9**	**-10.4**

5.3.3.2 Precipitation

Extended precipitation datasets for Meliadine Extension were developed by combining ECCC reported data at two stations operated in Rankin Inlet for different periods, plus pre-1981 data for a station at Baker Lake, which was transposed to Rankin Inlet using adjustments determined from a comparison of 32 years of coincident data for the two stations (Tetra Tech 2021c).

The extended precipitation datasets were developed using adjusted data for Rankin Inlet, obtained from ECCC Adjusted and Homogenized Canadian Climate Data (AHCCD). The precipitation analyses and water balance calculations in the 2014 FEIS were based on AHCCD data and, for consistency, updated precipitation frequency analyses and quantiles for this update are based on AHCCD data. ECCC adjusted AHCCD data for the original Rankin Inlet Climate Station (1981 to 2013) were combined with ECCC AHCCD data for Baker Lake (1950 to 2013) and transposed to Rankin Inlet. ECCC AHCCD data after 2013 are not available for either station and were instead approximated using relationships determined from analysis of the coincident ECCC reported and ECCC adjusted data for Rankin Inlet for 1981 to 2013. These relationships were then applied to recorded data for the successor Rankin Inlet station which has operated since 2013 (Tetra Tech 2021c).

Rankin Inlet A Recorded Data

Recorded precipitation data from multiple ECCC stations were processed to develop an extended continuous record of maximum annual daily rain amounts for Rankin Inlet, combining the two Rankin Inlet A stations which operated over different periods, and supplementing missing years with maximum annual amounts transposed from nearby regional stations, as shown in Table 5.3-2.

Table 5.3-2: Rankin Inlet Environment and Climate Change Canada Climate Stations

Station Name	Station ID	Period of Record	Years Recorded
Rankin Inlet[a]	2303400	1954	1
Rankin Inlet A	2303401	1981-2013	32
Rankin Inlet A	2303405	2013 – 2020	8

(a) Not used due to incomplete and limited data record

Regional Station Recorded Data

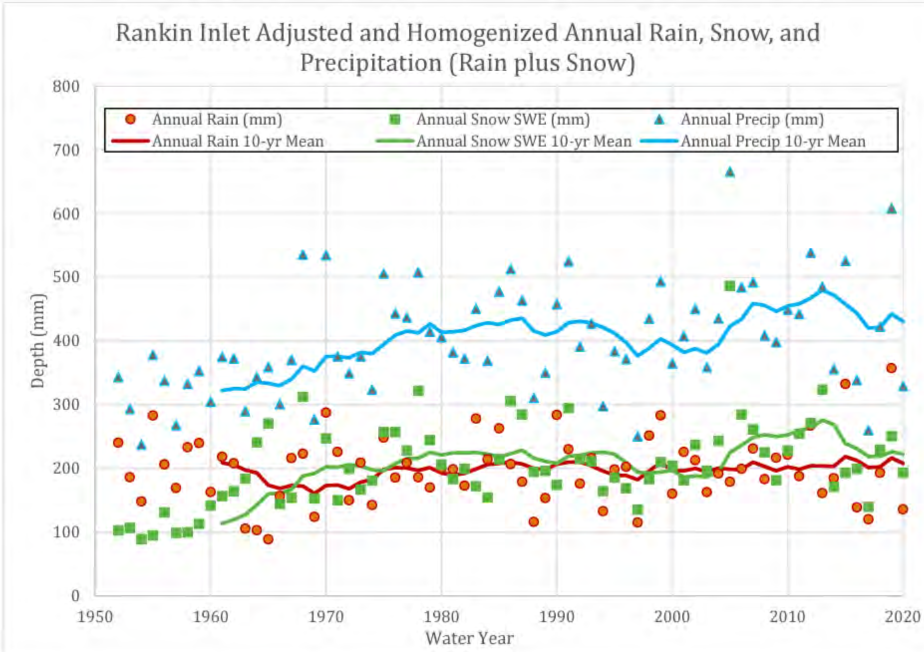
Regional ECCC climate stations listed in Table 5.3-3 were used to fill missing annual maximum daily rain values in the Rankin Inlet data, and to extend the data set to years before 1981. The filling and extension of the recorded data was initially done only for maximum annual daily rain amounts, one value per year as required for subsequent precipitation frequency analyses. Filling and extension of ordinary (not limited to maximum annual) data was done later to compute Probable Maximum Precipitation amounts for multi-day sequences (Tetra Tech 2021c).

Table 5.3-3: Regional Environment and Climate Change Canada Climate Stations

Station Name	Station ID	Distance from Rankin Inlet (km)	Period of Record	Years Recorded
Chesterfield Inlet A	2300700	68	1931 – 1980	51
Chesterfield Inlet A	2300707	68	1985 – 2014	29
Whale Cove A	2303985	92	1974 – 1984	11
Whale Cove A	2303986	92	1985 – 2014	29
Baker Lake A	2300500	259	1950 – 2013	65

Adjustments to transpose regional maximum annual daily rain data to Rankin Inlet were determined by comparing frequency analyses results of maximum annual daily rain data at each station for concurrent periods of record. The ECCC reported daily rain data for Rankin Inlet from 1981 to 2020 is very complete, with very few missing values to be filled. Figure 5.3-1 shows the Rankin Inlet adjusted average rain, snow, and precipitation from 1951 to 2020.

Figure 5.3-1: Rankin Inlet Adjusted Average Rain, Snow, and Precipitation from 1951 to 2020



Source: Tetra Tech (2021c).

The annual data plots presented in Figure 5.3-1 show the following (Tetra Tech 2021c):

- Annual precipitation (1981-2020) is approximately 425.4 mm, distributed relatively evenly as snowfall and rainfall. Annual precipitation appears to be trending upward, due to the snow component which is low for the years 1952 to 1959.
- An apparent discontinuity in the snow data before and after 1960 may be due to a change in snow measurement equipment or methods.
- An extraordinarily large snowfall occurred in 2005, raising the 10-year moving mean to record highs for the following decade.
- The two years with the highest annual rain both occurred in the past decade, in 2015 and 2019. A single year with exceptionally high record snowfall occurred in 2005, with 50% more snow than the next highest snowfall years, 1978 and 2013. The higher rain amounts that occurred in 2015 and 2019 are consistent with higher amounts predicted by climate change models.

The record rain amount of 357 mm in 2019 is about 25% greater than in prior record wet years with from 283 to 289 mm rain which occurred in 1955, 1970, 1990, and 1999. However, the two recent years of record high rain occur between years of low rain and are insufficient to identify a trend or to validate climate change predictions.

These set of datasets were used in the design of water management infrastructure and dam classification for Meliadine Extension.

5.3.3.3 Wind

To account for creation of micro-climates on mine landforms, such as the TSF and the WRSFs of the Meliadine Extension, calibrations to the base 100-year climate database were done to the net radiation and wind speed parameters. Wind direction and speed were also adjusted for the modelled cross sections by creating a specific wind speed data set for NW and SW directions according to the wind roses shown in Figure 5.3-2. This data was prepared from hourly wind speed and direction data from Rankin Inlet between January 1981 and January 2020 (Okane 2021). Figure 5.3-3 shows the wind roses for wind speed and direction from Meliadine site between September 2014 and December 2019. The modelled wind direction for Meliadine Extension is consistent with the wind direction and speed of the air dispersion CALMET wind-Rose from the 2014 FEIS. Winds are moderate to strong and generally originate from the north-northwest and the north, the mean monthly wind speeds are typically between 19 kilometres per hour (5 m/s) and 29 km/hr (8 m/s), with an average of 22.3 km/hr (6.2 m/s).

Figure 5.3-2: Wind Rose Rankin Inlet, January 1981 to January 2020

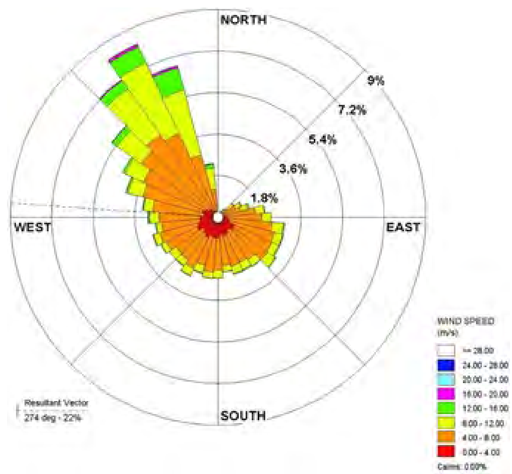
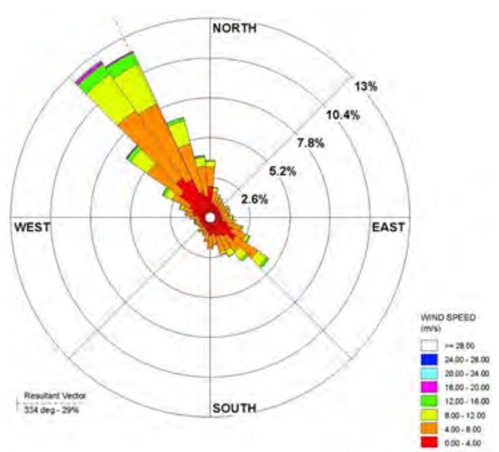


Figure 5.3-3: Wind Rose Meliadine Site, September 2014 to December 2019



The effects of surrounding landforms (such as the WRSFs and the TSFs) were assumed not to affect wind speed and direction. As the WRSFs are expected to be the dominant landform in the adjacent landscape, this is a reasonable assumption. The impact of wind on the thermal regime is limited to the edges of the WRSF materials in the predominant wind direction (NW) are not sufficient to allow high enough air velocities in the centre of the WRSF (Okane 2021).

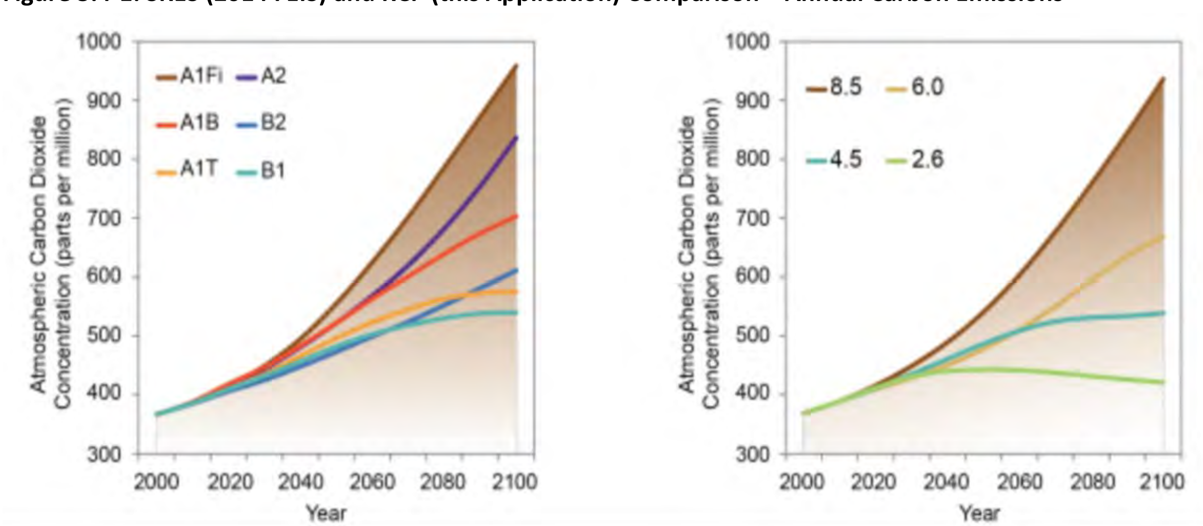
5.4 Climate Change and Greenhouse Gases

In October 2014, the Intergovernmental Panel on Climate Change's (IPCC) adopted four new Representative Concentration Pathways (RCPs) to replace the Special Report on Emission Scenarios (SRES)3 that was used for the 2014 FEIS climate change assessment (IPCC 2014).

The SRES scenarios were named by family (A1, A2, B1, and B2), where each family was designed around a set of consistent assumptions: for example, a world that is more integrated or more divided. In contrast, the current RCP scenarios are simply numbered according to the change in radiative forcing (from +2.6 to +8.5 watts per square metre) that results by 2100.

Figure 5.4-1 compares SRES and RCP annual carbon emissions, carbon dioxide equivalent levels in the atmosphere, and temperature change that would result from the central estimate and the likely range of climate sensitivity. The old SRES scenarios are slightly higher than the current RCP scenarios.

Figure 5.4-1: SRES (2014 FEIS) and RCP (this Application) Comparison – Annual Carbon Emissions



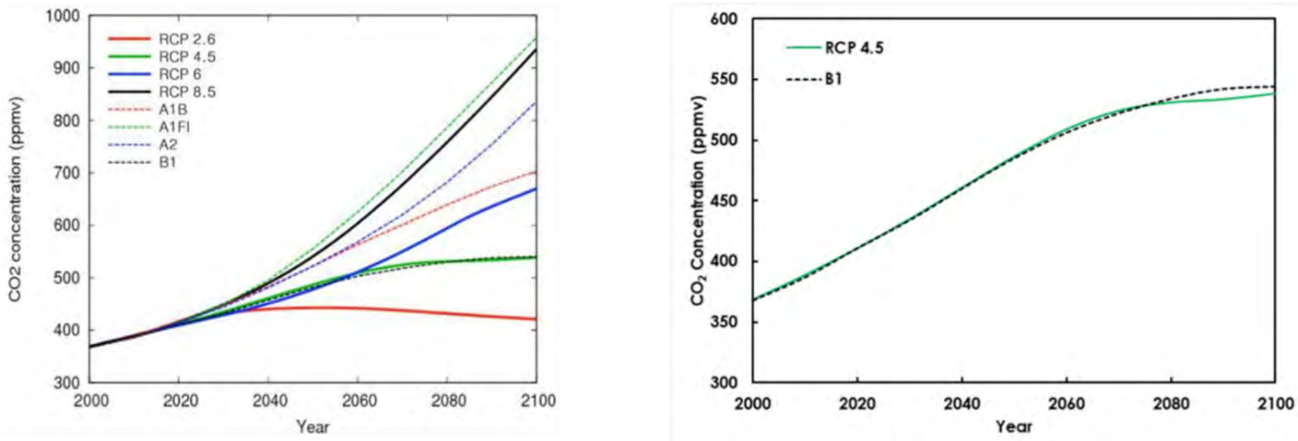
a. SRES (2014 FEIS Climate Change Classification) **b. RCP (Meliadine Extension Climate Change Classification)**

Source: Melillo et al. (2014).

Figure 5.4-2 (a) presents a comparison between carbon dioxide concentrations and global temperature change between the SRES and RCP scenarios. SRES A1fI is similar to RCP8.5 and SRES B1 to RCP4.5. Figure 5.4-2 (b) presents a comparison between SRES B1 to RCP4.5. As shown in the figure these two scenarios have very similar CO_2 projected concentrations with slightly lower trajectory for RCP4.5. The

RCP2.6 scenario is much lower than any SRES scenario because it includes the option of using policies to achieve net negative carbon dioxide emissions before end of century, while SRES scenarios do not.

Figure 5.4-2: CO2 projected concentrations – SRES (2014 FEIS) vs. RCP (this Application) scenarios



a. General comparison of all SRES and RCP Climate Change Trajectories

b. Meliadine Extension climate change base case RCP compared to its analog SRES (2014 FEIS)

Source: Okane Consultants

5.4.1 Meliadine Extension Specific Climate Change Database

The Meliadine Extension climate change analysis was conducted under the current state of the art methodology adopted by the IPCC in October 2014. The RCP represent GHG concentration (not emissions) trajectories. Three scenarios (RCP2.6, RCP4.5, and RCP8.5) publicly available are named after the radiative target forcing level for 2100, which are based on the forcing of greenhouse gases and other agents and are relative to preindustrial levels 4.

- RCP2.6 represents a very low RCP with a peak of radiative forcing at around 3.1 W/m2 mid-century, followed by a decline to 2.6 W/m2 by 2100.
- RCP4.5 represents a medium RCP with stabilization of radiative forcing around 2100.
- RCP6.0 represents a high RCP with stabilization of radiative forcing after 2100
- RCP8.5 represents a high RCP with increasing radiative forcing that does not stabilize until after 2200.

RCP4.5 was selected as the Meliadine Extension climate change base case for all the models and design. RCP4.5 was selected for the Meliadine Extension because this scenario is intended to inform research on the atmospheric consequences of reducing greenhouse gas emissions to stabilize radiative forcing in 2100. It is also a mitigation scenario – the transformations in the energy system, land use, and the global economy required to achieve this target are not possible without explicit action to mitigate GHG emissions (Okane 2022).

The IPCC recommends that a site-specific climate change database be developed following the

Temperatures at Meliadine are anticipated to rise at approximately the same rate (0.06°C/year relative to historical averages) for RCP4.5 an average annual temperature of approximately -4.6°C over the last 30 years of the climate change database from 2092 to 2120 (Okane 2022).

A summary of annual average precipitation for 2020 to 2120 is presented in Table 5.4-1.

Table 5.4-1: Annual Average Temperature Estimates from 2020 to 2120

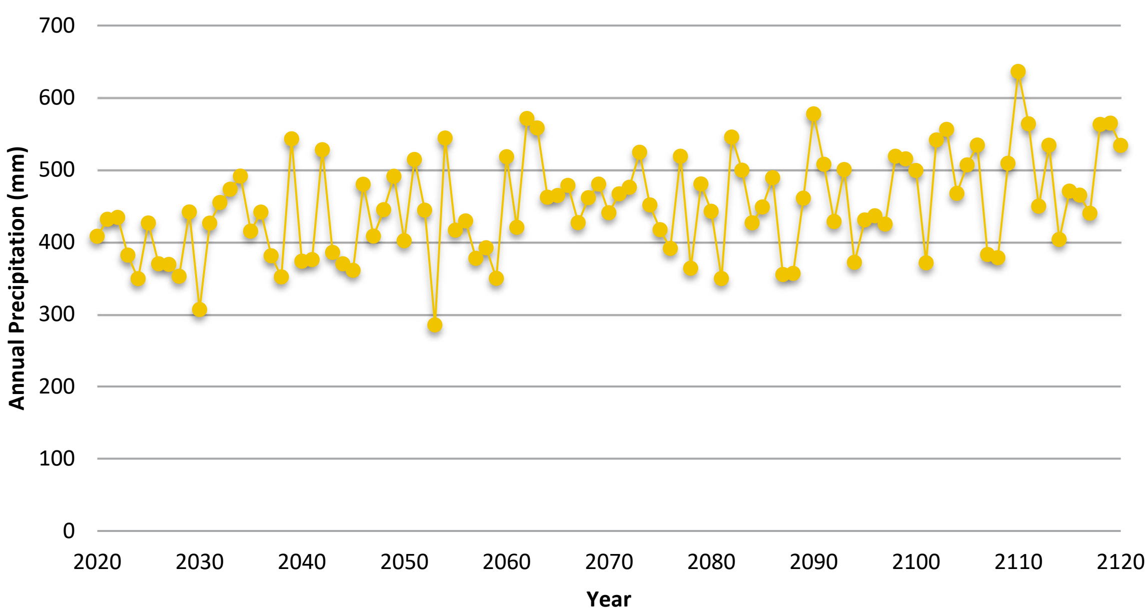
Climate Change Scenario	Climate Normals 1981 to 2020 (°C)	2020 to 2050 (°C)	2050 to 2090 (°C)	2090 to 2120 (°C)
RCP4.5 [a]	-10.4	-7.7	-5.9	-4.4

(a) Meliadine Extension base case climate change scenario

5.4.1.1 Precipitation

Figure 5.4-4 shows the annual precipitation estimated for the RCP4.5 climate database developed for the Meliadine Extension.

Figure 5.4-4: Annual Precipitation Estimated for RCP4.5



Precipitation at Meliadine is also predicted to increase approximately 0.7 mm/year (70 mm total increase over 100 years) for RCP4.5. Precipitation Normals for the Meliadine Extension were adjusted for missing data, as presented in Section 5.3.2 of this Application, and for gauge undercatch and evaporation due to wind effect (Okane 2021). A summary of annual average precipitation for 2020 to 2120 is presented in Table 5.4-2 (Okane 2021; Tetra Tech 2021).

Temperatures at Meliadine are anticipated to rise at approximately the same rate (0.06°C/year relative to historical averages) for RCP4.5 an average annual temperature of approximately -4.6°C over the last 30 years of the climate change database from 2092 to 2120 (Okane 2022).

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Table 5.4-1: Annual Average Temperature Estimates from 2020 to 2120

Climate Change Scenario	Climate Normals 1981 to 2020 (°C)	2020 to 2050 (°C)	2050 to 2090 (°C)	2090 to 2120 (°C)
RCP4.5 [a]	-10.4	-7.7	-5.9	-4.4

(a) Meliadine Extension base case climate change scenario

5.4.1.1 Precipitation

Figure 5.4-4 shows the annual precipitation estimated for the RCP4.5 climate database developed for the Meliadine Extension.

Figure 5.4-4: Annual Precipitation Estimated for RCP4.5

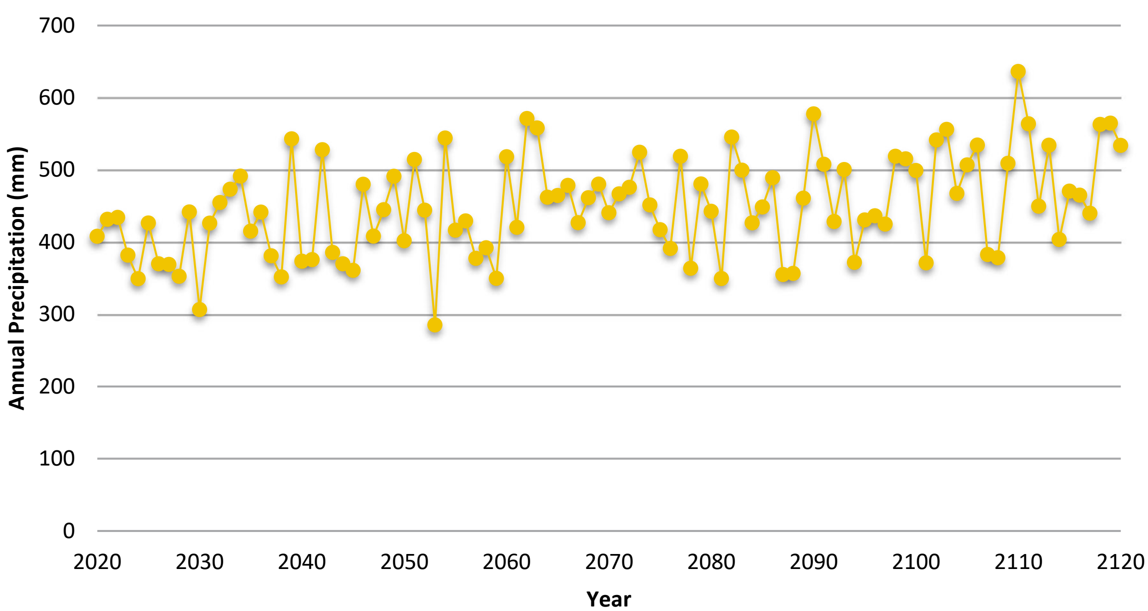

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Table 5.4-2: Annual Average Precipitation Estimates from 2020 to 2120

Climate Change Scenario	Climate Normals 1981 to 2020 (mm)	2020 to 2050 (mm)	2050 to 2090 (mm)	2090 to 2120 (mm)
RCP4.5 [a]	430	415	451	486

(a) Meliadine Extension base case climate change scenario

5.4.2 Assessment of Potential Meliadine Extension-related Effects

Consistent with the 2014 FEIS, there is no assessment endpoint for climate change and GHGs.

5.4.3 Effects of Meliadine Extension on Climate Change

5.4.3.1 Direct GHG emissions

Meliadine Extension includes the installation of five wind turbines in the first phase with the alternative for an additional six, which is anticipated to result in a positive change to the overall Meliadine Mine. By reducing electricity generated using diesel at the powerplant, wind energy will lead to an overall reduction in greenhouse gas emissions of the Meliadine Mine. There are no other proposed changes that would affect GHG emissions.

5.4.3.2 Indirect GHG emissions

Same as established in the 2014 FEIS, the Meliadine Extension will have negligible indirect GHG emissions.

5.4.3.3 Comparison of Project Greenhouse Gas Emissions to Nunavut and Canadian Emissions

Agnico Eagle is required by ECCC's Greenhouse Gas Emissions Reporting Program (GHGRP) to track GHG emissions. Likewise, per Project Certificate No.006 T&C 9, Agnico Eagle will develop initiatives pro-active approach to limit GHG emissions throughout the life of the Meliadine Mine.

Table 5.4-3 compares the estimated annual direct GHG emissions in kilotons (kt) of CO_2 equivalents (CO_2e) from the Meliadine Mine site and marine operations at Rankin Inlet for the 2014 FEIS and Meliadine Extension. In the 2014 FEIS, total GHG emissions from the Meliadine Mine site were conservatively estimated to be not more than 304 kt/yr. of CO_2e. The Meliadine Extension proposes the installation and operation of five wind turbines in the first phase with the alternative of an additional six, which would reduce GHG emissions by about 47kt CO_2e (Hatch 2021), bringing the total GHG emission from the Meliadine Mine site to about 270 kt/yr. Calculated emissions for the Meliadine site (including Rankin Inlet operations) were reported in June 2021 for the 2020 year. Total emissions were 122.8kt CO2e, which is less than the 2014 FEIS-predicted maximum of 317kt CO_2e/yr.

The 2019 annual GHG emissions for Nunavut and Canada are also provided in Table 5.4-3. It is important to note that this prediction is extremely conservative as the estimated emissions from the Meliadine Extension are based on maximum values that consider all sources operating at maximum capacity; the emissions will be much less in reality, these quantities can be revised as further details of the project are brought to a higher level of engineering.

The reported values for Nunavut and Canada are taken from the "National Inventory Report 1990 –2019: Greenhouse gas sources and sinks in Canada" (ECCC 2021). For clarity, in climate change a sink is anything that absorbs more carbon dioxide from the atmosphere than it releases.

Table 5.4-3: Comparison of Meliadine Extension GHG Emissions to Nunavut and Canadian Emissions

Source	Annual GHG Emissions (kt CO_2e/yr.) 2014 FEIS	Annual GHG Emissions (kt CO_2e/yr.) Meliadine Extension	Meliadine Extension Relative to Nunavut and Canada GHG as a Percentage
Meliadine Site (Operations)	304	304[a]	
Rankin Inlet shipping (Operations)	13	13	
Indirect Emissions	negligible	negligible	
Removed GHG emissions from 5 wind turbines	n/a	(47)[b]	
Estimated total GHG emissions	317	270	
Nunavut	422 (2010)	733 (2019)[c]	40%
Canada	692 000 (2010)	730 000 (2019)[c]	0.04%

(a) Meliadine 2014 FEIS emission estimate carried into Meliadine Extension. Actual GHG emission for Meliadine Mine in 2020 122.8 kt CO_2e/yr (OPBS Report, BBA 2021)

(b) GHG estimates for Meliadine Extension Wind Turbines (Hatch 2021)

(c) Canada.ca/ghg-inventory National Inventory Report – 2021 Edition Part 3 – Table A11–27 2019 GHG Emission Summary for Nunavut and Table A10–2 Canada's GHG Emissions by Canadian Economic Sector, 1990–2019

5.4.4 Climate Change and Infrastructure Interactions

Climate change was included in the modelling and conceptual design of Meliadine Extension infrastructures same as in the 2014 FEIS. As mentioned in Section 5.4.1, RCP4.5 was selected as the base case climate change scenario of the Meliadine Extension. Projections for temperature according to RCP4.5 show the level of radiative forcing by GHG emissions stabilizing at 4.5 W/m2 by 210 (Okane 2022). RCP4.5 was selected for the Meliadine Extension because this scenario is intended to inform research on the atmospheric consequences of reducing greenhouse gas emissions to stabilize radiative forcing in 2100. It is also a mitigation scenario – the transformations in the energy system, land use, and the global economy required to achieve this target are not possible without explicit action to mitigate GHG emissions (Okane 2022).

5.4.4.1 Future Sea-level Rise and Coastal Erosion

Consistent to the 2014 FEIS, climate change may have an impact on changing sea ice conditions, sea level rise, and coastal erosion may impact Itivia Harbour, thereby affecting marine operations, possibly impacting the movement of fuel and equipment to/from the Meliadine Mine via this location.

Warming temperatures may affect permafrost in the vicinity of the Meliadine Mine site, potentially leading to an increased active layer. This could directly affect infrastructure at the Meliadine Mine site in the long-term.

It is concluded that the effects of a potentially changing climate on the Meliadine Extension is not significant. Due to the global insignificance of the predicted Meliadine Extension GHG emissions, the Meliadine Extension is anticipated to reduce the impact on future global climate change emission in Nunavut with the phased installation and operation of renewable energy sources such as the proposed wind turbines.

The previous assessments considered the potential effect of future sea-level rise and coastal erosion in the Meliadine Mine. Since the Meliadine Extension will involve inbound and outbound shipping of fuel and product. However, these potential impacts could become important climate-related considerations at Rankin Inlet. These impacts have been considered in the marine environment impact assessment of the 2014 FEIS (Volume 9, Section 9.2.3).

5.4.4.2 Changing Sea Levels and Sea Ice

Sea level and sea ice changes have the potential to affect marine operations at Rankin Inlet, potentially impacting the Meliadine Extension. These impacts have been considered in the marine environment impact assessment of the 2014 FEIS (Volume 9, Section 9.2.3).

5.4.4.3 Changes in Coastal Erosion Dynamics

The previous assessments considered changes in coastal erosion dynamics due to climate change. These considerations remain the same for the Meliadine Extension.

5.4.4.4 Permafrost

Increasing average temperatures and more frequent freeze thaw cycles have the potential to affect permafrost. These potential changes have been considered in Section 6.3 Permafrost of this Application.

5.4.4.5 Precipitation

Potential for impacts of climate change (e.g., future large precipitation events) have been taken into account for Meliadine Extension. Refer to Appendix H-07 for further details.

In terms of precipitation and flux of freshwater into Itivia Harbour, since this is the ocean, the water density is not expected to be affected from discharges.

5.4.4.6 Geotechnical Hazard

The occurrence of geotechnical hazards related to climate change for the Meliadine Extension is low. Refer to Appendix D-18 for further details.

5.5 Noise

5.5.1 Abstract

There are two new primary pathways for Meliadine Extension. It is associated with operation of the windfarm and alternative airstrip that will increase noise levels during operations. The maximum predicted incremental change in sounds levels are low at receptor locations. Effects on sound levels associated with Meliadine Extension are assessed as non-significant.

5.5.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ, TK, and concerns related to noise were provided by community members and incorporated into the Meliadine Extension noise assessment, which considers review of community engagement notes from focus group meetings, public consultations, the VMR and other consultation processes.

The following IQ, TK, comments, and concerns have been expressed by community members related to effects of Meliadine during the 2014 FEIS:

- Impact of noise on wildlife, including caribous and birds.
- Impact of noise on humans around the site.

No additional concerns regarding noise have been raised in later rounds of consultations for the Meliadine Extension.

5.5.3 Existing Environment

Baseline information collected prior to development of the Meliadine Mine, are described in the 2014 FEIS (Agnico Eagle 2014). Baseline noise levels were representative of undisturbed environment as human activity in the study areas was minimal (35 dBA). Some measurements were also collected closer to Rankin Inlet where noise levels were measured in the 45-52 decibel (dBA) range.

A total of 20 locations were identified within the SSA and LSA as being at risk of receiving noise emissions. Modeling exercises and monitoring strategies for the existing environment are based upon limiting the impact on those 20 noise receptors. Monitoring data from Meliadine's noise monitoring plan collected since 2016 shows sounds levels at selected stations within the predictions and site noise criterion.

5.5.4 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the Application and noise was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-1 of this Application and are also described in Volume 5, Section 5.5.5, Table 5.5-6 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC noise as a result of Meliadine Extension, there is no change from the previous assessment. Primary pathways identified for Meliadine Extension are further assessed below and Table 5.5-1.

The following primary pathways were identified for Meliadine Extension for the noise assessment:

- Mine Site (operation):
  - Noise emissions from mobile equipment, stationary equipment, and blasting can increase ambient noise levels.
  - NEW: Wind turbines will emit noise during operation. This noise will propagate into the surrounding environment, where it may have residual effects on NPORs and wildlife.
  - NEW: Noise emissions from the landing and take-off of planes can increase ambient noise levels.
- AWAR (operation):
  - Project vehicles along the AWAR will result in noise emissions, which may cause changes in noise levels.
- Rankin Inlet:
  - Activities associated with material receipt, storage and transfer to the Meliadine Extension will result in noise emissions, which may cause localized changes in noise levels.

Table 5.5-1: Potential Primary Pathways for Noise

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Mine Site (Operation)	Noise emissions from mobile equipment, stationary equipment, and blasting can increase ambient noise levels. NEW: Wind turbines will emit noise during operation. This noise will propagate into the surrounding environment, where it may have residual effects on NPORs and wildlife. NEW: Noise emissions from the landing and take-off of planes can increase ambient noise levels.	Where feasible, Agnico Eagle will continue to procure equipment designed to minimize noise emissions, install silencers on inlets and exhausts of noisy equipment. Windfarm operation noise will be monitored. Turbines were sited to be away from existing cabins and Meliadine camp. The blades of wind turbines will be equipped with trailing edge serrations to reduce noise emissions. Where feasible, flight corridor restrictions could be applied over sensitive areas with known high concentration of wildlife. The planes should maintain a minimum elevation of 300 metres, except for landing and take-off, as Project Certificate No.006 currently requires for Agnico Eagle charters landing in Rankin Inlet's airport.	Primary	Primary	Table 5.5-6 of 2014 FEIS	No change	Not Significant	No change	Mitigation measures outlined in the 2014 FEIS and corresponding management plans will be carried forward through Meliadine Extension.
AWAR (operations)	Meliadine project vehicles along the AWAR will result in noise emissions, which may cause changes in noise levels.	Best management practices to control noise emissions from vehicles travelling along the AWAR as described in the NAMP.	Primary	Primary	Table 5.5-6 of 2014 FEIS	No change	Not Significant	No change	Mitigation measures outlined in the 2014 FEIS and corresponding management plans will be carried forward through Meliadine Extension.
Rankin Inlet	Activities associated with material receipt, storage and transfer to the Meliadine Mine will result in noise emissions, which may cause localized changes in noise levels.	Bypass road developed to keep traffic in and near Rankin Inlet isolated from residences. Best management practices to control noise emissions from access roads and lay down area as described in the NAMP. Noise controls will be designed inherent, which may include selection of quieter equipment, enclosures, silencers, etc. Equipment noise control systems will be maintained. Limited Meliadine Mine air traffic, which is negligible compared to the existing air traffic	Primary	Primary	Table 5.5-6 of 2014 FEIS	No change	Not Significant	No change	Mitigation measures outlined in the 2014 FEIS and corresponding management plans will be carried forward through Meliadine Extension.

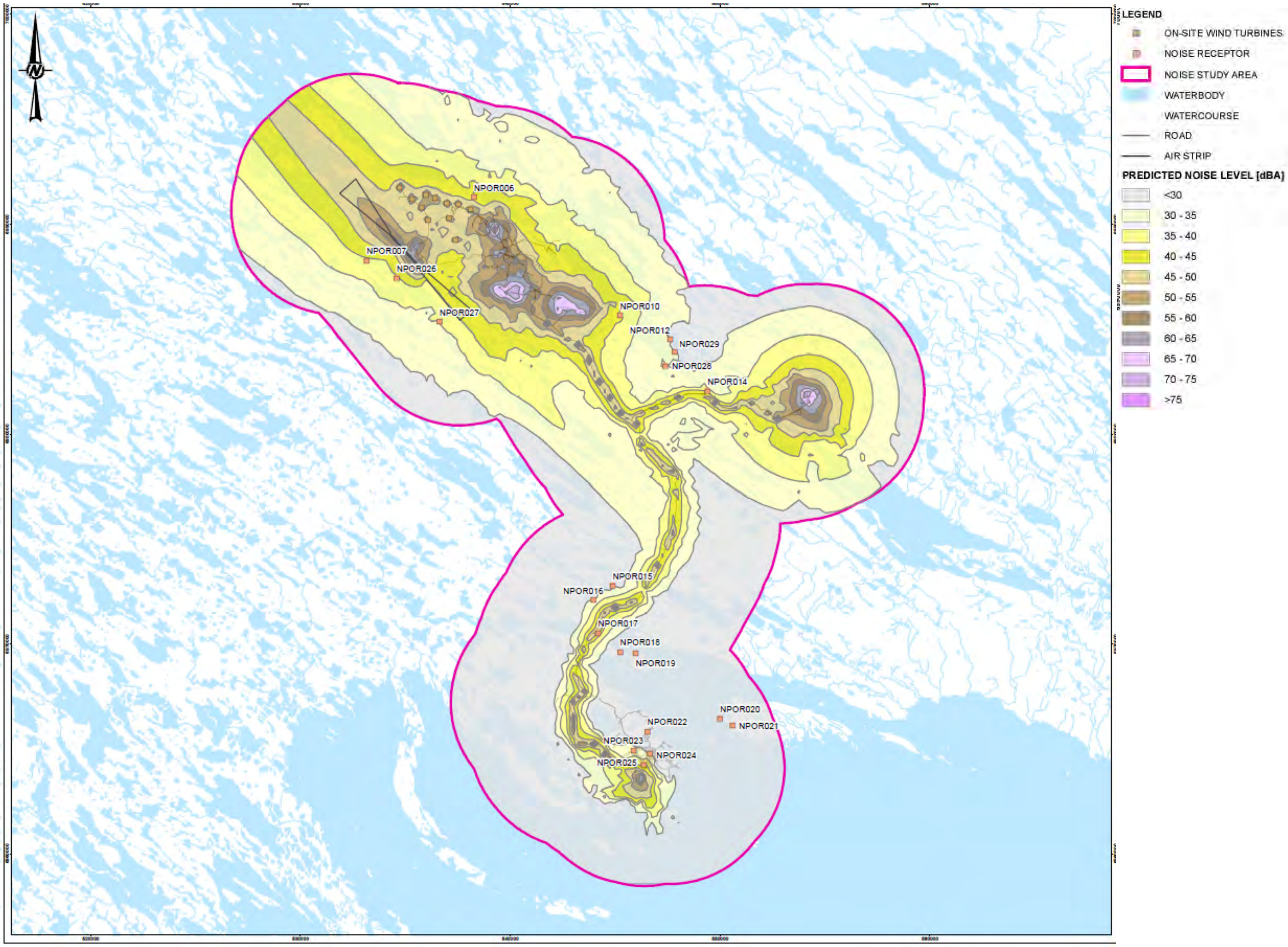
5.5.4.1 Mine Site (Operations)

To evaluate the potential effects of Meliadine Extension mining operations on noise, this assessment undertook modeling of the noisiest year. Although no change in the level of activity were planned, the refined mine plan presented in the Meliadine Extension can have different location of noise sources.

The operation of an on-site airstrip during Meliadine Extension was assessed as a potential source of noise. It was incorporated to the worst-case scenario as an additional emission source. For conservatism, it was assessed that 100% of the flights landing in Rankin Inlet would be landing on the new infrastructure.

The operation of an on-site windfarm consisting of 11 wind turbines was assessed as a potential source of noise. It was incorporated to the new worst-case scenario as an additional emission source. It was evaluated separately from the airstrip. However, an analysis combining both has been done to assess their cumulative effect. Figure 5.5-1 show worst case scenario predicted noise levels.

Figure 5.5-1: Predicted Noise Levels from Core Meliadine Extension Plus Wind Turbines and Optional Airstrip



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5.5.5 Residual Impact Classification

Residual impact classification for noise is determined based on the increase in noise level at different noise points of reception (NPOR) within the RSA and LSA. In total, 20 NPOR were assessed as points of interest of the community around the mine site, such as cabins used for hunting and fishing activities. For each assessment endpoint, the change in noise levels below were considered for the magnitude of effects, which concords with the 2014 FEIS thresholds:

- Negligible – increase less than 3 dBA
- Low – increase less than 6 dBA
- Moderate – increase less than 10 dBA
- High – increase greater than 10 dBA

For the Meliadine Extension modelling, noise effects are classified based on change relative to the existing conditions as defined in the 2014 FEIS.

The assessment methodologies and limits are based on cumulative noise levels (i.e., combination of Meliadine Extension with existing ambient noise levels). Details on modeling methodology are presented in Appendix H-02. The noisiest year (2034) in terms of total activity on site was used as a worst-case scenario. Detailed inputs on noise levels per source for the mobile fleet, stationary equipment and blasting and presented in Appendix H-02.

Table 5.5-2 shows the number of receptors affected by changes in noise levels with the corresponding impact levels and Table 5.5-3 presents the summary of significance.

Table 5.5-2: Prediction Results

Noise Receptor	Study Area	Cumulative Noise Level from 2014 FEIS [dBA]	Meliadine Extension Noise Level [dBA]	Change [dBA]	Magnitude
NPOR006	LSA	39.8	43.3	3.5	Low
NPOR007	LSA	35.5	40.5	5.0	Low
NPOR010	LSA	37.7	40.5	2.8	Negligible
NPOR012	LSA	35.7	36.1	0.4	Negligible
NPOR014	SSA	44.7	40.3	-4.4	Negligible
NPOR015	LSA	35.4	35.6	0.2	Negligible
NPOR016	LSA	36.6	36.5	-0.1	Negligible
NPOR017	SSA	43.4	44.1	0.7	Negligible
NPOR018	LSA	35.4	35.4	0.0	Negligible
NPOR019	LSA	35.3	35.2	-0.1	Negligible
NPOR020	LSA	35.1	35.1	0.0	Negligible
NPOR021	LSA	35.1	35.1	0.0	Negligible
NPOR022	LSA	48.0	48.0	0.0	Negligible
NPOR023	LSA	45.2	45.2	0.0	Negligible
NPOR024	LSA	52.0	52.0	0.0	Negligible
NPOR025	LSA	46.9	47.1	0.2	Negligible
NPOR026	LSA	36.2	40.8	4.6	Low
NPOR027	LSA	38.2	38.2	0.0	Negligible
NPOR028	LSA	35.4	36.0	0.6	Negligible
NPOR029	LSA	35.6	36.2	0.6	Negligible

Table 5.5-3: Significance Criteria Summary Table

Study Area	Point of Reception	Change in Existing Noise Level (dBA)	Magnitude	Geographic Extent
SSA	NPOR017	+0.7	Negligible	Negligible
LSA	NPOR005	+5	Low	Low

Consistent with the 2014 FEIS:

- direction is considered to be negative;
- the duration is considered to be medium-term, where conditions causing the effect are evident for an extended period of time, and last throughout the operational phase;
- the effects are likely to occur;
- the frequency is considered moderate where conditions causing the effect are expected to occur regularly; and
- effects are considered reversible (i.e., low) once the emissions decrease.

As such, using the 2014 FEIS methodology, the environmental significance is considered "non-significant" as effects are of a low magnitude and restricted to the LSA.

The optional airstrip scenario would reduce the number of flights landing in Rankin Inlet's airport, therefore probably reducing noise levels to receptors in the town. This was not part of the modelling scenarios, however.

5.5.6 Cumulative Effects Assessment

As the potential noise effects from Meliadine Extension activities are limited to the LSA, a review was carried out of other known projects within the LSA. There are no known projects within the defined LSA. Therefore, the cumulative noise effects for PORs within the LSA will be limited to those predicted for the Meliadine Extension.

5.5.7 Uncertainty

The overall accuracy of the model's propagation algorithms is plus or minus 3 dB for distances between source and receptor up to 1 km. No accuracy is stated in the ISO 9613-2 standard for distances greater than 1 km.

Conservative assumptions regarding Meliadine Extension were made to account for the level of uncertainty inherent in the noise level predictions in terms of blasting frequency, mobile fleet size and equipment quantity. All receptors were assumed to be downwind from sources, 100% of the time.

5.5.8 Monitoring and Follow-up

Agnico Eagle will continue to comply with the Noise Abatement and Monitoring Plan, the Airstrip Management Plan, and the Windfarm Management Plan (Appendix D-22, D-03, D-36, respectively). The plans have been revised to take into account Meliadine Extension.

Agnico Eagle considers that existing T&C 10 and 11 of Project Certificate No.006 are sufficient to protect, mitigate, and monitor noise impacts associated with the Meliadine Extension.

6 TERRESTRIAL ENVIRONMENT

6.1 Introduction

The freshwater section provides an update of the 2014 FEIS, and the 2018 and 2020 FEIS Addenda in relation to the impacts of the Meliadine Extension. Section 6 addresses the Meliadine Extension effects to the terrestrial environment which includes terrestrial ecology, landform and soils, permafrost, and ground stability.

Section 6 includes a discussion on VECs, incorporation of TK/IQ, description of the study areas, and an assessment of direct effects to changes to the terrestrial environment in the study area. One new primary pathways was identified. Results of the effects assessment were updated for the Meliadine Extension. The effects assessment evaluates the maximum footprint for the operational and closure phase, resulting in a conservative assessment.

6.1.1 Comparison to Previous Assessments

The Meliadine Extension activities represent a negligible change from the previously assessed and approved FEIS activities (Agnico Eagle 2014, 2018a, 2020a). One new primary pathway was identified; otherwise, all effects have been previously assessed, and there is no change from the previous assessments.

To address uncertainty, and validate assumptions, monitoring developed for the approved activities (Agnico Eagle 2014, 2018a, 2020a), with updates to associated management plans, as required, for the Meliadine Extension will be completed.

6.1.2 Valued Ecosystem Components

The identification of VECs and factors considered in their selection have not changed for this the methods used to select the VECs are summarized in Section 4.3 of this Application, as well as Section 4.2 of the 2014 FEIS (Agnico Eagle 2014).

The following VEC's for terrestrial environment have been identified for this Application:

- geology and geochemistry;
- permafrost;
- soil and terrain;
- vegetation;
- terrestrial wildlife and wildlife habitat; and
- birds and bird habitat.

Geology and geochemistry, permafrost, and soil and terrain are VECs but they do not have assessment endpoint. Assessment endpoints represent the key properties of the VEC or VSEC that should be protected for their use by future human generations. Assessment endpoints are general statements about what is being protected. For example, protection of water supply and water quality; maintenance of population abundance, assemblages and distribution of wildlife; and continued opportunities for traditional and non-traditional use of these ecological resources may be assessment endpoints for groundwater, surface water, wildlife, and traditional and non-traditional land use. Consistent with the 2014 FEIS, for Meliadine Extension there was an assessment of potential effects to geology and geochemistry, permafrost, and soil and terrain, but residual impacts were not classified. Residual impacts to those VECs with assessment endpoints that could be influenced by changes in geology and geochemistry, permafrost, and soil and terrain were completed. The Meliadine Extension is expected to result in no detectable to negligible environmental change in geology and geochemistry, permafrost, and soil and terrain.

6.1.3 Application Components

The area of the 11 main components of the Meliadine Extension is presented in Table 6.1-1. Descriptions of these components are provided in Section 2 of this Application.

Table 6.1-1: Meliadine Extension Components by Area

Meliadine Extension Component	Area (ha)
Access Roads	12
Airstrip	19
Channel 10	8
CP2/CP2 Berm	14
D-B4 West	4
Discovery Area	18
Sump F1/Channel F1/Channel F2	10
WES09	15
Windfarm	18
Wolf Area	33
WRSF9	77
Total	**227**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

6.1.4 Spatial and Temporal Boundaries

6.1.4.1 Terrestrial Local Study Area

The approved terrestrial LSA boundary is presented in the 2014 FEIS (Volume 6, Section 6.1.1, Agnico Eagle 2014). Three Mine components that cover three distinct geographical locations (i.e., the Mine site and associated infrastructure, the AWAR, and the footprint of the Hamlet of Rankin Inlet) were considered when defining the LSA covering a total of 10,598 ha.

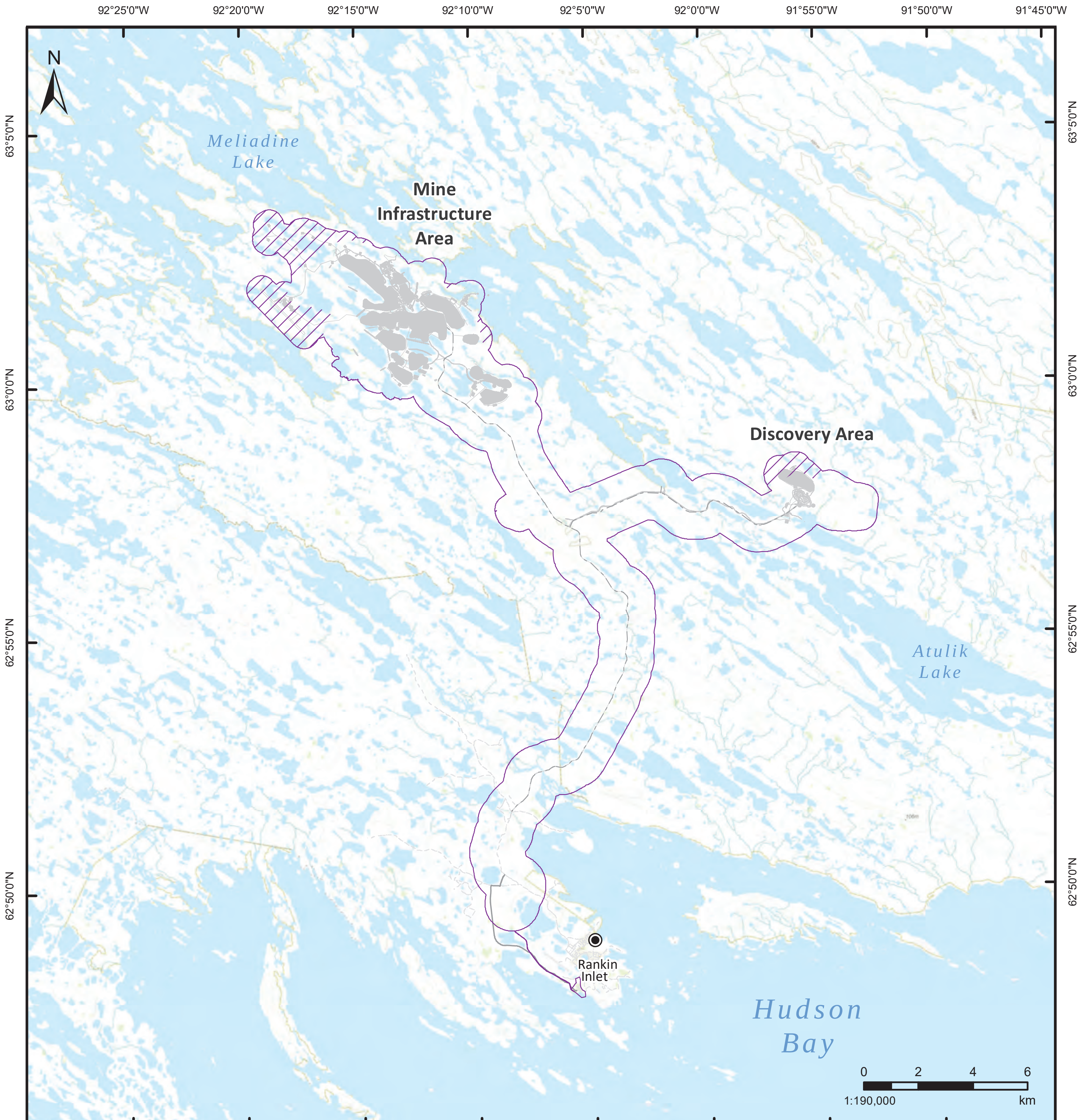
For the Meliadine Extension, the LSA has been extended to accommodate the proposed windfarm, airstrip, additional underground mining and associated infrastructure, and the Tiriganiaq-Wolf mining area. The Meliadine Extension LSA reflects footprint components that were outside, but immediately adjacent to, the previously assessed LSA and allows to assess indirect effects of the Meliadine Extension on the terrestrial environment. Consistent with the 2014 FEIS LSA a 500 m buffer was applied to the Meliadine Extension footprint, the Meliadine Footprint and buffer area was added to the Approved LSA for a total Meliadine Extension LSA of 11,657 ha representing a 10% increase from the 10,598 ha of the 2014 FEIS LSA (Figure 6.1-1).

6.1.4.2 Regional Study Area

The RSA is consistent with the 2014 FEIS (Volume 6, Section 6.1.1.2, Agnico Eagle 2014). The RSA has a radius of 28 km centered on the mine site and encompasses an area of 246,300 ha (Figure 6.1-2).

6.1.4.3 Caribou Effects Study Area

The Caribou Effects Study Area (CESA) is consistent with the 2014 FEIS (Figure 6.1-3). The CESA consists of the post-calving range of the Qamanirjuaq Caribou Herd using collar data from 1998 to July 2011 to produce a 95% kernel density estimate. This was modified using an 85% volume contour to create the CESA for caribou and wolf (Volume 6, Section 6.1.1.3, Agnico Eagle 2014).



Meliadine Extension

Local Study Area – Terrestrial

Legend

- Local Study Area (LSA)
- Extension Area
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Bypass Rd.
- Existing Road

Date: 12/3/2021
Map Number: MEL-029
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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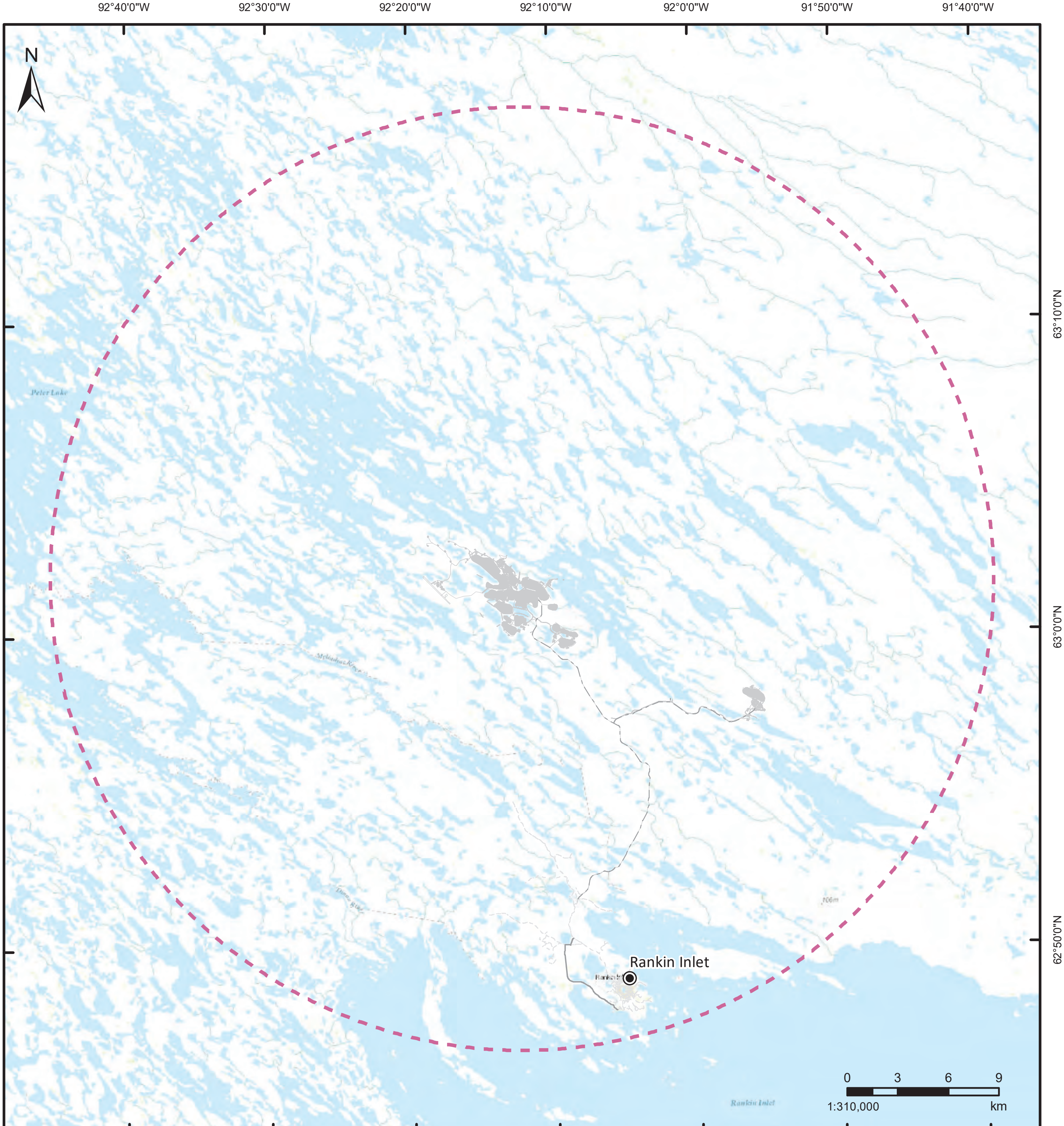

Meliadine Extension

Regional Study Area – Terrestrial

Legend

- Regional Study Area (RSA)
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Bypass Road
- Existing Road

Date: 11/2/2021
Map Number: MEL-027
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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Meliadine Extension

Caribou Effects Study Area

Legend

- Community
- Regional Study Area (RSA)
- Caribou Effects Study Area (CESA)
- Provincial/Territorial Boundary
- Treeline

Date: 12/3/2021
Map Number: MEL-034
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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6.2 Geology and Geochemistry

The purpose of this section is to address updates to the approved activities for the Meliadine Mine (Agnico Eagle 2014), in relation to the impacts of the changes made to the Meliadine Extension. The Meliadine Extension does not change the geology and geochemistry existing conditions of the mine but provides an update on additional data gathered since the issuance of the 2014 FEIS.

6.2.1 Geology

Meliadine Extension will not change the local or regional geology, nor the geochemical characteristics of these materials (i.e., no pathways), as such, geology and geochemistry were not considered valued components, and were not subject to a formal effects assessment. However, it is recognized that geology and geochemistry are important considerations to how Meliadine Extension is designed, constructed, operated, and closed. Geology and geochemistry influence potential impacts on VECs, such as water quality, water quantity, and terrain and soil, and were considered in the effects assessment for other valued components, where applicable.

The following section provides a summary of the geology and geochemistry existing conditions in the Meliadine Extension area.

6.2.1.1 Geology Baseline Environment

The following sections establish the existing conditions of the geologic and geochemical setting within the LSA of the Meliadine Extension (Figure 6.1-1 of this Application). The existing conditions setting is defined from the 2014 FEIS (Agnico Eagle 2014).

6.2.1.2 Surficial Geology

There are no proposed changes from the 2014 FEIS in surficial geology for Meliadine Extension. In general, the local overburden stratigraphy in the area consists of a thin layer of topsoil overlying a layer of silty gravelly sand. Cobbles and boulders are observed throughout the entire site and at various depths in the boreholes. The grain angularity is found mainly to be sub-angular to angular and few are identified as sub-rounded. The bedrock surface at site is encountered between about 2 to 18 m below the ground surface.

Additional information on the surficial geology in the local area, including geotechnical properties, can be found in SD 2-4A of the 2014 FEIS.

6.2.1.3 Bedrock Geology

There are no proposed changes from the 2014 FEIS bedrock geology for Meliadine Extension.

Meliadine Extension is located within the Archaean Rankin Inlet Greenstone Belt, within the Churchill Structural Province of the Canadian Shield. The rocks of the Rankin Inlet Greenstone Belt have been subjected to polyphase deformational events and metamorphism. The rocks consist of a sequence of mafic volcanic rocks, felsic pyroclastic rocks, sedimentary rocks and gabbro sills.

The Meliadine Mine is situated in a region of historically low seismicity. Archaean and Proterozoic deformational events have resulted in an alignment of stratigraphy trending in a northwest to southeast direction which defines the Meliadine trend. To the south of the deposits is the Pyke Fault, a major regional fault zone, which extends over several kilometres and is characterized by multiple foliations and regional shear zones.

The geology of the Tiriganiaq Deposit consists of greywacke and argillite sediments (Sam Formation), iron formation, and mixed iron formation, greywacke, and siltstone (Upper Oxide Formation) in fault contact with underlying mafic volcanic rocks (Wesmeg Formation). The sequence trends in an east/west direction, and dips northward at inclinations greater than about 60 degrees. The stratigraphy is aligned for over 3 km along the mineralized shear direction. The fault contact between the Tiriganiaq and the Wesmeg Formation is referred to as the Lower Fault Zone. A zone of graphitic, mineralized fault gouge (0.5 to 3 m in thickness) commonly occurs over this zone.

The Tiriganiaq-Wolf mining area is a hybrid deposit hosted in stratigraphy similar to the Tiriganiaq deposit in the northern portion, while the southern portion is hosted in stratigraphy similar to the F Zone deposit. The geology of the Tiriganiaq-Wolf deposit contains chlorite-rich, massive basalts and pillowed basalts belonging to the Wesmeg Formation, which forms the structural footwall (refer to SD 6-3 of the 2014 FEIS).

Ongoing monitoring of geological structures has led to the identification of 17 faults (i.e., KMS corridor, RM-175) that have been incorporated into the conceptual hydostratigraphy, in addition to the three regional faults (Lower Fault, Pyke Fault, and North Fault) that were previously considered in the 2014 FEIS.

The additional structures are generally located between the Lower Fault and Pyke Fault within the Mafic Volcanic Rock formations, and range in thickness between 2 and 6 m. An exception is the KMS corridor, which is a wider zone of poor rock quality that is generally located between the KMS fault and Lower Fault. The improved understanding of the different structural features in the mining area have contributed to reduced conservatism in the hydrogeology modelling, presented in Section 7.2.2.6 of this Application.

There appears to be two parts to the Wesmeg gold deposit: a northern and southern part. In the northern part, the stratigraphy strikes east-west and dips 65 degrees to the north. The stratigraphy in the southern part strikes northwest-southeast and dips 50 degrees to the north. The host Wesmeg Formation is massive to pillowed basalts and interlayered mafic volcaniclastics, with rare gabbro dykes and some interflow sediments consisting of siltstone, mudstone, and minor iron formations.

The stratigraphy in the Pump deposit area strikes northwest-southeast and dips 50 degrees to the north. Similar to the F Zone and Wesmeg deposits, the host rocks at the Pump area are massive to pillowed basalts of the Wesmeg Formation, which are cut by rare gabbro dykes and interflow sediments.

The stratigraphy of the F Zone area is dominated by mafic volcanic rocks and the east southeast striking Lower Lean Iron Formation. The deposit area is located north of the Pyke Fault which runs sub-parallel to the Lower Iron Formation. Mineralization of the F Zone is hosted by the Lower Lean Iron Formation and is associated with quartz veins and east striking shear zones.

The stratigraphy of the Discovery area is dominated by a thick package of inter-bedded clastic sedimentary units, chemical sediments (oxide facies iron formations) and minor gabbroic dykes. In the deposit area, the hanging wall to the main gold-bearing iron formation horizon is dominated by a greywacke unit which contains minor interbedded argillaceous units, chemical sediments and gabbroic dykes.

Gold mineralization is generally restricted to a folded and variably sheared oxide facies iron formation package, which generally consists of banded chert and magnetite horizons (banding on the millimetre [mm] to centimetre [cm] scale), with lesser interbedded chlorite-rich beds and chert and minor local interbedded greywacke units. The footwall to the main mineralized iron formation horizon consists of a similar succession of clastic sedimentary units as found in the hanging wall. The footwall stratigraphy is dominated by greywacke, with a more argillaceous interval, approximately 20 to 40 m below the mineralized iron formation.

6.2.2 Geochemistry

Geochemical characterization samples considered in this geochemical assessment include a subset of samples collected in support of the 2014 FEIS submission and supplemental sampling conducted in support of the Meliadine Extension. Supplemental samples for Meliadine Extension were collected to assess areas that were not characterized as part of the 2014 FEIS.

Consistent with the 2014 FEIS regional geology considerations for geochemical assessment, the Meliadine properties are located in the Rankin Inlet Greenstone Belt of the Churchill Structural Province. This is an Archean, deformed and metamorphosed sequence of mafic volcanic, felsic pyroclastic, sedimentary rocks and gabbro sills. The Meliadine trend is defined by the regional Pyke Fault, a prominent high-strain fault zone which is northwest trending within the stratigraphy of the Archean Rankin Inlet Group. The Rankin Inlet Group was subjected to lower to middle greenschist facies metamorphism and multiple periods of deformation, including two identified periods of Archean and Proterozoic age. The Meliadine ore deposits are low-sulphide, gold-quartz vein deposits as per the geo-environmental classifications provided in Plumlee et al. (1999). Stratigraphy in the Project area strikes east-west, and dips to the north at inclinations of 60 to 70 degrees. The stratigraphy is interpreted as being overturned. The principal lithological units that are likely to be disturbed by mining include:

- Turbiditic sedimentary rocks of the hanging wall, comprising greywacke, siltstone and argillite (Sam Formation) with gabbro dykes;
- Volcanic-hosted and sediment-hosted iron formation, including greywacke, siltstone and argillite (Upper Iron Formation) with abundant magnetite and chert layers;
- Sericite altered siltstones and graphitic argillite near the Lower Fault zone contact (Tiriganiaq Formation); and
- Schistose and carbonate-altered mafic volcanic rocks in the footwall (Wesmeg Formation).

Since the issuance of the 2014 FEIS, Agnico Eagle has continued to extend its knowledge and validation of the gold deposits around the Meliadine Mine by way of additional exploration. As a result, an improved classification of lithologies was possible for Meliadine Extension. A summary of lithologies that have been included in the Meliadine Extension block model and corresponding lithology codes and lithologies used in the 2014 FEIS are shown in Table 6.2-1.

Table 6.2-1: Meliadine Extension Lithologies and Corresponding 2014 FEIS Lithology Codes

Meliadine Extension Lithology	Meliadine Extension Lithology Codes	Lithology Codes	2014 FEIS Lithology
Gabbro	GB	MG	Gabbro
Iron Formation	IF	KSC-LJ, LL, LLM, NLJ	Iron Formation
Sedimentary	SE	K, KWA-S	Greywacke/Siltstone
Graphitic Mudstone	KMG	KMG	
Siltstone	TIRFM	KS	
Oxidized Sediments	UOFM	KSC-WA	
Ultramafic Volcanics	UV	U	Ultramafic
Lamprophyres	LP	AUA	
Mafic Volcanics	VO	M	Mafic Volcanics
Sericitized Volcanics	VOSR	M	

Source: Lorax (2022)

6.2.2.1 Sample Selection and Screening

As previously mentioned, the geochemical characterization samples considered in Meliadine Extension include a subset of samples collected in support of the 2014 FEIS and supplemental sampling conducted in support of the Meliadine Extension (Lorax 2022). The 2014 FEIS geochemical characterization program included ore, waste rock, overburden, and tailings at Tiriganiaq, Tiriganiaq-Wolf, Wesmeg, Wesmeg North, F Zone, Pump, and Discovery. Some samples were collected to assess potential open pit operations at Wesmeg-North and Tiriganiaq-Wolf. Sample collection for the 2014 FEIS included:

- Waste rock (n= 557) and ore (n=25) samples collected from drill core.
- Tailings samples produced from metallurgical testing (n=20).
- Overburden samples collected from shallow test pits (0.3 to 0.7 m depth) (n=34).
- Waste rock samples collected from a pad constructed near the Tiriganiaq exploration pad (n=12).
- Ore (n=2) samples from two stockpiles (Lode 1000 and Lode 1100) present at the mine surface.

A comprehensive analytical testing program was completed on these samples. A subset of samples was also analyzed for net acid generation (NAG) pH, shake flask extraction (SFE) and X-ray diffraction (XRD). A kinetic testing program was initiated which included 46 humidity cell tests, 9 unsaturated column experiments and 4 field cells. Details on analytical methods and sample collection methods can be found in SD 6-3 of the 2014 FEIS.

The Meliadine Extension supplemental sampling was initiated in 2020 and completed in 2021 and included sampling of drill core, tailings, overburden, saline mine wastes, and a water quality survey

(Lorax 2022).

The objectives of the Meliadine Extension supplemental sampling programs were to characterize:

- Geologic material that will be disturbed by the Meliadine Extension which were not characterized in the 2014 FEIS. This mainly consists of deeper bedrock associated with underground mine operations and changes in pit shell geometry from what was planned in the 2014 FEIS.
- Existing mine waste sampling to examine composition of mill tailings and saline mine wastes that were unavailable during the 2014 FEIS
- Seep survey of existing mine facilities to supplement monitoring database.
- Kinetic testing to assess long term drainage chemistry, develop source terms for water quality predictions and evaluate disposal strategies for mine waste.

Existing monitoring data from the approved Meliadine Mine was also used to calibrate model assumptions and predictions for Meliadine Extension.

6.2.2.2 Drill Core Sampling

The drill core sampling program produced a dataset representative of the different rock types that would be exposed by the Meliadine Extension. The supplemental samples largely targeted the extension of the underground mining areas which include Discovery, Pump, F Zone, and Tiriganiaq-Wolf.

Waste rock samples were selected from drill core, while ore samples were selected from a combination of drill core and head samples composited for metallurgical testing. Ore was distinguished from waste rock using a cutoff grade of 1.8 ppm Au, and a drill core length between 1 and 2 m was targeted.

Table 6.2-2 and Table 6.2-3 present a summary of open pit and underground waste rock and ore samples from the 2014 FEIS and from the supplemental sampling program included in The Meliadine Extension Database, respectively (Lorax 2022). Note that 2014 FEIS samples listed in this table are screened to exclude samples collected from beyond the currently proposed pit shells. The detailed assessment of the geochemical characteristics of the ore, waste rock and overburden for Meliadine Extension are presented in the Geochemical Characterization Report (Appendix G).

Table 6.2-2: Summary of Open Pit, Waste Rock and Ore Samples from the 2014 FEIS and Supplemental Sampling Program Included in the Meliadine Extension Database

Deposit	Lithologic Unit	Waste Rock				Ore			
		Tonnage	2014 FEIS Sample Selection	Supplemental Sampling	Meliadine Extension Database	Tonnage	2014 FEIS Sample Selection	Supplemental Sampling	Meliadine Extension Database
		t	n	n	total n	t	n	n	total n
Discovery	GB	4,066,011	9	1	10	0	0	0	0
	IF	5,544,560	28	21	49	494,288	5	0	5
	SE	27,353,163	48	29	77	2,107,227	2	0	2
	TIRFM	0	3	0	3	0	0	0	0
F Zone	IF	1,684,840	5	4	9	507,870	3	1	4
	VO	16,661,198	62	8	70	1,608,256	0	1	1
Pump	GB	713,876	0	1	1	23,614	0	0	0
	IF	1,507,071	4	4	8	212,522	4	0	4
	VO	5,711,006	15	3	18	944,544	0	2	2
Tiriganiaq	GB	442,316	4	0	4	0	0	*0*	0
	IF	3,538,525	1	8	9	3,254,906	0	5	5
	SE	16,807,992	99	0	99	171,311	0	*0*	0
	TIRFM	2,211,578	8	0	8	513,933	3	*0*	3
	UOFM	14,154,099	14	0	14	4,111,460	0	3	3
	VO	7,077,049	17	0	17	171,311	*3*	*0*	3
Wesmeg	GB	3,870,471	1	0	1	389,366	0	0	0
	IF	3,386,662	0	4	4	1,622,360	0	1	1
	UV	0	4	0	4	64,894	1	0	1
	VO	39,188,516	42	2	44	4,347,925	0	3	3
Wesmeg-North	GB	1,332,645	0	1	1	268,531	0	0	0
	IF	222,107	0	2	2	146,472	0	0	0
	SE	3,331,611	0	0	0	0	0	0	0
	VO	15,769,628	0	14	14	1,489,128	0	3	3
Total		**174,574,923**	**364**	**102**	**466**	**22,449,918**	**21**	**19**	**40**

Source: Lorax (2022)

Table 6.2-3: Summary of Underground Waste Rock and Ore Samples from the 2014 FEIS and Supplemental Sampling Program Included in the Meliadine Extension Database

Deposit	Lithologic Unit	Waste Rock				Ore			
		Tonnage	2014 FEIS Sample Selection	Supplemental Sampling	Meliadine Extension	Tonnage	2014 FEIS Sample Selection	Supplemental Sampling	Meliadine Extension
		t	n	n	total n	t	n	n	total n
Discovery	GB	11,089	0	4	4	0	0	0	0
	IF	188,511	0	15	15	721,741	0	16	16
	SE	909,288	0	19	19	1,128,878	0	0	0
	TIRFM	0	0	0	0	0	0	0	0
F Zone	IF	444,074	0	4	4	1,296,422	0	5	5
	VO	1,467,376	0	4	4	1,790,297	0	6	6
Pump	GB	143,870	0	0	0	178,012	0	0	0
	IF	328,846	0	2	2	1,017,209	0	5	5
	VO	1,459,255	0	9	9	1,347,802	0	4	4
Tiriganiaq	GB	54,782	2	0	2	230,149	0	0	0
	IF	547,821	2	3	5	6,444,170	0	10	10
	SE	931,296	7	0	7	1,150,745	0	1	1
	TIRFM	493,039	9	0	9	3,912,532	0	3	3
	UOFM	1,753,028	1	6	7	10,356,701	0	6	6
	VO	1,643,464	12	0	12	230,149	0	0	0
Tiriganiaq-Wolf	IF	131,781	0	5	5	2,363,866	0	7	7
	SE	680,867	0	0	0	656,629	0	3	3
	VO	285,525	0	6	6	262,652	0	3	3
Wesmeg	GB	686,650	0	0	0	1,041,883	0	0	0
	IF	363,521	0	4	4	1,736,472	0	7	7
	UV	80,782	0	0	0	86,824	0	0	0
	VO	2,908,165	0	4	4	5,817,182	0	3	3
Wesmeg-North	GB	36,604	0	3	3	39,596	0	0	0
	IF	21,962	0	2	2	134,627	0	2	2
	SE	0	0	2	2	0	0	0	0
	VO	300,151	0	8	8	593,945	0	5	5
Total		**15,871,751**	**33**	**100**	**133**	**42,538,482**	**0**	**86**	**86**

Source: Lorax (2022)

6.2.2.3 Tailings Sampling

Tailings samples were collected from the TSF and the paste plant in Q2 of 2021. Whole ore tailings samples collected from the TSF through test pits excavated by hand shovel and paste samples were collected from the paste plant. The paste was produced using a binder content of 4.5% and was collected in two buckets where it was allowed to cure. The tailings were characterized by static testing, and used to construct a humidity cell, two saturated columns and an unsaturated column (Lorax 2022).

6.2.2.4 Saline Mine Waste

Saline permafrost within the overburden is known to exist in the region around Meliadine (Lorax 2022). Saline connate water from the Tiriganiaq underground entrained with waste rock can lead to the release of TDS from underground mine waste stored at surface. Therefore, an extension of the existing monitoring program was developed to characterize saline mine waste for Meliadine Extension (Lorax 2022).

The objectives of this monitoring program were to develop an understanding of the potential and duration for salinity release from different material types and to inform water quality predictions. Samples were collected from the WRSFs across the mine site to determine the distribution and persistence of salinity in underground waste rock temporarily stored at surface during operations and in overburden materials, and to assess the influence of depth and duration of exposure on salinity release. Water quality analysis of rinse waters and porewater were conducted on a subset of salinity rinse test samples (Lorax 2022).

Saline mine waste samples were collected from test pits, pit wall exposures, drill core samples and blast-hole drill cuttings. Characterization of this material consisted of rinsing tests and two unsaturated columns.

6.2.2.5 Water Quality Survey

A targeted water quality survey was completed in the summer and fall of 2020. Mining operations were initiated in Spring 2019, resulting in 2020 being the first year that significant quantities of mine waste were present at the surface. Water quality monitoring provides an opportunity to directly observe the expression of mine rock weathering in the field. The objective of this program was to collect water quality samples which directly reflect mine waste drainage from a known source (e.g., waste rock, ore, or tailings) with minimal dilution (Lorax 2022). Water quality samples were also collected from seepage formed at the interface of rock and natural ground, and from low-flow ditches (representing run-off water) located adjacent to the road, stockpile or toe of mine facility.

6.2.2.6 Kinetic Test Sample Selection

A comprehensive humidity cell testing program was completed for the 2014 FEIS, which included 46 humidity cells and 9 unsaturated columns. Supplemental kinetic testing conducted in support of the Meliadine Extension included one humidity cell, 11 unsaturated columns and two saturated columns. These kinetic tests were initiated to assess long term drainage chemistry, develop source terms for water quality predictions and evaluate disposal strategies for mine waste.

Waste rock kinetic tests for specific lithologies used composite samples each constructed from three to eight drill core segments. Drill core samples were selected by comparing acid base accounting (ABA) and metal abundance results to the respective 2014 FEIS statistics for potentially acid generating (PAG) and non-potentially acid generating (NPAG) rock for the targeted lithologic units. A composition within the median to 75th percentile range for 2014 FEIS statistics was targeted for key parameters including Arsenic, Iron and total-Sulphur, Neutralization Potential Ratio, and NAG pH.

Salinity rinsing columns were initiated using run of mine waste rock collected as part of the saline mine waste characterization sampling program. Unsaturated and saturated tailings kinetic test work was conducted on the same composite material constructed from five dry stack tailings samples collected from test pits in the TSF. The humidity cell was constructed from the cemented paste sample, containing 4.5% binder content.

6.2.2.7 Analytical Methods

A variety of analytical methods were employed in the geochemical characterization program. The testing procedures included static test, kinetic tests, mineralogical characterization, metal assays, and salinity rinsing tests. in addition to detailed mineralogical analysis. A summary of the number of samples and type of tests (by material type) is provided in Table 6.2-4 both the 2014 FEIS samples and supplemental geochemical characterization samples included in the Meliadine Extension database. A detailed description of the test procedures and analytical methods is provided in the Geochemical Characterization Report (Appendix G).

Table 6.2-4: Summary of Analytical Tests Performed on the 2014 FEIS and Supplemental Geochemical Samples included in the Meliadine Extension Database as a Function of Material Type

Analytical Test	2014 FEIS Sample Selection				Supplemental Sampling				Meliadine Extension Database			
	Over-burden	Waste Rock	Ore	Tailings	Over-burden	Waste Rock	Ore	Tailings	Over-burden	Waste Rock	Ore	Tailings
Static Tests												
Acid base accounting (ABA)	31	353	21	10	0	191	92	6	31	544	113	16
Shake Flask Extraction (SFE)	30	397	21	10	0	35	25	0	30	432	46	10
Aqua Regia (ICP-MS) Trace Metals	31	397	21	10	0	191	92	6	31	588	113	16
Whole Rock Analysis (WRA)	30	397	21	10	0	190	92	6	30	587	113	16
NAG pH	0	27	1	10	0	191	92	6	0	218	93	16
Salinity Rinsing	0	0	0	0	69	29	0	0	69	29	0	0
Kinetic Tests												
Humidity Cells	0	46	0	0	0	0	0	1	0	46	0	1
Unsaturated Columns	0	9	0	0	0	10	0	1	0	19	0	1
Saturated Columns	0	0	0	0	0	0	0	2	0	0	0	2
Field Cells	0	2	2	0	0	0	0	0	0	2	2	0
Mineralogy												
X-Ray Diffraction (XRD)	0	49	0	0	0	26	10	6	0	75	10	6
QEMSCAN or TIMA-X	0	0	0	8	0	8	2	0	0	8	2	8

Source: Lorax (2022)

QEMSCAN- Quantitative Evaluation of Materials by Scanning Electron Microscopy; TIMA-X- Tescan Integrated Mineral Analyzer

Consistent with the 2014 FEIS, and as shown in Table 6.2-4, samples were subjected to a variety of static testing and kinetic testing to evaluate chemical and mineralogical composition, the potential to generate ARD, as well as short- and long-term metal leach potential. Acid rock drainage potential was assessed following Guidelines for Acid Rock Drainage Prediction in the North (AANDC 1992) for waste rock and tailings. All leach test water quality results were screened against MDMER and Aquatic Effects Monitoring Program (AEMP) Water Quality Guidelines (Lorax 2022).

6.2.3 Meliadine Extension Geochemical Characterization Results

6.2.3.1 Waste Rock

Characterization of ARD potential and metal leaching behaviour of waste rock materials are overall consistent with the conclusions of the 2014 FEIS. The supplemental characterization work develops an understanding regarding the characterization of underground mine rock and the persistence and influence of salinity associated with connate water in underground mine rock

Most waste rock that will be excavated as part of the Meliadine Extension is classified as NPAG outside of the Discovery deposit. The distinct ARD potential at Discovery is due to lower carbonate mineralization compared to other deposits, reducing the amount of Neutralization Potential (NP) available to neutralize acid potential associated with sulphide minerals. Due to the relatively low carbonate content, material classified as PAG or Uncertain are found in all three major waste rock lithologies at Discovery (Sedimentary, Gabbro and Iron Formation). The occurrence of PAG rock outside of Discovery is essentially limited to the Iron Formation lithology.

Overall, 60% of Discovery waste rock is classified as PAG or Uncertain. Conversely, only 5% of the total waste rock outside of Discovery is expected to be classified as PAG or Uncertain. The ARD potential associated with Discovery open pit waste rock will be mitigated through the progressive construction of a thermal cover using NPAG mine rock, as defined in the thermal and seepage model completed for this facility (Okane 2022). Discovery underground waste rock will be backfilled into the underground mine workings and flooded at mine closure, thereby eliminating the ARD potential associated this material.

The metal leaching potential of waste rock was assessed through a variety of laboratory tests and through a seep survey completed in the summer-fall of 2020. Both laboratory kinetic tests and the seep survey confirmed that Arsenic was the only parameter to exceed MDMER guidelines in waste rock seepages. Kinetic tests and SFEs results showed that TIRFM and SE lithologies generally produced the highest As concentrations, while lower concentrations were generally observed in IF waste. A field survey of waste rock seepage found that a number of parameters exceeded AEMP guidelines, including Ammonia, Cobalt, Copper, Nickel and Zinc.

The survey results also indicated distinct metal leaching potential of underground versus open pit mine rock; that is, underground mine rock tended to show greater concentrations of metal cations Cobalt), Copper, Nickel, and Zinc, while open pit mine rock tended to have higher Arsenic and Antimony concentrations. This behaviour was also observed in SFE, where both connate water and Deionized water

(DI) was used to rinse water soluble metal content.

A subset of SFE tests were initiated using connate water in place of DI water to examine metal leaching potential specific to underground mine waste. These tests consistently produced elevated concentrations for Barium, Cobalt, Copper, Nickel, and Zinc relative to testing that used deionized water on duplicate waste rock samples. The elevated concentrations are likely related to cation exchange and the lower, but still circumneutral, pH of leachate solutions. The impact of connate water on arsenic concentrations was more variable, and likely related to the counteracting influences of cation exchange and lower pH on arsenic solubility. Overall, the result indicate that underground waste rock will have elevated metal leaching potential compared to the equivalent lithologies excavated from open pits.

Underground mine rock is a potential source of salinity release due to the presence of connate water in the initial pore water of mine rock brough to the surface. To assess the salinity leaching potential of existing and future underground mine rock, salinity rinsing tests were completed on waste rock stockpiled at the mine surface. The results showed that over 90% of the salinity load appears to have been rinsed from surficial (<30 cm) waste rock samples after 2 to 4 years of exposure. Deeper profiles (1-4 m depth) completed on stockpiles of recently excavated waste rock (0-1 years) showed relatively high salinity loads, indicating that minimal rinsing of connate water has occurred in the relatively short period that the stockpiles have been exposed. During mine operations, seepage from underground mine rock will be directed into the saline water management system. This water will be isolated from surrounding lakes and will ultimately be treated and discharged to Itivia Harbour via the approved waterline.

6.2.3.2 Ore

Characterization of ARD potential for ore materials corresponds with the findings of the 2014 FEIS regarding the designation of Discovery ore primarily as PAG. Results from laboratory tests and the seep survey completed in 2020 demonstrates that ore presents greater metal leaching potential than waste rock materials. Discovery is the only deposit where most ore is classified as PAG or Uncertain due to the low carbonate content at this deposit. Outside of Discovery, a total of 30% of Meliadine Extension ore is classified as PAG or Uncertain.

Ore will only be temporarily stockpiled before being milled and deposited as dry stack tailings or paste backfill.

The metal leaching potential of ore was assessed through laboratory SFE tests and a field seepage survey. Ore samples generally showed higher SFE concentrations compared to waste rock, particularly for As and Selenium. The results indicate that ore will have greater metal leaching potential compared to waste rock, and underground ore stockpiles will have elevated metal leaching potential compared to the equivalent lithologies excavated from adjacent open pits. All ore will be processed through the mill before the end of mine life, eliminating the long-term metal leaching and ARD potential associated with this material type.

6.2.3.3 Tailings

Metallurgical whole ore tailings were characterized as part of the 2014 FEIS, while mill tailings and paste tailings were characterized as part of the supplemental geochemical sampling program. In contrast to metallurgical tailings, mill tailings reflect additional dewatering and deposition in a dry stack. These processes are not expected to alter the intrinsic geochemical properties of whole ore tailings. As such, there are broad similarities between the ARD/ML properties of both materials.

Milled tailings tend to have lower ARD potential compared to ore due to differences in ARD screening criteria. Discovery is the only deposit where most tailings are considered PAG. At Discovery, both major lithology types (Sedimentary and Iron Formation) are expected to be PAG or Uncertain. Outside of Discovery, the ARD potential is essentially limited to Iron Formation. Only 18% of tailings from all other deposits are classified as PAG or Uncertain. Mitigation of ARD potential of tailings placed in the TSF will occur through encapsulation by NPAG tailings.

The paste plant will substantially increase the NP of tailings through cement addition. That is, cement addition is expected to increase NP by 80 kg$CaCO_3$/t. Applying this NP increase to the ore ABA results would result in over 90% of paste samples being classified as non-PAG. Any residual ARD potential of paste tailings would be mitigated through flooding of mine workings at the end of operations.

Tailings will have distinct metal leaching potential compared to waste rock and ore due to grinding and reagent addition within the mill and paste plant. Kinetic tests and seepage surveys have found that arsenic and Ammonium are the only parameters to exceed MDMER guidelines. TSF seepage water quality shows a variety of AEMP exceedances for other parameters Total Dissolved Solids, Arsenic, Boron, Cadmium, Cobalt, Copper, Lead, Manganese, Nickel, Selenium, Silver, Titanium, Uranium and Zinc, which are likely related to rinsing of process water from recently placed tailings.

Consistent with the Meliadine Mine approved TSF, a closure cover will be progressively installed over the TSF throughout operations and at the beginning of closure of Meliadine Extension. The intent for this cover is to limit the depth of the active layer, and thus limit the degree to which infiltrated water interacts with the PAG/ML tailings and oxygen, so water quality standards can be met.

6.2.3.4 Overburden

Overburden from within the pit footprints is non-acid-generating and does not require means to prevent oxidation. Metal release under laboratory conditions is low despite the relatively high total arsenic content. Leachate concentrations in overburden are generally lower than waste rock and meet MDMER monthly mean limits. Waste rock and overburden have compatible geochemical characteristics such that they could be managed together in the same facility (Geochemical Characterization Report, Appendix G).

Salinity associated with overburden permafrost is the primary water quality concern associated with this material type. Permafrost salinity in the Kivalliq Region is related to the intrusion by the Tyrrell Sea which inundated the area at the postglacial marine maximum 5-6 ka (Hivon and Sego, 1993). Investigation of overburden salinity at Meliadine found that salinity is generally absent from the active zone above permafrost. Below the active zone, permafrost salinity is observed to increase with from 2 to 6 m depth.

Below a depth of 6m, salinity was observed to remain relatively constant, with a peak pore water TDS of 10,000 mg/L. A relationship between landform and overburden salinity has not been established. However, any overburden present in the active zone, or formed from sediments deposited after the post-glacial marine maximum can be assumed to contain minimal salinity.

Overburden excavated from mine pits will be co-disposed with waste rock in the WRSFs. Overburden excavations will be mostly conducted during winter months, to maintain frozen conditions, mitigating metal and salinity leaching potential from this material.

6.3 Permafrost and Permafrost Terrain

The purpose of this section is to address updates to the 2014 FEIS, in relation to the impacts of the Meliadine Extension for permafrost conditions. This section includes an assessment of direct effects to changes to permafrost and permafrost terrain in the study area. The term ‘permafrost terrain’ in this report refers to the geomorphology, surface geology, and periglacial processes that have shaped the terrain features, both soil and rock, that occurs in the Meliadine Extension area. Permafrost is the state or condition in which the terrain, or terrain materials, continuously exists at a temperature below 0°C for 2 or more years. The effects assessment evaluates all assessment phases, including construction, operation, and closure and reclamation. The effects from the Meliadine Extension must be considered in combination with other developments, activities, and natural factors that influence permafrost within the study area.

The Meliadine Mine is located in a zone of continuous permafrost, as illustrated in (Figure 6.3-1).

6.3.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

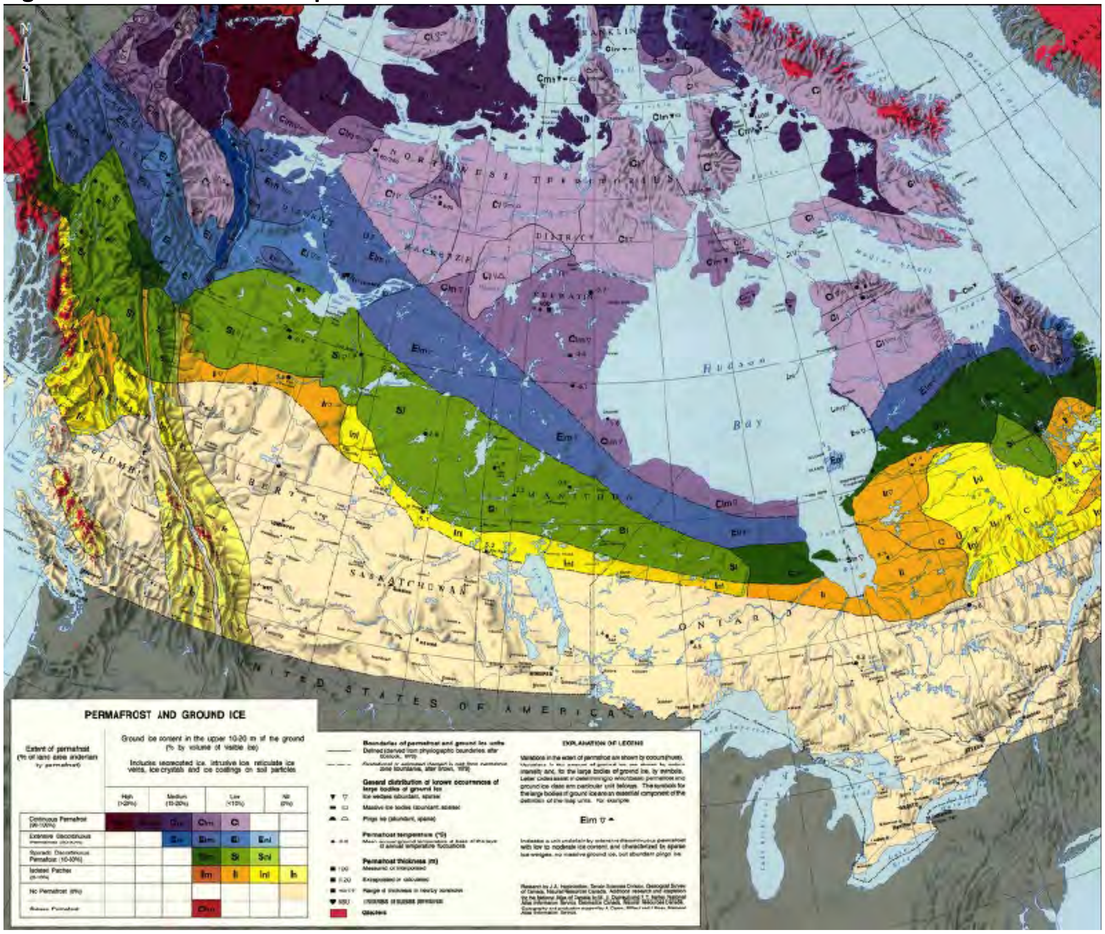
There is no IQ specific to permafrost or permafrost terrain.

6.3.2 Existing Environment

The reader is referred to Section 6.3.2 to Section 6.3.8 of Volume 6 of the 2014 FEIS (Agnico Eagle 2014) for the permafrost terrain classification methods, regional and local permafrost characterization, snow drift accumulation, bedrock geology and surface geomorphology of the Project Area, and observed periglacial processes. The reader is also referred to the SD 6-1: Permafrost Thermal Regime Baseline Studies Report (Agnico Eagle 2014) for the baseline conditions at the Project site which include geotechnical drilling investigations, installation of thermistor instrumentation, and geomorphological mapping of the periglacial environment up to 2014.

The following sub-sections address the updates to the Meliadine Extension with respect to new environment and baseline information.

Figure 6.3-1: Permafrost Map of Canada



Source: NRCan (1995)

6.3.2.1 Local Permafrost Characterization

Permafrost conditions at the time of the 2014 FEIS are described in SD 6-1 Permafrost Baseline Report in the 2014 FEIS (Agnico Eagle 2014). In total, 33 thermistors were installed around the Meliadine Mine area during geotechnical investigations in 1998, 2007, 2009, 2011, and 2012. Supplemental thermistors were installed since the 2014 FEIS to improve and update the understanding of existing permafrost conditions compared to what was evaluated in the 2014 Permafrost Baseline Study. The location of new active thermistors installed at depths greater than 40 m within the vicinity of the area of interest is shown in Figure 6.3-2 and summarized in Table 6.3-1. Additional thermistors installed at depths less than 40 m were not used to interpret permafrost characterization.

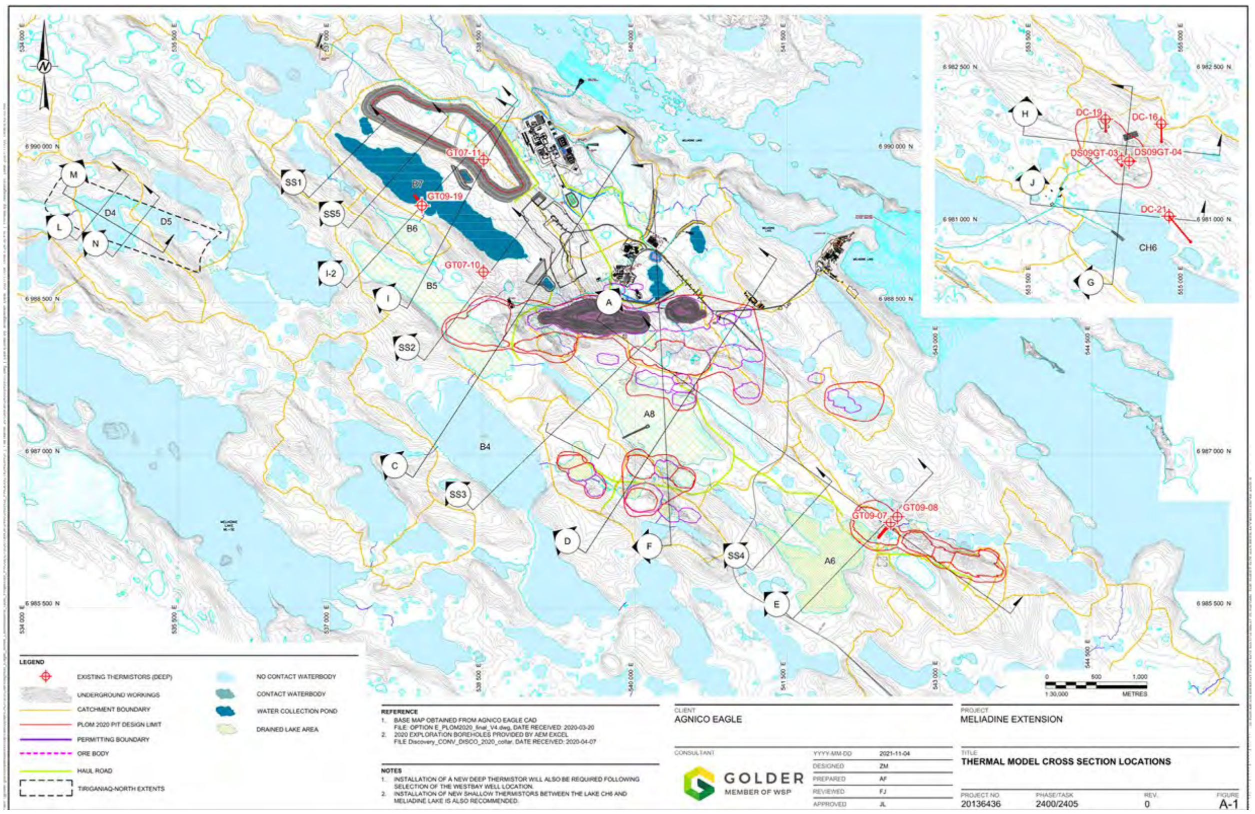
Table 6.3-1: Thermistor Summary

Location	Thermistor[a]	Collar Coordinates					Depth Below Ground Surface (m)
		Northing (m)	Easting (m)	Elevation (m)	Inclination (°)	Azimuth (°)	
Discovery	DC-16	6,981,980	554,770	67	70	179	475
	DC-19	6,982,025	554,220	67	66	179	260
	DC-21	6,981,071	554,846	70	60	140	572

Source: Golder (2021b)

(a) Thermistors installed in 2020 and were still in the process of temperature stabilization at the time of the study.

Figure 6.3-2: Thermistor Location Plan



The thermistors were installed into boreholes that were drilled as part of the 2020 hydrogeological investigations. The depth of each installation varied depending on the desired information to be obtained. The data collected from the thermistor installations were used to characterize the permafrost conditions of the Meliadine Mine site along with other important geothermal properties for the various deposit areas. Summaries of the permafrost soils encountered during drilling are presented in the 2020 hydrogeological and thermistor installation program factual report (Golder 2021a).

6.3.2.2 Thermal model

The 2014 FEIS predicted that taliks extending through the permafrost would exist beneath circular lakes having a minimum radius of approximately 290 to 330 m, and beneath elongated lakes having a minimum half width of approximately 160 to 195 m. In support of the Meliadine Extension, 2D thermal modelling was completed to update the predicted depth to the base of permafrost in the study area, to assess the extent of lake taliks and to determine whether the proposed open pits and additional underground developments will remain within the permafrost limits (Golder 2021b). This approach was adopted given the number of proposed undergrounds and proximity of these undergrounds to lakes with potential open taliks.

The 2D thermal modelling considered supplemental thermistor data collected since the 2014 FEIS to improve and update understanding of existing permafrost conditions and to consider the effects of lake terrace geometries compared to what was evaluated in the 2014 FEIS (Golder 2021b,c). Only data from deep thermistors were used in the updated model compared to the shallower thermistors (less than 40 m deep) evaluated during the 2014 FEIS.

Bathymetry surveys of critical lakes included in the 2D thermal modelling are presented in Table 6.3-2 and result from new bathymetry survey performed in 2019 for the Meliadine site (Agnico Eagle 2019a). The bathymetry data was used to determine maximum lake depth of critical lakes and develop temperature boundary conditions for the model. Average ice thicknesses used for modelling were based on the data presented in SD 6-1: Permafrost Thermal Regime Baseline Studies Report (Agnico Eagle 2014).

Table 6.3-2: Maximum Lake depths

Area	Lake	Maximum Lake Depth[(a)] (m)
Main	B4	2.0
	B5	3.0
	B7	4.5
	A6	4.0
	A8	4.0
Discovery	CH6	8.0

(a) Based on bathymetry survey using 0.5 m contours (Agnico Eagle 2019a)

Following completion of the 2D thermal models, results were used to create a three-dimensional (3D) block model to provide an overall view of the permafrost conditions with the project areas. Results of the thermal modelling indicated:

- Open taliks were interpreted to be present beneath portions of each of the following lakes near the proposed open pits and undergrounds: Lake B4, Lake B5, Lake B7, Lake A6, Lake A8, Lake CH6, and Lake D4.

- The depth of the base of permafrost was interpreted to be between 285 and 430 m depth, with the interpreted depth dependent on the proximity to nearby lakes. Shallower depths are from locations near to lakes both with and without open taliks.

Some important characteristics of the permafrost based on the available data and results from the numerical modelling are also summarized in Table 6.3-3. Of the three thermistors installed in the Discovery Area, DC-16 and DC-19, installed in May 2020, did not have enough data to determine zero annual amplitude. Temperatures along the thermistor string DC-21, which was also installed at the Discovery Area in 2020, were still stabilizing and were therefore not used as reference for permafrost characterization except as a conceptual verification of the modelling predictions (Golder 2021b). Table 6.3-4 summarizes the assumptions used for the interpretation of open talik for the Meliadine Extension and compares it to what was assessed in the 2014 FEIS.

It should be noted that the differences outlined for the Meliadine Extension are based on new data and a better understanding of the Meliadine site. The methodology that has been implemented for the thermal modelling update is based on several modelling refinements that have been considered in past applications and favors a conservative approach. As mentioned, new deep thermistors were installed in the Meliadine Mine and only data from deeper thermistors were used to characterize local permafrost and interpretation of open taliks within the Meliadine site.

Depending on the reference source, permafrost that has a temperature range of 0 to -4°C is considered ‘warm’ permafrost whereas permafrost that has a temperature range colder than -4°C is considered ‘cold’ permafrost (Hammer et al. 1985). The Meliadine Mine area is in a region of ‘cold’ permafrost, having an average annual surface temperature and zero amplitude temperature less than -4°C, as presented in Table 6.3-3.

It should be noted that the depth of permafrost and of the active layer varies based on proximity to lakes, soils thickness, vegetation, climate conditions, and slope direction. The base of the permafrost is expected to be an irregular surface, and so the actual thickness of permafrost will be variable. In the local context of the Meliadine site, the land surface is underlain by continuous permafrost, except under bodies of water too deep to freeze to the bottom during winter.

The salinity level of the deep groundwater in the Meliadine Mine area is elevated (approximately 61,000 mg/L) which will result in freezing point depression so that the depth of frozen permafrost (depth to the basal cryopeg) is less than the depth of perennially cryotic ground (ground at a temperature less than 0 degrees) (Golder 2021c). The reader is referred to Section 7.2 of this Application for the freezing point depression estimated for the Meliadine Extension following an update on the groundwater quality for the Meliadine site.

Table 6.3-3: Permafrost Characteristics in the Project Area Based on Available Data

Reference	Depth of Zero Annual Amplitude (m)		Zero Amplitude Temperature (°C)			Geothermal Gradient (°C/m depth)			Mean Annual Surface Temperature (°C)			Active Layer Depth (m)			Permafrost Base (mbgs)		
	Min.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.
2014 FEIS	15	35	-7.5	-6.3	-4.8	0.010	0.016	0.020	-8.7	-7.2	-6.0	1.2	2.3	3.2	360	412	495
2021 FEIS	18	40	-7.0	-6.5	-3.5/-5.9[a]	0.016	0.018	0.020	N/A[b]	-7.9	N/A[b]	1.0	2.0	3.0	285	400	430

(a) -3.5 next to lake B7 and -5.9 away from lakes

(b) The model was calibrated using only an annual ground surface temperature of -7.9°C. This value was defined during the model calibration phase and based on surface temperature, lake temperature and geothermal gradients.

°C = degrees Celsius; m = meter; min = minimum; max = maximum; avg = average; mbgs = meters below ground surface

Table 6.3-4: Open Talik Assumptions and Modelling Results

	2014 FEIS[a]	**Meliadine Extension Application[b]**
Method	Analytical solutions	2D and 3D thermal analysis
No consideration of lake terrace geometry		
Circular lakes min. radius (m)	290-330	N/A
Elongated lakes half width (m)	160-195	
Consideration of lake terrace geometry		
Assumption	25% to 75% of the total lake width/diameter	Within the model
Circular lakes min. radius (m)	310-485	Lake geometry integrated in the model
Elongated lakes half width (m)	170-280	
Lakes with interpreted open talik	Meliadine Lake **Lake B7** **Lake A8** Lake D7	**Lake B7** **Lake A8** Lake B5 Lake A6 Lake B4 Lake D4 Lake CH6

(a) Critical lake sizes for open talik formation are presented in Vol. 6, section 6.3.4.2 (Agnico Eagle 2014). Interpreted lakes with open talik are presented in Vol. 7, section 7.1.1.1 (Agnico Eagle 2014).

(b) Meliadine Lake and Lake D7 were not assessed since they are away from target areas defined for modelling.

6.3.3 Assessment of Potential Meliadine Extension-related Effects

The Meliadine Extension activities represent a negligible change from the 2014 FEIS (Agnico Eagle 2014) and no new pathways were identified. This section provides a summary of the effects assessment for the permafrost in the region of the Meliadine Extension.

A pathway analysis to identify and assess linkages between activities included in the Application and permafrost was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-2 of this Application and are also described in Volume 6, Section 6.3.9, Table 6.3-8 of the 2014 FEIS. A new minor pathway for the permafrost VEC was determined for Meliadine Extension; however, this pathway has already been assessed and submitted as exhibit No. 2 at the Water Licence Amendment Hearing. Therefore, this pathway was not carried forward further in this Application.Otherwise, no linkage and minor pathways for the permafrost VEC are consistent with the 2014 FEIS. Thus, there is no change from the previous assessments.

In the 2014 FEIS, six primary pathways were analyzed and classified in the effects assessment. Table 6.3-5 summarizes these primary pathways and compares the 2014 FEIS to the Meliadine Extension pathway assessment, residual impacts, and rationale.

There are no new primary pathways for the permafrost terrain. The Meliadine Extension does not change the size of the spatial boundary for the assessment, but there is an increase in the temporal boundary due to the extension of mine life. The extended temporal boundary does not change the results of primary pathways identified from the previous assessments; however, a summary of the effects analysis for the primary pathways are provided below.

Table 6.3-5: Potential Primary Pathways for Permafrost

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Meliadine Extension Rationale
Construction Activities	Physical alteration of terrain, soils, and permafrost due to earthworks, facilities construction, and ground disturbance. Gain of permafrost into structural fills used for foundations. Physical removal of permafrost soils and rock where stripping is required.	Use of appropriate engineering design for structural fills and fill thickness to promote permafrost growth. Minimize footprint areas of facilities and infrastructure. Minimize footprint areas and excavation depth of any quarrying for construction materials to limit permafrost degradation. Minimize ground disturbance.	Primary	Primary	No changes are proposed during the construction activities that could impact permafrost degradation. The proposed footprint of most of the infrastructures of the Meliadine Extension is similar to the 2014 FEIS. The terrain units that will be affected by the Meliadine Extension are the same as the 2014 FEIS. Therefore, this effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Construction Activities	Physical alteration of terrain, soils, and permafrost due to earthworks, facilities construction, and ground disturbance. Gain of permafrost in structural fills used to construct AWAR and site roads.	Use appropriately designed structural fill and thickness to promote permafrost growth. Minimize footprint of roads while maintaining safe construction and operation practices. Use appropriate engineering design and construction practices for permafrost environments.	Primary	Primary	No changes are proposed during the construction activities that could impact the areas of disturbance for the proposed quarries. The AWAR being already constructed, the mitigation measures outlined in the 2014 FEIS were followed and will continue to be carried forward for the upcoming site roads required for the Meliadine Extension.
Operation	Physical loss or permanent alteration of terrain, soils, and permafrost within the mined out areas. Permafrost degradation and retreat due to excavation of open pits. Potential groundwater inflows to the open pit during operations if depth extends below the base of permafrost.	Appropriate design of open pit walls to promote stability, and to minimize annual slope degradation. Management of water inflows to the pit will require sumps and pumps to collect the water for monitoring and, if necessary, treatment before discharge.	Primary	Primary	No changes are proposed during the operation phase for the Meliadine Extension. The excavation of the open pits will still result in minimal retreat of permafrost into the walls and floor of the pit during excavation, as previously assessed in the 2014 FEIS. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Operation	Physical gain of terrain and permafrost within the tailings storage facility. Permanent alteration of terrain, soils, and permafrost beneath the tailings storage facility.	Use appropriate design of facility to promote the growth of permafrost into the base of the facility and into the tailings. Use appropriate facilities management methods to reduce the amount of ice trapped within the facility. Use appropriate tailings deposition plan (tailings placed in layers to promote freezing, and maintain a centralized pond).	Primary	Primary	The footprint of the proposed tailings storage facility is within the footprint of the 2014 FEIS and therefore this effect is considered to have been previously assessed. The overall reduction of the Meliadine Extension TSF footprint from 1681 to 453 ha will substantially reduce the disturbance and loss of permafrost at the mine site. With the reduction of the TSF footprint and the lower water content in the tailings, a shorter time will be required to freeze the pad below the TSF and freeze the tailings, resulting in a gain of permafrost quicker than what was previously assessed in the 2014 FEIS (Agnico Eagle 2015). Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Decommissioning and Closure	Flooding of pits at closure may result in the creation of a talik beneath the pit lake. The talik may be closed, or it may be open, depending on the depth of the pit and the size of the pit lake that is formed. If an open talik is formed beneath the pit lake, the lake will become either a regional discharge point, or a regional recharge point, for the sub-permafrost groundwater system. If an open talik is formed a hydraulic connection will exist between the pit lakes and the sub-permafrost groundwater system. There will be the potential for constituent transport from the pit lakes into the groundwater system.	Monitor pit lake water quality.	Primary	Primary	No changes are proposed during the decommissioning and closure phase for the Meliadine Extension. The proposed pit site layout for the Meliadine Extension is similar to the 2014 FEIS and therefore it can still be concluded that no net cumulative effects will result from the development of open taliks beneath pit lakes. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Decommissioning and Closure	Backfilling during operations and flooding of underground workings at closure may result in permafrost re-establishing in the areas of the workings not beneath lakes. If underground mine workings extend below the base of permafrost, or are located beneath pit lakes large enough to develop an open talik, then there may be a hydraulic connection between the pit lakes, underground workings, and sub-permafrost groundwater system.	Use appropriate mine closure methods to decommission the underground workings and to close the portal. Monitor appropriately.	Primary	Primary	No changes are proposed during the decommissioning and closure phase for the Meliadine Extension. The proposed pit site layout for the Meliadine Extension is similar to the 2014 FEIS and therefore it can still be concluded that no net cumulative effects will result from the development of open taliks beneath pit lakes and incorporating underground workings resulting in hydraulic connection between surface waters and the deep groundwater flow regime. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.

- **Physical loss or permanent alteration of terrain and soils within the Meliadine Extension footprint.**

No changes are proposed during the construction activities that could impact permafrost degradation. The proposed footprint of most of the infrastructures of the Meliadine Extension is similar to the 2014 FEIS. The terrain units that will be affected by the Meliadine Extension are the same as the 2014 FEIS. Therefore, this effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.

- **Physical loss or permanent alteration of terrain and soils within the Meliadine Extension area.**

No changes are proposed during the construction activities that could impact the areas of disturbance for the proposed quarries. The AWAR being already constructed, the mitigation measures outlined in the 2014 FEIS were followed and will continue to be carried forward for the upcoming site roads required for the Meliadine Extension.

- **Physical gain of terrain and permafrost within the tailings storage facility; permanent alteration of terrain, soils, and permafrost beneath the tailings storage facility.**

The footprint of the proposed tailings storage facility is within the footprint of the 2014 FEIS and therefore this effect is considered to have been previously assessed. The overall reduction of the Meliadine Extension TSF footprint from 1681 to 453 ha will substantially reduce the disturbance and loss of permafrost at the mine site. With the reduction of the TSF footprint and the lower water content in the tailings, a shorter time will be required to freeze the pad below the TSF and freeze the tailings, resulting in a gain of permafrost quicker than what was previously assessed in the 2014 FEIS (Agnico Eagle 2015). Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.

- **Physical loss or permanent alteration of terrain, soils, and permafrost within the mined out areas; permafrost degradation and retreat due to excavation of open pits; potential groundwater inflows to the open pit during operations if depth extends below the base of permafrost; flooding of pits will result in creation of talik zones beneath pit lakes; Flooding of underground workings at closure may or may not result in permafrost re-establishing in the areas of the workings.**

No changes are proposed during the operation nor the decommissioning and closure phase phases for the Meliadine Extension. The excavation of the open pits will still result in minimal retreat of permafrost into the walls and floor of the pit during excavation, as previously assessed in the 2014 FEIS. In addition, the proposed pit site layout for the Meliadine Extension is similar to the 2014 FEIS and therefore it can still be concluded that no net cumulative effects will result from the development of open taliks beneath pit lakes and incorporating underground workings resulting in hydraulic connection between surface waters and the deep groundwater flow regime. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.

6.3.4 Residual Impact Classification

Although primary pathways have been identified for permafrost, no residual impact predictions are made because permafrost does not have assessment endpoints. Any potential effects associated with the primary pathways for permafrost are captured in the assessment of the potential effects to, and residual impact classifications for other VECs. Mitigation measures designed to reduce impacts are provided in Table 6.3-5 and Appendix B-2, Table B-2.

6.3.5 Cumulative Effects Assessment

The Meliadine Extension is anticipated to have negligible effects on the permafrost conditions and therefore there are no cumulative effects.

6.3.6 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted.

- The mapping uncertainty described in the 2014 FEIS does not restrict the ability to draw conclusions or inferences relating to the material types that are expected to be encountered in the various areas of the Meliadine Extension.
- The thermal modelling uncertainties described in the 2014 FEIS have been addressed by updating the thermal model with new thermistor data.

Therefore, any uncertainty with the Meliadine Extension is related to assumptions in the thermal model. This will be addressed through monitoring programs as described below.

6.3.7 Monitoring and Follow-up

Agnico Eagle considers that existing T&C 12, 17, and 21 of Project Certificate No.006 is sufficient to protect, mitigate, and monitor the permafrost terrain for the Meliadine Extension. Follow-up monitoring for the Approved activities for the Meliadine Mine (Agnico Eagle 2014, 2018a, 2020a) and Meliadine Extension will be conducted in general accordance with the regular monitoring currently being conducted as part of the Groundwater Management Plan (provided as an appendix within Water Management Plan in Appendix D-35).

Existing monitoring and follow-ups that have been implemented during construction and operation will continue to be carried forward through the Meliadine Extension.

Any new required mitigation measures related to the Meliadine Extension are described in relation to the predicted effects and summarized in pathway tables provided in Table 6.3-5 and Appendix B-2, Table B-2 of this Application. Mitigation, management, and monitoring plans are summarized in Section 12 and provided in Appendix D of this Application. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

6.4 Soil and Terrain

6.4.1 Abstract

There are no new primary pathways for soil and terrain associated with Meliadine Extension. A 1% change to terrain and 2% change to soil are predicted for Meliadine Extension compared to the 2014 FEIS. Effects associated with the loss or alteration of soil and terrain from the Meliadine Extension are captured in the assessment of effects, residual impact classifications, and cumulative effects assessments for vegetation (Section 6.5) and wildlife habitat (Section 6.6). As effects from each primary pathway assessed by wildlife and vegetation VCs are considered not significant for the Meliadine Extension, it can be inferred that changes to soil and terrain in this FEIS addendum are also not significant and do not change the conclusions from the 2014 FEIS.

6.4.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ for the Meliadine Extension did not highlight any new concerns related to soil and terrain and is consistent with IQ integration from the 2014 FEIS (Agnico Eagle 2014).

6.4.3 Existing Environment

Soil and terrain mapping was completed for the 2014 FEIS for the Meliadine Mine and the AWAR (Agnico Eagle 2014) to describe and characterize the existing soil and terrain resources and their distribution across the landscape. The approach to classifying and describing soil and terrain units involved a review of existing information, soil sampling and analysis, and development of soil and terrain maps in a Geographical Information System (GIS) platform. For soil mapping, delineated Ecological Landscape Classification (ELC) were used to derive correlations between soil types and the ELC vegetation types. The soil map unit delineations were inferred from the interpretation of landscape features (i.e., elevation contours and landform), ELC units, without field ground truthing. Due to the resolution of the ELC data, many soil map units were presented as complexes to capture the range of soil types on the landscape. Thus, the soil map was considered a predictive model of soil distribution.

Six soil map units were mapped in the LSA (Agnico Eagle 2014). Within each of these soil map units, soil complexes were defined from the four major soil types identified in the LSA. Cryosolic soils, of which the Turbic, Static, and Organic Great Groups were described, were the most common soil type identified, consisting of approximately 60% of the LSA. These soils predominate in areas with cold climates and in the presence of permafrost. Regosolic soils made up approximately 20% of the LSA for the 2014 FEIS development and are considered weakly developed for many reasons including climate and are often associated with exposed or shallow bedrock.

Soil samples were collected in 2008 and 2009 for total metals analysis to measure background metal concentrations in soils. Most of the soil metal concentrations were within acceptable guidelines, except for arsenic, which exceeded guidelines values in a few locations near the main mine site. Additional soil sampling was completed to assess moisture content, pH, and metal concentrations in 2017 and 2019 as part of on-going soil and vegetation monitoring. Analyzed soil values from this monitoring were found to be within the natural range of variability for the area. Detailed methods and results of this sampling are outlined in the respective TEMMP annual reports.

The terrain mapping used existing data for most of the LSA (Martin 2002), with air photo interpretation and digital elevation models used to complete the mapping in areas without coverage. Fifteen terrain map units were defined and mapped for the LSA in the 2014 FEIS (Agnico Eagle 2014) which covered a total of 10,598 ha. The till blanket/veneer terrain unit (Tbv) and till and marine sediments (Tm) terrain units covered 40% of the LSA, with the remining units composing less than 10% each of the LSA.

6.4.3.1 Meliadine Extension Methods

The mapping process established for the 2014 FEIS and the additional soil sampling associated with the TEMMP annual reports were used to update soil and terrain mapping and characterize the existing soil and terrain resources for the Meliadine Extension footprint and LSA. Like the 2014 FEIS, no field ground truthing was completed for the soil and terrain mapping. Edge matching was required to integrate new terrain mapping for the Meliadine Extension LSA with the terrain map units from the 2014 FEIS. This resulted in area differences for some of the terrain map units that were originally presented in the 2014 FEIS. These terrain units are identified in Table 6.4-1.

6.4.3.2 Soil

Table 6.4-1 and Figure 6.4-1 show the soil map units present in the 2014 FEIS LSA and Meliadine Extension LSA based on pre-disturbance conditions.

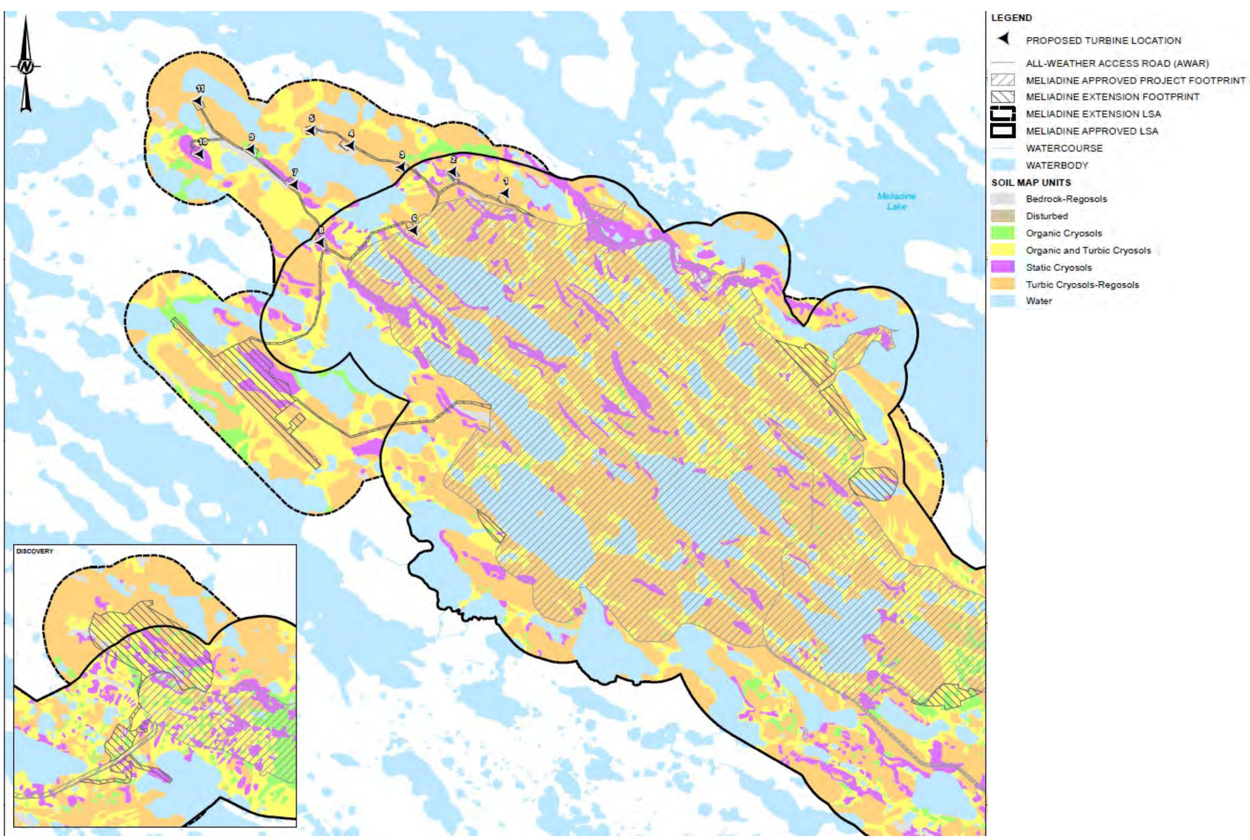
The most common soil map unit in the Meliadine Extension LSA is the Turbic Cryosols-Regosols which covers 4,525 ha (39%) of the Meliadine Extension LSA and is associated with the Heath Tundra vegetation community. The Organic and Turbic Cryosols map unit is the second most common covering 2,650 ha (23%) of the Meliadine Extension LSA and correlates with the Sedge vegetation community. The Static Cryosols unit and the Organic Cryosols soil map unit comprise 1,394 ha (12%) and 366 ha (3%), respectively, and are associated with the Lichen Heath vegetation communities and the Birch Seep vegetation community, respectively. The Bedrock-Regosols unit corresponds to the Lichen-Rock vegetation community and covers 259 ha (2%) of the Meliadine Extension LSA. Water covers 2,462 ha (21%) and previously disturbed areas comprise less than 1% (0.1 ha).

Table 6.4-1: Total Area of Soil Map Units within the 2014 FEIS and Meliadine Extension Local Study Areas

Soil Map Unit	Total Area in 2014 FEIS LSA	Percent in 2014 FEIS LSA	Total Area in Meliadine Extension LSA	Percent in Meliadine Extension LSA
	(ha)	(%)	(ha)	(%)
Bedrock-Regosols	233	2	259	2
Disturbed	<1	<1	<1	<1
Organic and Turbic Cryosols	2,449	23	2,650	23
Organic Cryosols	317	3	366	3
Static Cryosols	1,342	13	1,394	12
Turbic Cryosols-Regosols	4,036	38	4,525	39
Water	2,221	21	2,462	21
Total	**10,598**	**100**	**11,657**	**100**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

Figure 6.4-1: Soil Map Units in the Terrestrial Local Study Area



6.4.3.3 Terrain

Table 6.4-2 and Figure 6.4-2 show the terrain map units present in the 2014 FEIS LSA and Meliadine Extension LSA based on pre-disturbance conditions. The approved LSA covered a total of 10,598 ha. The Meliadine Extension footprint expanded this by 1,059 ha, for a total of 11,657 ha.

Terrain in the Meliadine Extension LSA is dominated by deposits of till and water bodies. The till blanket/veneer terrain unit (Tbv) covers 4,177 ha (36%), followed by water which comprises 2,301 ha (20%) of the Meliadine Extension LSA. Till and marine sediments (Tm) (1,844 ha [16%]), and hummocky till (Th) (623 ha [5%]) cover a total of 2,467 ha (22%). The bedrock unit comprises 561 ha (5%) while the remaining 11 terrain map units (e.g., alluvium/marine sediments, ice contact stratified sediments, tidal flat sediments) each cover less than 5% of the Meliadine Extension LSA.

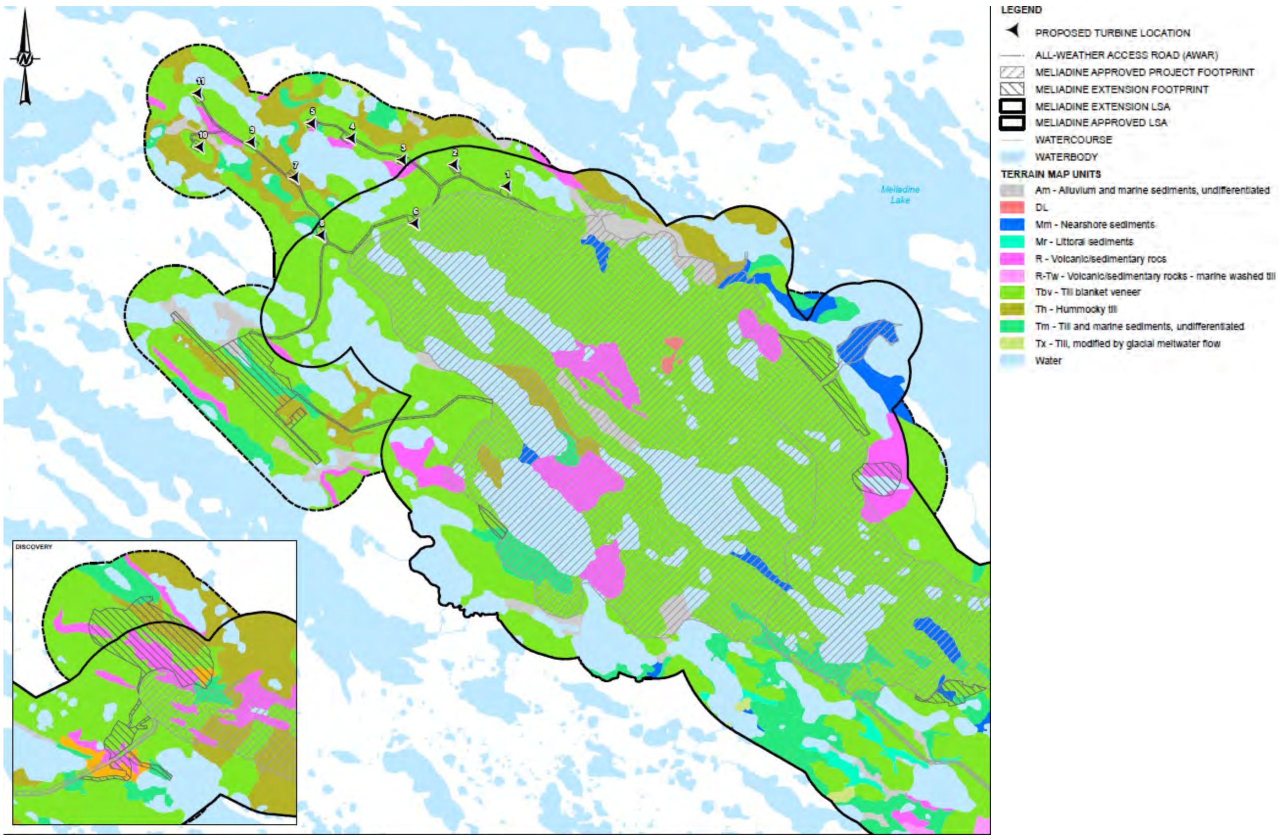
Table 6.4-2: Total Area of Terrain Map Units within the 2014 FEIS and Meliadine Extension Local Study Areas

Terrain Map Unit	Terrain Map Unit Description	Total Area in 2014 FEIS LSA	Percent in 2014 FEIS LSA	Total Area in Meliadine Extension LSA	Percent in Meliadine Extension LSA
		(ha)	(%)	(ha)	(%)
Am	Alluvium and marine sediments	283	3	323	3
DL	Disturbed land	5	<1	5	<1
Gh	Glaciofluvial and morainal deposits	107	1	107	1
Gk	Ice contact stratified sediments	102*	1	102	1
Mm	Nearshore sediments	478*	5	484	4
Mr	Littoral sediments	428	4	428	4
Mt	Tidal flat sediments	86	1	86	1
O	Organic	20	<1	20	<1
R	Bedrock	520*	5	561	5
R-Mr	Bedrock-littoral sediments	192	2	192	2
R-Tw	Bedrock-till	362	3	362	3
Tbv	Till blanket/veneer	3721*	35	4,177	36
Th	Till hummocky	430*	4	623	5
Tm	Till and marine sediments	1,754*	17	1,844	16
Tx	Till, modified by glacial meltwater	42*	<1	45	<1
W	Water	2,070*	20	2,301	20
Total		**10,599**	**100**	**11,657**	**100**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

* = values not equivalent to those presented in 2014 FEIS

Figure 6.4-2: Terrain Map Units in the Terrestrial Local Study Area



6.4.4 Assessment of Potential Meliadine Extension-related Effects

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided in Table 6.4-3. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-3 of this Application and are also described in Volume 6, section 6.4.2 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC soil and terrain as a result of Meliadine Extension, there is no change from the previous assessment.

The following primary effect pathway for the Meliadine Extension's soil and terrain assessment was identified:

- *physical loss or alteration of soil and terrain from the Meliadine Extension footprint.*

This primary pathway identified in the 2014 FEIS (Volume 6, Section 6.4.2.3) has been updated as a result of the Meliadine Extension and is assessed in more detail below.

Table 6.4-3: Potential Primary Pathways for Soil and Terrain

Project Phase/ Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts
Construction Operation, Closure	Physical loss or alteration of Terrain and Soil from the Meliadine Extension Footprint	Equipment will be selected and used to minimize surface disturbance. Wind turbine platforms are designed to be compact to reduce the overall Meliadine Extension footprint Terrain and Soil disturbance will be restricted to the extent necessary to safely construct and operate the Meliadine Extension Design and construction of access roads will be as narrow as possible, while maintaining safe construction and operation practices and meeting legislated requirements. Make use of existing roads as much as possible to minimize the Meliadine Extension footprint. Grading will be restricted to what is required for the access and safe construction and operation practices.	Primary	Primary	no impact predictions are made because soil and terrain do not have assessment endpoints.

6.4.4.1 Physical Loss or Alteration of Soils and Terrain from the Meliadine Extension Footprint

To evaluate the potential effects of Meliadine Extension on soil and terrain quantity and distribution, this assessment undertook:

- **Changes to soil and terrain (i.e., soil and terrain map units) were assessed for the maximum predicted point of development of the Meliadine Extension footprint (operations case), which should have the largest magnitude and geographic extent of effects to soil and terrain.**

Consistent with the 2014 FEIS, any additional site clearing and construction for the Meliadine Extension, particularly through the processes of soil stripping and storage, will result in changes to soil quantity and distribution, and changes to terrain. Soil removal will occur mainly during the construction phase, and to a much lesser extent during operations. No changes are proposed during the construction activities that could impact permafrost degradation and subsequently change the quantity and distribution of soil and terrain resources (Section 6.4). As such, for the purposes of the Meliadine Extension assessment, it is assumed that the total 2014 FEIS and Meliadine Extension footprint will be disturbed. Changes to the existing soil and terrain conditions will continue to be confined to the total area of the 2014 FEIS and Meliadine Extension footprint, which is 3,596 ha and comprises 6% of the LSA (11,657 ha).

A summary of the soil and surficial materials (terrain types) that are anticipated to be lost or permanently altered within the 2014 FEIS and Meliadine Extension footprint are presented in Table 6.4-4 and Table 6.4-5, respectively. Areas may not be consistent between the soil map units and terrain map units presented below (e.g., water is 680 ha [Table 6.4-4] and water is 578 ha [Table 6.4-5]). This is a result of the different mapping methods used to delineate the soil types and terrain features. These methods are described in Section 6.4.3.

Table 6.4-4: Total Disturbed Area of Soil Map Units within the 2014 FEIS and Meliadine Extension Footprints and Local Study Areas

Soil Map Unit	2014 FEIS Footprint		Meliadine Extension Footprint		Change from Baseline Through Meliadine Extension Footprint	
	Area (ha)	Proportion of 2014 FEIS LSA (%)	Area (ha)	Proportion of Meliadine Extension LSA (%)	Area (ha)	Proportion of Meliadine Extension LSA (%)
Bedrock-Regosols	48	<1	53	<1	5	<1
Disturbed	<1	<1	<1	<1	-	<1
Organic and Turbic Cryosols	119	1	133	1	14	<1
Organic Cryosols	681	6	753	6	72	1
Static Cryosols	422	4	458	4	36	<1
Turbic Cryosols-Regosols	1,428	13	1,520	13	92	1
Water	672	6	680	6	8	<1
Total	**3,369**	**30**	**3,596**	**30**	**227**	**2**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
- = not applicable

As presented above, a 2% change is predicted for Meliadine Extension compared to the 2014 FEIS.

Table 6.4-5: Total Disturbed Area of Terrain Map Units within the 2014 FEIS and Meliadine Extension Footprints and Local Study Areas

Terrain Map Unit	2014 FEIS Footprint		Meliadine Extension Footprint		Change from Baseline Through Meliadine Extension Footprint	
	Area (ha)	Proportion of 2014 FEIS LSA (%)	Area (ha)	Proportion of Meliadine Extension LSA (%)	Area (ha)	Proportion of Meliadine Extension LSA (%)
Am	54	1	57	<1	3	<1
DL	1	<1	1	<1	-	-
Gh	23	<1	29	<1	6	<1
Gk	10	<1	10	<1	-	-
Mm	79	1	81	1	2	<1
Mr	125	1	125	1	-	-
Mt	7	<1	7	<1	-	-
O	1	<1	1	<1	-	-
R	213	2	244	2	31	<1
R-Mr	11	<1	11	<1	-	-
R-Tw	54	1	54	<1	-	-
Tbv	1,770	17	1,904	16	134	1
Th	104	1	131	1	26	<1
Tm	298	3	316	3	18	<1
Tx	44	<1	44	<1	-	-
W	571	5	578	5	7	<1
Total	**3,369**	**32**	**3,596**	**29**	**227**	**1**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
- = not applicable

As presented above, a 1% change to terrain is predicted for Meliadine Extension compared to the 2014 FEIS.

6.4.5 Residual Impact Classification

Although primary pathways have been identified for soil and terrain, no impact predictions are made because soil and terrain do not have assessment endpoints. Any Meliadine Extension-related effects associated with the primary pathways for soil and terrain are captured in the assessment of the effects to, and residual impact classifications for, other VCs, such as vegetation (Section 6.5) and wildlife habitat (Section 6.6).

6.4.6 Cumulative Effects Assessment

A cumulative effects assessment was not completed for terrain and soil as effects to this component are limited to within the Meliadine Extension footprint. Cumulative effects to vegetation (Section 6.5) and wildlife (Section 6.6) are considered in Section 6.7.6 of this Application.

6.4.7 Uncertainty

Consistent with the uncertainty identified for the 2014 FEIS, the following key uncertainties apply to the Meliadine Extension and the assessment:

- *Baseline* soil and terrain *mapping provide an estimation of the presence and distribution of surficial materials and soil resources at a given map scale resolution. Consequently, an amount of uncertainty is always present as maps cannot provide detailed, site-specific information to all areas.*

Uncertainty was addressed in the assessment by being conservative in defining impacts, incorporating information from available and applicable literature, and using past experience in similar areas.

A detailed discussion of uncertainty related to the assessment of soil and terrain is available in the 2014 FEIS, Volume 6, Section 6.4.5.

6.4.8 Monitoring and Follow-up

Agnico Eagle considers that existing T&C 13 of Project Certificate No.006 is sufficient to protect and mitigate soil and terrain impacts associated with the Meliadine Extension.

6.5 Vegetation

6.5.1 Abstract

A 2% change to vegetation is predicted for Meliadine Extension compared to the 2014 FEIS. There are no new primary pathways for vegetation associated with Meliadine Extension. The magnitude of incremental effects to vegetation associated with each pathway were classified as low. Changes to vegetation quantity will continue to be confined to the Meliadine Extension footprint, as they were in the 2014 FEIS and were assessed in this Application as not significant effects. While dust, hydrologic, and non-native plant effects were evaluated as minor effects, they were evaluated and summarized in this Application because of their potential influence on vegetation quality.

6.5.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ, TK, and concerns related to vegetation were provided by community members and incorporated into the Meliadine Extension vegetation assessment, which takes into account review of community engagement notes from focus group meetings, public consultations, and the VMR. The consultation notes pertaining Meliadine Extension have been incorporated in Section 3 of this Application.

Initial consultations were completed for the 2014 FEIS, and again in 2021 for the Meliadine Extension with focused group meetings and public meetings. The following IQ, TK, comments, and concerns were expressed by community members related to effects of Meliadine Extension on vegetation:

- *Effects from mine operations and dust on surrounding vegetation, including berries, and the* *potential to affect harvesting and food quality.*

- *Effect of traffic along the AWAR on the ability to harvest berries in the proximity of the AWAR. Berry picking used to take place from Km 12 to Km 27 of the AWAR, but now it is too dusty to harvest.*

These vegetation concerns were already raised during 2014 consultation. No new vegetation concerns surrounding the Meliadine Extension arose during 2021 consultation.

6.5.3 Existing Environment

In 1998, 2008, 2009, and 2012, vegetation surveys (at 456 plots) were conducted to establish baseline land cover conditions summarized in the 2014 FEIS for the Mine and the AWAR (Agnico Eagle 2014). In 2018, additional vegetation surveys were completed to sample areas of the proposed windfarm footprint. Since 2017, monitoring per the TEMMP has been ongoing, with additional annual weed assessment surveys completed in 2018, 2019, 2020 and 2021 and vegetation health assessment completed in a three-year interval and included in the respective TEMMP annual reports.

The RSA encompassed 246,300 ha and was found to be comprised predominantly of heath tundra plant communities which covered 45% and water at 28% of the RSA. The LSA for the 2014 FEIS covered a total of 10,598 ha, with the most abundant plant community being heath tundra at 38% followed by water comprising 21% of the LSA. Sedge plant communities also comprised 23% of the LSA.

During the 1998-2012 vegetation surveys, 146 vascular plants were identified. No federally listed or non-native species were found (COSEWIC 2012; SARA 2012). There were three species listed territorially as "Sensitive" observed (CESCC 2011), including: Tyrrell's willow (*Salix tyrrellii)*, Arctic daisy (*Arctanthemum arcticum)*, and Hairy butterwort (*Pinguicula villosa*), all of which are found in moist habitats.

6.5.3.1 Vegetation Communities

Vegetation field programs were completed in 2018 and 2021 to map and classify the land cover types including vegetation communities and unvegetated cover types within the Meliadine Extension LSA. Field surveys were conducted July 23 to 28, 2018, and July 25 and 29, 2021. Surveys included plot-based and meander-based vegetation inventories to characterize plant species (including listed plant species and those having traditional uses) within the Meliadine Extension LSA. Surveys were also completed to verify the land cover (vegetation) classification and important wildlife habitat (e.g., graminoid and lichen-dominated vegetation communities) within the Meliadine Extension LSA.

Data collected from the 2018 field program were used to inform and ground-truth the desktop mapping, and to identify the presence of listed, non-native, and invasive plant species. During the July 2021 field program, a total of twenty-eight vegetation survey plots were completed. Sixty vascular plants and 24 non-vascular plants (6 bryophytes and 18 lichens) were identified.

Table 6.5-1 describes the land cover types present in the 2014 FEIS LSA and Meliadine Extension LSA based on pre-disturbance conditions. The 2014 FEIS LSA covered a total of 10,598 ha. The Meliadine Extension footprint expanded this by 1,059 ha (i.e., 10%), for a total of 11,657 ha.

The Meliadine Extension LSA is dominated by the heath tundra vegetation community covering 4,525 ha (39%). The sedge community has a high year-round habitat suitability for ungulates and occupies 2,650 ha (23%) followed by water with 2,462 ha (21%) in the LSA. High-quality caribou habitat includes the lichen/rock and lichen-heath (hair lichen) vegetation communities, covering 2% and 5% of the LSA, respectively (Table 6.5-1).

Table 6.5-1: Total Area and Percent Cover of Land Cover Types within the 2014 FEIS and Meliadine Extension Local Study Area

Land Cover Type	Description	Total Area of 2014 FEIS LSA[(a)]	Percent of 2014 FEIS LSA	Total Area of Meliadine Extension LSA[(a)]	Percent of Meliadine Extension LSA	Difference Meliadine Extension LSA from 2014 FEIS LSA
		(ha)	(%)	(ha)	(%)	ha
Heath						
Lichen-Rock Community	characterized by crustose lichens growing on the boulders or rocks that predominate on eskers or rocky plateaus	233	2	259	2	26
Lichen-Heath (*Cetraria* Lichen)	occurs on lower slope positions, often below the lichen-health – hair lichen community, on more rapidly drained sandy substrates	601	6	635	5	34
Lichen-Heath (Hair Lichen)	occurs almost exclusively on the higher ridges of slopes and on drumlin and esker crests, where the ground cover consists of a high percentage of black and green hair lichens	560	5	577	5	17
Heath Tundra Community	occurs on uplands and slopes of most ridges characterized by gently rolling to undulating terrain with rapidly to well-drained soils	4,036	38	4,525	39	489
Heath subtotal		**5,429**	**51**	**5,996**	**51**	**567**
Wetlands/Riparian						
Sedge Community	occurs adjacent to lakes and streams on very poorly drained soils and in low-lying areas	2,449	23	2,650	23	201
Birch Seep	occurs on imperfectly to poorly drained soils, such as the edges of solifluction lobes, on the slopes of some eskers, in stream valleys and along transitions to some sedge associations	305	3	354	3	49
Riparian Willow or Birch	typically occurs along the banks of stream courses; characterized by imperfectly drained, nutrient enriched soils	12	<1	12	<1	0
Wetlands/ Riparian subtotal		**2,767**	**26**	**3,018**	**26**	**251**
Unvegetated						
Un-vegetated (Sand)	associated with steep sandy slopes and the margins of rivers and lakes; limited to no vegetation cover	182	2	182	2	0
Water	associated with waterbodies and watercourses	2,221	21	2,462	21	241

Land Cover Type	Description	Total Area of 2014 FEIS LSA[(a)]	Percent of 2014 FEIS LSA	Total Area of Meliadine Extension LSA[(a)]	Percent of Meliadine Extension LSA	Difference Meliadine Extension LSA from 2014 FEIS LSA
		(ha)	(%)	(ha)	(%)	ha
Disturbed	cleared areas and access roads associated with the Meliadine Extension as well as various natural disturbance features	<1.0	<1	<1.0	<1	<1
	Un-vegetated subtotal	**2,403**	**23**	**2,644**	**23**	**241**
	Total	**10,598**	**100**	**11,657**	**100**	**1,059**

a) Area summaries for the 2014 FEIS and Meliadine Extension are based on pre-disturbance conditions.
Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

6.5.3.2 Listed Plants and Listed Communities

Prior to initiating field work, listed plants with the potential to occur in the Meliadine Extension footprint were compiled from the 2014 FEIS (Agnico Eagle 2014, Section 6.5) and relevant vegetation studies completed in and around Rankin Inlet and the Arctic to provide a perspective of available information including:

- federal (COSEWIC 2012; SARA 2012), NatureServe (2021) and territorial status (CESCC 2011) documents;
- vascular plant checklists for the Northwest Territories (Porsild and Cody 1980); and
- other public listed plant species reports for the Arctic Archipelago (Aiken et al. 2007).

Table 6.5-2 summarizes the listed plant species with the potential to occur in the Meliadine Extension LSA.

Table 6.5-2: Listed Plants with the Potential to Occur in the Southern Arctic Ecozone

Scientific Name	Common Name	Rank			
		CESCC[a]	NatureServe Global[b]	NatureServe Nunavut[c]	COSEWIC[d]
Forbs					
Ranunculus cymbalaria	alkali or shore buttercup	SU	G5	U	Not listed
Ranunculus pallasii	Palla's buttercup	SU	G4	U	Not listed
Woodsia alpina	northern woodsia	S4	G4	G4	Not listed
Grasses					
Calamagrostis deschampsioides	circumpolar reedgrass	S4	G4	G4	Not listed
Puccinellia deschampsioides	polar alkali grass	S4	G5	U	Not listed
Bryophytes					
Sphagnum fimbriatum	sphagnum moss	S1S3	G5	G2	Not listed
Lichens					
Cladonia borealis	Boreal pixie-cup	S3S5	G5	G4	Not listed
Cladonia crispata	organ-pipe lichen	S3S4	G5	G3	Not listed

Scientific Name	Common Name	Rank			
		CESCC[a]	NatureServe Global[b]	NatureServe Nunavut[c]	COSEWIC[d]
Cladonia squamosa	dragon-funnel	S3S4	G5	G3	Not listed
Peltigera didactyla	alternating dog-lichen	S3S5	G5	G4	Not listed
Stereocaulon tomentosum	gray mealy lichen	S3S4	G5	G3	Not listed

(a) CESCC [Canadian Endangered Species Conservation Council] (2016)
(b) NatureServe 2021 (Global Ranking)
(c) NatureServe 2021 (Nunavut Populations)
(d) COSEWIC 2021

During the 2018 and 2021 plant surveys, no federally or territorially listed plant species were found within the Meliadine Extension LSA.

6.5.3.3 Traditional Use Plants

Information for traditional use plant species for the Meliadine Extension, which includes plant-based country foods, was gathered through a review of existing literature, secondary data collection, and field studies as described in 2014 FEIS (Volume 6, Section 6.5). The literature review considered IQ and Traditional Land Use activities within the Meliadine Extension LSA and RSA.

Interviews were completed with Elders from Rankin Inlet, Chesterfield Inlet, and Whale Cove during the IQ traditional plant use workshop during the summer of 2010. Results from 2021 consultation are documented in this FEIS Volume 3, Section 3.6. Species that were identified in 2010 as having traditional uses are listed in Table 6.5-3. Additionally, Table 6.5-3 itemizes those species mentioned again during the 2021 community engagement and recorded during vegetation surveys conducted in 2021.

Table 6.5-3: Traditional Use Plant Species Identified During Traditional Knowledge and IQ Consultation in 2010 and 2021

Local Name	Common Name	Scientific Name	Traditional Use	2010 Consultation Workshop [a]	2021 Consultation Workshop [b]	2021 Vegetation Surveys [c]
kanguujait	single-flowered Arctic cotton	*Eriophorum scheuchzeri*	wick for the qulliq	•		•
pualunnguat	multiple-flowered Arctic cotton	*Eriophorum angustifolium*	wick for the qulliq	•		•
ivit, iviksukat, ivialuit, ivigjuag	beach ryegrass	*Leymus mollis*	food	•		•
avaalaqqiat	dwarf birch	*Betula nana*	firewood, mats, use in storage caches	•		•
suputiit	Arctic willow	*Salix arctica*	firewood, food, medicine; seeds used for wick for the qulliq, tinder, wound dressing	•		•
avaalaqiat or suputiit	felt-leaf willow	*Salix calcicola*	firewood, use in storage caches, ribs for kayak, tender for the qulliq; seeds used from wick for the qulliq, tinder	•		

Local Name	Common Name	Scientific Name	Traditional Use	2010 Consultation Workshop [a]	2021 Consultation Workshop [b]	2021 Vegetation Surveys [c]
airaq	moss campion	*Silene acaulis*	food	•		•
maliksuagaiit	seabeach sandwort	*Honckenya peploides*	food	•		
tuqlak	bistort	*Polygonum viviparum* or *Persicaria vivipara*	food	•		
qunguliit, siirnat	mountain sorrel	*Oxyria digyna*	food	•		
malikkaat, isurramuat	mountain avens	*Dryas integrifolia*	wick for the qulliq, tinder	•		•
aqpik or aqpiit	cloudberry	*Rubus chamaemorus*	food	•	• *	•
uqkaujat (leaves); kigutauja (flowers)	large-flowered wintergreen	*Pyrola grandiflora*	food	•		
airaq or airait	bell's crazyweed	*Oxytropis arctica var. bellii*	food	•		
airaq or airait	Hudson Bay crazyweed	*Oxytropis hudsonica*	food	•		
airaq	yellow crazyweed	*Oxytropis maydelliana*	food	•		
masu, mahok	liquoriceroot	*Hedysarum alpinum*	food	•		
airaq	wooly lousewort	*Pedicularus lanata*	food	•		
paunait (plant); kakkautit (leaves)	dwarf fireweed	*Chamerion latifolium*	food	•		•
aupilattunguat	purple mountain saxifrage	*Saxifraga oppositifolia*	food	•		•
kakilarnaq	prickly saxifrage	*Saxifraga tricuspidata*	food, dog medicine and dog bedding	•		
iksutit	white Arctic heather	*Cassiope tetragona*	bedding, firewood, emergency fuel	•		•
qisiqtuutitq	Labrador tea	*Ledum palustre* ssp. *groenlandicum*	firewood, emergency fuel, tea, medicine	•		
kakautit	lingonberry	*Vaccinium vitis-idaea*	food, tobacco substitute	•	•	•
kablaqutit	bearberry	*Arctous alpina* or *Arctostaphylos alpina*	food	•	• *	•
kigutangirnaq	blueberry	*Vaccinium uliginosum*	food	•	• *	•
pauungait	crowberry	*Empetrum nigrum*	food, firewood, bedding	•	• *	•
uqjuk	grey moss	*Racomitrium lanuginosum*	bedding	•		
maniq	cushion or lamp moss	several species	wick for the qullik, medicine	•		
tingaujait	black hair lichen	*Alectoria nigricans*	tinder	•		
nirnait	snow lichen	*Flavocetraria nivalis*	food for caribou	•		•

(a) 2014 FEIS (Agnico Eagle 2014. Section 6.5.3)

(b) Section 3 and Appendix E of this Application

(c) Vegetation Technical Memorandum Appendix A Table A1 (refer to Appendix G of this Application)

*=2021 community engagement consultation refers to berries in general, but no species were referenced except for lingonberry. Berries species have been marked with a star under the 2021 consultation column.

During public meetings and focus groups that took place June 18 and June 21, 2021, locals raised concerns regarding dust accumulation on berries near the AWAR. There weren't any specific references to which species. However, a statement previously recorded for the 2014 FEIS regarding lingonberry gathering was validated by questionnaires filled out by community members at engagement sessions between June 21 and 23 in 2021 (Appendix E-2 of this Application).

Existing conditions levels of metals in berry producing plants, sedges, and lichen, and soil chemistry potentially affected by the 2014 FEIS were completed in 2017 and 2019 as part of the TEMMP to evaluate the potential for adverse health effects to terrestrial life associated with changes in environmental quality due to chemical releases from the 2014 FEIS. Vegetation samples had concentrations of most metals below laboratory detection limits, except for levels of antimony, beryllium, bismuth, selenium, silver and tin. All vegetation samples had metal concentrations below the Canadian Council of Ministers of the Environment (CCME) Guidelines (2012) and signs of plant illness, such as chlorosis were not observed.

6.5.4 Assessment of Potential Meliadine Extension-related Effects

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-3 of this Application and are also described in Volume 6, section 6.5.4 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC vegetation as a result of Meliadine Extension, there is no change from the previous assessment.

Primary effect pathway for the Meliadine Extension's vegetation assessment are provided in Table 6.5-4 and summarized below.

- ***Physical loss or alteration of vegetation from the Meliadine Extension Footprint***

This primary pathway assessed for the 2014 FEIS (Volume 6, Section 6.5.4.4) has been updated and identified as a result of the Meliadine Extension and is assessed in more detail below.

Table 6.5-4: Potential Primary Pathways for Vegetation

Valued Component	Project Phase/ Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Plant populations and communities (including rare plants and traditional use plants)	Construction Operation, Closure	Physical loss or alteration of vegetation from the Meliadine Extension Footprint, impacting available wildlife habitat	Equipment will be selected and used to minimize surface disturbance. Wind turbine platforms are designed to be compact to reduce the overall Meliadine Extension footprint Vegetation disturbance will be restricted to the extent necessary to safely construct and operate the Meliadine Extension Design and construction of access roads will be as narrow as possible, while maintaining safe construction and operation practices and meeting legislated requirements. Make use of existing roads as much as possible to minimize the Meliadine Extension Footprint. Grading will be restricted to what is required for the access and safe construction and operation practices. All vehicle traffic and equipment will remain within the designated areas and associated temporary workspaces. All construction equipment will enter construction areas in clean condition to limit the potential for introduction of non-native and invasive plant species	Primary	Primary	The 2014 FEIS footprint is predicted directly impact 3,369 ha (31.7% of the approved LSA) of vegetation communities available in the LSA. The 2014 FEIS was predicted to remove 502 ha (5% of LSA) of potential habitat for listed plant species and 977 ha (9% LSA) of vegetation communities of high traditional plant use potential, relative to baseline conditions. No confirmed federally or territorially listed plant species identified as “At Risk” or “May be at Risk” were found in the LSA, though three plant species listed as “Sensitive” in Nunavut were found in the LSA.	The Meliadine Extension is predicted to remove 227 ha (1.9% of the LSA) of available vegetation communities in the LSA with an absolute change from baseline through Meliadine Extension of 3,596 ha. The Meliadine Extension is predicted to remove 133 ha (1.1%) of vegetated heath plant communities and 36 ha (0.7%) of wetland/riparian communities. The Meliadine Extension footprint is considerably smaller than the 2014 FEIS footprint (227 ha and 3,369 ha, respectively) and therefore the percent change in landscape metrics is also expected to be smaller.	Not significant	Not significant	Incremental losses to vegetation communities from the Meliadine Extension are low in magnitude, local and reversible. It is expected that disturbed areas will return to scarified natural revegetation providing suitable wildlife habitat and habitat for listed plants and plants used for traditional purposes. Indirect impacts to vegetation remain low and are expected to be reversible. Therefore, residual effects to vegetation quality are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.

6.5.4.1 Physical Loss or Alteration of Vegetation from the Meliadine Extension Footprint

Primary effects to vegetation will include the physical removal of vegetation in all construction areas (i.e., windfarm, airstrip, additional underground mining and infrastructure, and Tiriganiaq-Wolf mining area). The predicted loss of vegetated and unvegetated land cover units from the 2014 FEIS to the Meliadine Extension footprint is 219 ha (2%) and 8 ha (<1%), respectively (Table 6.5-5).

Table 6.5-5 shows the land cover types and their respective changes in disturbance in relation to the Meliadine Extension. Losses of vegetated heath communities will increase by 133 ha (1% of the Extension LSA), of which the major loss will be to the heath tundra community with an increased loss of 92 ha (1% of the Extension LSA), for an absolute change from baseline of 1,428 ha to 1,520 ha.

Federally or territorially listed plant species were not found within the Meliadine Extension LSA though three plant species listed as "Sensitive" in Nunavut were found during field surveys for the 2014 FEIS. Loss of vegetated wetlands and riparian communities containing a moderate to high potential for listed plant species occurrences (Agnico Eagle 2014) will increase by 86 ha (1% of the Meliadine Extension LSA).

The effect to traditional use plants are associated with direct losses of the heath tundra and the lichen-heath (hair lichen) plant communities which were classified as having high traditional plant use potential during the assessment for the 2014 FEIS. It is anticipated that an additional loss of 103 ha (1% of the Meliadine Extension LSA) of these two vegetation communities will occur due to the Meliadine Extension.

Table 6.5-5: Direct Disturbance of Land Cover Types

Land Cover Type	2014 FEIS Footprint	Meliadine Extension Footprint	Change from 2014 FEIS Meliadine Extension		Proportion of LSA (11,657 ha) that the Meliadine Extension Represents
	Area (ha)	Area (ha)	Area (ha)	%	%
Vegetated Heath					
Lichen-Rock Community	48	53	5	9.0	<1
Lichen-Heath (*Cetraria* Lichen)	179	204	25	12.2	<1
Lichen-Heath (Hair Lichen)	175	186	11	6.1	<1
Heath Tundra Community	1,428	1,520	92	6.0	<1
Vegetated heath subtotal	**1,830**	**1,963**	**133**	**6.8**	**1**
Vegetated Wetlands/Riparian Units					
Sedge Community	681	753	72	9.5	<1
Birch Seep	117	131	14	10.6	<1
Riparian Willow or Birch	2	3	1	22.7	<1
Vegetated wetlands/riparian subtotal	**800**	**886**	**86**	**9.7**	**<1**
Unvegetated					
Unvegetated (Sand)	67	67	0	0.2	<1
Water	672	680	8	1.2	<1
Unvegetated subtotal	**739**	**747**	**8**	**1.1**	**<1**

Land Cover Type	2014 FEIS Footprint	Meliadine Extension Footprint	Change from 2014 FEIS Meliadine Extension		Proportion of LSA (11,657 ha) that the Meliadine Extension Represents
	Area (ha)	Area (ha)	Area (ha)	%	%
Vegetated Heath					
Disturbance					
Disturbance	<1	<1	0	0.0	<1
Disturbance subtotal	<1	<1	0	0.0	<1
Total	**3,369**	**3,596**	**227**	**6.3**	**2**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values. Percent of area is calculated as the percent of baseline area affected by the Meliadine Extension.

LSA = Local Study Area; ha = hectare; % = percent; <= less than

As presented in Table 6.5-5, a 2% change is predicted for Meliadine Extension compared to the 2014 FEIS.

6.5.5 Residual Impact Classification

As summarized in Section 4.5 of this Application, the residual impact classifications (i.e., direction, magnitude, geographic extent, duration, frequency, reversibility, and likelihood) of effects from primary pathways are the same as the 2014 FEIS. The residual impact classification for this primary effect pathway is summarized in Table 6.5-6.

Definitions for criteria used in the residual impact classification are provided in Section 4, Table 4.5-1 of this Application. Consistent with the 2014 FEIS, the following thresholds for magnitude were applied for quantitative analyses and results (e.g., loss and fragmentation of habitat, and changes to habitat suitability):

- negligible: less than a 1% change from the Meliadine Extension relative to 2014 FEIS values;
- low: 1 to 10% change from the Meliadine Extension relative to 2014 FEIS values;
- moderate: greater than 10 to 20% change from the Meliadine Extension relative to 2014 FEIS values; and
- high: more than 20% change from the Meliadine Extension relative to 2014 FEIS values.

Table 6.5-6: Residual Impact Classification and Determination of Significance for the Vegetation Valued Component

Effect Pathways	Measurement Indicator	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance
Physical loss or alteration of vegetation (wildlife habitat) from the Meliadine Extension	Changes to Vegetation Quantity	Negative	Low	Local	Medium to Long-term	Continuous	Reversible	Highly Likely	Not significant
	Changes to Vegetation Quality	Negative	Low	Local	Medium-term	Continuous	Reversible	Likely	Not significant

Consistent with the 2014 FEIS, physical loss of vegetation communities (and wildlife habitat) will be negative in direction and low in magnitude because the direct loss of vegetation communities is limited 227 ha (Table 6.5-4), where the Meliadine Extension infrastructure will directly impact vegetation during construction and operation. Consistent with the 2014 FEIS, although upland (58% of the RSA and 51% of the LSA) and wetland communities (12% of the RSA and 26% of the LSA) (Agnico Eagle 2014) will be affected by the Meliadine Extension, these vegetation communities will remain well represented across the LSA and RSA. The geographic extent is local, because during construction and operations, the effects on vegetation will be localized and are not expected to extend beyond the Meliadine Extension LSA. It is anticipated that once vegetation is removed the loss is considered medium (reversible at the end of closure) to long-term (impact is reversible within a defined length of time beyond closure) and continuous until functional habitat is reclaimed during the progressive reclamation progress and the closure phase (refer to the Conceptual Closure and Reclamation Plan). The probability of loss or alteration of vegetation communities is highly likely but is considered common for similar developments. The results indicate that the Meliadine Extension will not result in significant adverse impacts to the persistence of plant populations and communities, including listed plant species, and the use of traditional plants and should be reversible in the long-term (i.e., 50 to 75 years following closure) for those areas that will be reclaimed (i.e., scarified and left to naturally re-vegetate).

Consistent with the 2014 FEIS, dust accumulation, temporary changes in water levels and the introduction of invasive plants have the potential to alter the quality of the vegetation communities during construction and operation of the Meliadine Extension. While dust, hydrologic and non-native plant effects were evaluated as minor effects, they are summarized here because of their potential influence on vegetation quality.

Dust accumulation on vegetation may induce visible symptoms such as chlorosis or necrosis of the leaves (e.g., brown or black spots) in affected plants, but in general, there is an overall reduction in plant productivity. Lichens, mosses, and other plants that derive some of their moisture and nutrient requirements from the atmosphere are especially sensitive to the effects of dust (Farmer 1993). Auerbach et al. (1997) found that although plant species composition may change and aboveground biomass reduced by dust deposition, ground cover is maintained. Some plants such as cloudberry (*Rubus chamaemorus*), willow, and cottongrass (*Eriophorum* spp.) were observed to be more abundant as a result of dust deposition, as these species have a higher tolerance to dust and may be able to out-compete less tolerant species (Forbes 1995).

The effects of the accumulation of dust (i.e., particulate matter and TSP deposition) and concentrations of air emissions produced from the 2014 FEIS on vegetation were assessed in detail in Volume 6, Section 6.5.4.2 of the 2014 FEIS (Agnico Eagle 2014). Particulate matter modelling completed for the 2014 FEIS was conservative, and the Meliadine Extension is not expected to change particulate matter emissions (Section 5.2.4.1 of this Application). Measurement of dustfall deposition and associated impact on vegetation occurred at Meliadine in 2020 (Agnico Eagle 2021d). Transects extending 2 km from the Mine Site and AWAR were compared to a reference site. Dustfall deposition decreased quickly with distance from the mine and AWAR where deposition levels were comparable to the reference site within 500 m of the 2014 FEIS. However, close to the dust sources (50 m from the mine site) dustfall was four times background levels and at 50 m from the AWAR, dustfall was three time background levels (Agnico Eagle 2021d).

The decline in dust deposition with distance from the mine and AWAR, was generally matched by the decline in metals in vegetation samples with distance from the mine and AWAR (Agnico Eagle 2021d). Metals measured in reindeer lichen (*Cladonia rangiferina*) and Arctic willow (*Salix arctica*) were comparable to reference conditions within 1,500 m of the 2014 FEIS.

In addition, air quality monitoring including dustfall has been ongoing since issuance of Project Certificate No.006 in 2015. Dustfall results from this monitoring are mostly within the Alberta Environment's Ambient Air Quality Guidelines for recreational and industrial areas. Despite increasing site activity, levels of dustfall at site perimeter monitoring stations are generally well within Alberta recreational guidelines, with exceedances occurring in a maximum of 4% of total dustfall samples in any given year since 2015. Along the AWAR, annual average rates of dustfall have only exceeded the Alberta recreational guideline at the 25-m distance as expected in the 2014 FEIS (Volume 5, Section 5.2). Results of dustfall monitoring indicate that these best management practices are being effectively implemented to minimize emissions.

Dust deposition is expected to result in low and localized changes to vegetation along the right-of-way for the access roads. Concentrations of air emissions from increased truck traffic may result in a local indirect change on the quality of vegetation and associated wildlife habitat within the Meliadine Extension LSA.

Effects of dust on vegetation will be reversible during the closure phase and will be reduced relative to effects expected during the construction and operations phases. Dust will no longer affect air quality once the Meliadine Extension is decommissioned and the haul road becomes inactive. Therefore, dustfall effects on vegetation are predicted to be reversible. Environmental design features and mitigation have been incorporated into the 2014 FEIS to reduce potential effects from dust deposition, which will continue to be applied for the proposed Meliadine Extension. The construction and operation of the windfarm and other Meliadine Extension components do not change the impact predictions nor the determination of no significance effects to plant populations and communities provided in the 2014 FEIS (Agnico Eagle 2014).

The Meliadine Extension is not predicted to change flows, drainage patterns and drainages areas outside the range of baseline values. It is unlikely that there will be permanent changes in vegetation community composition due to the Meliadine Extension. The effects on vegetation habitat communities due to changes in hydrology would be localized and limited to the Meliadine Extension LSA. Environmental design features, structures, and mitigations pertaining to hydrology are expected to reduce disturbances resulting in negligible to minor changes to vegetation communities. Water flows and levels, surface runoff, and contaminants from waste rock, seepage, and leachate are predicted to be maintained near baseline levels and/or not surpass previously set exceedance levels. At post-closure, it is expected that hydrology conditions would return to baseline (Agnico Eagle 2014). Therefore, changes in vegetation community composition due to changes in hydrology are expected to be reversible.

Non-native invasive plant species, or weeds, may alter nutrient cycling, competition, and the energy budget of an ecosystem, which may lead to a decrease in native plant community structure and species diversity (Jager et al. 2009), and lower native species survival and abundance (Mack et al. 2000). Non-native invasive plant species are those species whose rapid establishment and spread can adversely affect ecosystems, habitats and/or other species (Haber 1997). The main contributor to the introduction of non-native invasive plants and noxious weeds is human transport (Mack et al. 2000). Non-native invasive plant species are not a common occurrence in the north, which is in part due to the extreme ecological conditions (e.g., short growing season, harsh winters) that are outside the optimal range for most plant species that are not adapted to Arctic conditions. However, with increasing development and changing climate, there is increased potential for non-native invasive plant species to become established in Arctic environments (Lassuy and Lewis 2010).

6.5.6 Cumulative Effects Assessment

A cumulative effects assessment was not completed for vegetation (wildlife habitat) as effects to this component are localized and will not interact with other disturbances regionally. Cumulative effects to wildlife are considered in Section 6.7.6 of this Application.

6.5.7 Uncertainty

Consistent with the uncertainty identified for the 2014 FEIS, the following key uncertainties apply to the Meliadine Extension and the assessment:

- Baseline vegetation survey and mapping provide an estimate of the presence and distribution of land cover units, vegetation communities and vegetation species. Consequentially, an amount of uncertainty is present because maps cannot provide detailed, site-specific information to all areas. The effects associated with air emissions and dust deposition, have not been extensively studied in subarctic environments and anticipated effects have been extrapolated from studies completed in more temperate climates.

- Dust deposition models, including: differences in actual versus predicted natural mitigation of windblown dust from unpaved surfaces, drilling and blasting activities, material handling, or wind erosion and/or the effectiveness of proposed dust mitigation measures at the Meliadine Mine.
- Accuracy of the hydrology modelling: differences in actual versus predicted results may vary based on climate conditions and actual filling duration.
- Adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Mine (e.g., climate change and catastrophic events).

Uncertainty was addressed in the assessment by incorporating information from available and applicable literature and using past experience in similar areas including the experiences at nearby Meadowbank Mine. Uncertainty has also been addressed by applying a conservative estimate of effects in the residual impact classification and in the determination of significance. Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and the current knowledge of the system. It is anticipated that the baseline data is moderately sufficient for understanding current conditions, and that there is a moderate level of understanding of 2014 FEIS and Meliadine Extension-related impacts on the ecosystem.

In addition, the application of environmental design features and mitigation, the Conceptual Closure and Reclamation Plan, the Dust Management Plan, and the Windfarm Management Plan will mitigate effects to vegetation.

A detailed discussion of uncertainty related to the assessment of vegetation is available in the 2014 FEIS, Volume 6, Section 6.5.14.

6.5.8 Monitoring and Follow-up

To address key uncertainties associated with the primary effect pathways introduced by the Meliadine Extension, the TEMMP will be updated as per the existing T&C 37, 38, and 39 to include mitigation and monitoring associated with Meliadine Extension infrastructure (i.e., airstrip and windfarm).

Follow-up vegetation monitoring for the 2014 FEIS and the Meliadine Extension will be conducted in general accordance with the regular vegetation and habitat loss monitoring currently being conducted as part of the TEMMP.

Where applicable to the Meliadine Extension, Agnico Eagle has implemented new management plans, or has updated existing management plans (refer to Section 12 and Appendix D) applicable to vegetation:

- Dust Management Plan (Existing)
- Conceptual Closure and Reclamation Plan (Existing)
- Windfarm Management Plan (New)

6.6 Terrestrial Wildlife and Wildlife Habitat

6.6.1 Abstract

A 2% change to terrestrial wildlife and wildlife habitat is predicted for Meliadine Extension compared to the 2014 FEIS. The LSA represents 0.002% of the area of the Qamanirjuaq herd annual range. There are no new primary pathways for terrestrial wildlife and wildlife habitat associated with Meliadine Extension. The magnitude of incremental and cumulative effects associated with each pathway were classified as negligible or low. Consequently, incremental effects are predicted to be not significant to all wildlife VCs. The significance of conclusions did not change from the 2014 FEIS.

6.6.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ, TK, and concerns related terrestrial wildlife and wildlife habitat were provided by community members and incorporated into the Meliadine Extension terrestrial wildlife and wildlife habitat assessment. The assessment considers review of community engagement notes from focus group meetings, public consultations and the VMR. The consultation notes pertaining to Meliadine Extension have been incorporated in Section 3 of this Application.

Initial consultations were completed for the 2014 FEIS, and again in 2021 for the Meliadine Extension with focused group meetings and public meetings. The following IQ, TK, comments, and concerns were expressed by community members related to effects of Meliadine Extension on vegetation:

- Effects of mine roads and dust on caribou herds.
- Effects of windfarm on caribou due to overlap with migration routes.

Effects of mine roads and dust on caribou were assessed for the 2014 FEIS. Sections 6.6.5 and 6.6.6 of this Application discuss potential effects of wind turbines on caribou herds.

6.6.3 Existing Environment

Information from baseline studies conducted from 1998 to 2000, and 2008 to 2009 was used to characterize the existing environment for terrestrial wildlife and wildlife habitat for the 2014 FEIS (Table 6.6-1). A variety of methods were used to quantify populations of caribou (*Rangifer tarandus groenlandicus*), muskoxen (*Ovibos moschatus*), wolverine (*Gulo gulo*), grizzly bears (*Ursus arctos*), polar bears (*Ursus maritimus*), wolves (*Canis lupus arctos*), and less conspicuous species that may be maximally exposed to contaminants. Detailed methods and results of these surveys are available in the 2014 FEIS (Volume 6, Section 6.6).

Table 6.6-1: Summary of Wildlife Surveys Completed for the 2014 FEIS

Surveys	1998	1999	2000	2008	2009
Caribou – aerial surveys	√	√	√	√	√
Fox dens – ground surveys	√				
Incidental wildlife observations	√	√	√	√	√

Caribou, gray wolf, and polar bear were selected as VECs for the 2014 FEIS. Grizzly bear, muskoxen, and wolverine were also considered as VECs, but not selected because the core part of their distributional range does not overlap with the Meliadine Mine. Since 2017, no grizzly bear has been documented in the RSA, and limited numbers of muskox and wolverine have been observed (Golder 2018, 2019b, 2021f; Nuqsana Golder 2020). One wolverine was observed incidentally in the RSA in 2018 (Golder 2019b). It was predicted that Muskoxen would gradually be present in the RSA based on range expansion patterns (Volume 6, Section 6.6.1.2 in 2014 FEIS). Muskoxen have been observed incidentally in the RSA in 2017 (1 individual; Golder 2018) and 2020 (22 individuals; Golder 2021f). Arctic fox (*Vulpes lagopus*) was also considered as a VEC, but was not selected because the species is listed as secure or common by governmental agencies, and can thrive in and around human developments.

Additional data is available from the following surveys conducted as part of the TEMMP (Golder 2018, 2019b, 2021f; Nuqsana Golder 2020) including:

- Caribou behaviour monitoring during migration;
- Ground reconnaissance and viewshed surveys for caribou, muskox, and predatory mammals;
- Wildlife track surveys; and
- Pre-construction surveys for denning carnivores.

Additional field studies including caribou trail mapping and carnivore den habitat suitability surveys were completed at the Meliadine Extension in 2021 (ERM 2021b).

6.6.4 Species of Concern

There are five wildlife species of concern with breeding or wintering ranges that overlap with the Meliadine Extension (Table 6.6-2Table 6.6-1). In May 2018, wolverine and grizzly bear (western population) were listed as Special Concern under Schedule 1 of the *Species at Risk Act*. Caribou, barren ground population, were listed as threatened by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November 2016, and are under consideration for addition to Schedule 1 of the *Species at Risk Act* (SARA). Although there are changes to wildlife species of concern, these are the same species assessed in the 2014 FEIS.

Table 6.6-2: Mammal Species of Concern with Potential to Occur in the Regional Study Area

Common Name	Scientific Name	COSEWIC Status[a]	SARA Status[b]	Record of Presence in the Regional Study Area
Polar bear	*Ursus maritimus*	Special Concern	Special Concern	Observed within RSA (1998, 1999, 2000, 2007, 2008, 2010, 2012, 2018, 2019, 2020)
Wolverine	*Gulo gulo*	Special Concern	Special Concern	Observed within RSA (2018)
Grizzly bear, Western population	*Ursus arctos*	Special Concern	Special Concern	Not observed
Arctic gray wolf	*Canis lupus arctos*	Data Deficient	Not Listed	Observed within RSA (2008, 2011, 2017,

Common Name	Scientific Name	COSEWIC Status[a]	SARA Status[b]	Record of Presence in the Regional Study Area
				2019, 2020, 2021)
Caribou, Barren-ground population	*Rangifer tarandus groenlandicus*	Threatened	Not on Schedule 1 (under consideration for addition)	Observed within RSA (1998, 1999, 2000, 2008, 2009, 2011, 2012, 2017, 2018, 2019, 2020, 2021)

(a) COSEWIC Status: Committee on the Status of Endangered Wildlife in Canada.
(b) SARA Status: *Species at Risk Act*.

6.6.4.1 Caribou

The Meliadine Extension falls within the seasonal range of the Qamanirjuaq caribou herd. The annual range of the Qamanirjuaq herd occupies an area from northern Manitoba and Saskatchewan in the south, to southwestern Nunavut and southeastern Northwest Territories (BQCMB 1999; Campbell et al. 2012). A portion of the Qamanirjuaq herd may pass through the RSA in summer but in some years, they may linger from late October through March (Hubert and Associates 2007).

Migration of the Qamanirjuaq herd from the southern winter range to the calving grounds occurs mid-March to late May (BQCMB 1999). Arviat hunters noted that habitat near Whale Cove and Rankin Inlet provides caribou wintering grounds (Kendrick and Manseau 2008). The traditional calving grounds of the Qamanirjuaq herd are located west of the RSA, and south of Baker Lake (BQCMB 2008). After calving in early June, barren-ground caribou form post-calving aggregations. It is during this time, the post-calving period, when the herd may interact with the 2014 FEIS and Meliadine Extension (Campbell et al. 2012; Nuqsana Golder 2020). Information regarding caribou seasonal abundance, movement patterns, water crossings, habitat use, and harvesting patterns is summarized in the following sections.

A Terrestrial Advisory Group (TAG) will be established to provide input on the effectiveness of monitoring and adaptive management, focusing on caribou at Meliadine. Agnico Eagle, in collaboration with the GN and the KivIA and including participation of Kangiqliniq Hunters and Trappers Organization (KHTO), undertake the implementation of a caribou monitoring and work suspension protocol during caribou migration to minimize sensory disturbance at Meliadine Mine and along the AWAR. The environmental department monitors caribou presence as per the caribou migration protocol, including the use of collar data and regular surveys, and issues caribou advisories. The results of the surveys are communicated to all Departments, including the KivIA and KHTO, indicating if any work stoppages or restrictions (e.g., AWAR closures) are required in the affected work areas. A decision tree is used to guide adaptive monitoring and mitigation in three action levels based on results of surveys. The timing and duration of AWAR closures has varied between years, with the longest period of work stoppage and restricted duties occurring in 2019 (Table 6.6-3).

Table 6.6-3: Caribou Advisory for Meliadine Mine, 2017 to 2020

Year	Road closures for caribou migration (days)	Date Range of closure or Partial Closure
2017	Work stoppage 111 hours; restricted duties 94 hours	7 July to 19 July
2018	Work stoppage 191 hours; restricted duties 93 hours	5 July to 20 July
2019	Work stoppage 240 hours; restricted duties 222 hours	26 June to 6 July
2020	Work stoppage 143 hours; All-Weather Access Road closed 165 hours	5 July to 22 July

Caribou behaviour monitoring occurs during migration. Monitoring caribou behaviour in proximity to the mine is integral to understanding how caribou interact with Mine infrastructure including roads (i.e., crossing, deflection, walking parallel) and other infrastructure. The surveys are designed to document activity budgets (i.e., time spent feeding, resting, walking, running), and the immediate effect of specific stressors (e.g., aircraft, vehicles, other wildlife) on caribou behaviour. Ground-based behavioural observations, or scan sampling, are conducted to provide data on changes in caribou behaviour as a function of distance from the Mine. Analysis of caribou behavioural responses to different forms of disturbance were summarized as part of the 2020 TEMMP report (Golder 2021f, Appendix D).

Two caribou mortalities were recorded in 2020 at the km 25 quarry. The cause of death was unknown and potentially attributed to hunting (Golder 2021f). No caribou mortalities were recorded from 2017 to 2019. Based on these results, the proposed threshold of one vehicle collision related mortality per year and one mine-related mortality per year for ungulates has not been exceeded. Mitigation implemented to reduce the road-related effects to caribou includes speed limit signs, wildlife activity notices, and road closures. Details of all wildlife mortalities can be found in the annual wildlife monitoring reports (Golder 2018, 2019b, 2021f; Nuqsana Golder 2020).

Seasonal Abundance

Based on a Nunavut government population survey in 2017, the Qamanirjuaq herd numbers an estimated 288,000 (BQCMB 2021). The estimate is an increase from the 265,000 estimated in 2014, but a decrease from the 344,000 estimated in 2008 (BQCMB 2021). This decline since 2008 is consistent with trends recently observed for other barren-ground caribou herds.

During baseline surveys for the 2014 FEIS, 195 groups of barren-ground caribou were observed during 16 aerial surveys, comprising a total of 10,254 individual animals. The mean density of barren-ground caribou observed across aerial surveys was estimated to range from 0 to 13 caribou/km^2. The highest density was observed during the spring migration/calving survey in 2000 (32.34 caribou/1000 ha; Volume 6, Section 6.6.2.2.1, Table 6.6-5 in 2014 FEIS).

Analysis of Qamanirjuaq collared caribou from 1993 to 2019 indicate presence in the RSA (including baseline) in 13 of 27 years and alternate between periods of presence and absence through time (Nuqsana Golder 2020). Collared caribou have typically entered the RSA in mid to late April. Annual exits from the RSA have been more variable ranging from late April to October. Evidence from collared caribou support that a portion of the Qamanirjuaq herd may pass through the RSA in summer but on occasion may in some years linger from late October through March (Hubert and Associates 2007; Nuqsana Golder 2020). When present, collared caribou spend about one to three weeks in the RSA and over all years are present for an average of six days (Nuqsana Golder 2020). Over all years, collared caribou spend less than half a day inside the LSA. The LSA represents 0.002% of the area of the Qamanirjuaq herd annual range.

Movement Patterns

The Qamanirjuaq caribou herd generally interacts with Meliadine Mine during the post-calving movement east towards the coast, for approximately 5 to 10 days during late June to mid-July (Nuqsana Golder 2020). Analysis of 2014 to 2019 Qamanirjuaq collared caribou movement paths was completed to determine the frequency of AWAR crossings for the 2020 FEIS Addendum (Golder 2021f, Appendix E). Based on the annual report results, the 2014 FEIS threshold of <10% caribou deflections from the AWAR has not been exceeded.

Surveys were performed in 2021 to examine historic and/or current movement trails within approximately 5 km of the Meliadine Extension (i.e., in proximity to proposed airstrip and windfarm) (Figure A-1 in ERM 2021b). Six heavily used, and thirteen moderately used routes were identified near the Meliadine Extension. Similar route density was observed within and outside the Meliadine Extension. Several heavily used trails were identified overlapping the proposed airstrip and Tiriganiaq-Wolf mining area, and fewer were observed overlapping with the proposed windfarm. Five pinch points were identified along the west arm of Meliadine Lake.

The Qamanirjuaq herd have alternated between periods of presence and absence in the RSA over time. Analysis of caribou collar data from 1993 to 2019 found that caribou were present for 13 of 27 years in the RSA for an average of 6 days across all years. In the LSA, caribou were present 10 of 27 years, typically in mid-July, for an average of less than half a day across all years (Nuqsana Golder 2020).

Habitat Use

Seasonal differences in the percent use of existing habitat types relative to availability were observed during baseline studies (Volume 6, Section 6.6.4.1.2 of the 2014 FEIS). In early and late winter, late summer, and post- calving, the percentage of locations detected in heath tundra was higher than the percentage of heath tundra available on the landscape. Heath boulder was also used more than available during the post-calving season and heath lichen – hair lichen was used more during late summer. Bare ground and water were used more than available during spring migration; which may be due to movement across the landscape. heath lichen – *Cetraria* was used equal to availability in all seasons. Caribou in the Northwest Territories select lichen veneer, heath tundra, and low shrub habitat (Johnson et al. 2005). The main diet for barren-ground caribou is lichen; thus they are also expected to occur in heath lichen – *Cetraria* and heath lichen – hair lichen habitat types in the RSA (Larter and Nagy 1997).

Harvesting Patterns

Historical harvesting data were summarized for the 2014 FEIS (Volume 6, Section 6.6.2.2.1). The total net economic value of this harvest is estimated at $15 million (BQCMB 2014). Wildlife harvest statistics for

Rankin Inlet indicate that 411 to 1,615 caribou are harvested annually from the area (NWMB 2004).

Agnico Eagle signed a Memorandum of Understanding, with the KHTO in 2019 and renewed in 2021 for the development and execution of a Hunter Harvest Survey (HHS). Agnico Eagle developed a calendar for the HHS with a focus on data collection by the KHTO from hunters and outfitters in the local community. The hunter harvest calendar was distributed to the KHTO to provide harvesters in the study area. Agnico Eagle engaged with the KHTO throughout 2020 to encourage regular participation in the HHS program.

Four community members contributed to the HHS in 2020 for the KHTO. Harvest records were submitted from 4 January to 21 December 2020, with one datasheet omitting a date. A total of 24 reports were submitted. In total, 62 individual caribou were reported harvested in 2020 (Golder 2021f).

6.6.4.2 Gray Wolf

Details on gray wolf presence in the RSA, population status, and distribution were summarized for the 2014 FEIS (Volume 6, Section 6.6.2.3). One incidental observation of 3 wolves was made during baseline work in 2008. Wolves are monitored on site through incidental observations, wildlife track surveys, and pre-construction surveys for denning carnivores. Wolves have been observed in the RSA in 2017, 2019, 2020, and 2021 (Golder 2018, 2021f; Nuqsana Golder 2020). No wolf dens have been documented in the RSA to date. To date, no project-related wolf mortalities have been reported (Golder 2018, 2019b, 2021f; Nuqsana Golder 2020).

Surveys were performed in 2021 to evaluate suitability of the Meliadine Extension for carnivore denning, and to document any previous dens (ERM 2021b). Ground surveys were performed in the vicinity of proposed wind turbines, and aerial surveys were completed within 1 km of the windfarm, Tiriganiaq-Wolf mining area, and airstrip. Additional locations for ground surveys (e.g., esker features) were identified during aerial surveys. Denning suitability was assigned between 1 (High) and 5 (Nil) at each proposed wind turbine location, or additional esker feature. No sites were classified as high quality carnivore denning habitat. Seven sites were moderately high suitability habitat, four were moderate suitability habitat, and the remaining were moderate to nil quality habitat (ERM 2021b).

6.6.4.3 Polar Bear

Details on polar bear presence in the RSA, population status, and distribution were summarized for the 2014 FEIS (Volume 6, Section 6.6.2.4). Observations near the Meliadine Mine were documented in 1998, 1999, 2000, 2007, 2008, 2011, and 2012 (Figure 6.6-6 in 2014 FEIS). Polar bears are monitored on site through incidental observations, wildlife track surveys, and pre-construction surveys for denning carnivores. As part of annual monitoring, polar bears have been observed incidentally in the RSA in 2018, 2019, 2020 (Golder 2019b, 2021f; Nuqsana Golder 2020). No polar bear dens have been observed in the RSA to date. To date, no project-related polar bear mortalities have been reported (Golder 2018, 2019b, 2021f; Nuqsana Golder 2020).

6.6.5 Assessment of Potential Meliadine Extension-related Effects

Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-3 of this Application and are also described in Volume 6, Section 6.6.3.1 of the 2014 FEIS.

The following primary effect pathways were identified for the Meliadine Extension terrestrial wildlife and wildlife habitat assessment:

- Direct loss and fragmentation of wildlife habitat from the Meliadine Extension footprint
- Sensory disturbance can change the amount of different quality habitats, and alter movement and behaviour
- Disruption or alteration of migration routes from the presence of the mine or from mine-related activities
- Permanent changes in wildlife habitat following closure of the mine site and supporting infrastructure

These four updated primary pathways have been identified as a result of the Meliadine Extension and are presented in Table 6.6-4 and assessed in more detail below. The pathway "Improved access for harvesting wildlife can affect wildlife population sizes" that was assessed as a primary pathway for the 2014 FEIS (Volume 6, Section 6.6.4.3) was assessed as a minor pathway for this Application.

The following cases are discussed for the effects assessment, applicable to calculation of direct (Section 6.6.5.1) and indirect habitat loss (Section 6.6.5.2):

- Baseline: Developments on landscape up to 2012.
- 2014 FEIS: 2014 FEIS and developments on landscape up to 2012.
- Existing Conditions: Developments on landscape up to 2021, including 2014 FEIS.
- Meliadine Extension: Developments on landscape up to 2021, including 2014 FEIS and Meliadine Extension.

The Existing Conditions case was added to account for developments that have occurred within the CESA between the 2014 FEIS and the Meliadine Extension (i.e., represent the current state of development on the landscape).

For the Existing Conditions case, six new developments have been identified within the CESA since the 2014 FEIS (Section 6.6.7, Figure 6.6-1 of this Application):

- Cone Hill Project (mineral exploration): This project is between 158 km and 174 km northwest of Rankin Inlet. Exploration activities occurred in 2019.
- Kahuna Gold Project (mineral exploration): This project is located between the communities of Rankin Inlet and Chesterfield Inlet. Exploration activities occurred in 2006, 2008, 2019, and 2020.
- Parker Lake Project (mineral exploration): This project is located between 120km and 160 km

northwest of Rankin Inlet. Exploration activities occurred in 2019.

- Pistol Bay Project (mineral exploration): This project is located near Whale Cove. Exploration activities occurred between 2015 and 2018, but did not proceed in 2020 due to COVID-19 restrictions.
- Whale Cove Project (mineral exploration): This project is located 20 km to 70 km south, west and north of Whale Cove. No holes were drilled in 2019 and 2020, and no activities were planned for 2021.
- Contaminated Site – Rankin Inlet (contaminated site).

Table 6.6-4: Potential Primary Pathways for Wildlife and Wildlife Habitat

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Caribou, Wolf	Mine infrastructure footprint (e.g., open pit, site roads) Access Road, Rankin Inlet Infrastructure, Meliadine Extension Infrastructure	Direct loss and fragmentation of wildlife habitat from the Meliadine Extension footprint, including the mine infrastructure, AWAR, and Rankin Inlet infrastructure, Meliadine Extension Infrastructure	Compact plant arrangement is designed to reduce the overall project footprint. Design roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. For example, minimum haul road widths are defined under the Mine Health and Safety Act, SNWT (Nu). Layouts of mining infrastructure have been configured to limit footprints, and utilize underground mining rather than open pit mining. Wind turbine platforms are designed to be compact to reduce the overall Windfarm footprint.	Primary	Primary	Table 6.6-30 of 2014 FEIS	Table 6.6-8	Not Significant	No change	Due to the small footprint of the Meliadine Extension, and all environmental design features and mitigation actions, incremental direct wildlife habitat loss due to the Meliadine Extension is negligible. The magnitude of the cumulative effects of habitat loss to wildlife remains low. The additional incremental effects of the Meliadine Extension do not change this conclusion. Therefore, residual effects to the terrestrial wildlife and wildlife habitat are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.
Caribou, Wolf	General construction and operation of mine and supporting infrastructure	Sensory disturbance can change the amount of different quality habitats, and alter movement and behaviour	All employees will be provided with wildlife environmental awareness training. Design will use conventional insulation, baffles and noise suppressors on equipment. Stationary equipment will be housed inside buildings. Regular maintenance of equipment to limit noise. Blades of the wind turbines will be equipped with trailing edge serrations to reduce noise emissions. Aircraft will maintain a 1.5 km distance from groups of caribou.	Primary	Primary	Table 6.6-30 of 2014 FEIS	Table 6.6-8	Not Significant	No change	Due to the small increase in indirect habitat loss due to the Meliadine Extension, and all environmental design features and mitigation actions, incremental indirect direct wildlife habitat loss due to the Meliadine Extension is negligible. The magnitude of the cumulative effects of indirect habitat loss to wildlife is low. The additional incremental effects of the Meliadine Extension do not change this conclusion. Therefore, residual effects to the terrestrial wildlife and wildlife habitat are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.
Caribou	Operation of Mine and supporting infrastructure	Disruption or alteration of migration routes from the presence of the mine or from mine-related activities	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Design will use conventional insulation, baffles and noise suppressors on equipment. Stationary equipment will be housed inside buildings. Regular maintenance of equipment to limit noise.	Primary	Primary	Table 6.6-30 of 2014 FEIS	Table 6.6-8	Not Significant	No change	Due to the nature of the proposed infrastructure, and all environmental design features and mitigation actions, increase in disruption of caribou migration routes is expected to be low. The magnitude of the cumulative effects of disruption of migration to caribou remains low. The additional incremental effects of the Meliadine Extension do not change this conclusion. Therefore, residual effects to caribou migration routes are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.
Caribou, Wolf	Post-Closure	Permanent changes in wildlife habitat following closure of the mine site and supporting infrastructure	Implement a Mine Closure and Reclamation Plan Hydraulic connections to the natural receiving environment will be re-established once water quality monitoring demonstrates that the water meets water quality guidelines for direct release without further treatment. Site infrastructure will be decommissioned and removed from site. All roads will be decommissioned and scarified.	Primary	Primary	Table 6.6-30 of 2014 FEIS	Table 6.6-8	Not Significant	No change	Due to the small footprint, and potential to reclaim habitats in the Meliadine Extension, the incremental permanent habitat loss to wildlife remains low. Therefore, residual effects to the terrestrial wildlife and wildlife habitat are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.

6.6.5.1 Direct Loss and Fragmentation of Wildlife Habitat from the Meliadine Extension Footprint

The Meliadine Extension will result in loss of vegetation communities leading to a direct loss of wildlife habitat. Analysis of direct habitat loss for the 2014 FEIS footprint, including other previous, existing, and future developments on wildlife were analyzed by quantifying changes in the area on the landscape at the RSA and CESA (Volume 6, Section 6.6.4.1 of the 2014 FEIS). The CESA is based on the post-calving range of the Qamanirjuaq Caribou Herd scale (Figure 6.1-3).

Changes in fragmentation were assessed for the 2014 FEIS by quantifying changes in spatial configuration of habitat types on the landscape (Volume 6, Section 6.6.4.1 and 6.6.5.1 of the 2014 FEIS). In addition to direct loss of habitat, the Meliadine Extension may also result in fragmentation of the existing landscape. However, given that the Meliadine Extension footprint consists of small expansions in areas adjacent to the existing infrastructure, incremental increases in habitat fragmentation are likely to be minimal.

Caribou collar data were assessed to determine use of existing habitat types relative to availability for the 2014 FEIS (Volume 6, Section 6.6.4.1.2, Table 6.6-18 of the 2014 FEIS). Heath tundra and heath boulder habitats were used by caribou more than expected based on their availability on the landscape during the post-calving season (26 June to 31 July). These landcover classes will be considered preferred caribou habitats for the purpose of this Application.

Habitat preferences were not quantitatively assessed for wolves for the 2014 FEIS (Volume 6, Section 6.6.5.1.1 of the 2014 FEIS).

Baseline information suggests that the RSA constitutes part of the home range of limited number of polar bears (Volume 6, Section 6.6.6 of the 2014 FEIS). Thus, the Meliadine Extension is predicted to cause limited incremental change in the amount and configuration of habitat for these individuals relative to the baseline locations.

Direct habitat changes due to the 2014 FEIS were less than 1% for all habitat types except heath lichen - *Cetraria* (4.67%; Volume 6, Section 6.6.4.1.2, Table 6.6-19 of the 2014 FEIS). The incremental effect of the 2014 FEIS at the CESA scale was 0.02% across habitat types (Volume 6, Section 6.6.4.1.2, Table 6.6-21 of the 2014 FEIS).

The total area impacted by the footprint of the Meliadine Extension is 227 ha, and area associated with individual components is summarized in Section 6.1.3, Table 6.1-1 of this Application. The airstrip, being proposed as an alternative with this application, accounts for 19 ha of the Meliadine Extension footprint, and the windfarm accounts for 18 ha. The remaining footprint consists of access roads, contact water infrastructure, open and underground mining areas, and a waste rock storage facility (Section 6.1.3, Table 6.1-1 of this Application). The footprint of the Meliadine Extension and other previous and existing developments were used to assess direct habitat loss at the CESA scale for Baseline, 2014 FEIS, Existing Conditions, and Meliadine Extension (Table 6.6-5). The incremental direct habitat loss due to the Meliadine Extension footprint were analyzed through changes in the area on the landscape from Existing Conditions at the CESA scale. Existing Conditions accounts for the six additional developments that have occurred in the CESA since the 2014 FEIS and before the Meliadine Extension, further described in Section 6.6.4 of this Application. Incremental changes in ELC at the RSA scale due to the Meliadine Extension are described in Section 6.7.4.1, Table 6.7-5: Direct Change in Area of Habitat Types from Development within the Regional Study Area during Baseline, 2014 FEIS, and Meliadine Extension Table 6.7-5 of this Application.

The following equations were used to estimate the percent relative change in direct habitat loss for the following development cases:

- 2014 FEIS incremental effects = (2014 FEIS value – Baseline value) / 2014 FEIS value
- Meliadine Extension incremental effects = (Meliadine Extension value – Existing Conditions value) / Meliadine Extension value

The resulting value was multiplied by 100 to give the percent change in a landscape metric for each comparison. The result provides both the direction and magnitude of the effect. For example, a high negative value for habitat area would indicate a substantial loss of habitat type.

Table 6.6-5: Direct Incremental Habitat Loss within the Caribou Effects Study Area for Baseline, Existing Conditions, 2014 FEIS, and Meliadine Extension

Area (ha) Removed from Baseline to 2014 FEIS	Change Baseline to 2014 FEIS (%)	Area (ha) Removed from 2014 FEIS to Existing Conditions	Change 2014 FEIS to Existing Conditions (%)	Area (ha) Removed from Existing Conditions to Meliadine Extension	Change Existing Conditions to Meliadine Extension (%)
2,589	<1	308	<1	227[a]	<1

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

(a) Calculated value was 211 ha is results from the spatial projection and extent of Caribou Effects Study Area. Value of 227 ha was used to be consistent with other sections and to maximize predicted effects.

Direct habitat loss is anticipated for all caribou and wolves, but as a low percentage of the available habitat in the RSA and CESA. Incremental changes in habitat area in the RSA from the 2014 FEIS due to the Meliadine Extension are expected to be less than 2% for all habitat classes (Section 6.7.4.1, Table 6.7-5: Direct Change in Area of Habitat Types from Development within the Regional Study Area during Baseline, 2014 FEIS, and Meliadine Extension Table 6.7-5 of this Application). Incremental direct loss of heath tundra and heath boulder habitats in the RSA are <1%, and therefore loss of key habitat to caribou and wolf are expected to be limited. The incremental direct habitat loss due to the Meliadine Extension in the CESA is 227 ha, or <1% of the CESA (Table 6.6-5).

6.6.5.2 Sensory Disturbance Can Change the Amount of Different Quality Habitats

In addition to direct habitat loss, changes to habitat quality will also occur due to the Meliadine Extension. Previously completed work in the Canadian Arctic suggests that sensory disturbances from development influence wildlife behaviour, movements, and distributions. The 2014 FEIS estimated this zone of influence (ZOI) of the mine site to be 14 km, based on previous studies on the effects of disturbance on barren-ground caribou (Boulanger et al. 2009, 2012). The mechanism causing these effects is not fully understood but is likely a combination of different sources of sensory disturbance outside the mine footprint (e.g., noise, smell, dust, visual effects). Sensory disturbances may reduce the amount of different quality habitats available for use if quality habitats are avoided and change fitness because energy that could be allocated to survival or reproduction is instead used to cope with disturbance (Bisson et al. 2009).

Indirect effects from the 2014 FEIS were assumed to reduce the suitability of these habitats, reducing the availability of preferred habitat for wildlife in the RSA and CESA. Other VCs present during baseline studies tended to be present in low densities or are known to be less affected by sensory disturbance based on monitoring results at Meliadine and other mines, resulting in negligible effects. Focus for these species has shifted to focus on detecting and mitigating direct interactions with mines, rather than attempting to detect effects of sensory disturbance or a ZOI (ERM Rescan 2014; Gebauer et al. 2015).

Direct and indirect effects from human disturbance were used to quantify changes in the relative availability of different habitat types, due to the 2014 FEIS for the RSA and CESA. Analysis of indirect habitat loss for the 2014 FEIS, including other previous, existing, and future developments on wildlife used maximum published disturbance coefficients and ZOIs for different disturbance types from empirical studies (Volume 6, Section 6.6.4.2.1, Table 6.6-23 of the 2014 FEIS). Indirect incremental habitat loss due to the 2014 FEIS ranged from 1.25% to 9.01% in the RSA, and from 0% to 1.72% in the CESA depending on habitat type (Volume 6, Section 6.6.4.2.2 of the 2014 FEIS).

ZOIs and disturbance coefficients for different disturbance types (Table 6.6-6) were used to assess indirect habitat loss due to the Meliadine Extension and other previous and existing developments at the CESA scale for Baseline, 2014 FEIS, Existing Conditions, and Meliadine Extension (Table 6.6-7). Incremental change due to the Meliadine Extension are presented in relation to the Existing Conditions case, which accounts for the six developments that have occurred in the CESA since the 2014 FEIS (Section 6.6.5 of this Application). The same disturbance coefficients and ZOIs that were used for the 2014 FEIS were applied (Table 6.6-6).

Table 6.6-6: Disturbance Coefficients and Associated Zones of Influence used to Estimate Indirect Habitat Loss

Disturbance Type	Feature Type	Footprint		ZOI Range 1		ZOI Range 2		ZOI Range 3	
		Extent (m)[a]	DC	Range[b](km)	DC	Range (km)	DC	Range (km)	DC
Campgrounds	point	200	0	n/a	n/a	n/a	n/a	n/a	n/a
Community	polygon	actual	0	0 to 1	0.05	1 to 5	0.5	5 to 15	0.75
Contaminated Sites	point	200	0	n/a	n/a	n/a	n/a	n/a	n/a
Fuel storage	point	200	0	0 to 5	0.75	n/a	n/a	n/a	n/a
Mineral exploration	point	500	0	0 to 5	0.5	n/a	n/a	5 to 14	**0.75**
Operating mine	polygon	actual/500	0	0 to 1	0.05	1 to 5	0.5	5 to 14	0.75
Power	point	500	0	0 to 1	0.5	n/a	n/a	n/a	n/a
Quarry	point	200	0	0 to 5	0.75	n/a	n/a	n/a	n/a
Road	line	actual	0	0 to 1	0.05	1 to 5	0.75	n/a	n/a
Territorial Park	point	200	0	0 to 1	0.90	n/a	n/a	n/a	n/a
Miscellaneous	point	200	0	0 to 5	0.75	n/a	n/a	n/a	n/a

Note: DC and ZOI values were guided by published literature (Johnson et al. 2005; Weir et al. 2007; Boulanger et al. 2009).

(a) Footprints estimated with the exception of communities, operating mines, and roads which were delineated and digitized from remote sensing imagery.

(b) From edge of measured or hypothetical footprint.

n/a = not applicable; DC = disturbance coefficient; ZOI = zone of influence; m = metre; km = kilometre.

The following equations were used to estimate the percent relative change in indirect habitat loss for the following development cases:

- 2014 FEIS incremental effects = (2014 FEIS value – Baseline value) / 2014 FEIS value
- Meliadine Extension incremental effects = (Meliadine Extension value – Existing Conditions value) / Meliadine Extension value

The resulting value was multiplied by 100 to give the percent change in a landscape metric for each comparison. The result provides both the direction and magnitude of the effect. For example, a high negative value for habitat area would indicate a substantial loss of habitat type.

Factors that may contribute to sensory disturbance were assessed for the Meliadine Extension, including air quality (including dust; Section 5.2 of this Application) and noise (Section 5.5 of this Application). Particulate matter modelling completed for the 2014 FEIS was conservative, and the Meliadine Extension is not expected to change particulate matter emissions (Section 5.2 of this Application). Measurement of dustfall deposition and associated impact on vegetation occurred at Meliadine in 2020 (ERM 2021c). Transects extending 2 km from the Mine Site and AWAR were compared to a reference site. Dust deposition followed an exponential decline with distance from road, and dust levels were comparable to the reference site within 500 m of the Mine Site and AWAR. Metals measured in reindeer lichen (*Cladonia rangiferina*) and Arctic willow (*Salix arctica*) were comparable to reference conditions within 1,500 m of the Mine Site and AWAR. These findings represent smaller effects than estimated by ZOIs used for calculation sensory disturbance operating mines (14 km) and roads (5 km; Table 6.6-6). Noise modelling completed for the Meliadine Extension found that noise was expected to be consistent with effects predicted for the 2014 FEIS (Section 5.5 of this Application).

Overlap of caribou migration routes with wind turbines was raised as a concern by community members for this Application (Section 6.6.2 of this Application). Limited information exists on the response of barren-ground caribou to wind turbines. However, several previous studies have assessed the response of reindeer (*Rangifer tarandus tarandus*) to windfarm construction and operation in Sweden and Norway. Reindeer were previously found to display sensory disturbance within 5 km of wind turbines during the construction phase (Skarin et al. 2015). Another study found that reindeer moved home ranges to locations away from locations where wind turbines were visible on the landscape, and calving areas farther from wind turbines during operation than construction (Skarin et al. 2018). However, Tsegaye et al. (2017) found overall similar use of areas around windfarm before and after development (i.e., construction) by reindeer, but changes to caribou distribution during the calving season during construction. Sensory disturbance analysis for the Meliadine Extension included the proposed windfarm as components. Therefore, the ZOI of 14 km was applied to the Meliadine Extension (including areas with wind turbines), which is conservative compared to the distance at which sensory disturbance was assessed in previous studies of reindeer response to wind turbines (Skarin et al. 2015, 2018).

Table 6.6-7: Indirect Incremental Habitat Loss within the Caribou Effects Study Area for Baseline, Existing Conditions, 2014 FEIS, and Meliadine Extension

Area (ha) Removed from Baseline to 2014 FEIS	Change Baseline to 2014 FEIS (%)	Area (ha) Removed from 2014 FEIS to Existing Conditions	Change 2014 FEIS to Existing Conditions (%)	Area (ha) Removed from Existing Conditions to Meliadine Extension	Change Existing Conditions to Meliadine Extension (%)
16,508	<1	58,203	<1	4,233	<1

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

Direct habitat loss is anticipated for caribou and wolves, but as a low percentage of available habitat in the CESA. Incremental change in area due to indirect effects of the Meliadine Extension compared to the Existing Conditions case was estimated to be 4,233 ha, or <1% of the CESA scale (Table 6.6-7). This reduction in habitat quality may be accompanied by a limited increase in fragmentation due to movement barriers, based on presence of caribou trails in portions of the Meliadine Extension, notably the proposed airstrip (ERM 2021b). The reduction in habitat quality would not be accompanied by a reduction in survival, as the Meliadine Extension is not expected to increase access to harvesting. The RSA is typically used by the Qamanirjuaq herd during the post-calving season, for an average period of 6 days (Nuqsana Golder 2020). Consequently, an increase in energetics as a result of disturbance-related effects from the Meliadine Extension during these sensitive seasons is likely negligible.

6.6.5.3 Disruption or Alteration of Migration Routes from the Presence of the Mine or from Mine-Related Activities

The Qamanirjuaq caribou herd are known to migrate through the RSA during their post-calving movement (Nuqsana Golder 2020). Movement was assessed through IQ investigations, and by mapping subsequent collar locations in the region for the 2014 FEIS (Volume 6, Section 6.6.4.1.1 of the 2014 FEIS). Analysis of GPS collar data for the 2014 FEIS found that caribou move through the southern portion of the RSA in the post-calving and late summer seasons, and through the Narrows region (i.e., where the land on either side of Meliadine Lake constricts) at the main Mine and camp site in early and late winter. Analysis of caribou collar data from 1993 to 2019 found that caribou were present for 13 of 27 years in the RSA for an average of 6 days across all years. In the LSA, caribou were present 10 of 27 years, typically in mid-July, for an average of less than half a day across all years (Nuqsana Golder 2020).

The footprint of the Meliadine Extension extends from existing infrastructure, and includes development of new access roads for wind turbines, Tiriganiaq-Wolf mining area and the airstrip. Mapping of caribou trails for the Meliadine Extension found concentration of trails along the north and west sides of Meliadine Lake (ERM 2021b). Several established caribou trails overlap the proposed airstrip, but fewer trails overlap the proposed windfarm (ERM 2021b). The configuration of proposed roads in the Meliadine Extension is expected to allow passage of caribou. In other words, the Meliadine Extension does not include extensive length of the roads beyond those approved that would completely divert caribou migration routes if roads were completely avoided. Previous studies have also found avoidance of wind turbines by reindeer during construction and operation (Skarin et al. 2015, 2018).

6.6.5.4 Permanent Changes in Wildlife Habitat Following Closure of the Mine Site and Supporting Infrastructure

A portion of wildlife habitat disturbed by the Meliadine Extension is expected to be reclaimed during closure. However, terrestrial ecosystems in the RSA are slow to regenerate, and certain features, including waste rock and tailings storage facilities will remain permanent features on the landscape. The quantity of wildlife habitat restored or reclaimed at post-closure was calculated for the 2014 FEIS (Volume 6, Section 6.6.4.1 of the 2014 FEIS). There is uncertainty in the type of vegetation that may naturally encroach on disturbed areas, so the following general categories were used: reclaimed lichen-rock community, reclaimed water bodies, and scarified natural re-vegetation (Volume 6, Section 6.6.4.1 of the 2014 FEIS). Based on these categories, the amount of reclaimed habitat expected to be reclaimed was calculated for each habitat type. Of important habitats preferred by caribou and wolves, it was estimated that 69.40% of heath tundra and 92.87% of heath boulder habitats disturbed by the 2014 FEIS would be reclaimed (Volume 6, Section 6.6.4.1.2, Table 6.6-22 of the 2014 FEIS).

The total area impacted by the footprint of the Meliadine Extension is 227 ha, and area associated with individual components is summarized in Section 6.1.3, Table 6.1-1 of this Application. Incremental changes in habitat area in the RSA due to the Meliadine Extension are expected to be less than 2% for all habitat classes (Table 6.7-5 of this Application). Approximately 40% of the Meliadine Extension footprint is heath tundra (92 ha), and only a small portion of the Meliadine Extension footprint is heath boulder (5 ha; Table 6.7-5 of this Application). The incremental direct habitat loss due to the Meliadine Extension is <1% of the CESA (Table 6.6-5).

Closure will adhere to practices in the Meliadine Conceptual Closure and Reclamation Plan, however the proportion of different habitats reclaimed in the Meliadine Extension will vary based on final approaches to closure. During closure, areas of the footprint will be recolonized by native vegetation to some degree, which will lead to the use of these habitats by wildlife. Other components of the Meliadine Extension footprint will lead to permanent and irreversible habitat loss, including a 77 ha waste rock storage facility (Section 6.1.3, Table 6.1-1 of this Application). Assuming similar percentages of these habitats would be reclaimed in the Meliadine Extension footprint as were reclaimed for the 2014 FEIS, the Meliadine Extension will result in minimal incremental changes in permanent wildlife habitat loss.

6.6.6 Residual Impact Classification

The following new and/or updated primary effect pathways were identified for the Meliadine Extension:

- Direct loss and fragmentation of wildlife habitat from the Meliadine Extension footprint
- Permanent changes in wildlife habitat following closure of the mine site and supporting infrastructure
- Sensory disturbance can change the amount of different quality habitats, and alter movement and behaviour
- Disruption or alteration of migration routes from the presence of the mine or from mine-related activities

The residual impact classification for these primary effect pathways is summarized in Table 6.6-8. Definitions for criteria used in the residual impact classification are provided in Section 4, Table 4.5-1 of the FEIS Addendum. Consistent with the 2014 FEIS, the following thresholds for magnitude were applied for quantitative analyses and results (e.g., loss and fragmentation of habitat, and changes to habitat suitability):

- negligible: less than a 1% change from the Meliadine Extension relative to 2014 FEIS values;
- low: 1 to 10% change from the Meliadine Extension relative to 2014 FEIS values;
- moderate: greater than 10 to 20% change from the Meliadine Extension relative to 2014 FEIS values; and
- high: more than 20% change from the Meliadine Extension relative to 2014 FEIS values.

Table 6.6-8: Residual Impact Classification and Determination of Significance for Terrestrial Wildlife and Wildlife Habitat

Effect Pathways	Direction	Magnitude Incremental	Geographic Extent Incremental	Duration	Frequency	Reversibility	Likelihood	Significance
Direct loss and fragmentation of wildlife habitat from the Meliadine Extension footprint	Negative	Negligible	Local	Long-term	Continuous	Reversible	Highly likely	Not Significant
Sensory disturbance can change the amount of different quality habitats	Negative	Negligible	Local	Medium-term	Continuous	Reversible	Highly likely	Not Significant
Disruption or alteration of migration routes from the presence of the mine or from mine-related activities	Negative	Low	Local	Long-term	Periodic	Reversible	Likely	Not Significant
Permanent changes in wildlife habitat following closure of the mine site and supporting infrastructure	Negative	Negligible	Local	Permanent	Continuous	Irreversible	Highly likely	Not Significant

The incremental effect of the 2014 FEIS on terrestrial wildlife and wildlife habitat was assessed as negative, low magnitude, and regional in geographic extent (Volume 6, Section 6.6.10.2, Table 6.6-30 of the 2014 FEIS). Based on the relatively small footprint of the Meliadine Extension, and all environmental design features and mitigation actions, incremental direct wildlife habitat loss due to the Meliadine Extension is expected to be negative, local in geographic extent, and negligible in magnitude (Table 6.6-8). Therefore, the residual effects to the terrestrial wildlife and wildlife habitat are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.

The incremental impact of sensory disturbance for the 2014 FEIS on terrestrial wildlife and wildlife habitat was assessed as negative, low, and regional scale in geographic extent (Volume 6, Section 6.6.10.2, Table 6.6-30 of the 2014 FEIS). Impacts from sensory disturbance were expected to be continuous throughout the life of the mine but are anticipated to be reversed following closure (i.e., medium-term) when dust, noise and activity are no longer present. Due to the small increase in indirect habitat loss due to the Meliadine Extension, and all environmental design features and mitigation actions, incremental indirect wildlife habitat loss due to the Meliadine Extension is assessed as negligible, and local in geographic extent (Table 6.6-8). Therefore, residual effects to terrestrial wildlife and wildlife habitat are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.

The 2014 FEIS was expected to have a low magnitude, negative effect on caribou, by presenting potential long-term barriers to their migration at a regional scale (Volume 6, Section 6.6.10.2, Table 6.6-30 of the 2014 FEIS). Due to the nature of the proposed infrastructure for the Meliadine Extension, and environmental design features and mitigation actions, incremental disruption of caribou migration routes is expected to remain low (Table 6.6-8). Therefore, residual effects to caribou migration routes are expected to be not significant, and the conclusion from the 2014 FEIS remains the same. The Meliadine Mine and Meliadine Extension have potential to interact with the post-calving movements of the Qamanirjuaq caribou herd. Within the Meliadine Extension, several established caribou trails overlap the proposed airstrip, but fewer trails overlap the proposed windfarm (ERM 2021b). The configuration of the Meliadine Extension is expected to allow passage of caribou around the proposed infrastructure when mitigations to limit disturbance in these areas are applied. The Meliadine Extension has been designed to have a compact footprint, and extends from the approved mine (i.e., roads and infrastructure do not extend far beyond areas of existing development). Additional road related mitigation includes design of roads with low profiles, avoidance of build-up of snowbanks in winter, enforcement of speed limits, and providing wildlife with the right-of-way on all roads (refer to TEMMP). The TEMMP specifies tiered mitigation and monitoring during caribou migration. Agnico Eagle will implement work suspension protocol when the caribou herd is moving in the direction of the activities and crosses the 5 km mark from the Mine site activities. Work suspension will include suspension of helicopter flights, drill operations, and circulation of vehicles.

The incremental impact of permanent loss of habitat due to the 2014 FEIS was assessed as long term and low magnitude at the regional scale (Volume 6, Section 6.6.10.2, Table 6.6-30 of the 2014 FEIS). Due to small incremental changes in direct habitat loss due to the Meliadine Extension and potential to reclaim habitats, the incremental permanent habitat loss to wildlife is negligible (Table 6.6-8). Therefore, residual effects to the terrestrial wildlife and wildlife habitat are expected to be not significant, and the conclusion from the 2014 FEIS remains the same.

6.6.7 Cumulative Effects Assessment

6.6.7.1 Methods

Within the ranges of the Qamanirjuaq caribou herd that interacts with the Meliadine Mine and Meliadine Extension, there are exploration camps, roads, and communities, exposing caribou to cumulative effects (Figure 6.6-1). The cumulative effects analysis for the 2014 FEIS calculated direct and indirect habitat loss at the RSA and CESA scales, summarized by habitat type for Reference, Baseline, Phase 1 AWAR, 2014 FEIS, and Future cases. Indirect habitat loss was calculated using published ZOIs and disturbance coefficients (Volume 6, Section 6.6.4.2.1 in 2014 FEIS).

The approach was simplified for the Meliadine Extension to calculate total direct and indirect habitat loss at the CESA scale, not summarized by habitat type. The footprints, ZOIs and disturbance coefficients used to calculate indirect habitat loss, were the same as those used for the 2014 FEIS with the addition of the transmission line class applicable to the Future case (Table 6.6-6). The Existing Conditions case was added to account for developments that have occurred within the CESA between the 2014 FEIS, and the Meliadine Extension (i.e., represent the current state of development on the landscape).

The following definitions were used for cases assessed in the cumulative effects analysis:

- Baseline: Developments on landscape up to 2012.
- 2014 FEIS: 2014 FEIS and developments on landscape up to 2012.
- Existing Conditions: Developments on landscape up to 2021, including 2014 FEIS.
- Meliadine Extension: Developments on landscape up to 2021, including 2014 FEIS and Meliadine Extension.
- Future: Developments on landscape up to 2021, 2014 FEIS, Meliadine Extension, and RFFDs.

Table 6.6-9: Disturbance Coefficients and Associated Zones of Influence used to Estimate Indirect Habitat Loss

Disturbance Type	Feature Type	Footprint		ZOI Range 1		ZOI Range 2		ZOI Range 3	
		Extent (m)[a]	DC	Range[b](km)	DC	Range (km)	DC	Range (km)	DC
Campgrounds	point	200	0	n/a	n/a	n/a	n/a	n/a	n/a
Community	polygon	actual	0	0 to 1	0.05	1 to 5	0.5	5 to 15	0.75
Contaminated Sites	point	200	0	n/a	n/a	n/a	n/a	n/a	n/a
Fuel storage	point	200	0	0 to 5	0.75	n/a	n/a	n/a	n/a
Mineral exploration	point	500	0	0 to 5	0.5	n/a	n/a	5 to 14	**0.75**
Operating mine	polygon	actual/500	0	0 to 1	0.05	1 to 5	0.5	5 to 14	0.75
Power	point	500	0	0 to 1	0.5	n/a	n/a	n/a	n/a
Quarry	point	200	0	0 to 5	0.75	n/a	n/a	n/a	n/a
Road	line	actual	0	0 to 1	0.05	1 to 5	0.75	n/a	n/a
Territorial Park	point	200	0	0 to 1	0.90	n/a	n/a	n/a	n/a

Disturbance Type	Feature Type	Footprint		ZOI Range 1		ZOI Range 2		ZOI Range 3	
		Extent (m)[a]	DC	Range[b](km)	DC	Range (km)	DC	Range (km)	DC
Transmission Line[c]	line	50	0.25	0 to 1	0.50	1 to 5	0.75	n/a	n/a
Miscellaneous	point	200	0	0 to 5	0.75	n/a	n/a	n/a	n/a

Note: DC and ZOI values were guided by published literature (Johnson et al. 2005; Weir et al. 2007; Boulanger et al. 2009).

(a) Footprints estimated with the exception of communities, operating mines, and roads which were delineated and digitized from remote sensing imagery.

(b) From edge of measured or hypothetical footprint.

(c) A 100 m footprint was used along the centre of the proposed corridor for the Kivalliq Hydro-Fiber Link project. Values for disturbance coefficients and zones of influence were adapted from Dominion Diamond (2014).

n/a = not applicable; DC = disturbance coefficient; ZOI = zone of influence; m = metre; km = kilometre.

The projects considered for the future condition for the 2014 FEIS (Manitoba to Nunavut Road, Churchill Diamonds Project, Ferguson Lake Project, and Kiggavik Uranium Project) may have not proceeded to development (Volume 6, Section 6.5.13.1 in the 2014 FEIS). These developments were not included in the cumulative effects analysis for the Meliadine Extension.

For the Existing Conditions case, six new developments have been identified within the CESA since the 2014 FEIS (Figure 6.6-1):

- Cone Hill Project (mineral exploration): This project is between 158 km and 174 km northwest of Rankin Inlet. Exploration activities occurred in 2019.
- Kahuna Gold Project (mineral exploration): This project is located between the communities of Rankin Inlet and Chesterfield Inlet. Exploration activities occurred in 2006, 2008, 2019, and 2020.
- Parker Lake Project (mineral exploration): This project is located between 120km and 160km northwest of Rankin Inlet. Exploration activities occurred in 2019.
- Pistol Bay Project (mineral exploration): This project is located near Whale Cove. Exploration activities occurred between 2015 and 2018, but did not proceed in 2020 due to COVID-19 restrictions.
- Whale Cove Project (mineral exploration): This project is located 20 km to 70 km south, west and north of Whale Cove. No holes were drilled in 2019 and 2020, and no activities were planned for 2021.
- Contaminated Site – Rankin Inlet (contaminated site).

The following RFFDs were included in the Future case (Figure 6.6-1):

- Kivalliq Hydro-Fiber Link Project (transmission line): The Kivalliq Hydro-Fiber link project is led by the Kivalliq Inuit Association and would comprise a 1200 km long power line running from Manitoba (Gillam) to the Kivalliq communities of Arviat, Whale Cove, Rankin Inlet, Chesterfield Inlet and Baker Lake via a 370 km long lower voltage feeder line.
- Rankin Inlet sandpit (quarry): The Rankin Inlet sandpit is a borrow pit located 7 km north of Rankin Inlet. It has been used since the last 30 years as a source of sand and gravel material to the Hamlet and local contractors. For the purpose of this assessment, it is assumed that the Rankin Inlet Sandpit continues operation until the end of the Meliadine mine life.

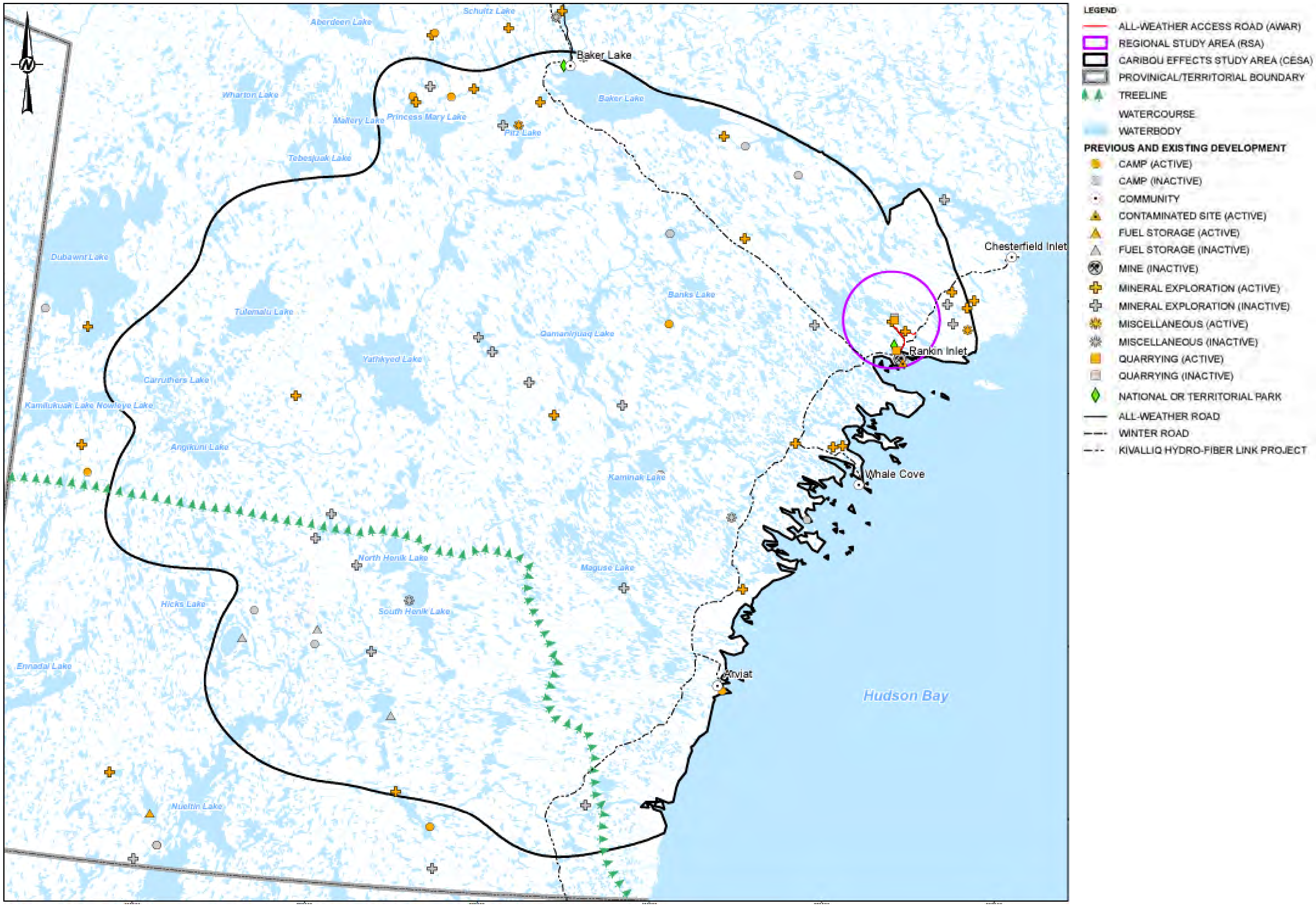
Other RFFDs that occur outside the CESA that were considered include the Meadowbank Precious Metals Property, Greyhound Project, White Hills Project, and Qilalugap Diamond Project (Figure 6.6-1).

The following equations were used to estimate the percent relative change in direct and indirect habitat loss for each development case:

- Existing cumulative effects = (Baseline value – Reference value) / Reference value;
- 2014 FEIS incremental effects = (2014 FEIS value – Baseline value) / 2014 FEIS value;
- Meliadine Extension incremental effects = (Meliadine Extension value – Existing Conditions value) / Meliadine Extension value;
- Future incremental effects = (Future value – Meliadine Extension value) / Meliadine Extension value; and
- Future cumulative effects = (Future value – Reference value)/ Reference value.

The resulting value was multiplied by 100 to give the percent change in a landscape metric for each comparison. The result provides both the direction and magnitude of the effect. For example, a high negative value for habitat area would indicate a substantial loss of habitat type.

Figure 6.6-1: Previous, Existing, and Possible Future Developments in the Caribou Effects Study Area



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6.6.7.2 Direct Loss and Fragmentation of Wildlife Habitat from the Meliadine Extension Footprint

The direct cumulative changes in land area developed in the RSA as a result of known and expected future developments, including the 2014 FEIS, were expected to be less than 7% for all habitat types (Volume 6, Section 6.6.4.1.2, Table 6.6-19 in 2014 FEIS). The direct cumulative changes in land area developed in the CESA as a result of known and expected future developments, including the 2014 FEIS, were expected to be less than 0.50%, and the incremental effect of the 2014 FEIS was 0.02% (Volume 6, Section 6.6.4.2.2 in 2014 FEIS).

When future RFFDs are considered, the cumulative effects of development on direct habitat loss at the CESA scale is expected to be 13,382 ha, or <1% (Table 6.6-10). The Future case is expected to have the greatest incremental effect on the amount of land developed in the CESA (<1%; Table 6.6-10).

6.6.7.3 Sensory Disturbance Can Change the Amount of Different Quality Habitats

The indirect cumulative changes in land area as a result of known and expected future developments, including the 2014 FEIS, were expected to be less than 3% at the CESA scale (Volume 6, Section 6.6.4.2.2 in 2014 FEIS). Cumulative indirect habitat loss at the RSA scale ranged between 18.49% and 43.48%, depending on habitat type (Volume 6, Section 6.6.4.2.2, Table 6.6-25 in the 2014 FEIS).

When future RFFDs are considered, the cumulative effects of development on indirect habitat loss at the CESA scale is expected to be 3% (Table 6.6-11 of this Application). Changes from Reference to Baseline (2%) followed by Meliadine Extension to Future (1%) represent the largest incremental effects on the amount of land developed in the CESA (Table 6.6-11).

6.6.7.4 Disruption or Alteration of Migration Routes from the Presence of the Mine or from Mine-Related Activities

The Kivalliq Hydro-Fiber Link Project is an RFD that extends through the CESA (Section 6.6.7, Figure 6.6-1). However, this transmission line is not expected to act as an absolute barrier to caribou migration. There are currently no new major roads or mines proposed in the CESA that are expected to cause significant alteration or disruption of caribou migration routes.

6.6.7.5 Permanent Changes in Wildlife Habitat Following Closure of the Mine Site and Supporting Infrastructure

The Meliadine Extension will result in direct loss of 227 ha (<1%) of the CESA. Although reclamation estimates are not available for the Meliadine Extension, not all direct habitat loss will constitute permanent change in habitat because some of it will be reclaimed. Similarly, not all direct habitat loss from other RFFDs will constitute permanent change in wildlife habitat. It is conservatively noted that the maximum possible cumulative permanent change in habitat is equal to the cumulative direct loss of habitat, which is <1% of the CESA (Table 6.6-10).

Table 6.6-10: Direct Incremental Habitat Loss within the Caribou Effects Study Area for Reference, Baseline, Existing Conditions, 2014 FEIS, Meliadine Extension, and Future Cases

Reference Area (ha)	Area Removed from Reference to Baseline (ha)	Change Reference to Baseline (%)	Area (ha) Removed from Baseline to 2014 FEIS	Change Baseline to 2014 FEIS (%)	Area (ha) Removed from 2014 FEIS to Existing Conditions	Change 2014 FEIS to Existing Conditions (%)	Area (ha) Removed from Existing Conditions to Meliadine Extension	Change Existing Conditions to Meliadine Extension (%)	Area (ha) Removed from Meliadine Extension to Future	Change Meliadine Extension to Future (%)	Area (ha) Removed from Reference to Future	Cumulative Change Reference to Future (%)
14,791,483	3,979	<1	2,589	<1	308	<1	227[a]	<1	6,295	<1	13,382	<1

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

(a) Calculated value was 211 ha, discrepancy due to spatial projection and extent of Caribou Effects Study Area. Value of 227 ha was used to be consistent with other sections.

Table 6.6-11: Indirect Incremental Habitat Loss within the Caribou Effects Study Area for Reference, Baseline, Existing Conditions, 2014 FEIS, Meliadine Extension, and Future Cases

Reference Area (ha)	Area Removed from Reference to Baseline (ha)	Change Reference to Baseline (%)	Area (ha) Removed from Baseline to 2014 FEIS	Change Baseline to 2014 FEIS (%)	Area (ha) Removed from 2014 FEIS to Existing Conditions	Change 2014 FEIS to Existing Conditions (%)	Area (ha) Removed from Existing Conditions to Meliadine Extension	Change Existing Conditions to Meliadine Extension (%)	Area (ha) Removed from Meliadine Extension to Future	Change Meliadin e Extension to Future (%)	Area (ha) Removed from Reference to Future	Cumulative Change Reference to Future (%)
14,791,483	227,775	2	16,508	<1	58,203	<1	4,233	<1	176,634	1	483,353	3

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

6.6.7.6 Cumulative Effects Residual Impact Classification

Residual impact classification of cumulative effects was completed for each of the four primary pathways identified for the Meliadine Extension. The same criteria were used for residual impact classification of cumulative effects and incremental Meliadine Extension effects (Table 6.6-12). These criteria are defined in Section 4, Table 4.5-2 of this Application. Residual impact classification for cumulative effects for the 2014 FEIS are summarized in Volume 6, Section 6.6.10.2, Table 6.6-30 of the 2014 FEIS.

Cumulative effects from primary effect pathways are not expected to decrease resilience and increase the risk to wildlife population maintenance and opportunities for traditional use. Consequently, cumulative effects from each primary effect pathway are considered not significant for all wildlife VCs. These conclusions are consistent with the 2014 FEIS.

The residual impact classification for primary effect pathways is summarized in Table 6.7-17. Essentially, the only difference in the outcome of impact criteria between cumulative and incremental effects from the Meliadine Extension is in the magnitude and geographic extent of impacts. The magnitude for cumulative impacts involves changes from Reference case through application of the Meliadine Extension and into the Future case, while incremental impacts are based on changes from the Meliadine Extension relative to the Existing Conditions values. The magnitude of cumulative effects associated with each pathway are negligible to low for all VCs because they are predicted to result in a less than 10% change relative to Reference Case.

Cumulative impacts from Meliadine Extension and other developments influence the entire annual range of wildlife populations (i.e., regional to beyond regional scale). The Meliadine Extension does not increase the geographic extent to beyond regional because, by definition, the result of beyond regional is linked to whether VCs naturally move in and out of regional study areas (Section 4.5.2). Thus, a beyond regional extent result for cumulative effects exists in the presence of previous and existing developments and before the Meliadine Extension. In contrast, the geographic extent of incremental impacts from the Meliadine Extension are expected have a local influence on wildlife populations.

Caribou are likely to be affected by transboundary effects from human disturbances across their annual range. However, the contribution of the Meliadine Extension when considered with transboundary developments and activities is expected to be negligible. The incremental direct and indirect effects are both <1% at the scale of the Qamanirjuaq herd post-calving range (Sections 6.6.5.1, 6.6.5.2), which are considered negligible residual effects (Section 6.6.6). The contribution of direct and indirect effects from the Meliadine Extension will be even smaller at a larger annual range scale, are unlikely to be measurable ecologically and be within the resilience limits of caribou.

Table 6.6-12: Cumulative Residual Impact Classification and Determination of Significance for Terrestrial Wildlife and Wildlife Habitat

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance
Direct loss and fragmentation of wildlife habitat from the Meliadine Extension footprint	Negative	Negligible	Regional to Beyond Regional	Long-term	Continuous	Reversible	Highly likely	Not Significant
Sensory disturbance can change the amount of different quality habitats	Negative	Low	Regional to Beyond Regional	Medium-term	Continuous	Reversible	Highly likely	Not Significant
Disruption or alteration of migration routes from the presence of the mine or from mine-related activities	Negative	Low	Regional to Beyond Regional	Long-term	Periodic	Reversible	Likely	Not Significant
Permanent changes in wildlife habitat following closure of the mine site and supporting infrastructure	Negative	Negligible	Regional	Permanent	Continuous	Irreversible	Highly likely	Not Significant

6.6.8 Uncertainty

Consistent with the uncertainty identified for the 2014 FEIS, the following key uncertainties apply to the Meliadine Extension:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the 2014 FEIS and Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- model inputs (e.g., ZOI and disturbance coefficients from developments);
- understanding of 2014 FEIS and Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the 2014 FEIS and Meliadine Extension will influence caribou); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., revegetation of wildlife habitat).

The approach to calculation of incremental and cumulative direct and indirect changes in habitat quantity for the Meliadine Extension followed the approach used for the 2014 FEIS. This approach uses conservative estimates for the footprints, zones of influence, disturbance coefficients, and duration of operation for different disturbances (Volume 6, Section 6.6.12, 2014 FEIS). With respect to the Future case, uncertainty exists for the route of the Kivalliq Hydro-Fiber Link Project. It was assumed that the footprint will be approximately 100 m wide and will occur within the proposed 1.2 km corridor. Uncertainty related to the final footprint is accounted for by use of conservative estimate of a ZOI up to 5 km (Table 6.6-9 of this Application).

Uncertainty remains related to sensory disturbance due to wind turbines to caribou and other wildlife. Monitoring and mitigation implemented as part of the TEMMP should allow adaptive management of wind turbines to limit disturbance to caribou during migration. Caribou movement monitoring and behaviour surveys are done as part of the TEMMP.

Uncertainty has also been addressed by applying a conservative estimate of effects in the residual impact classification and in the determination of significance. Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and the current knowledge of the system. It is anticipated that the baseline and existing conditions (i.e Operational) data is moderately sufficient for understanding current conditions, and that there is a moderate level of understanding of 2014 FEIS and Meliadine Extension-related impacts on the ecosystem.

Conservatisms applied to the assessment provide confidence that the assessment has not underestimated the incremental and cumulative impacts from the 2014 FEIS and Meliadine Extension and environmental significance of the Meliadine Extension with other past, present and RFFDs on wildlife, and the people that value wildlife for their livelihood. A detailed discussion of uncertainty related to the assessment of terrestrial wildlife and wildlife habitat is available in the 2014 FEIS, Volume 6, Section 6.6.12.

6.6.9 Monitoring and Follow-up

Agnico Eagle considers that existing T&C 45, 46, 47, 52, 55, 56, 57, 118, and 119 of the Project Certificate No.006 are sufficient to protect, mitigate and monitor impacts to wildlife and wildlife habitat associated with the Meliadine Extension.

Mitigation, management, and monitoring plans are summarized in Section 12 and provided in Appendix D of this Application.

Where applicable to the Meliadine Extension, Agnico Eagle has implemented new management plans, or has updated existing management plans applicable to terrestrial wildlife:

- Dust Management Plan
- Conceptual Closure and Reclamation
- Noise Abatement and Monitoring Plan
- Roads Management Plan
- Wildlife Protection and Response Plan
- Windfarm Management Plan (New)

6.7 Birds and Bird Habitat

6.7.1 Abstract

A 2% change to birds and birds habitat is predicted for Meliadine Extension compared to the 2014 FEIS. There is one new primary pathway for birds and birds habitat associated with Meliadine Extension. It is associated with the proposed windfarm and potential collision between birds and turbines causing bird injury or mortality. The magnitude of incremental and cumulative effects associated with each pathway were classified as negligible or low. Consequently, incremental effects are predicted to be not significant for each primary pathway for all bird VCs. The significance conclusions did not change from the 2014 FEIS.

6.7.2 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

Inuit Qaujimajatuqangit for the Meliadine Extension did not highlight any new concerns related to birds and bird habitat. The consultation notes pertaining to Meliadine Extension have been incorporated in Section 3 of this Application.

6.7.3 Existing Environment

Information from baseline studies conducted from 1998 to 2000, 2008 to 2009, and 2011 was used to characterize the existing environment for birds and bird habitat for the 2014 FEIS (Table 6.7-1). Those studies used a variety of species-specific methods to quantify bird populations with a focus on loons, waterfowl, upland birds, raptors, and bird species at risk. Detailed methods and results of these surveys are available in the 2014 FEIS, Volume 6, Section 6.7.

Table 6.7-1: Summary of Bird Surveys Completed for the 2014 FEIS

Survey	1998	1999	2000	2008	2009	2011
Upland bird – point count surveys				√	√	√
Shorebirds – PRISM surveys				√	√	√
Waterfowl – aerial surveys				√	√	
Loon and Swans – nest surveys	√	√	√		√	
Raptors – nest surveys	√	√	√	√	√	√

Additional data is available from the following surveys conducted as part of the TEMMP (Golder 2021f):

- Shoreline surveys of waterbodies within 200 m of the 2014 FEIS footprint (2018 to 2020)
- Point count surveys for upland birds within 1 km of the AWAR (2018 to 2020).
- Program for Regional and International Shorebird Monitoring (PRISM) surveys for shorebirds in 2018 and 2019.

To augment existing available information for the Meliadine Extension, avian use surveys were conducted in June 2018 to understand potential bird interactions with wind turbines (Golder 2018b). Supplementary breeding bird surveys were conducted in June/July 2021 within and near the proposed windfarm and airstrip footprints using point count methods (Golder 2021h).

Waterbirds

Waterfowl aerial surveys in June and July of 2008 and 2009 recorded 13 waterbird species (Volume 6, Section 6.7.3.1 of the 2014 FEIS). Canada geese *(Branta canadensis)*, snow geese *(Chen caerulescnes)*, tundra swans *(Cygnus columbianus)*, and long-tailed ducks (*Clangula hyemalis*) were the most common waterfowl observed. Waterbird density ranged across survey strata from 7.9 to 51.4 individuals/km^2 (<0.01 birds/ha) (Volume 6, Section 6.7.3.1, Tables 6.7-6 and 6.7-7 of the 2014 FEIS). The maximum density of waterbirds observed during aerial surveys over the surveyed strata when adjusted for area of water only was 0.69 birds/ha.

Six waterbird species were detected during shoreline surveys conducted from 2018 to 2019 as part of the TEMMP. The number of waterbird nests ranged annually from 20 in 2018, 22 in 2019 and 8 in 2020. Canada and cackling geese (*Chen hutchinsii*) were the most numerous nesting waterbird species. Incidental waterbird observations recorded during the TEMMP from 2018 to 2020 included 181 brant (*Branta bernicla*), 682 Canada geese, and 1,630 snow geese (*Anser caerulescens)* (Golder 2021f).

Nine waterbird species were observed in 2021 during breeding bird surveys conducted for the Meliadine Extension within and near the proposed windfarm, Tiriganiaq mining area and airstrip footprints. Canada geese and sandhill cranes (*Grus canadensis*) were the most common observed waterbirds (Golder 2021h).

Upland Birds

Eleven upland bird species were identified in four habitat types during point count surveys for upland birds from 2008 to 2011, including incidental observations (Volume 6, Section 6.7.3.2 of the 2014 FEIS). In 2008, nine identified species and one unidentified species of upland songbirds and shorebirds were recorded within the plots. Six identified species were recorded within the plots in 2009, and three identified species were recorded in 2011. Lapland longspurs (*Calcarius lapponicus*), horned larks (*Eremophila alpestris*), and savannah sparrows (*Passerculus sandwichensis*), were the most common birds observed in all years. None of the upland birds occurring within the study area are listed federally (Government of Canada 2021). The highest mean density (individuals per hectare) of upland birds was recorded in heath boulder habitat (Table 6.7-2). The mean density for all habitats combined was 1.04 individuals per hectare, which is similar to the average density of upland birds reported from the Meadowbank Mine between 2003 and 2015 (1.15 individuals per hectare) (Agnico Eagle 2018b). Variation in species richness among habitat types was low, ranging from 0 to 3 across the four different habitat types.

Table 6.7-2: Density (Individuals per Hectare) and Species Richness of Observed Upland Birds per Habitat Type in the Regional Study Area over 2008, 2009, and 2011 Combined

Habitat	Number of Plots	Species Richness		Density	
		Mean ± SE	Min-Max[a]	Mean ± SE	Min-Max[a]
Heath Tundra	222	0.52 ± 0.04	0 – 3	0.87 ± 0.09	0.00 - 8.92
Heath Boulder	17	0.82 ± 0.21	0 – 2	1.42 ± 0.44	0.00 - 6.37
Tussock Hummock	123	0.72 ± 0.07	0 – 3	1.32 ± 0.15	0.00 - 7.64
Heath Lichen – *Cetraria*	23	0.48 ± 0.12	0 – 2	0.83 ± 0.25	0.00 - 3.82
Total	**385**	**0.59 ± 0.04**	**0 – 9**	**1.04 ± 0.07**	**0.00 - 8.92**

(a) Minimum to maximum values.

Note: ± = plus or minus; SE = standard error of the mean.

Six passerine (i.e., songbird) species were detected during point count surveys during 2020 TEMMP monitoring. No upland breeding bird species at risk were recorded during the 2020 TEMMP monitoring. Annual passerine density observed within each habitat type during TEMMP point count surveys is presented in Table 6.7-3. Species richness was not different among habitat types and ranged from 0 to 4 species at the point count level (Golder 2021f).

Table 6.7-3: Passerine Bird Densities (Individuals per Hectare) by Habitat Type from 2018 to 2020

Habitat	2018 Density			2019 Density			2020 Density		
	N	Mean ± SE	Min – Max	N	Mean ± SE	Min – Max	N	Mean ± SE	Min – Max
Esker Complex	1	1.27[(a)]	1.27 – 1.27	2	0.48 ± 0.16	0.32 – 0.64	1	0.96[(a)]	0.96 – 0.96
Gravel Quarry	2	0.32 ± 0	0.32 – 0.32	2	0.96 ± 0	0.96 – 0.96	3	0.42 ± 0.21	0 – 0.64
Heath Bedrock	4	0.64 ± 0.23	0 – 0.96	5	0.45 ± 0.16	0 – 0.96	3	0.96 ± 0.18	0.64 – 1.27
Heath Boulder	18	0.92 ± 0.12	0 – 1.91	12	0.90 ± 0.15	0 – 1.59	18	0.76 ± 0.1	0 – 1.59
Heath Tundra	21	0.73 ± 0.10	0.32 – 1.91	34	0.94 ± 0.11	0 – 2.55	35	0.44 ± 0.05	0 – 1.27

Table 6.7-3: Passerine Bird Densities (Individuals per Hectare) by Habitat Type from 2018 to 2020

Habitat	2018 Density			2019 Density			2020 Density		
	N	Mean ± SE	Min – Max	N	Mean ± SE	Min – Max	N	Mean ± SE	Min – Max
Low Shrub	2	0.80 ± 0.48	0.32 – 1.27	1	0.64(a)	0.64 – 0.64	1	1.27[(a)]	1.27 – 1.27
Sedge Wetland	7	0.82 ± 0.12	0.32 – 1.27	6	0.58 ± 0.10	0.32 – 0.96	4	0.48 ± 0.21	0 – 0.96
Tussock-Hummock	17	0.75 ± 0.09	0.32 – 1.27	10	0.67 ± 0.14	0 – 1.59	7	0.32 ± 0.1	0 – 0.64
Totals	**72**	**0.78 ± 0.05**	**0 – 1.91**	**72**	**0.81 ± 0.06**	**0 – 2.55**	**72**	**0.55 ± 0.05**	**0 – 1.59**

SE = standard error; Min = minimum; Max = maximum; N = number of plots.

(a) Only the mean is reported as only a single point count was done in this habitat type in this year.

Seven upland bird species were observed in 2021 during breeding bird surveys conducted for the Meliadine Extension within and near the proposed windfarm and airstrip footprints. Consistent with previous surveys, lapland longspur and horned lark were the most common birds observed. No federally listed bird species at risk or new bird species were observed in 2021 (Golder 2021h).

Four shorebird species were identified during PRISM surveys from 2008 to 2011: least sandpiper (*Calidris minutilla*), semipalmated sandpiper (*Calidris pusilla*), dunlin (*Calidris alpina*), and semipalmated plover (*Charadrius semipalmatus*) (Volume 6, Section 6.7.3.2 of the 2014 FEIS). American golden plover (*Pluvialis dominica*) has also been recorded in the RSA. Density of shorebirds ranged from 0 to 0.05 individuals/ha and the mean Simpson's Diversity Index was low, ranging from 1.0 to 1.6 among years. No shorebird species were confirmed as breeding from 2008 to 2011.

Three shorebird species were identified during PRISM surveys in 2018 and 2019: least sandpiper, dunlin, and semipalmated plover. Breeding evidence (i.e., probable nest according to behavioural cues, paired birds) was observed for dunlin in 2018 and for semipalmated plover in both 2018 and 2019 (Nuqsana Golder 2020).

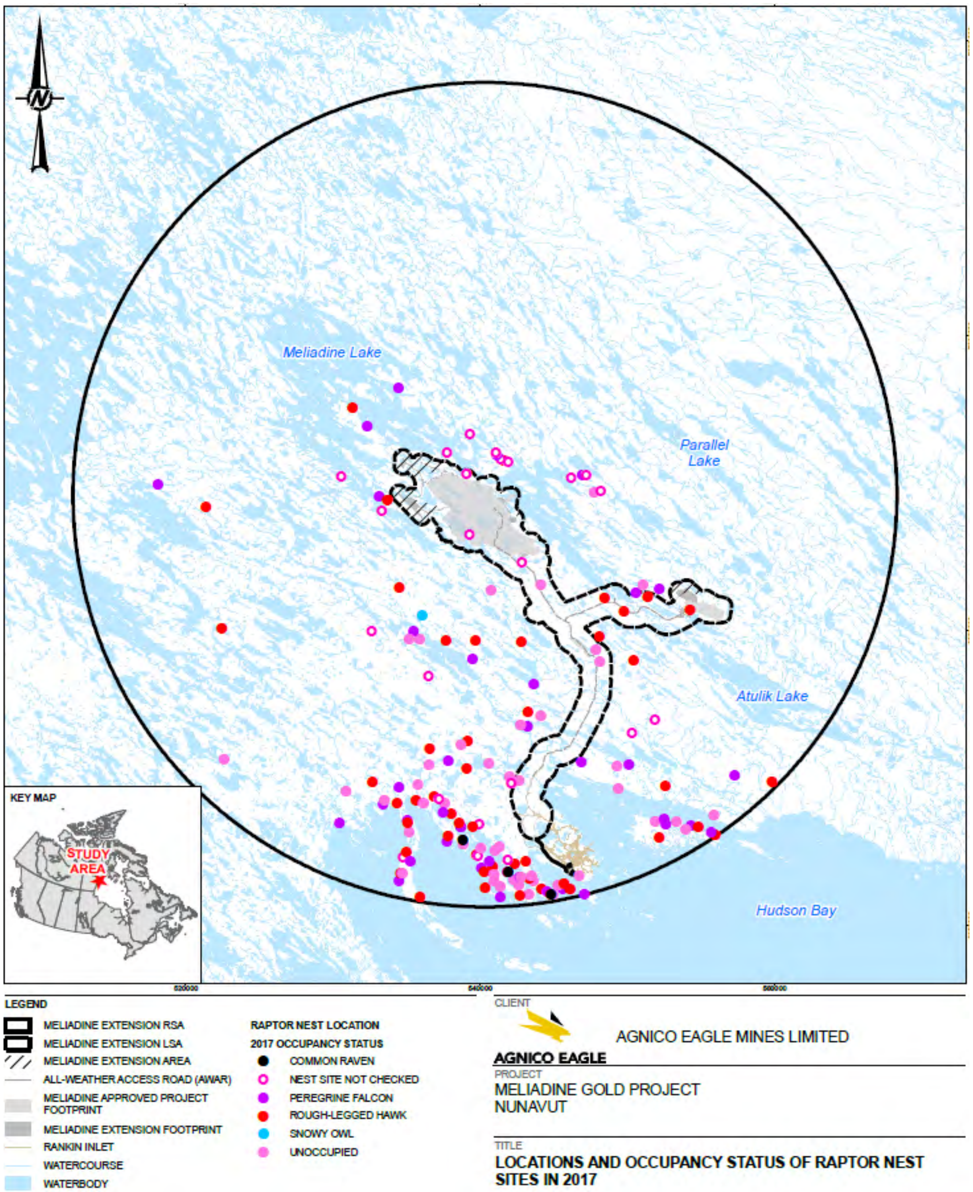
Raptors

The raptor population size in the RSA is unknown because surveys have not been completed throughout the entire RSA. A total of 158 raptor nesting sites have been identified in the RSA by the Arctic Raptors Research Program and Agnico Eagle (Figure 6.7-1). However, some of these nest sites represent alternate nest sites within a single territory and are not occupied every year. In 2017, 86 of the 135 raptor nesting sites that were checked were occupied by either peregrine falcons (*Falco peregrinus*) (n=38), rough-legged hawks (n=47), or snowy owls (*Bubo scandiacus*) (n=1). This was a year with high lemming abundance (Franke, pers. comm. 2022), which correlates with the abundance and reproductive effort and success of rough-legged hawks (*Buteo lagopus*) (Bechard and Swem 2002).

Information on occupancy and productivity is available for a subset of the identified raptor nests from the Arctic Raptors Research Program. Analysis of the data indicates that nest occupancy rates for peregrine falcons have been stable between 2013 and 2019 (mean of 0.61), while rough-legged hawk nest occupancy rates have been more variable (mean of 0.34, with peaks of 0.57 and 0.52 in 2013 and 2016, respectively) (Nuqsana Golder 2020). This variation is well-known for small mammal specialists in response to microtine rodent cycles (Nuqsana Golder 2020). Raptor productivity, defined as the number of young to reach banding age per occupied territory in a particular year, was 1.00 for rough-legged hawks and 1.05 for peregrine falcons in 2013 (Franke 2013). The long-term mean productivity for peregrine falcon nests monitored from 1980 to 2013 near Rankin Inlet is 1.12 (Franke 2013).

Incidental raptor observations recorded during the TEMMP from 2018 to 2020 included one bald eagle (Haliaeetus leucocephalus), nine peregrine falcons, 83 rough-legged hawks, and one snowy owl (Golder 2021). One short-eared owl (*Asio flammeus*) was observed during PRISM surveys in 2019.

Figure 6.7-1: Locations and Occupancy Status of Raptor Nest Sites in 2017



6.7.4 Assessment of Potential Meliadine Extension-related Effects

Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-3 of this Application and are also described in Volume 6, Sections 6.7.4.1 and 6.7.4.2 of the 2014 FEIS.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided in Table 6.7-4.

The following primary effect pathways for birds and bird habitat are associated with the Meliadine Extension:

- Direct loss and fragmentation of bird habitat from the Meliadine Extension footprint
- Permanent changes in bird habitat following closure of the mine site and supporting infrastructure
- Sensory disturbance can change the amount of different quality habitats and alter bird movement and behaviour (distribution)
- New: Collision with wind turbines causing injury or mortality to individual birds, which can affect population size

Three updated and one new primary pathways have been identified as a result of the Meliadine Extension and are assessed in more detail below. The following development cases are used to assess incremental changes associated with each primary pathway:

- Baseline case: existing developments up to 2012.
- 2014 FEIS case: existing developments up to 2012 and 2014 FEIS.
- Meliadine Extension case: 2014 FEIS case and the Meliadine Extension.

Table 6.7-4: Potential Pathways for Birds and Bird Habitat

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance - 2014 FEIS	Assessed Significance - Meliadine Extension	Rationale
Waterbirds, upland birds, raptors	General construction and operation of mine and supporting infrastructure	Direct loss and fragmentation of bird habitat from the Meliadine Extension footprint	• Compact arrangement of infrastructure to reduce the overall footprint • Windfarm footprint will overlap existing disturbance to the extent practicable. • Design roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. Make use of existing roads as much as possible to minimize windfarm footprint. • Use previous monitoring data and ongoing research from the Arctic Raptor Group to determine the location of raptor nests in the RSA. • Roads will be decommissioned and scarified. • Implement a Conceptual Closure and Reclamation Plan. • Hydraulic connections to the natural receiving environment will be re-established once water quality monitoring demonstrates the water meets water quality guidelines for direct release without further treatment.	Primary	Primary	Table 6.7-40 of 2014 FEIS	Table 6.7-11	Not Significant	No change	The Meliadine Extension footprint is considerably smaller than the 2014 FEIS footprint (227 ha and 3,369 ha, respectively) and therefore the percent change in landscape metrics (e.g., number of habitat patches, distance between habitat patches) is also expected to be smaller. The Meliadine Extension is not predicted to remove any existing raptor nests and is predicted to displace a small number of waterbird and upland birds. Thus, the 2014 FEIS assessed significance is not expected to change for Meliadine Extension.
Waterbirds, upland birds, raptors	General construction and operation of mine and supporting infrastructure	Permanent changes in bird habitat following closure of the mine site and supporting infrastructure	• Compact arrangement of infrastructure to reduce the overall footprint • Windfarm footprint will overlap existing disturbance to the extent practicable. • Design roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. Make use of existing roads as much as possible to minimize windfarm footprint. • Use previous monitoring data and ongoing research from the Arctic Raptor Group to determine the location of raptor nests in the RSA. • Roads will be decommissioned and scarified. • Implement a Conceptual Closure and Reclamation Plan. • Hydraulic connections to the natural receiving environment will be re-established once water quality monitoring demonstrates the water meets water quality guidelines for direct release without further treatment.	Primary	Primary	Table 6.7-40 of 2014 FEIS	Table 6.7-11	Not Significant	No change	A Closure and Reclamation has been prepared to a conceptual level for the Meliadine Extension. It is expected that the Meliadine Extension will result in minimal incremental changes in permanent loss of bird habitat.
Waterbirds, upland birds, raptors	General construction and operation of mine and supporting infrastructure	Sensory disturbance can change the amount of different quality habitats and alter bird movement and behaviour (distribution)	• All employees will be provided with wildlife environmental awareness training. • Operation noise levels will be monitored at select NPORs in accordance with the Noise Abatement Monitoring Plan. • A preventative maintenance program will be implemented and will include regular inspection and maintenance of equipment and equipment noise control features (e.g., mufflers). • Vehicles and equipment will be turned off when not in use to minimize idling, unless weather and/or safety conditions dictate the need to remain the vehicles and equipment turned on and in a safe operating condition. • Silencers will be installed on inlets and exhausts of certain noisy equipment (e.g., generators). • The blades of wind turbines will be equipped with trailing edge serrations to reduce noise emissions.	Primary	Primary	Table 6.7-40 of 2014 FEIS	Table 6.7-11	Not Significant	No change	Meliadine Extension is not expected to reduce significantly waterbirds, upland birds and raptors abundance. Sensory disturbance is considered reversible.
Waterbirds, upland birds, raptors	Operation of wind turbines	Collision with wind turbines causing injury or mortality to individual birds, which can affect population size	• Turbine blade height (i.e., rotor swept area) will be above average flight height of birds observed during the June 2018 avian use surveys (Golder 2018). • Use of flashing red aircraft obstruction warning lights to reduce attraction and collision of nocturnally migrating bird (Rebke et al. 2019; Kerlinger et al. 2010).	N/A	Primary	N/A	Table 6.7-11	N/A	Not Significant	Over the life of the mine, the Meliadine Extension is predicted to result in mortalities that are less than 1% of the estimated upland bird and waterbirds population in the RSA and 10% of the raptor population in the RSA. Bird mortality estimates from collision with wind turbines are considered conservative because they are based on average mortality rates reported in scientific literature. Bird mortality rates are related to abundance and flight behaviour and may vary regionally. For example, no bird carcasses were observed during 23 inspections at the Diavik windfarm in NT (Golder 2014), which is in a similar environment.

6.7.4.1 Direct Loss and Fragmentation of Bird Habitat from the Meliadine Extension Footprint

Developing the Meliadine Extension will result in the loss of vegetation communities leading to a direct loss of bird habitat. The total new footprint of the Meliadine Extension is 227 ha, of which 19 ha (8%) constitutes the airstrip and 18 ha (8%) constitutes the windfarm (Table 6.1-1). Direct habitat effects were analyzed through changes in the area and spatial configuration of habitat types on the landscape (i.e., landscape metrics). The landscape has been described in terms of ELC units, and incremental and cumulative loss of ELC units (i.e., habitat type) within the RSA is summarized in Table 6.7-5. Changes to bird abundance were calculated by multiplying the area of each habitat type within the footprint of each development case by habitat-specific bird density estimates derived from baseline surveys.

Table 6.7-5: Direct Change in Area of Habitat Types from Development within the Regional Study Area during Baseline, 2014 FEIS, and Meliadine Extension Cases

Habitat	Baseline Area (ha)	Area (ha) Removed from Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Area (ha) Removed from 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension
Bare ground	5,017	32	1	<1	<1
Heath Lichen – *Cetraria*	1,698	81	5	25	2
Heath Lichen – Hair Lichen	4,494	22	<1	11	<1
Heath Boulder	26,417	76	<1	5	<1
Heath Tundra	109,534	1,622	1	92	<1
Low Shrub	3,476	14	<1	14	<1
Tussock Hummock	25,6323	192	1	72	<1
Water	69,242	515	1	8	<1
Total	**245,510**	**2,554**	**1**	**227**	**<1**

ha = hectare; % = percent.

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

The maximum density of waterbirds observed during aerial surveys over the surveyed strata when adjusted for area of water only was 0.69 birds/ha. Key waterbird habitats in the RSA include open water (e.g., lakes and ponds) and wetlands (i.e., low shrub and tussock hummock habitats). Incremental changes to waterbird abundance from the Meliadine Extension were estimated by multiplying this estimated waterbird density by the area of the open water, low shrub, and tussock hummock habitat within the Meliadine Extension footprint. The 2014 FEIS footprint was predicted to displace approximately 0.77% of the estimated number of waterbirds in the RSA relative to Baseline case (Table 6.7-6). The Meliadine Extension is predicted to result in the direct loss of 14 ha (<1%), 72 ha (<1%), and 8 ha (<1%) of low shrub, tussock hummock, and water habitats, respectively (Table 6.7-5), and result in the displacement of approximately 65 waterbirds or <1% of the estimated number of waterbirds in the RSA relative to the 2014 FEIS case (Table 6.7-6).

Direct effects from the Meliadine Extension on upland bird populations were estimated using relative abundance (density) data from baseline studies and changes in the area of habitat types. For the 2014 FEIS, calculations were completed using raster file types within a GIS platform as described in Volume 6, Section 6.7.7.1.1 of the 2014 FEIS. For the Meliadine Extension, a simplified approach was applied, where incremental changes to upland bird abundance were estimated by multiplying the area of each habitat type within the Meliadine Extension footprint by the same habitat-specific mean density that was used to calculate changes in the 2014 FEIS (Table 6.7-6). The 2014 FEIS was predicted to decrease abundance of upland birds in the RSA by 1% relative to the Baseline case (Table 6.7-8). The Meliadine Extension is predicted to displace approximately 236 upland birds, corresponding to a decrease in abundance of <1% in the RSA relative to the 2014 FEIS case (Table 6.7-8).

Table 6.7-6: Density (Individuals per 0.09 hectare) of Observed Upland Birds per Habitat Type

Habitat Type	Bird Density (Individuals/0.09 hectare)
Bare Ground (rock outcrop)	0.11
Heath Boulder	0.13
Heath Lichen – *Cetraria*	0.08
Heath Lichen – Hair Lichen	0.08
Heath Tundra	0.08
Low Shrub	0.12
Tussock Hummock	0.12
Water	0.00

Table 6.7-7: Relative Incremental Changes in the Abundance of Waterbirds in the Regional Study Area from Direct Effects during Baseline, 2014 FEIS, and Meliadine Extension Cases

Habitat	Bird Abundance under Baseline Case	Change in Abundance Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Change in Abundance 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension
Low Shrub	2,398	-11	-<1	-10	-<1
Tussock Hummock	17,686	-134	-1	-50	-<1
Water	47,777	-377	-1	-6	-<1
Total	**67,861**	**-522**	**-1**	**-65**	**-<1**

ha = hectare; % = percent.

Table 6.7-8: Relative Incremental Changes in the Abundance of Upland Birds in the Regional Study Area from Direct Effects during Baseline, 2014 FEIS, and Meliadine Extension Cases

Habitat	Bird Abundance under Baseline Case	Change in Abundance Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Change in Abundance 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension
Bare ground	6,128	-39	-1	0	-0
Heath Boulder	38,182	-111	-<1	-7	-<1
Heath Lichen – *Cetraria*	3,924	-19	-<1	-22	-1

Habitat	Bird Abundance under Baseline Case	Change in Abundance Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Change in Abundance 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension
Heath Lichen – Hair Lichen	1,537	-78	-5	-10	-1
Heath Tundra	97,380	-1,500	-2	-81	-<1
Low Shrub	4,634	-20	-<1	-19	-<1
Tussock Hummock	34,184	-256	-1	-96	-<1
Total	**185,971**	**-2,023**	**-1**	**-236**	**-<1**

ha = hectare;% = percent.

For the 2014 FEIS, changes in the area of potential raptor nesting habitat in the 2014 FEIS LSA were estimated by calculating the loss of steep cliff habitat (i.e., slopes of 33 degrees or more). The 2014 FEIS was predicted to remove 18.79% of steep cliff habitat in the 2014 FEIS LSA relative to Baseline case. However, this does not consider spatial configuration of steep cliff habitat and raptor territoriality which influences where raptors nest (Court et al. 1988; Poole and Bromley 1988). Therefore, a similar analysis was not undertaken for the Meliadine Extension LSA. Instead, considering the available raptor nest site data from the Arctic Raptor Project, direct habitat effects on raptors were calculated by identifying the number of existing raptor nests that will be removed by the proposed Meliadine Extension footprint. The 2014 FEIS was predicted to remove four raptor nests, representing 44% and 8% of know nests in 2014 FEIS LSA and RSA, respectively. The Meliadine Extension is not predicted to remove additional raptor nests.

Habitat fragmentation from the Meliadine Extension was evaluated qualitatively by considering how trends in landscape metrics calculated for the 2014 FEIS (e.g., number of patches, mean distance to nearest patch of the same habitat, and nearest neighbour index) may change with the addition of the Meliadine Extension footprint. Generally, the 2014 FEIS was predicted to increase the number of patches, decrease the mean distance to nearest patches, and increase clustering (i.e., decrease in the nearest neighbour index) of habitat types in the RSA. The percent change in these landscape metrics from the 2014 FEIS relative to Baseline was less than 2% for all habitat types (2014 FEIS, Volume 6, Table 6.7-31). Based on the size and configuration of the Meliadine Extension footprint, it is predicted to have the same directional effect on these landscape metrics with a very small increased magnitude at the scale of the RSA. The Meliadine Extension footprint is considerably smaller than the 2014 FEIS (227 ha and 3,369 ha, respectively) and therefore the magnitude of change in landscape metrics is also expected to be negligible.

6.7.4.2 Permanent Changes in Bird Habitat Following Closure of the Mine Site and Supporting Infrastructure

The Meliadine Extension will result in a permanent change to the landscape. The closure and reclamation phase is the first opportunity to initiate major reclamation of areas lost to bird use during the construction and operations phases. Reclamation cannot completely remove the disturbance caused by the development and operation of the Meliadine Extension; certain features, such as the TSF, pit lakes and WRSF, will become permanent parts of the future landscape.

Subarctic ecosystems are slow to recover from disturbance. Permanent features of the Meliadine Mine, such as the open pits, TSF, collection ponds, other ponds, ditches, and the WRSFs will cover approximately 670 ha (0.27%) of the RSA. Approximately 1,884 ha (74%) of the land disturbed by the Meliadine Mine (including AWAR) will be reclaimed to lichen rock communities, waterbodies, or scarified natural re-vegetation (Volume 6, Section 6.7.6.1 of the 2014 FEIS). Assuming similar percentages of these habitats would be reclaimed in the Meliadine Extension footprint as identified for the 2014 FEIS, the Meliadine Extension will result in minimal incremental changes in permanent loss of bird habitat. For raptors, permanent features such as the open pits and WRSF may provide potential nesting sites and offset some permanent loss of natural nesting habitat.

6.7.4.3 Sensory Disturbance Can Change the Amount of Different Quality Habitats and Alter Bird Movement and Behaviour (Distribution)

In addition to direct habitat effects, indirect changes to habitat quality because of sensory disturbance from the Meliadine Extension have the potential to affect the population size and distribution of birds through altered movement and avoidance behaviour. Sensory disturbance from noise will be a localized effect around infrastructure and mining activities. Based on noise modelling, the magnitude of noise effects from the Meliadine Extension was predicted to be negligible (i.e., increase ≤3 dBA) at 17 receptors and low (i.e., increase ≤6 dBA) at 3 receptors (Section 5, Table 5.5-2 of this Application). Noise associated with the airstrip will be intermittent, occurring only during airplane take-off and landing.

To estimate indirect habitat effects on birds, habitat changes were quantified using ZOIs around the Meliadine Extension footprint. The ZOI used in the waterbird analysis was a 200 m buffer surrounding proposed footprint. To provide a conservative estimate of indirect effects on waterbird populations, complete loss of low shrub, tussock hummock, and water habitat within the ZOI was assumed. Indirect effects from the 2014 FEIS were predicted to reduce waterbird abundance in the RSA by 1.69% relative to Baseline case. Incremental indirect effects from the Meliadine Extension are predicted to displace approximately 143 waterbirds, corresponding to a decrease in abundance of <1% in the RSA relative to the 2014 FEIS case (Table 6.7-9).

Indirect effects from the 2014 FEIS on upland bird populations were estimated using a curvilinear one-asymptote relationship and a 1 km ZOI (Figure 6.7-15 in the 2014 FEIS). Upland bird densities were reduced (but not completely removed) within the ZOI. The adjusted densities were multiplied by the habitat area within the 1 km ZOI. Indirect effects from the 2014 FEIS were predicted to decrease total upland bird abundance by 2% in the RSA relative to Baseline Case. Generalized linear models based on data collected during TEMMP monitoring point count surveys along the AWAR indicated distance had a positive effect on bird density, meaning density was highest at farthest distances from the AWAR (Golder 2021f). Based on a qualitative examination of these generalized linear models, it is conservatively assumed that upland bird density will decrease by 50% within 500 m of the Meliadine Extension footprint. The Meliadine Extension is predicted to displace approximately 426 upland birds, corresponding to a decrease in abundance of <1% in the RSA relative to the 2014 FEIS case (Table 6.7-10).

The ZOI used in the raptor analysis was an 800 m buffer surrounding development footprint. Known, potential raptor nests within this ZOI were determined using a GIS platform. Nine raptor nests (17% of existing nest sites in the RSA) are within 800 m of the 2014 FEIS footprint and may be influenced by sensory effects. There are no additional raptor nests within 800 m of the Meliadine Extension footprint. Raptors may habituate to sensory disturbance. For example, peregrine falcons have successfully nested in open pits at the Ekati diamond mine (BHPB 2007) and at the Meadowbank Mine. A study near two diamond mines in the barren-ground tundra of the Northwest Territories determined that peregrine falcons, rough-legged hawks, and gyrfalcons had higher nest occupancy closer to mine sites, and there were no negative effects of human activity on nest productivity (Coulton et al. 2013).

Table 6.7-9: Relative Incremental Changes in the Abundance of Waterbirds in the Regional Study Area from Indirect Effects during Baseline, 2014 FEIS, and Meliadine Extension Cases

Habitat	Bird Abundance under Baseline Case	Change in Abundance Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Change in Abundance 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension
Low Shrub	2,385	-22	-1	-12	-1
Tussock Hummock	17,427	-455	-3	-74	-<1
Water	47,356	-658	-1	-57	-<1
Total	**67,168**	**-1,135**	**-2**	**-143**	**-<1**

ha = hectare; % = percent.

Table 6.7-10: Relative Incremental Changes in the Abundance of Upland Birds in the Regional Study Area from Indirect Effects during Baseline, 2014 FEIS, and Meliadine Extension Cases

Habitat	Bird Abundance under Baseline Case	Change in Abundance Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Change in Abundance 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension
Bare ground	5,710	-45	-1	0	-0
Heath Boulder	37,466	-232	-1	-19	-<1
Heath Lichen – *Cetraria*	3,653	-40	-1	-15	-<1
Heath Lichen – Hair Lichen	1,521	-119	-8	-8	-1
Heath Tundra	95,964	-2178	-2	-217	-<1
Low Shrub	4,607	-31	-1	-33	-1
Tussock Hummock	33,543	-359	-1	-134	-<1
Total	**182,465**	**-3005**	**-2**	**-426**	**-<1**

ha = hectare; % = percent.

6.7.4.4 Collision with Wind Turbines Causing Injury or Mortality to Individual Birds, Which Can Affect Population Size

To evaluate the potential effects of Meliadine Extension on birds related to mortality from collision with wind turbines, change in bird abundance from collisions with wind turbines was estimated by applying estimated mortality rates reported in scientific literature to the number and operational life of wind turbines proposed for the Meliadine Extension.

The Meliadine Extension will include 11 wind turbines, five of which will be operational for 18 years from 2026 to 2043 and six will conservatively be operational for 16 years from 2028 to 2043. Over the life of mine, this equates to 186 turbine-years. The operational life of wind turbines used in this assessment is a conservative estimate because the construction plan for the windfarm is still under development.

In a review of bird mortality due to collisions with wind turbines in Canada, Zimmerling et al. (2013) estimated that the average number of birds killed per turbine per year was 8.2 ± 1.4 (95% C. I.) and that passerines (i.e., songbirds) comprise approximately 80% of bird mortalities. Multiplying the estimated average songbird collisions per turbine per year (i.e., 6.6 individuals) derived from Zimmerling et al. (2013) by the number of operational turbine-years, the Meliadine Extension is predicted to result in 33 songbird mortalities per year when five wind turbines are operational and 73 songbird mortalities per year when eleven wind turbines are operational. This equals 1,220 songbird mortalities due to collision with wind turbines over the life of mine and represents <1% of the estimated upland bird population in the RSA relative to the 2014 FEIS case.

Zimmerling et al. (2013) do not provide an estimated proportional composition of waterbird mortalities. Assuming a conservative estimate of 20% (i.e., all remaining non-passerines are waterbirds), yields an estimated 1.6 waterbirds killed per turbine per year. Based on this estimate, the Meliadine Extension is predicted to result in an estimated 305 waterbird mortalities due to collision with wind turbines over the life of mine. This represents <1% of the estimated waterbird population in the RSA relative to the 2014 FEIS case.

Raptors appear to be especially susceptible to collision risk because they are large-bodied species with high wing loading and relatively low maneuverability and forage aerially (Smith and Dwyer 2016). Raptors use thermal and orographic updrafts during migratory flight, which makes them susceptible to collision risk when they gain lift from topographical features near wind turbines such as cliffs and steep slopes (Marques et al. 2014). Further, their reproductive strategy, specifically delayed maturity, long lifespans, and low reproductive rates, could mean that even a few mortalities can have population-level effects (Smith and Dwyer 2016). Data from the United States indicate an average 0.03 raptor mortalities per turbine per year (range 0 to 0.10) (Erickson et al. 2001). Using this estimate, the Meliadine Extension is predicted to result in an estimated 0.36 raptor mortalities per year when all 11 wind turbines are operational, which equates to 6 raptor mortalities due to collision with wind turbines over the life of mine (i.e., 18-year period). Note that mortality rates shown from Erickson et al. (2001) have been rounded to two decimal points for consistency.

This is considered a conservative estimate because raptor nest surveys have not been completed throughout the entire RSA and there are likely additional undetected raptor nests and individuals (i.e., breeders and floaters). These population estimates also do not account for annual survivorship and recruitment. During the 18-year period corresponding to the life-of-mine, some adult raptors will die of causes unrelated to the Project and be replaced by new individuals recruited into the regional breeding populations, as evidenced by stable peregrine falcon nest occupancy rates between 2013 and 2019 (Nuqsana Golder 2020). Therefore, the number of individual raptors nesting within the RSA over the 18-year period is greater than that nesting during any single breeding season due to turnover.

Furthermore, these estimated population decreases are based only on the number of nesting adult raptors and do not consider fledged young in the total estimated population, which may constitute some of the turbine collision mortalities. Raptor productivity was 1.00 young per occupied nest for rough-legged hawks and 1.05 young per occupied nest for peregrine falcons in 2013 (Franke 2013). Accounting for an annual productivity of 1.00 young per occupied nest, 86 occupied raptor nests would fledge 1,548 young over the 18-year period corresponding to the life of mine. If fledged young are considered part of the raptor population potentially affected by collisions with turbines, then the total estimated population in the RSA is 1,720 individuals (i.e., 172 nesting adults plus 1,548 fledged young). Mortality of adult raptors during the nesting period could jeopardize the survival of their young, resulting in one additional indirect mortality of a nestling for every adult killed from collision with turbines based on an annual productivity of 1.00 young per nest. Assuming there are six adult raptor mortalities, which in turn results in six nestling mortalities, 12 raptor mortalities would represent a population decrease of <1%. Depending on how the raptor population in the RSA is estimated (i.e., whether recruitment of fledged young is considered), six raptor mortalities from turbine collisions may represent a population decrease ranging from <1% to 4%. The 4% population decrease was considered during the residual impact classification such that the effects assessment is conservative.

Bird mortality estimates from collision with wind turbines are considered conservative. Bird mortality rates are related to bird abundance and flight behaviour (Smith and Dwyer 2016; Drewitt and Langston 2006). During avian use surveys at the proposed windfarm, the average height of flying birds was 10.0 m (Golder 2018b), which is below the rotor swept area of most industrial wind turbine models. At the Diavik mine windfarm in the Northwest Territories, which is located in a similar environment to Meliadine Extension, no bird carcasses were observed during 23 inspections conducted between 11 June and 23 August 2013 as part of post-construction mortality monitoring (Golder 2014). However, searcher efficiency is imperfect and some carcasses may go undetected during mortality monitoring. Nevertheless, mortality rates at Meliadine Extension are likely to be similar to those at the Diavik mine windfarm and lower than the Canada-wide estimate reported by Zimmerling et al. (2013). Furthermore, the number of mortalities is expressed as a percentage of the RSA population, whereas mortalities are likely to include some migrants that breed elsewhere. Therefore, the estimated number of mortalities is likely to represent a smaller percentage of the bird populations in the RSA than what is reported.

6.7.5 Residual Impact Classification

The following new and/or updated primary effect pathways were identified for the Meliadine Extension:

- Direct loss and fragmentation of bird habitat from the Meliadine Extension footprint
- Permanent changes in bird habitat following closure of the mine site and supporting infrastructure
- Sensory disturbance can change the amount of different quality habitats and alter bird movement and behaviour (distribution)
- Collision with wind turbines causing injury or mortality to individual birds, which can affect population size

The residual impact classification for these primary effect pathways is summarized in Table 6.7-11. Definitions for criteria used in the residual impact classification are provided in Section 4, Table 4.5-1 of this Application. Consistent with the 2014 FEIS, the following thresholds for magnitude were applied for quantitative analyses and results (e.g., loss and fragmentation of habitat, and changes to habitat suitability):

- negligible: less than a 1% change from the Meliadine Extension relative to 2014 FEIS values;
- low: 1 to 10% change from the Meliadine Extension relative to 2014 FEIS values;
- moderate: greater than 10 to 20% change from the Meliadine Extension relative to 2014 FEIS values; and
- high: more than 20% change from the Meliadine Extension relative to 2014 FEIS values.

Table 6.7-11: Incremental Residual Impact Classification and Determination of Significance for Birds and Bird Habitat Valued Component

Effect Pathways	Valued Component	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance
Direct loss and fragmentation of bird habitat from the Meliadine Extension footprint	upland birds	negative	negligible	regional	permanent	Continuous	irreversible	highly likely	not significant
	waterbirds	negative	negligible	regional	long-term	continuous	reversible	highly likely	not significant
	raptors	negative	negligible	regional	long-term	continuous	irreversible	highly likely	not significant
Permanent changes in bird habitat following closure of the mine site and supporting infrastructure	Raptors	negative	negligible	regional	permanent	continuous	irreversible	highly likely	not significant
	Upland birds, waterbirds	negative	negligible	regional	permanent	continuous	irreversible	highly likely	not significant
Sensory disturbance can change the amount of different quality habitats and alter bird movement and behaviour (distribution)	upland birds, waterbirds	negative	negligible	local	medium-term	continuous	reversible	likely	not significant
	raptors	negative	negligible	local	medium-term	continuous	reversible	likely	not significant
Collision with wind turbines causing injury or mortality to individual birds, which can affect population size	Upland birds, waterbirds	negative	negligible	beyond regional	medium-term or unknown	periodic	reversible or irreversible	highly likely	not significant
	raptors	negative	Negligible to low	beyond regional	medium-term or unknown	periodic	reversible or irreversible	highly likely	not significant

6.7.5.1 Direct Loss and Fragmentation of Bird Habitat from the Meliadine Extension Footprint

Following implementation of mitigation measures, the Meliadine Extension is predicted to decrease abundance of waterbirds and upland birds by <1% in the RSA, relative to the 2014 FEIS case, as a result of direct habitat loss. The magnitude of incremental effect of direct habitat loss for raptors is negligible because no additional loss of existing nest sites is anticipated. Magnitude of incremental direct habitat loss for waterbirds and upland birds is also negligible because it represents less than a 1% change due to the Meliadine Extension relative to the 2014 FEIS case. Habitat loss from the Meliadine Extension is expected to be a local scale effect but fragmentation is a landscape-scale process and so is expected to have effects on bird populations at the regional scale. Direct habitat loss will be continuous because the effects will persist throughout the life of the mine. Following completion of mining, the open pits will be flooded over a period of 7 years. Once flooded, they may constitute suitable open water habitat for waterbirds. Therefore, duration of potential effects of direct habitat loss will be long-term and reversible for waterbirds. However, effects will be permanent and irreversible for upland birds and raptors, because upland habitat within the open pit footprint will be converted to open water following closure. The likelihood that habitat loss will occur is highly likely based on the overlap of proposed footprint with suitable habitat for waterbirds and upland birds.

Incremental changes to habitat quantity from the Meliadine Extension are negligible in magnitude and not likely to decrease resilience and increase the risk to bird population maintenance and opportunities for traditional and non-traditional use. Consequently, incremental effects from changes in habitat quantity and fragmentation are predicted to be not significant for waterbirds, upland birds, and raptors. Thresholds identified by empirical and theoretical work on the relationship between loss of suitable habitat and the likelihood of population decline suggested that critical thresholds for changes in rates of population parameters in non-tropical bird and mammal species occur between 10% and 60% of original habitat (Andrén 1994, 1999; Fahrig 1997; Mönkkönen and Reunanen 1999; Flather and Bevers 2002). Incremental effects from the Meliadine Extension are predicted to remove less than 2% of each habitat type in the RSA relative to the 2014 FEIS case. The incremental habitat-specific losses are below the critical thresholds for population decline. Significance conclusions did not change from the 2014 FEIS.

6.7.5.2 Permanent Changes in Bird Habitat Following Closure of the Mine Site and Supporting Infrastructure

Reclamation estimates for the Meliadine Extension are not available because the Conceptual Closure and Reclamation Plan has been prepared to a conceptual level. Thus, residual impact classification of incremental effects is generally the same as that for direct habitat loss (Section 6.7.5.1), which would represent the maximum possible incremental permanent habitat loss if no reclamation was to occur, except that duration is permanent and effects are irreversible. Incremental residual impact classification for permanent habitat loss is summarized in Table 6.7-11.

Incremental effects of permanent changes to bird habitat are not likely to decrease resilience and increase the risk to bird population maintenance and opportunities for traditional and non-traditional use. Consequently, incremental effects are predicted to be not significant for waterbirds, upland birds, and raptors. Significance conclusions did not change from the 2014 FEIS.

6.7.5.3 Sensory Disturbance Can Change the Amount of Different Quality Habitats and Alter Bird Movement and Behaviour (Distribution)

Incremental indirect effects of sensory disturbance are predicted to be negligible for raptors because the sensory disturbance ZOI around the Meliadine Extension footprint does not overlap additional raptor nests. Magnitude of indirect habitat loss for waterbirds and upland birds is negligible because it represents less than a 1% change due to the Meliadine Extension relative to the 2014 FEIS case. Incremental indirect effects are expected to be local in geographic extent because they reduce habitat quality adjacent to the proposed footprint. Indirect effects will be continuous because sensory disturbance (e.g., noise, light) is anticipated during all phases of the Meliadine Extension from construction through closure. Indirect effects of habitat loss will be medium-term because habitat effectiveness is expected to return to baseline conditions with the removal of sensory disturbance following closure. Accordingly, sensory disturbance is considered reversible. The likelihood that indirect effects will occur is highly likely based on predicted increase in noise from activities associated with the Meliadine Extension (Golder 2021g).

Incremental changes to habitat quality from sensory disturbance associated with the Meliadine Extension are negligible in magnitude and not likely to decrease resilience and increase the risk to bird population maintenance and opportunities for traditional and non-traditional use. Consequently, incremental effects from changes to habitat quality, movement, and behaviour are predicted to be not significant for waterbirds, upland birds, and raptors. Significance conclusions did not change from the 2014 FEIS.

6.7.5.4 Collision with Wind Turbines Causing Injury or Mortality to Individual Birds, Which Can Affect Population Size

The following mitigation measures proposed to reduce the effects of sensory disturbance:

- Pre-construction avian use surveys have informed the placement of wind turbines based on potential mortality risk to birds.
- Turbine blade height (i.e., rotor swept area) will be above average flight height of birds observed during the June 2018 avian use surveys (Golder 2018b).
- Use of flashing red aircraft obstruction warning lights to reduce attraction and collision of nocturnally migrating bird (Rebke et al. 2019; Kerlinger et al. 2010).

The Meliadine Extension is predicted to decrease abundance of waterbirds and upland birds by <1% in the RSA, relative to Approved Project case, as a result of mortality from collisions with wind turbines. Magnitude of mortality from collisions with wind turbines is considered negligible for waterbirds and upland birds because it represents less than a 1% change due to the Meliadine Extension. The abundance of raptors within the RSA may decrease by <1% to 4% relative to the Approved Project case due to collisions with wind turbines, which is considered negligible to low in magnitude based on magnitude thresholds defined in Section 6.7.4. The effects of mortality from collisions with wind turbines are expected to be beyond regional in geographic extent because collisions during migration have potential to affect breeding populations beyond the RSA. Mortality from collisions will be periodic because bird collisions with wind turbines are likely to occur intermittently throughout operations, with highest frequency during migration when the number of birds flying through the windfarm is likely to be greatest. Closure options for the windfarm are being explored and include decommissioning and dismantling turbines or handing them over to provide power to nearby communities or other mines if transmission lines are built by end of the life of the Mine (Section 2.3.12). Depending on the selected closure option, the effects may be medium-term and reversible if the wind turbines are decommissioned at closure or of unknown duration and irreversible if their operation is extended for other purposes. The likelihood is considered highly likely based on documented bird mortality at wind turbines reported in scientific literature (Loss et al. 2013; Zimmerling et al. 2013).

Species composition data suggest that <0.2% of the Canadian population of any species is currently affected by mortality or displacement from wind turbine development (Zimmerling et al. 2013). Desholm (2009) concluded that from a demographic point of view, passerines (i.e., songbirds) are relatively insensitive to wind farm-related adult mortality. Incremental changes to bird mortality from the Meliadine Extension are negligible to low in magnitude and not likely to decrease resilience and increase the risk to bird population maintenance and opportunities for traditional and non-traditional use. Consequently, incremental changes to bird mortality are predicted to be not significant for waterbirds, upland birds, and raptors.

6.7.6 Cumulative Effects Assessment

6.7.6.1 Methods

Cumulative effects to birds were considered for primary pathways at the scale of the RSA. The following development cases were identified for the cumulative effects assessment for birds and bird habitat:

- Reference case: pristine conditions, no development on the landscape.
- Baseline case: existing developments up to 2012.
- 2014 FEIS case: existing developments up to 2012 and 2014 FEIS.
- Meliadine Extension case: 2014 FEIS case and the Meliadine Extension.
- Future case: Meliadine Extension case and RFFD.

Unlike for wildlife and wildlife habitat (Section 6.6.7), there is no Existing Conditions case for the cumulative effects assessment for birds and bird habitat. This is because new developments that have occurred since the 2014 FEIS are outside the RSA, except for the Rankin Inlet contaminated site which is within the community of Rankin Inlet and its footprint is accounted for by the community footprint. Therefore, at the scale of the RSA, the 2014 FEIS case represents the existing conditions for the Meliadine Extension.

As described in the cumulative effects assessment for wildlife and wildlife habitat (Section 6.6.7), projects that were considered for the future conditions in the 2014 FEIS but will not proceed to development were excluded from the cumulative effects assessment for the Meliadine Extension. Reasonably foreseeable developments within the RSA that were included in the Future Case are the Kivalliq Hydro-Fiber Link Project and the Rankin Inlet sandpit, which are described in Section 6.6.7.

Landscape metrics (i.e., direct and indirect changes in area of habitat) resulting from RFFDs were estimated using the same approaches described for assessing incremental effects of the Meliadine Extension in Section 6.7.5. The following equations were used to estimate the percent relative change in the value of landscape metrics for each development case:

- Existing cumulative effects = (baseline value – reference value) / reference value;
- 2014 FEIS incremental effects = (2014 FEIS value – baseline value) / 2014 FEIS value;
- Meliadine Extension incremental effects = (Meliadine Extension value – baseline value) / Meliadine Extension value;
- Future incremental effects = (future value – Meliadine Extension value) / Meliadine Extension value; and
- Future cumulative effects = (future value – reference value)/ reference value.

The resulting value was multiplied by 100 to give the percent change in a landscape metric for each comparison. The result for each development scenario provides both the direction and magnitude of the effect. For example, a high negative value for habitat area would indicate a substantial loss of habitat type.

The same criteria were used for residual impact classification of cumulative effects and incremental Meliadine Extension effects. These criteria are defined in Section 4, Table 4.5-2 of this Application.

6.7.6.2 Direct Loss and Fragmentation of Bird Habitat from the Meliadine Extension Footprint

Cumulative loss of ELC units (i.e., habitat type) within the RSA is summarized in Table 6.7-12. Changes to bird abundance were calculated by multiplying the area of each habitat type within the footprint of each development case by habitat-specific bird density estimates derived from baseline surveys, as described in Section 6.7.4-1. Cumulative direct loss of habitat from Reference case to the Future case is expected to decrease total waterbird abundance in the RSA by 1% (Table 6.7-13) and upland bird abundance by 2% (Table 6.7-14).

Direct habitat effects on raptors were calculated by determining the number of existing raptor nests identified by the Arctic Raptor Project that will be removed by the footprint of previous, existing, and RFFDs. The 2014 FEIS was predicted to remove four raptor nests, representing 44% and 8% of know nests in 2014 FEIS LSA and RSA, respectively. The Meliadine Extension and RFFDs are not predicted to remove additional raptor nests.

Table 6.7-12: Direct Change in Area of Habitat Types from Development within the Regional Study Area during Baseline, 2014 FEIS, Meliadine Extension and Future Cases

Habitat	Reference Area (ha)	Area (ha) Removed from Reference to Baseline	% Change Reference to Baseline	Area (ha) Removed from Baseline to 2014 FEIS	% Change Baseline to 2014 FEIS	Area (ha) Removed from 2014 FEIS to Meliadine Extension	% Change 2014 FEIS to Meliadine Extension	Area (ha) Removed from Meliadine Extension to Future	% Change Meliadine Extension to Future	Area (ha) Removed from Reference to Future	% Cumulative Change Reference to Future
Bare ground	5,263	246	5	32	1	<1	<1	39	1	318	6
Heath Lichen – *Cetraria*	1,733	35	2	81	5	25	2	22	1	164	9
Heath Lichen – Hair Lichen	4,504	10	<1	22	<1	11	<1	9	<1	52	1
Heath Boulder	26,500	82	<1	76	<1	5	<1	125	<1	287	1
Heath Tundra	109,826	292	<1	1,622	1	92	<1	427	<1	2,433	2
Low Shrub	3,478	3	<1	14	<1	14	<1	8	<1	39	1
Tussock Hummock	25,699	66	<1	192	1	72	<1	140	1	469	2
Water	69,298	56	<1	515	1	8	<1	79	<1	658	1
Total	**246,300**	**789**	**<1**	**2,554**	**1**	**227**	**<1**	**850**	**<1**	**4,420**	**2**

ha = hectare; % = percent.

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

Table 6.7-13: Cumulative Changes in the Abundance of Waterbirds in the Regional Study Area from Direct Effects from Reference to Reasonably Foreseeable Projects

Habitat	Area (ha)	Bird Abundance under Reference Case	% Change Reference to Baseline	% Change Baseline to 2014 FEIS	% Change Approved Project to Meliadine Extension	% Change Meliadine Extension to Future	% Cumulative Change from Reference
Low Shrub	3,478	2,400	-<1	-<1	-<1	-<1	-1
Tussock Hummock	25,699	17,732	-<1	-1	-<1	-1	-2
Water	69,298	47,815	-<1	-1	-<1	-<1	-1
Total	**98,475**	**67,947**	**-<1**	**-1**	**-<1**	**-<1**	**-1**

ha = hectare; % = percent.

Table 6.7-14: Cumulative Changes in the Abundance of Upland Birds in the Regional Study Area from Direct Effects from Reference to Reasonably Foreseeable Projects

Habitat	Area (ha)	Bird Abundance under Reference Case	% Change Reference to Baseline	% Change Baseline to 2014 FEIS	% Change Approved Project to Meliadine Extension	% Change Meliadine Extension to Future	% Cumulative Change from Reference
Bare ground	5,263	6,430	-5	-1	-0	-1	-6
Heath Boulder	26,500	38,301	-<1	-<1	-<1	-<1	-1
Heath Lichen – *Cetraria*	1,733	4,005	-2	-<1	-1	-<1	-3
Heath Lichen – Hair Lichen	4,504	1,541	-<1	-5	-1	-8	-13
Heath Tundra	109,826	97,634	-<1	-2	-<1	-<1	-2
Low Shrub	3,478	4,638	-<1	-<1	-<1	-<1	-1
Tussock Hummock	25,699	34,273	-<1	-1	-<1	-1	-2
Total	**177,002**	**186,821**	**-<1**	**-1**	**-<1**	**-<1**	**-2**

ha = hectare; % = percent.

6.7.6.3 Permanent changes in bird habitat following closure of the mine site and supporting infrastructure

Permanent features of the Meliadine Mine, such as the open pits, TSF, collection ponds, other ponds, ditches, and the WRSFs will cover approximately 670 ha (<1%) of the RSA. The Meliadine Extension will result in direct loss of 227 ha (<1%) of the RSA. Although reclamation estimates are not available for the Meliadine Extension, not all direct habitat loss will constitute permanent change in habitat because some of it will be reclaimed. Similarly, not all direct habitat loss from other RFFDs will constitute permanent change in bird habitat. In the absence of reclamation estimates, it is conservatively noted that the maximum possible cumulative permanent change in habitat is equal to the cumulative direct loss of habitat, which is 2% of the RSA (Table 6.7-12).

6.7.6.4 Sensory Disturbance Can Change the Amount of Different Quality Habitats and Alter Bird Movement and Behaviour (Distribution)

To estimate cumulative indirect habitat effects on birds, habitat changes were quantified using the same ZOIs around RFFDs as those applied to the Meliadine Extension in Section 6.7.4.3. Cumulative indirect loss of habitat from Reference case to Future case is expected to decrease total waterbird abundance in the RSA by 4% (Table 6.7-15) and total upland bird abundance in the RSA by 6% (Table 6.7-16).

Cumulative indirect effects may impact 10 raptor nests (19% of existing nest sites in the RSA). Nine raptor nests (17% of existing nest sites in the RSA) are within 800 m of the 2014 FEIS footprint and one additional rough-legged hawk nest (AR-18c) is within 800 m of RFFD footprints. However, raptors may habituate to sensory disturbance. For example, peregrine falcons have successfully nested in open pits at the Ekati diamond mine (BHPB 2007). A study near two diamond mines in the barren-ground tundra of the Northwest Territories determined that peregrine falcons, rough-legged hawks, and gyrfalcons had higher nest occupancy closer to mine sites, and there were no negative effects of human activity on nest productivity (Coulton et al. 2013).

Table 6.7-15: Cumulative Changes in the Abundance of Waterbirds in the Regional Study Area from Indirect Effects from Reference to Reasonably Foreseeable Projects

Habitat	Area (ha)	Bird Abundance under Reference Case	% Change Reference to Baseline	% Change Baseline to 2014 FEIS	% Change Approved Project to Meliadine Extension	% Change Meliadine Extension to Future	% Cumulative Change from Reference
Low Shrub	3,478	2,400	-<1	-1	-1	-1	-3
Tussock Hummock	25,699	17,732	-2	-3	-<1	-2	-6
Water	69,298	47,815	-1	-1	-<1	-1	-3
Total	**98,475**	**67,947**	**-1**	**-2**	**-<1**	**-1**	**-4**

ha = hectare; % = percent.

Table 6.7-16: Cumulative Changes in the Abundance of Upland Birds in the Regional Study Area from Indirect Effects from Reference to Reasonably Foreseeable Projects

Habitat	Area (ha)	Bird Abundance under Reference Case	% Change Reference to Baseline	% Change Baseline to 2014 FEIS	% Change Approved Project to Meliadine Extension	% Change Meliadine Extension to Future	% Cumulative Change from Reference
Bare ground	5,263	6,430	-11	-1	-0	-2	-13
Heath Boulder	26,500	38,301	-2	-1	-<1	-1	-4
Heath Lichen – *Cetraria*	1,733	4,005	-9	-1	-<1	-2	-12
Heath Lichen – Hair Lichen	4,504	1,541	-1	-8	-1	-3	-12
Heath Tundra	109,826	97,634	-2	-2	-<1	-1	-6
Low Shrub	3,479	4,638	-1	-1	-1	-1	-3
Tussock Hummock	25,699	34,273	-2	-1	-<1	-2	-5
Total	**177,002**	**186,821**	**-2**	**-2**	**-<1**	**-2**	**-6**

ha = hectare;% = percent.

6.7.6.5 Collision with Wind Turbines Causing Injury or Mortality to Individual Birds, Which Can Affect Population Size

Existing and RFFDs within the RSA do not include wind turbines, therefore the cumulative effects are the same as the incremental effect from the Meliadine Extension described in Section 6.7.4.4.

6.7.6.6 Cumulative Effects Residual Impact Classification

Residual impact classification of cumulative effects was completed for each of the four primary pathways identified for the Meliadine Extension. The same criteria were used for residual impact classification of cumulative effects and incremental Meliadine Extension effects. These criteria are defined in Section 4, Table 4.5-2 of this Application.

The residual impact classification for primary effect pathways is summarized in Table 6.7-17. Essentially, the only difference in the outcome of impact criteria between cumulative and incremental effects from the Meliadine Extension is in the magnitude and geographic extent of impacts. The magnitude for cumulative impacts involves changes from Reference case through application of the Meliadine Extension and into the Future case, while incremental impacts are based on changes from the Meliadine Extension relative to the 2014 FEIS values. The magnitude of cumulative effects associated with each pathway are negligible to low for all VCs because they are predicted to result in a less than 10% change relative to Reference Case. One exception is sensory disturbance to raptors, which is moderate in magnitude because 10 raptor nests (19% of existing nest sites in the RSA) may be impacted. However, raptors may habituate to sensory disturbance (BHPB 2007; Coulton et al. 2013). Cumulative impacts from Meliadine Extension and other developments influence the entire annual range of bird populations (i.e., regional to beyond scale). In contrast, the geographic extent of incremental impacts from the Meliadine Extension may have a local or regional influence on bird populations.

Cumulative effects from primary effect pathways are not expected to decrease resilience and increase the risk to bird population maintenance and opportunities for traditional use. Consequently, cumulative effects from each primary effect pathway are considered not significant for all bird VCs. These conclusions are consistent with the 2014 FEIS.

Table 6.7-17: Cumulative Residual Impact Classification and Determination of Significance for Birds and Bird Habitat Valued Component

Effect Pathways	Valued Component	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance
Direct loss and fragmentation of bird habitat from the Meliadine Extension footprint	upland birds	negative	low	regional	permanent	Continuous	irreversible	highly likely	not significant
	waterbirds	negative	low	regional	long-term	continuous	reversible	highly likely	not significant
	raptors	negative	low	regional	long-term	continuous	irreversible	highly likely	not significant
Permanent changes in bird habitat following closure of the mine site and supporting infrastructure	Raptors	negative	low	regional	permanent	continuous	irreversible	highly likely	not significant
	Upland birds, waterbirds	negative	negligible	regional	permanent	continuous	irreversible	highly likely	not significant
Sensory disturbance can change the amount of different quality habitats and alter bird movement and behaviour (distribution)	upland birds, waterbirds	negative	low	regional	medium-term	continuous	reversible	likely	not significant
	raptors	negative	moderate	regional	medium-term	continuous	reversible	likely	not significant
Collision with wind turbines causing injury or mortality to individual birds, which can affect population size	Upland birds, waterbirds	negative	negligible	beyond regional	medium-term or unknown	periodic	reversible or irreversible	highly likely	not significant
	raptors	negative	negligible to low	beyond regional	medium-term or unknown	periodic	reversible or irreversible	highly likely	not significant

6.7.7 Uncertainty

The following key uncertainties apply to the Meliadine Extension and the assessment:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- model inputs (e.g., ZOI and disturbance coefficients from developments);
- bird mortality estimates from collision with wind turbines;
- understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will influence raptors); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts.

Uncertainty has been addressed by applying a conservative estimate of effects in the residual impact classification and in the determination of significance. Bird mortality estimates from collision with wind turbines used in this assessment are based on averages from across Canada and are considered conservative as discussed in Section 6.7.4.4.

A detailed discussion of the remaining key uncertainties related to the assessment of birds and bird habitat is available in the 2014 FEIS, Volume 6, Section 6.7.15. Overall, the Meliadine Extension does not influence assessment uncertainty relative to the 2014 FEIS.

6.7.8 Monitoring and Follow-up

Agnico Eagle considers that existing T&C 10, 58, 59, 60, 61, 62, 69, 70, 71, 72, 73, 74 and 75 of the Project Certificate No.006 are sufficient to protect, mitigate and monitor impacts to wildlife and wildlife habitat associated with the Meliadine Extension.

Where applicable to the Meliadine Extension, Agnico Eagle has implemented new management plans, or has updated existing management plans applicable to terrestrial wildlife:

- Conceptual Closure and Reclamation
- TEMMP
- Windfarm Management Plan (New)

To address key uncertainties associated with new primary effect pathways introduced by the Meliadine Extension, the TEMMP will be updated to include a bird mortality monitoring program at the windfarm to test impact predictions by quantifying the number of bird collisions and species composition. The bird collision monitoring program will consist of weekly carcass searches around wind turbines from June 15 to August 15 during the first three years of operation, as well as searcher efficiency and scavenger removal trials to estimate the proportion of carcasses that may go undetected.

7 FRESHWATER ENVIRONMENT

7.1 Introduction

The freshwater section provides an update of the 2014 FEIS, and the 2018 and 2020 FEIS Addenda in relation to the impacts of the Meliadine Extension. Section 7 addresses the Meliadine Extension effects to the freshwater environment which includes hydrogeology, hydrology (including water quantity), water quality (including sediment quality), and fish and fish habitat.

Section 7 includes a discussion on VECs, incorporation of TK/IQ, description of the study areas, and an assessment of direct effects to changes to the freshwater environment in the study area. No new primary pathways are identified. Results of the effects assessment were updated for Meliadine Extension. The effects assessment evaluates the maximum footprint for the operational and closure phase, resulting in a conservative assessment.

The Meliadine Extension water management activities culminate in the discharge of treated mine contact water to the receiving environment. Treated mine contact water will be discharged to the freshwater environment (assessed in this section) and to the marine environment (assessed in Section 8).

7.1.1 Comparison to Previous Assessments

The Meliadine Extension activities represent a negligible change from the previously assessed and Approved FEIS activities (Agnico Eagle 2014, 2018a, 2020a). No new pathways were identified. All effects have been previously assessed, and there is no change from the previous assessments.

To address uncertainty, and validate assumptions, monitoring developed for the Approved activities (Agnico Eagle 2014, 2018a, 2020a), with updates to associated management plans, as required, for the Meliadine Extension will be completed.

7.1.2 Valued Ecosystem Components

The identification of VECs and factors considered in their selection have not changed for the Meliadine Extension; the methods used to select the VECs are summarized in Section 4.3 of this Application, as well as Section 4.2 of the 2014 FEIS (Agnico Eagle 2014). The freshwater environment VECs are summarized in Table 7.1-1.

Table 7.1-1: Summary of Freshwater Environment Valued Ecosystem Components

Valued Ecosystem Component	Rationale	Assessment Endpoint	Measurement Endpoint
Hydrogeology and Groundwater quantity and quality	Changes in hydrogeology and groundwater quantity and quality can influence surface flow paths	• Assessed through other valued components (i.e., through the path to surface water and then fish habitat; continued opportunity for traditional and non-traditional use of fish)	• Groundwater flows and levels • Groundwater quality
Hydrology including Water Quantity	Meliadine Extension is expected to affect existing availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial ecosystems Inuit Qaujimajatuqangit highlighted concerns about the effects of climate change on precipitation, freeze-thaw cycle, and water level conditions	• Availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial ecosystems • Assessed through other valued components (i.e., abundance and distribution of freshwater biota; continued opportunity for traditional and non-traditional use of fish)	• Flow rate and the spatial and temporal distribution of water • Surface topography, drainage boundaries, waterbodies, and water pathways
Water Quality (including sediment quality)	Concentration of total and dissolved parameters in water (e.g., total dissolved solids, total suspended solids, nutrients, total metals, dissolved metals, etc.) strongly influence the quality of water for aquatic organisms, wildlife, and the use of water as a drinking water source for Inuit or for recreational purposes (TK/IQ).	• Protection of surface water quality for aquatic and terrestrial ecosystems, and human use • Assessed through other valued components (i.e., changes to health of species; abundance and distribution of freshwater biota; continued opportunity for traditional and non-traditional use of fish)	• Physicochemical water quality parameters (e.g., pH, conductivity, turbidity, suspended solids) • Major ions and nutrients • Total and dissolved metals • Organic compounds
Fish habitat (as defined by DFO)	Protected under the *Fisheries Act*; changes to fish habitat have the potential to adversely affect fish health, and the persistence of self-sustaining populations; habitat characterized by all fish species, including forage species	• Habitat Units (as part of Offsetting Plan)	• Habitat Units
Arctic Char	Focus of commercial and subsistence fishery in the Hudson Bay; represents important ecosystem processes given that the species occupies top trophic positions and is relatively abundant in the region.	• Abundance and distribution • Continued opportunity for traditional and non-traditional use of fish	• Habitat quantity and fragmentation • Habitat quality, lower trophic levels • Fish health, including survival and reproduction • Access to fish
Lake Trout	Important to communities for subsistence use (TK/IQ) and are a popular sport-fish in Nunavut; represents important ecosystem processes given that the species occupies top trophic positions and is relatively abundant in the region.		
Arctic Grayling	Important to communities for subsistence use and are a popular sport-fish in Nunavut (TK/IQ); represents important ecosystem processes given that the species occupies top trophic positions and is relatively abundant in the region.		

DFO = Department of Fisheries and Oceans; TK/IQ = identified through IQ/TK consultation

Hydrogeology and groundwater is a VEC but it does not have assessment endpoint because groundwater is not used as a resource by local populations and is not anticipated to become a resource in the future. Consistent with the 2014 FEIS, for this Application, there was an assessment of both changes to groundwater and hydrogeology that are specific to that system, and changes to groundwater and hydrogeology that may present potential effect pathways to other VECs. Changes in hydrogeology and groundwater by itself can only be evaluated in context to how it changes the other components such as fish habitat. As a result, potential effects to groundwater were examined, but residual impacts were not classified because these were classified through effects to endpoints such as fish habitat and ecological risk assessment. The Meliadine Extension is expected to result in no detectable to negligible environmental change in groundwater and hydrogeology quality and/or quantity.

7.1.3 Spatial and Temporal Boundaries

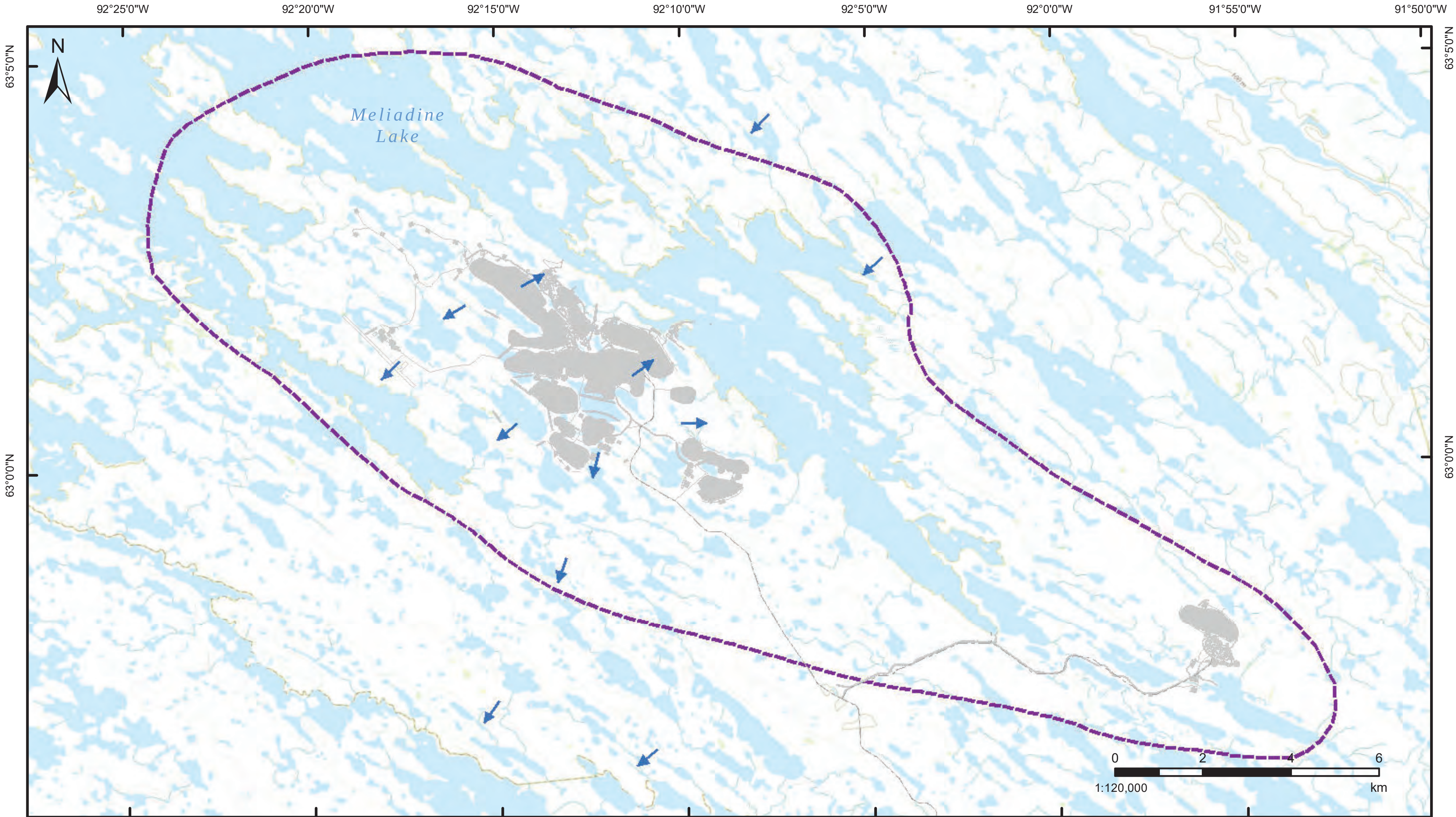
For the Meliadine Extension, the study area boundaries were developed based on the same criteria as the 2014 FEIS (Agnico Eagle 2014). These areas are described as follows:

- The LSA is the area where there exists the potential for measurable impacts due to Meliadine Extension activities.
- The RSA is the area within which there exists the potential for residual effects, including direct and indirect effects, as well as incremental effects from the Meliadine Extension and cumulative effects from historical, existing, and RFFDs, including the Meliadine Extension.
- The temporal boundary is defined as the amount of time between the start and end of a relevant Meliadine Extension activity or stressors (which are related to development phases), plus the duration required for the effect to be reversed (NIRB 2012a).

The spatial and temporal boundaries for the freshwater environment are described in detail in the 2014 FEIS in Section 7.1 and are summarized in Table 7.1.2 for this Application.

Table 7.1-2: Freshwater Environment Spatial and Temporal Boundaries

<table>
<tr><th rowspan="2">Valued Ecosystem Component</th><th colspan="2">Spatial Boundary</th><th rowspan="2">Temporal Boundary</th></tr>
<tr><th>Local Study Area</th><th>Regional Study Area</th></tr>
<tr><td>Hydrogeology and Groundwater</td><td>Area of all the Meliadine Extension facilities, open pits and underground mine, buildings and infrastructure and the nearest lakes with open taliks (Figure 7.1-1)</td><td>includes regional lakes with open taliks sufficient to define the regional groundwater flow directions (Figure 7.1-2)</td><td>Operations through post-closure (extending up to 100s years into post-closure)</td></tr>
<tr><td>Hydrology</td><td>Watersheds that contain a proposed component of mine infrastructure (e.g., pits, WRSF) (Figure 7.1-3) and watercourses along the AWAR.</td><td rowspan="3">Regional watersheds of the mine site and roads (Figure 7.1-5)</td><td rowspan="3">Operations through post-closure</td></tr>
<tr><td>Surface Water Quality</td><td rowspan="2">Waterbodies and watercourses that contain a proposed component of mine infrastructure (e.g., pits, WRSF) (Figure 7.1-4) and watercourses along the AWAR.</td></tr>
<tr><td>Fish and Fish Habitat</td></tr>
</table>



Meliadine Extension

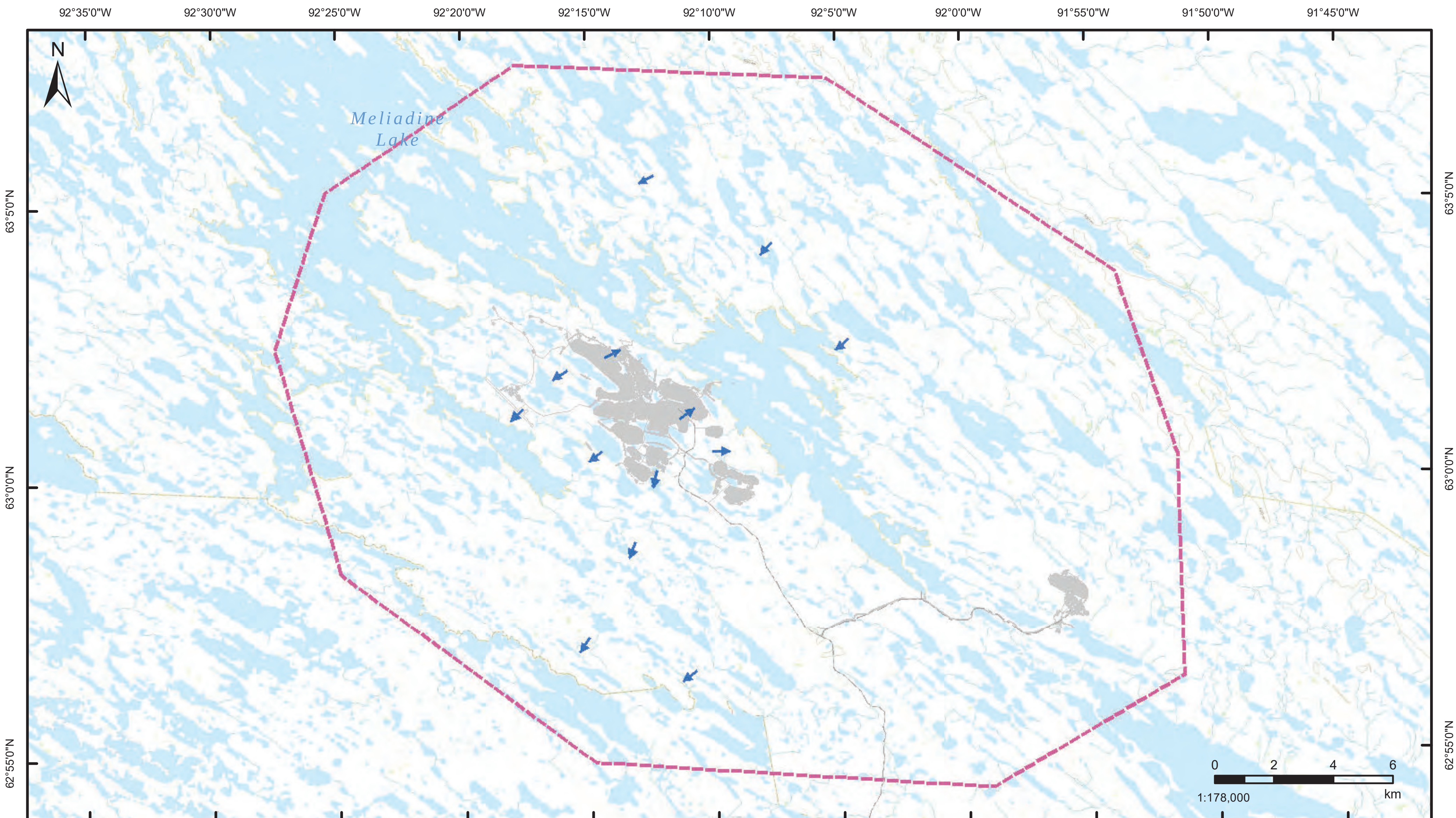
Local Study Area – Hydrogeology and Groundwater

Date: 11/2/2021
Map Number: MEL-018
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

AGNICO EAGLE ECOLOGIC

Legend

- Groundwater Local Study Area (LSA)
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Existing Road
- Inferred Groundwater Flow Direction



Meliadine Extension

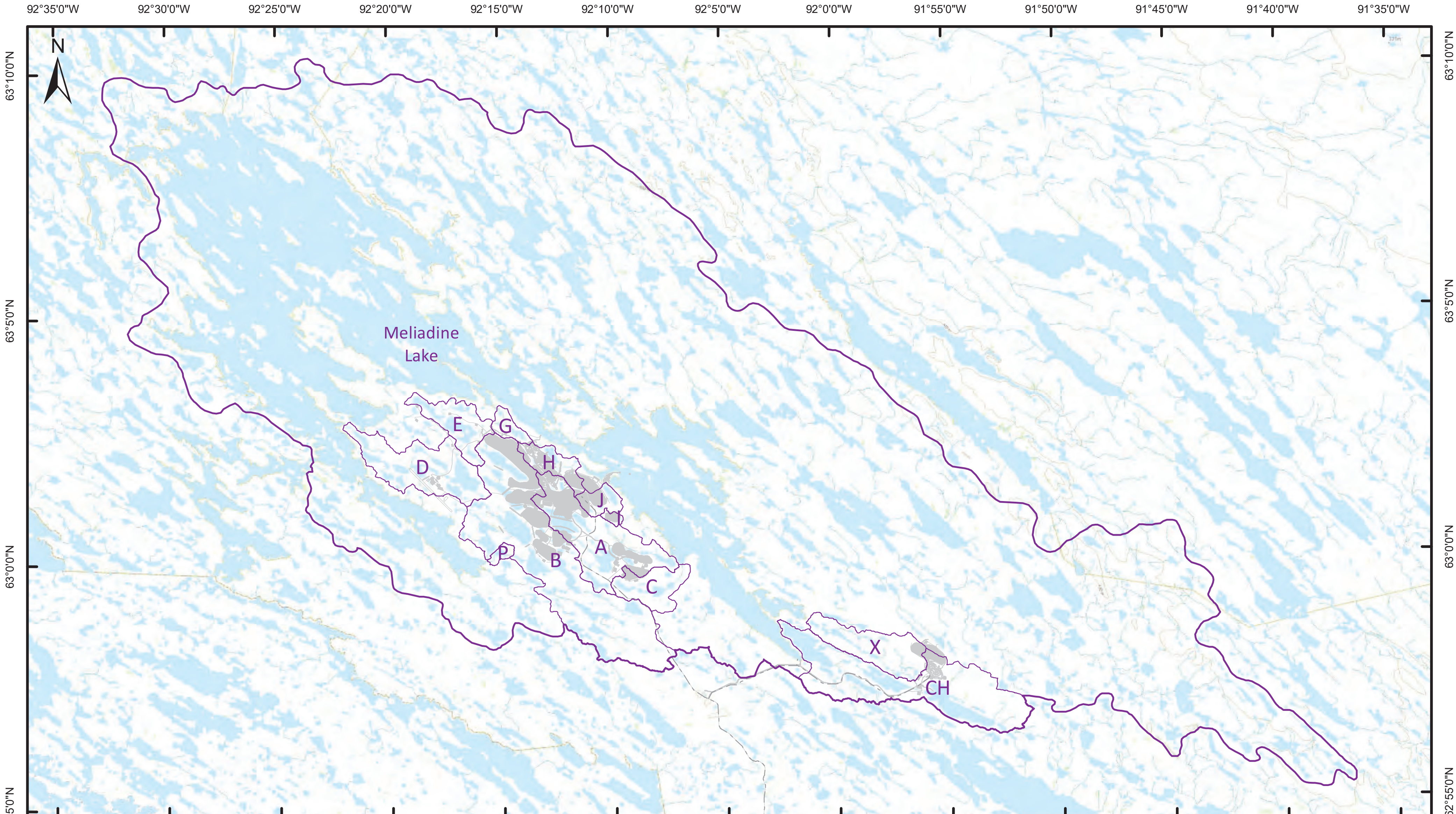
Regional Study Area – Hydrogeology

Legend

- Groundwater Regional Study Area (RSA)
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Existing Road
- Inferred Groundwater Flow Direction

Date: 11/2/2021
Map Number: MEL-026
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

AGNICO EAGLE
ECOLOGIC



Meliadine Extension

Local Study Area – Hydrology including Water Quantity

0 2 4 6 km

1:200,000

Date: 11/2/2021

Map Number: MEL-019

Coordinate System: NAD 1983 UTM Zone 15N

Projection: Transverse Mercator

Datum: North American 1983

AGNICO EAGLE

ECOLOGIC

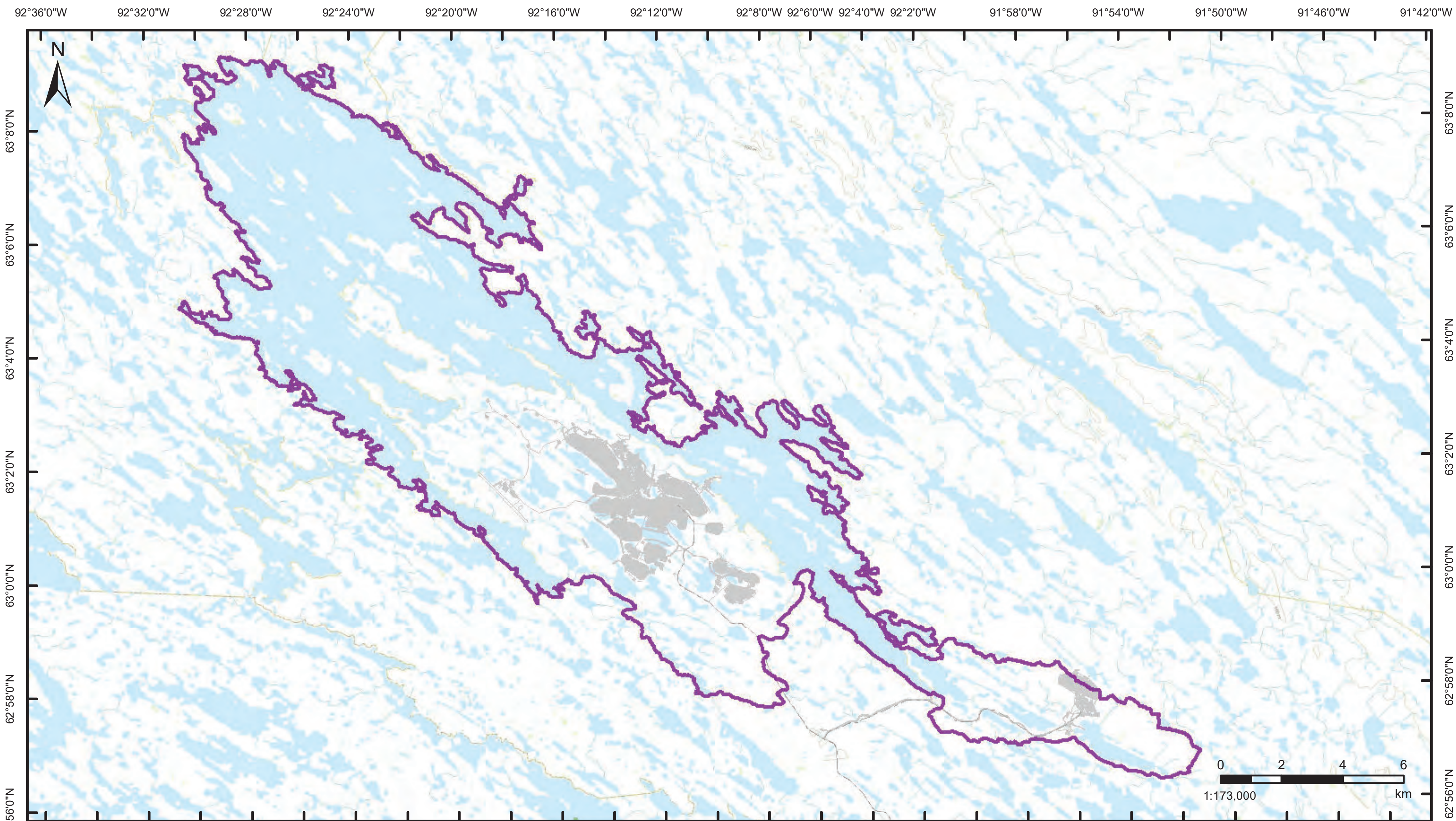
Legend

Sub-Watershed Boundary

Meliadine Extension

All-Weather Access Road (AWAR)

Existing Road



Meliadine Extension

Local Study Area – Water Quality, Fish and Fish Habitat – Mine Site

Date: 11/2/2021
Map Number: MEL-022
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

Legend
- Local Study Area
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Existing Road

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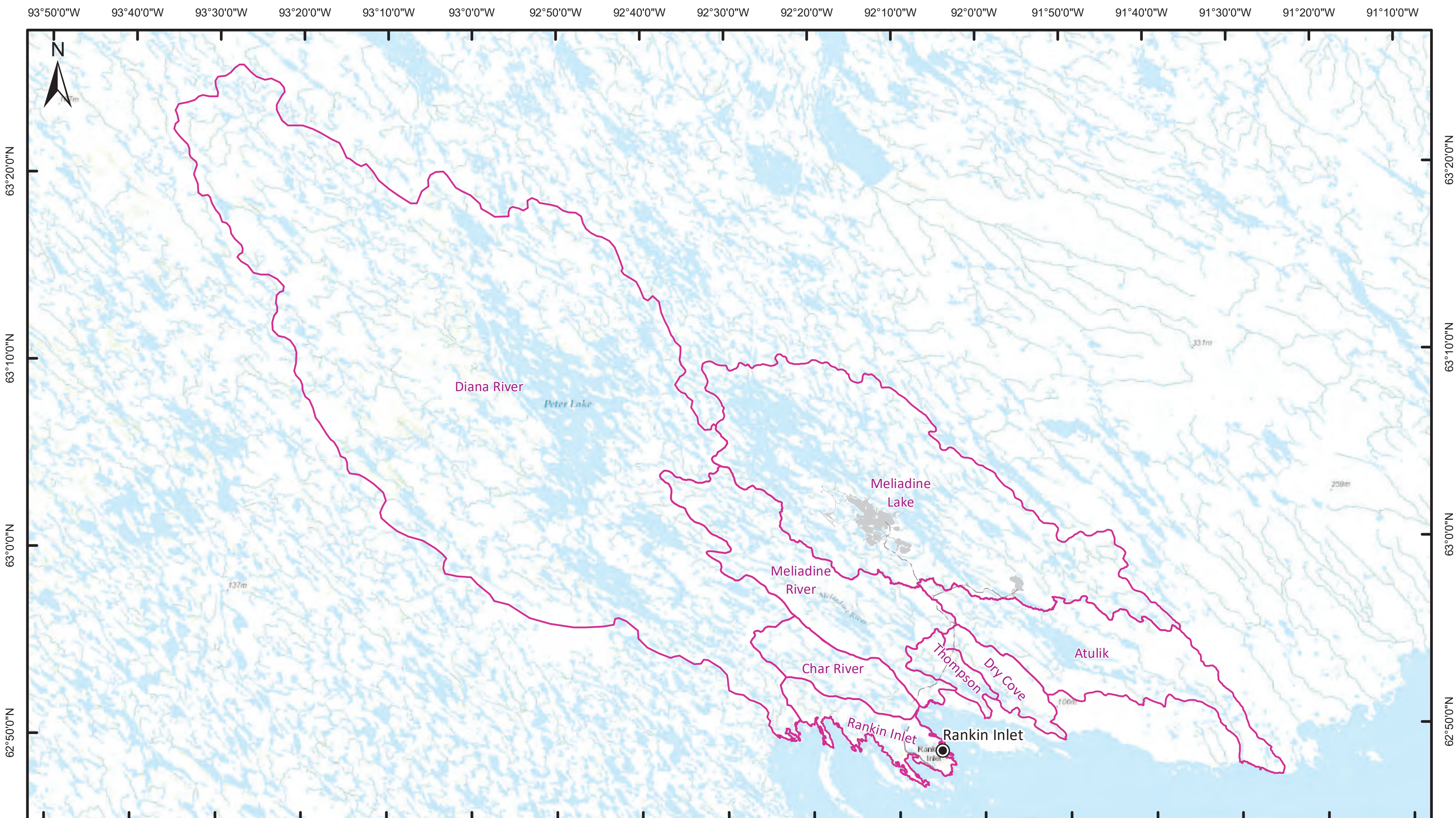


0 5 10 15
km
1:525,000

Meliadine Extension

Regional Study Area – Hydrology, Water Quality, Fish and Fish Habitat

Date: 11/2/2021
Map Number: MEL-025
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

Legend

- Watershed Boundary
- Meliadine Extension
- All-Weather Access Road (AWAR)

AGNICO EAGLE
ECOLOGIC

7.2 Hydrogeology and Groundwater Quantity and Quality

The purpose of this section is to address updates to the 2014 FEIS, in relation to the impacts of the Meliadine Extension for hydrogeology and groundwater quality conditions. This section includes an assessment of direct effects to changes to hydrogeology and groundwater quality in the study area. The effects assessment evaluates all phases, including construction, operation, maintenance, closure, and post-closure. The effects from the Meliadine Extension must be considered in combination with other developments, activities, and natural factors that influence hydrogeology and groundwater quality within the local and regional study areas.

While hydrogeology and groundwater quantity and quality is a VEC (Table 7.1-1 and Table 4.3-1), changes in hydrogeology and groundwater quantity and quality can only be evaluated in the context of how these changes in turn may result in changes to other VECs, such as fish habitat. No impact predictions are made for hydrogeology and groundwater quality by themselves as impacts to these components directly influence, and therefore are captured in, the assessment of impacts for other VECs including hydrology, surface water quality and fish and fish habitat.

Existing conditions and effects assessment for hydrology, surface water quality and fish and fish habitat are presented in Sections 7.3, 7.4, and 7.5, respectively.

7.2.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

There is no IQ specific to hydrogeology and groundwater quality.

7.2.2 Existing Environment

As part of the 2014 FEIS (Agnico Eagle 2014), potential groundwater inflow quantity to the Tiriganiaq underground was predicted using a groundwater numerical model (Agnico Eagle 2014). Groundwater model predictions included a best estimate (or base case) set of predictions based on the available data at the time of the 2014 FEIS and a series of sensitivity runs to account for the potential uncertainty in the model predictions due to the uncertainty in the assumptions behind the numerical model. The reader is referred to Volume 7, Section 7.2.2 of the 2014 FEIS (Agnico Eagle 2014) for the geological and hydrogeological settings that were established within the LSA of the 2014 FEIS.

To continue to reduce model uncertainty, the numerical and conceptual model for Tiriganiaq has been routinely reviewed and updated as new hydrogeological data was collected. This data collection included an extensive field campaign by Agnico Eagle in 2015, which utilized two independent technical advisors, Dr. Shaun Frape and Dr. Walter A. Illman (both of the University of Waterloo) to provide advice and comments throughout the development of the field work plan. Documentation of the field program and results of updated modelling that incorporated this test data is presented in two Golder reports (Golder 2016a,b).

In 2018, an environmental and socio-economic assessment was completed for the discharge of treated groundwater effluent from the underground mine of the Tiriganiaq deposit into the marine environment near Rankin Inlet. As a requirement of the Project Certificate No.006 T&C 25, Agnico Eagle had to provide a saline water management plan to address the potential for higher-than-predicted volumes of saline water inflows into the underground mine. The Groundwater Management Plan was issued on June 2018 using the 2016 groundwater inflows and submitted under the 2018 FEIS Addendum for the “Saline Effluent Discharge to Marine Environment” project (Agnico Eagle 2018a). An addendum to Project Certificate No.006 was approved in January 2019.

An additional model update was completed in 2019 and is documented in the “2019 Updated Predictions of Groundwater Inflow to Tiriganiaq Underground Mine” report (Golder 2020a). Relative to previous model updates, this revision was more comprehensive because data were available to support model calibration (i.e., the mine development had extended below the permafrost, which allowed for the comparison of model predicted inflows and hydraulic head to measured groundwater inflows and hydraulic head). This model update included a review of water intersections, on-going structural mapping, piezometric data collection, and inflow measurements during development of the Tiriganiaq Underground between 2015 and 2019.

In 2020, an environmental and socio-economic assessment was completed for a proposed increase of the discharge of treated groundwater effluent from the underground mine of the Tiriganiaq deposit into the marine environment near Rankin Inlet, by routing the treated groundwater effluent through waterlines. The Groundwater Management Plan was updated using the 2019 groundwater inflows and was submitted under the 2020 FEIS Addendum for the “Saline Effluent Discharge to Marine Environment” project (Agnico Eagle 2020a). The Minister provided approval on January 31, 2022.

Additional data has been collected in support of the environmental review to document existing conditions and to provide the foundation for a qualitative and quantitative assessment of the operations and mine development of the Meliadine Extension. This additional data is documented in the Summary of Hydrogeology Existing Conditions Report (Golder 2021c) and is summarized in the following sub-sections.

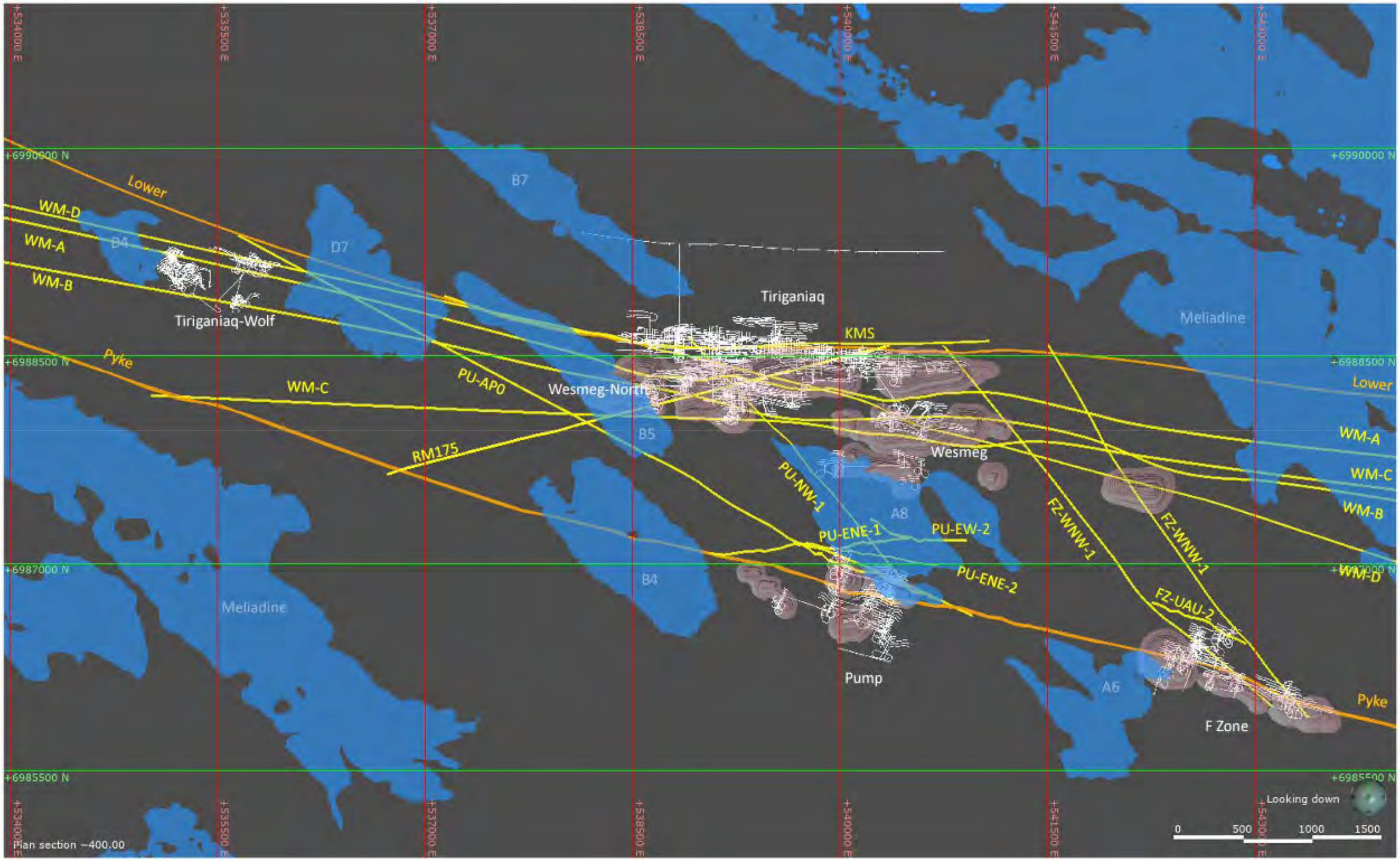
7.2.2.1 Geology

The geological setting within the LSA for the 2014 FEIS is presented in Volume 6, Section 6.2 (Agnico Eagle 2014). Based on the geological setting, three regional structures were considered in the 2014 FEIS hydrogeological assessment (Lower Fault, Pyke Fault, and North Fault). Since the 2014 FEIS, ongoing monitoring of geological structures has led to the identification of 17 faults (i.e., KMS corridor, RM-175) that have been incorporated into the conceptual hydostratigraphy (Section 7.2.2.6), in addition to the three regional faults (Lower Fault, Pyke Fault, and North Fault) that were previously considered in the 2014 FEIS.

The location of the identified faults is presented on Figure 7.2-1 and 7.2-2. The additional structures are generally located between the Lower Fault and Pyke Fault within the Mafic Volcanic Rock formations and range in thickness between 2 and 6 meters. An exception is the KMS corridor, which is a wider zone of poor rock quality is generally located between the KMS fault and Lower Fault.

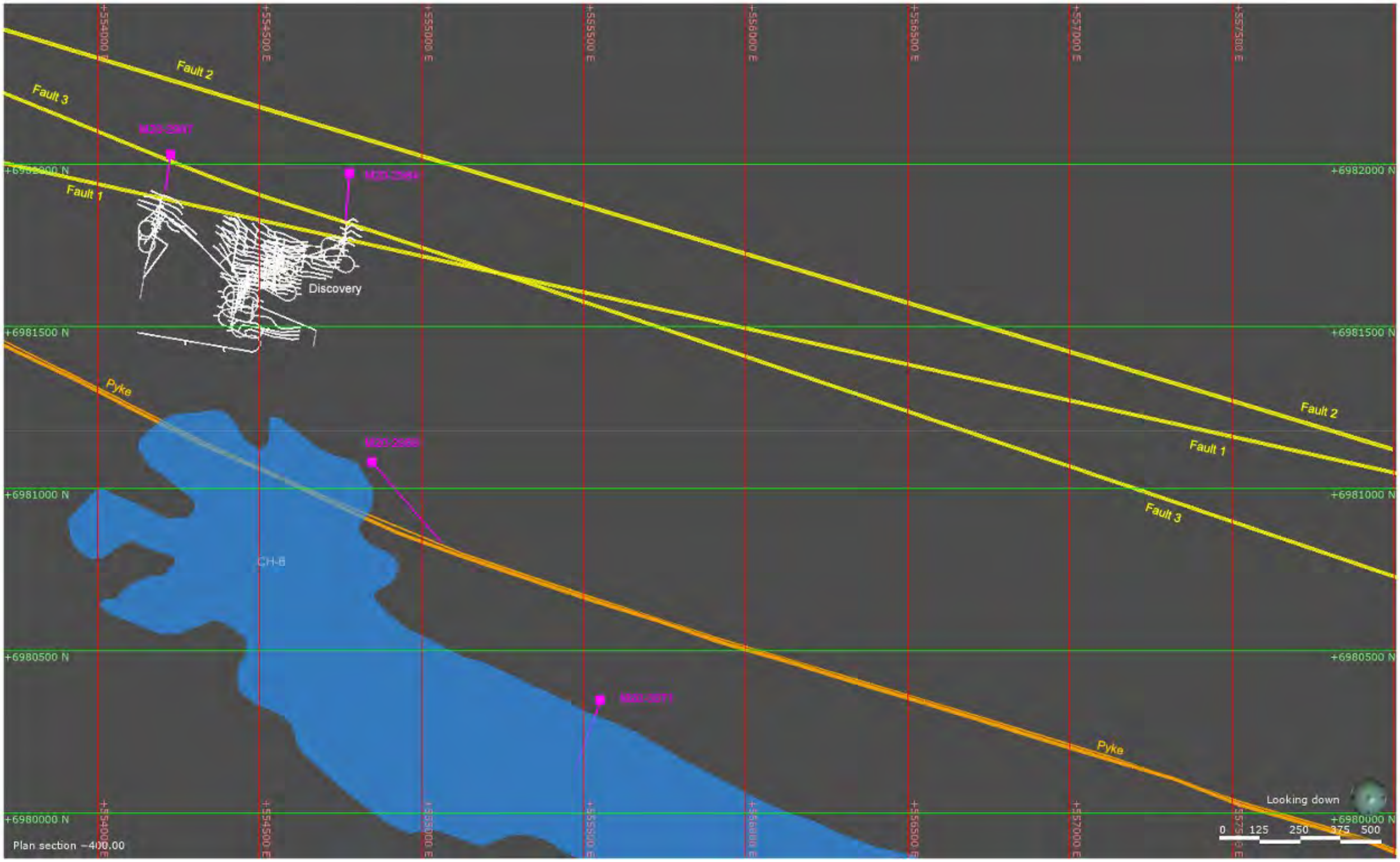
The improved understanding of the different structural features in the mining area have contributed to reduce conservatism in the hydrogeology modelling, presented in Section 7.2.2.6.

Figure 7.2-1: Structures of Enhanced Permeability – Main Area and Tiriganiaq-Wolf



Source: Figure 2 from Golder (2021c).

Figure 7.2-2: Structures of Enhanced Permeability – Discovery Area



Source: Figure 3 from Golder (2021c).

7.2.2.2 Hydrogeologic Testing

The hydrogeologic testing data that was used to inform the groundwater modelling presented in the 2014 FEIS (Agnico Eagle 2014), the 2018 FEIS Addendum (Agnico Eagle 2018a), and the 2020 FEIS Addendum (Agnico Eagle 2020a) is documented in the Summary of Hydrogeology Existing Conditions Report (Appendix G-05; Golder 2021c). This section provides a summary of new hydrogeologic testing that was used to inform the groundwater modelling for this Meliadine Extension.

In 2019 and 2020, short-term (few hours) and long-term (several days) recession tests were conducted from the Tiriganiaq underground. The recession tests were conducted in a series of 14 boreholes with pumping from borehole WH350-157-D1 and observation from the other 13 boreholes. The recession test pumping targeted the KMS corridor near the interpreted KMS fault and Lower Fault Zone (Figure 7.2-3). Data collection from the short-term recession tests were generally limited and did not provide reliable estimation of hydraulic conductivity. However, the long-term recession tests provided a good data set for estimation of the corridor hydraulic conductivity, which was estimated to range between $2x10^{-7}$ to $1x10^{-6}$ m/s, indicating that the corridor is a zone of enhanced permeability (Golder 2021c).

Based on the collected pressure response data, a screening-level estimation of the hydraulic diffusivity was also calculated and ranged from 0.8 to 791 m^2/s. This variability indicates changes in the bedrock hydraulic properties between the pumped borehole and the observation points and that the KMS corridor may be composed of multiple discrete fractures with competent rock in between the fractures, resulting in heterogeneity in the hydraulic response (Golder 2021c). The estimated hydraulic conductivities and calculated diffusivity from the 2019 and 2020 field work are presented in Table 7.2-1.

Table 7.2-1: Summary of Estimated Hydraulic Conductivity and Diffusivity Values from Long-term Recession Test at WH350-157-D1

K (m/s)	WH350-157-D1	WH350-161-D1	WH350-164-D1	ML350-165-U1	WH350-166-D1	PZ-WH350-152-VW1	PZ-WH350-152-VW2	PZ-WH350-152-VW3	PZ-ML17-350-161-VW1	PZ-ML17-350-161-VW2	PZ-WH350-171-D1-VW1	PZ-WH350-171-D1-VW2	PZ-ML375-164-D1-VW1	PZ-ML375-164-D1-VW3
Hydraulic Conductivity (m/s)[(a)]	-	$3x10^{-7}$	$1x10^{-6}$	$7x10^{-7}$	$8x10^{-7}$	$3x10^{-7}$	$3x10^{-7}$	$3x10^{-7}$	$3x10^{-7}$	$3x10^{-7}$	$5x10^{-7}$	$5x10^{-7}$	$3x10^{-7}$	$2x10^{-7}$
Time to First Response (min)	NA	1	1	2	1	1	1	1	1	1	30	30	85	1
Distance to Pumping Well (m)	0	82	135	150	171	88	88	88	106	103	269	278	129	132
Calculated Diffusivity (m^2/s)	NA	545.5	410.7	73	790.7	323.8	310.2	310.2	72.2	68.2	10.3	11	0.8	190.5

Note: Table 5 from Golder (2021c)

(a) Assuming an interpreted corridor thickness of 100 m.

Figure 7.2-3: Borehole Locations for Hydraulic Testing and Groundwater Sampling – KMS Corridor

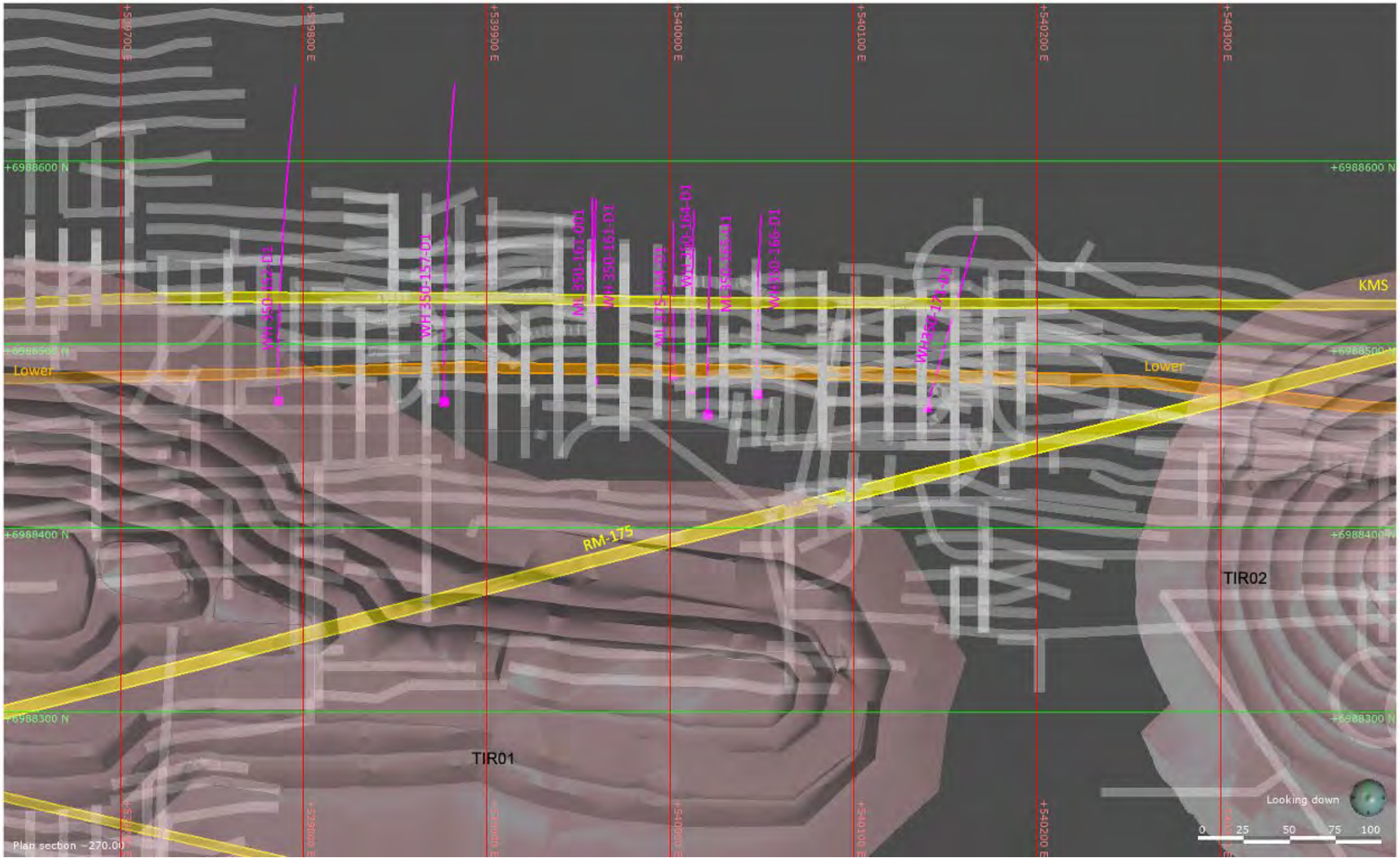


Figure 5 from Golder (2021c).

In May and June 2020, hydraulic testing was conducted in two boreholes in the proposed Discovery underground area. A zone of enhanced permeability was interpreted in borehole M20-2984 (Figure 7.2-2) which has been interpreted to correspond to Fault 2. Hydraulic conductivity values calculated in this structure range from $6x10^{-8}$ to $4x10^{-7}$ m/s indicating moderate to low hydraulic conductivity. Assuming a uniform thickness of 12 metres, the hydraulic conductivity of the enhanced permeability zone was estimated to be between $3x10^{-7}$ m/s and $5x10^{-7}$ m/s, indicating a moderate hydraulic conductivity.

In August 2020, 13 single-well response tests were conducted at borehole M20-3071, located to the west of the proposed Discovery underground near Lake CH6 (Figure 7.2-2). The first 8 tests were packer tests completed during drilling of this borehole (between 166.9 mbgs [metres below ground surface] and 560.7 mbgs). The last five tests were conducted after the installation of a Westbay system in the same borehole and were conducted at Ports 7, 8, 9, 10, and 11. The transmissivity and bulk hydraulic conductivity in these port intervals were estimated from the pressure response data collected by transducers within the sampling cylinders of the Westbay system. Overall, hydraulic conductivity estimates ranged from less than $1x10^{-10}$ m/s to $6x10^{-9}$ m/s. A summary of the hydrogeological test results is summarized in Table 7.2-2 and documented in Golder (2021c). Details of the installation of the Westbay system is documented in Section 7.2.2.3 and in Golder (2021e).

Table 7.2-2: Summary of Hydraulic Test Results Near Discovery Underground – Fall of 2020

Borehole	Test Number	Interval Top (mbgs)	Interval Bottom (mbgs)	Interval length (mbgs)	Interval Length (mah)	Transmissivity (m2/s)	Hydraulic Conductivity (m/s)	Geology
M20-2984	1 [(b)]	256.4	388.1	131.7	142.4	6×10^{-7}[(b)]	1×10^{-9} [(b)]	Greywacke and Siltstone, Chert-Magnetite Iron Formation,
M20-2984	2 [(b)]	397.9	485.4	87.4	94.5	6×10^{-6}	6×10^{-8}	Greywacke and Siltstone, Chert-Magnetite Iron Formation, Fault 2
M20-2984	3 [(b)]	470.1	485.4	15.3	16.5	6×10^{-6}	4×10^{-7}	Greywacke and Siltstone, Chert-Magnetite Iron Formation, Fault 2
M20-2984	4 [(b)]	389.6	485.4	95.8	103.5	6×10^{-6}	6×10^{-8}	Greywacke and Siltstone, Chert-Magnetite Iron Formation, Fault 2
M20-2984	5 [(b)]	483.8	499.2	15.5	16.7	8×10^{-8}	5×10^{-9}	Gabbro, Greywacke and Siltstone, Chert-Magnetite Iron Formation
M20-2984	6 [(c)]	4.6	499.2	494.6	534.6	[(c)]	[(c)]	Greywacke and Siltstone, Chert-Magnetite Iron Formation,
M20-2984	7	464.3	499.2	35.0	37.8	3×10^{-6}	8×10^{-8}	Gabbro, Greywacke and Siltstone, Chert-Magnetite Iron Formation, Fault 2
M20-2989	1 [(c)]	254.5	535.7	281.2	303.9	[(c)]	[(c)]	Chloritic Siltstone and Greywacke, Altered Mafic Volcanics

Table 7.2-2: Summary of Hydraulic Test Results Near Discovery Underground – Fall of 2020

Borehole	Test Number	Interval Top (mbgs)	Interval Bottom (mbgs)	Interval length (mbgs)	Interval Length (mah)	Transmissivity (m2/s)	Hydraulic Conductivity (m/s)	Geology
M20-2989	2 (b)	254.5	566.2	311.7	336.9	5×10^{-6}	2×10^{-8}	Chloritic Siltstone and Greywacke, Altered Mafic Volcanics
M20-2989	3 (b)	376.6	566.2	189.6	204.9	2×10^{-6}	9×10^{-9}	Siltstone, Greywacke and Siltstone
M20-2989	4 (b)	326.6	566.2	239.6	258.9	1×10^{-6}	4×10^{-9}	Altered Mafic Volcanics, Siltstone, Greywacke and Siltstone
M20-2989	5	418.2	610.6	192.4	207.9	7×10^{-7}	3×10^{-9}	Greywacke and Siltstone
M20-3071	1	166.9	208.2	187.5	44.6	5×10^{-8}	1×10^{-9}	Chloritic Siltstone and Greywacke
M20-3071	2	205.5	244.3	224.9	41.9	3×10^{-9}	$<1 \times 10^{-10}$	Chloritic Siltstone and Greywacke
M20-3071	3	240.6	280.3	260.4	42	3×10^{-7}	6×10^{-9}	Chloritic Siltstone and Greywacke
M20-3071	4	240.6	280.3	260.4	45	(c)	(c)	Chloritic Siltstone and Greywacke
M20-3071	5	319.6	355.3	337.4	38.6	$< 2 \times 10^{-10}$	$<1 \times 10^{-10}$	Chloritic Siltstone and Greywacke
M20-3071	6	399.9	444.1	422.0	47.8	6×10^{-10}	$<1 \times 10^{-10}$	Chloritic Siltstone and Greywacke
M20-3071	7	352.5	444.1	398.3	99	1×10^{-9}	$<1 \times 10^{-10}$	Chloritic Siltstone and Greywacke
M20-3071	8	441.3	560.7	501.0	129	7×10^{-9}	$<1 \times 10^{-10}$	Chloritic Siltstone and Greywacke, Chert-Magnetite Iron Formation
M20-3071	Port 11	237.0	267.2	252.1	32.6	2×10^{-8}	$<1 \times 10^{-10}$	Chloritic Siltstone and Greywacke
M20-3071	Port 10	268.0	285.6	276.8	19	3×10^{-8}	4×10^{-9}	Chloritic Siltstone and Greywacke
M20-3071	Port 9	286.4	303.9	295.2	18.9	7×10^{-9}	4×10^{-10}	Chloritic Siltstone and Greywacke
M20-3071	Port 8	304.8	321.0	312.9	17.5	6×10^{-8} (d)	3×10^{-9} (d)	Chloritic Siltstone and Greywacke
M20-3071	Port 7	321.8	377.3	349.5	60	1×10^{-9} (d)	$<1 \times 10^{-10}$ (d)	Chloritic Siltstone and Greywacke

Note: Table 6 in Golder (2021c).

T = Transmissivity, K = Hydraulic Conductivity, mbgs = metres below ground surface, mah = metres along hole.

(a) Results are estimate only due to suspected packer bypass.

(b) Results are estimate only because the static conditions were not reached prior to test.

(c) Test not performed due to casing leak / packer bypass.

(d) Low to moderate confidence in the result due to small magnitude of pressure change during the test.

A summary of the hydraulic testing that has been conducted in the area near the Meliadine Mine and that has been used to inform the groundwater modelling presented in the 2014 FEIS, the 2018 FEIS Addendum, and this Applicationis provided in Table 7.2-3.

Table 7.2-3: Comparison of Hydrogeological Testing Conducted in Meliadine

Reference		2014 FEIS	2018 FEIS Addendum	Meliadine Extension Application
Field program date		2009 and 2011	2015	2019 and 2020
Type of test		• 10 single well response tests in 3 BH	• 24 packer tests in 3 BH • 2 flow recession pumping tests in 2 BH • 2 injection tests in 1 BH	• Recession tests in 14 BH • 12 packer tests in 2 BH • 13 single well response tests in 1 BH
Location		Tiriganiaq	Tiriganiaq	Tiriganiaq and Discovery
Depth (m)		40 to 632	313 to 689	5 to 611
Hydraulic conductivity (m/s)	Bulk bedrock	$5x10^{-10}$ to $7x10^{-9}$	$1x10^{-10}$ to $1x10^{-9}$	$1x10^{-10}$ to $6x10^{-9}$
	Lower Fault	$1x10^{-7}$ to $5x10^{-8}$	-	-
	Fault A	-	$4x10^{-8}$ to $2x10^{-7}$	-
	RM-175	-	$2x10^{-8}$	-
	KMS corridor(a)	-	-	$2x10^{-7}$ to $1x10^{-6}$
	Fault 2(b)	-	-	$3x10^{-7}$ to $5x10^{-7}$
Bedrock specific storage (1/m)			$1x10^{-7}$ to $2x10^{-7}$	-
Hydraulic diffusivity (m^2/s)		-	-	0.8 to 791

BH = Borehole
(a) Based on Tiriganiaq hydrogeological testing
(b) Based on Discovery hydrogeological testing

7.2.2.3 Groundwater Sampling and Quality

In the 2014 FEIS, groundwater sampling was conducted to characterize the groundwater quality, in particular the salinity as indicated by TDS. Additional data was collected from the Tiriganiaq underground between 2014 and 2017 and used to provide information on the lateral variability of groundwater quality (TDS) in the Tiriganiaq underground area. This data was presented in the 2018 FEIS Addendum and is documented in Golder (2016a,b).

In support of the Meliadine Extension, a second Westbay well (M20-3071) was installed near the proposed Discovery underground and near the potential talik below CH6 (Golder 2021e) and shown on Figure 7.2-3. The well was installed in September 2020 to a depth of 606 mbgs. Two ports were selected for development and sampling (Port 8 at approximately 310 to 326 mbgs and Port 4 at approximately 439 to 457 mbgs), with development and sampling methods and results documented in Golder (2021e). Port 8 sampling was selected to support assessment of water salinity in the talik between Lake CH6 and the deeper regional groundwater (below the regional permafrost). Port 4 sampling was selected to support assessment of water quality to be intercepted at the Discovery underground (i.e., at a similar elevation) and the overall interpretation of regional water quality below the permafrost at similar depths. Only Port

8 results are considered appropriate for estimating formation groundwater quality as this Port was developed at approximately 30% and the consistent fluorescein and salinity of the drill fluid used during drilling at that depth (Golder 2021e). Furthermore, the estimated formation groundwater quality from Port 8 was found to have a sodium chloride signature similar to regional chemistry measured at M11-1257 (Westbay well installed to the northwest of Tiriganiaq Underground in 2011) though slightly more diluted. This relative dilution is consistent with the previously interpreted TDS profile for the site that shows increasing TDS with depth (Golder 2021e).

Additional details of the Westbay well installation, well development and groundwater sampling are documented in Golder (2021e).

Table 7.2-4 presents a summary of the groundwater sampling that has been conducted in the area near the Meliadine mine and that has been used to characterize the groundwater quality presented in the 2014 FEIS, 2018 FEIS Addendum, and this Application.

Table 7.2-4: Comparison of Groundwater Sampling Conducted in Meliadine

Reference	2014 FEIS	2018 FEIS Addendum	Meliadine Extension Application
Sampling program date	2009, 2011 to 2013	2014 to 2017	2019 and 2020
Number of samples and location	• 1 sample in 1 BH • GT09-19 (Lake B7) • Samples from 8 intervals from Westbay well • M11-1157 (Lake B5)	• Samples from 8 intervals from Westbay well M11-1157 • 3 groundwater samples from seeps (Tiriganiaq UG) • 8 groundwater samples from BH TIS-200-001 (Tiriganiaq UG) • 64 groundwater samples from DDH (Tiriganiaq UG)	• 37 groundwater samples (Tiriganiaq UG) • Samples from 2 ports from Westbay well M20-3071 (Discovery UG)
Depth (m)	105 to 620	225 to 725	230 to 457
TDS (mg/L)	4 700 to 61 000	16 400 to 66 300	28 344 to 67 000

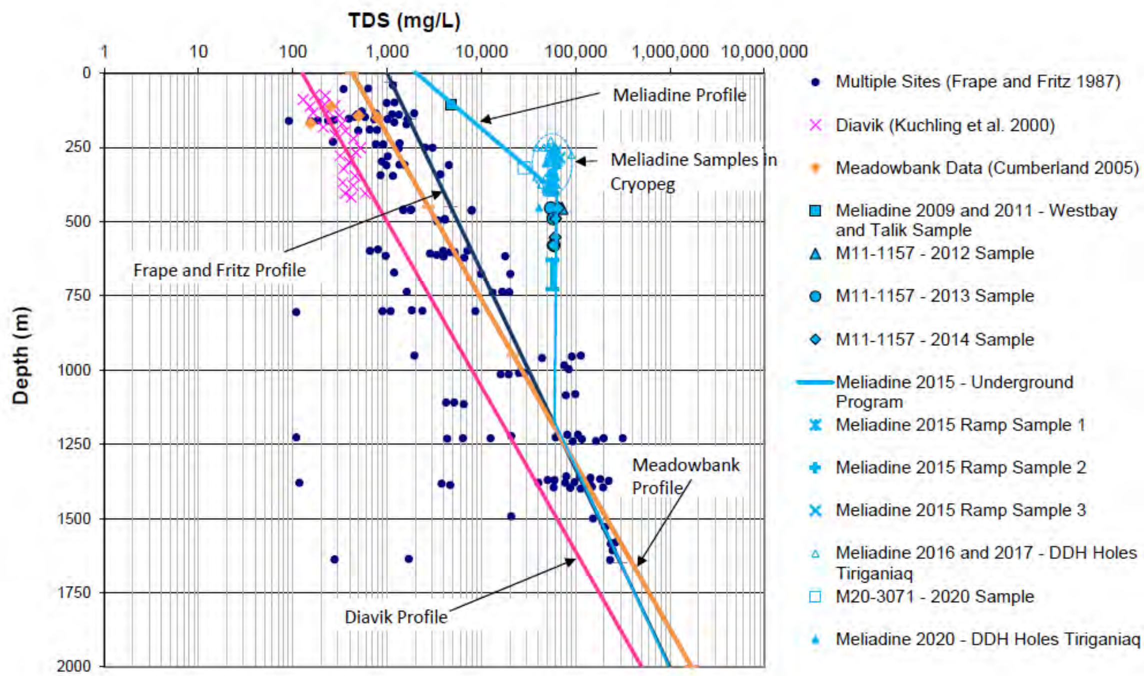
BH = Borehole; DDH = Diamond Drill Hole

The salinity of deep groundwater samples collected to date from the Meliadine Mine area are at the high end of what has been observed at other sites in the Canadian Shield at corresponding depths (Frape and Fritz 1987; Holden et al. 2009; Dominion 2014b), as presented in Figure 7.2-4. The Diavik dataset is based on site-specific data from Diavik, supplemented by information from the Lupin Mine site located about 200 km north of Diavik (Blowes and Logsdon 1997). The Meadowbank dataset (Golder 2004) was developed based on site specific data from the Meadowbank Mine site supplemented by the data sources discussed above (Frape and Fritz 1987; Blowes and Logsdon 1997). Of note is that the Meadowbank and Diavik datasets reflect talik groundwater rather than sub permafrost groundwater. The hydraulic connection with an overlying freshwater lake at these sites results in lower salinity at equivalent depths than has been observed below fully developed permafrost at the Meliadine Mine.

Although additional data has been collected to refine the profile, the interpreted TDS concentrations with depth is generally consistent with the TDS profile adopted in the 2014 FEIS (Agnico Eagle 2014). Water quality in deep groundwater samplings suggest the salinity remains consistent with depth following the transition from near surface freshwater. Salinity concentrations in deep groundwater at Meliadine are approximately 1.6 times that of sea water (35 g/L).

It should be noted that data collected from the underground diamond drill holes at Tiriganiaq are collected from depths between 230 and 450 mbgs. The circled tests on Figure 7.2-4 are inferred to be located above the zero-degree isotherm (base of permafrost) based on thermal modelling, and therefore within the cryopeg. TDS within the cryopeg may be elevated relative to groundwater in unfrozen rock at similar elevations due the preferential freezing of 'fresher' water and is similar to the assumed TDS below the regional permafrost (approximately 61,000 mg/L).

Figure 7.2-4: Groundwater Salinity Profile with Depth



Source: Figure 6 from (Golder 2021c).

7.2.2.4 Permafrost

The updates to the Meliadine Extension with respect to new information of the permafrost terrain is presented in Section 6.3. Based on thermistor data collection and thermal modelling, the depth of the base of permafrost was interpreted to be between 285 and 430 mbgs, with the interpreted depth dependent on the proximity to nearby lakes. Shallower depths were found near lakes both with and without open taliks (Golder 2021b).

As described in Section 6.3, permafrost is defined as soil or rock where temperatures remain at or below 0°C for at least two consecutive years.The freezing temperature of water decreases when pressure and salinity increase. Consequently, within the permafrost, unfrozen ground can be encountered at temperatures less than 0°C and in isolated pockets. These areas of unfrozen ground water are referred to as cryopeg.

Groundwater inflows to the underground mine workings are expected to be negligible until mining extends below the depth of the permanently frozen portion of the permafrost; however, mine inflows can occur in the cryopeg where the ground is partially frozen. The depth at which these inflows may occur will depend on the thickness of the cryopeg.

Permafrost depth and cryopeg thickness was estimated for Meliadine using the site-specific TDS/depth profile, presented in Figure 7.2-4, and an iterative method used to estimate the permafrost depth (Golder 2021e). In the 2014 FEIS, the freezing point depression was estimated to be approximately 350 mbgs. Based on the updated groundwater quality data for the Meliadine Extension and the thermal modelling results, the depth to cryopeg has been refined and is estimated to be approximately 280 to 290 mbgs, and near the proposed underground developments (Golder 2021c).

7.2.2.5 Groundwater Flow

Tiriganiaq Groundwater Inflow Monitoring

Since the fourth quarter of 2015, groundwater inflow to the Tiriganiaq underground has been observed. Table 7.2-5 presents a summary of groundwater inflow estimates based on sump measurements and seepage surveys for the Tiriganiaq Underground.

Table 7.2-5: Measured Groundwater Inflows - Tiriganiaq

Month and Year	Estimated Average Monthly Inflow (m³/day)
Q4 2015	15
January 2017	35
October 2018	155
November 2018	175
December 2018	200
January 2019	195
August 2020	200

Groundwater inflow ranges from 15 m^3/day in the fourth quarter of 2015 and up to 190 and 295 m^3/day (from 2020 inflow estimates). The 2020 inflows are lower than predicted in the 2014 FEIS which ranged from 420 to 750 m^3/day in the first few years of mining to 640 to 970 m^3/day in later years. It is interpreted that the lower than predicted inflows are a result of active grouting as the development advances. Grouting was not considered in the 2014 FEIS groundwater inflow estimates.

Hydraulic Head Monitoring

Hydraulic head monitoring was conducted at the Westbay Monitoring Well M11-1257 situated near Lake B5 between Lakes B7 and D7 since its installation in 2011, to monitor depressurization during mining

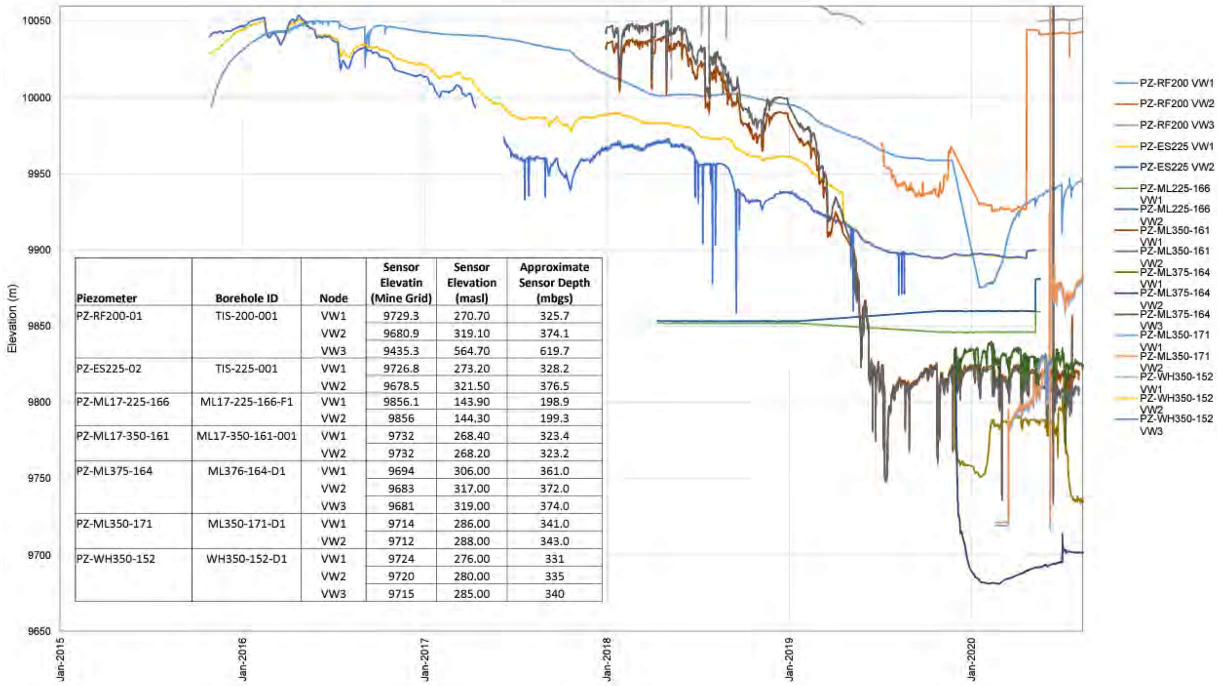
(Agnico Eagle 2014). Stabilized hydraulic head measurements from Westbay Well M20-2071 near Discovery were unable to be collected in 2020 as the pressures near the well were still recovering from drilling and development at the time of the 2020 data collection.

As part of the 2014 FEIS, the approximate direction of groundwater flow between Lake B7 and M11-1257 was estimated using the freshwater heads with a correction for the buoyancy effects, as outlined by Post et al. (2007).These calculations are sensitive on the assumed TDS vs depth profile. For the assumed base TDS profile in the 2014 FEIS, which is overall consistent with the updated TDS profile presented in Section 7.2.2.4, the gradients for the individual ports and Lake B7 are variable but the overall groundwater flow direction between the lake and deep bedrock is downward. This is consistent with flow from high elevation lakes (e.g., Lake B7 at 62 masl) to low elevation lakes (e.g., Lake B5 at 58 masl). Relative to Lake B5, a variable vertical groundwater flow direction was observed. This may reflect that Lake B5 is both a recharge and discharge boundary given the relative elevation of the surrounding lakes (Agnico Eagle 2014).

Vibrating wire piezometers have been installed from the Tiriganiaq underground between 2015 and 2020 to measure changes in hydraulic head as mining progresses (Figure 7.2-5). The measurements show high variability as result of intersection of permeable features, progressive grouting of the underground development, delays in grouting or sealing of vibrating wire piezometer in the borehole, and challenges / potential malfunction of the dataloggers. Although local temporal variations are difficult to understand in the piezometric data because of the multiple sources of this variability, the long-term trend of these data can be used to understand the extent of depressurization near the underground, particularly at sensors that were installed at the end of 2015, just after the underground extended into the cryopeg.

The data presented on Figure 7.2-5 indicates that depressurization has increased in the underground area as mine development has advanced. Hydraulic heads are generally near the top of the cryopeg and indicate that saturated conditions are generally present near the underground development within the cryopeg and underlying bedrock.

Figure 7.2-5: Pressure Monitoring Data – Tiriganiaq Underground



Piezometer	Borehole ID	Node	Sensor Elevatin (Mine Grid)	Sensor Elevation (masl)	Approximate Sensor Depth (mbgs)
PZ-RF200-01	TIS-200-001	VW1	9729.3	270.70	325.7
		VW2	9680.9	319.10	374.1
		VW3	9435.3	564.70	619.7
PZ-ES225-02	TIS-225-001	VW1	9726.8	273.20	328.2
		VW2	9678.5	321.50	376.5
PZ-ML17-225-166	ML17-225-166-F1	VW1	9856.1	143.90	198.9
		VW2	9856	144.30	199.3
PZ-ML17-350-161	ML17-350-161-001	VW1	9732	268.40	323.4
		VW2	9732	268.20	323.2
PZ-ML375-164	ML376-164-D1	VW1	9694	306.00	361.0
		VW2	9683	317.00	372.0
		VW3	9681	319.00	374.0
PZ-ML350-171	ML350-171-D1	VW1	9714	286.00	341.0
		VW2	9712	288.00	343.0
PZ-WH350-152	WH350-152-D1	VW1	9724	276.00	331
		VW2	9720	280.00	335
		VW3	9715	285.00	340

Source: Figure 7 from (Golder 2021c).

7.2.2.6 Numerical Hydrogeological Model

Groundwater model predictions presented in the 2014 FEIS included a best estimate (or base case) and a series of sensitivity runs to account for the potential uncertainty in the model predictions due to the uncertainty in the assumptions behind the numerical model (see Appendix 7.2-B submitted with Agnico Eagle 2014). For the 2014 FEIS, the best estimate of average groundwater inflow to the Tiriganiaq underground was 420 m^3/d in the first year of mining increasing up to 640 m^3/d in the final seven years of mining. The maximum groundwater inflow predicted in the sensitivity analysis was 970 m^3/d, which considered the possibly that the hydraulic conductivity assumed for the Lower Fault Zone could be a factor of ten higher than assumed for the Base Case.

In 2016, the numerical and conceptual model for Tiriganiaq was updated following an extensive field campaign in 2015 to fill in data gaps. The model assessed the potential influence of additional structures through sensitivity analysis. At the time of the 2016 model update, mining was predominantly within permafrost and observations of groundwater inflow associated with potential structures could not be assessed. Predicted groundwater inflows to the underground based on the 2016 model ranged from 280 m^3/d in the first year of mining increasing up to 420 m^3/d in the fifth and sixth years of mining. The updated modelling results were presented in the 2018 FEIS Addendum (Agnico Eagle 2018a).

Predictions of groundwater inflow to Tiriganiaq Underground was completed in 2019 and included calibration to inflow data collected up to January 2019 (Golder 2020a). Additional structures were considered in the model based on review of water intersections. The updated best estimate (or Base Case estimates) of groundwater inflow using the calibrated 2019 model ranged from an average flow of 420 m^3/day in Q4 of 2020 to a high of 580 m^3/day in 2025 and then down to 450 m^3/day at the end of the life of mine. The sensitivity scenarios selected for the 2019 model update considered the knowledge of the groundwater flow system at the time of the 2019 modelling, and the results of past sensitivity analyses. For each set of predicted inflows, the mitigation of groundwater inflows by grouting was not considered.

In support of the Meliadine Extension, an updated numerical groundwater model has been developed and is presented in the Hydrogeology Modelling Report (Golder 2021d). This report addresses the approaches and assumptions adopted in the estimate of the potential groundwater inflow quantity and groundwater quality (TDS only) associated with the development of the open pits and undergrounds, as presented in Section 2.2 of this Application. In this assessment, a three-dimensional numerical groundwater model was developed using FEFLOW (V7.2). In consideration of the expanded number and location of undergrounds, the model domain is larger than the model developed for the 2014 FEIS and the 2018 and 2020 FEIS Addenda for the Tiriganiaq underground. The model also incorporates an updated conceptual model relative to the 2014 FEIS described in Golder (2021c,d).

The Base Case Scenario represents the best estimate of groundwater inflow and groundwater TDS based on the measured data and the results of the model calibration. Since the groundwater inflows are being mitigated by active grouting, the predicted groundwater inflows incorporate the effects of grouting as grouting of the underground development is assumed to continue as part of future inflow predictions.

A summary of the predicted groundwater inflow to the underground developments during operations for the Base Case is presented in Table 7.2-6. Groundwater Inflow to the Tiriganiaq Underground were predicted to increase from 350 m^3/day in 2021 to a peak inflow of 1,650 m^3/day in 2027. Inflows then decrease as storage effects diminish from 2027 to 2037, where the predicted inflow to the underground is 1,300 m^3/day. Future predicted groundwater inflows are not directly comparable to past groundwater inflows, as the future extent of the Tiriganiaq underground is larger and deeper. The lateral expansion of the underground includes a drift to the north of the underground development, which causes the increase in the predicted inflows in 2025.

Groundwater inflows to the other underground developments are lower than Tiriganiaq, reflecting the shallower planned mine depth, greater proportion of the development in permafrost, and overall smaller footprint of these developments. Peak inflows at the other developments range from less than 50 m^3/day at Wesmeg-North, up to 200 m^3/day at Wesmeg. Flows to Wesmeg, Wesmeg-North, and Pump are mitigated by dewatering of Lakes B5 and A8 West. In the absence of this dewatering, higher inflows to the underground would be expected as the mine development extends below these lakes. Inflow to Wesmeg and Wesmeg-North are also affected by depressurization from the adjacent mining at Tiriganiaq, which acts a stronger hydraulic sink given its greater depth of mining (maximum base elevation of -845 masl versus -590 at Wesmeg and -395 m^3/day at Wesmeg-North) (Golder 2021d).

Table 7.2-6: Predicted Base Case Scenario Groundwater Inflows – Groundwater Inflow, TDS Quality and Lake Water Contributions

Year	Base Case Predictions																				
	Predicted Groundwater Inflow (m^3/day)							Predicted TDS in Groundwater Inflow (mg/L)							Lake Water Contribution (%)						
	Tiriganiaq Deposit				F Zone	Pump	Discovery	Tiriganiaq Deposit				F Zone	Pump	Discovery	Tiriganiaq Deposit				F Zone	Pump	Discovery
	Tiriganiaq	Wesmeg	Wesmeg-North	Tiriganiaq -Wolf				Tiriganiaq	Wesmeg	Wesmeg-North	Tiriganiaq -Wolf				Tiriganiaq	Wesmeg	Wesmeg-North	Tiriganiaq -Wolf			
2021	350	<50	-	-	-	-	-	59,500	59,500	-	-	-	-	-	<1	<1	-	-	-	-	-
2022	500	<50	-	-	-	-	-	59,500	60,000	-	-	-	-	-	<1	<1	-	-	-	-	-
2023	550	50	<50	-	-	-	-	59,500	59,000	38,000	-	-	-	-	<1	<1	<1	-	-	-	-
2024	700	100	<50	-	-	-	-	59,500	59,500	21,500	-	-	-	-	<1	<1	5	-	-	-	-
2025	1,050	100	<50	-	-	-	-	57,500	59,500	13,000	-	-	-	-	<1	<1	19	-	-	-	<1
2026	1,500	100	<50	-	-	-	50	56,000	59,000	10,000	-	-	-	59,000	<1	<1	30	-	-	-	<1
2027	1,650	150	<50	-	-	-	100	56,000	58,500	9,000	-	-	-	59,000	<1	<1	34	-	-	-	<1
2028	1,450	150	<50	-	-	-	100	56,000	58,000	10,000	-	-	-	60,000	<1	<1	36	-	-	-	<1
2029	1,400	150	<50	-	-	<50	200	56,000	58,000	9,000	-	-	59,000	59,000	1	<1	47	-	-	<1	<1
2030	1,400	150	<50	-	-	100	200	55,500	57,000	8,000	-	-	57,500	60,000	2	<1	52	-	-	<1	<1
2031	1,350	200	<50	-	-	100	200	55,500	54,500	7,500	-	-	51,500	60,000	2	1	54	-	-	<1	-
2032	1,350	150	<50	-	-	100	-	55,500	55,000	11,000	-	-	49,000	-	3	2	48	-	-	1	-
2033	1,350	150	<50	-	-	150	-	55,500	53,500	11,500	-	-	44,000	-	3	3	48	<1	<1	2	-
2034	1,300	150	<50	-	50	150	-	55,000	53,000	10,000	-	59,000	44,500	-	4	4	54	<1	<1	3	-
2035	1,300	150	<50	<50	100	100	-	55,000	52,500	8,000	56,500	59,000	45,500	-	4	5	60	<1	<1	3	-
2036	1,300	150	<50	50	150	-	-	55,000	51,500	7,500	53,000	59,500	-	-	5	6	65	<1	<1	-	-
2037	1,300	150	<50	50	150	-	-	55,000	50,500	6,500	50,500	60,000	-	-	5	8	68	<1	<1	-	-
2038	-	-	-	100	150	-	-	-	-	-	49,500	60,000	-	-	-	-	-	2	<1	-	-
2039	-	-	-	150	150	-	-	-	-	-	52,500	60,000	-	-	-	-	-	2	<1	-	-
2040	-	-	-	150	-	-	-	-	-	-	52,000	-	-	-	-	-	-	4	-	-	-
2041	-	-	-	150	-	-	-	-	-	-	52,000	-	-	-	-	-	-	5	-	-	-
2042	-	-	-	150	-	-	-	-	-	-	51,000	-	-	-	-	-	-	7	-	-	-
2043	-	-	-	150	-	-	-	-	-	-	49,500	-	-	-	-	-	-	9	-	-	-

Source: Table 9 from (Golder 2021d).

A comparison of the predicted inflows presented in the 2014 FEIS, the 2018 and 2020 FEIS Addenda, and the updated predictions as part of the Meliadine Extension is presented in Table 7.2-7. Key changes in the conceptual model since the completion of the 2014 FEIS include: shallower interpreted base of permafrost, conservative inclusion of additional structures of enhanced permeability, and implementation of grouting as a mitigation measure. As mentioned, the future predicted groundwater inflows are not directly comparable to past groundwater inflows, as the future extent of the Tiriganiaq underground is larger and deeper (-845 masl). Overall, predicted inflows for the Meliadine Extension are within the range considered for the 2014 FEIS during the early years of mining when the mine plans more precisely align, although the 2014 FEIS flows did not consider mitigation by grouting.

Table 7.2-7: Comparison of Predicted Base Case Scenario Groundwater Inflows

Mine Year	Year	Predicted Groundwater Inflow (m3/day)				
		2012 Model (FEIS 2014)	2016 Model (2018 FEIS)	2019 Model (2020 FEIS)	2021 Model (Meliadine Extension Application)	
					Tiriganiaq	All UG
-1	2019	420	280	380 to 430	220	-
1	2020		300	410 to 420	280	-
2	2021		340	420 to 460	350	400
3	2022	540	340	480 to 510	500	550
4	2023		420	530	550	650
5	2024			540	700	850
6	2025	640	380	580	1050	1200
7	2026			570	1500	1700
8	2027		390	530	1650	1950
9	2028			510	1450	1750
10	2029		380	490	1400	1800
11	2030			480	1400	1900
12	2031		360	470	1350	1900
13	2032			460	1350	1650
14	2033			450	1350	1700
15	2034				1300	1700
16	2035				1300	1750
17	2036				1300	1700
18	2037				1300	1700
19	2038				0	250
20	2039				0	300
21	2040				0	150
22	2041				0	150
23	2042				0	150
24	2043				0	150

7.2.3 Assessment of Potential Meliadine Extension-related Effects

Pathway analysis for groundwater and hydrogeology identifies and assesses the linkages between mine components or activities. However, changes in hydrogeology and groundwater quantity and quality can only be evaluated in the context of how these changes in turn may result in changes to valued components with assessment endpoints. Therefore, no impact predictions are made for hydrogeology and groundwater quantity and quality as impacts to these components directly influence, and therefore are captured in, the assessment of impacts on other VECs including hydrology, surface water quality and fish and fish habitat.

Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-4 of this Application and are also described in Volume 7, Section 7.2.3, Table 7.2.-5 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC hydrogeology and groundwater as a result of Meliadine Extension, there is no change from the previous assessment.

There are no primary pathways for hydrogeology and groundwater quality, or to other VECs as a result of change to hydrogeology and groundwater quality. Therefore, effects analysis and subsequent residual impact classification were not undertaken.

7.2.4 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- Adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- Understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will affect water flows); and
- Knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., grouting).

Therefore, any uncertainty with the Meliadine Extension is related to assumptions in the mitigations and site water balance model. This will be addressed through monitoring programs as described in the following section.

7.2.5 Monitoring and Follow-up

Follow-up monitoring for the Approved activities for the Meliadine mine (Agnico Eagle 2014, 2018a, 2020a) and Meliadine Extension will be conducted in general accordance with the regular monitoring currently being conducted as part of the Groundwater Management Plan (Appendix D-35) which includes the groundwater management strategies and mitigation measures (short-term, medium-term, and long-term) and the groundwater monitoring program (water quantity and quality), and by applying the adaptive measures presented in the Adaptive Management Plan (Appendix D-01).

For the Meliadine Extension, Agnico Eagle has updated the associated plans or reports for further guidance and mitigation. Agnico Eagle considers that existing T&C 24, 25, and 26 of Project Certificate No.006 are sufficient to mitigate and monitor groundwater associated with the Meliadine Extension.

Any new required mitigation measures related to the Meliadine Extension are described in relation to the predicted effects and summarized in pathway tables provided in Appendix B-2, Table B-4 of this Application. Mitigation, management, and monitoring plans are summarized in Section 12 and provided in Appendix D of this Application. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

7.3 Hydrology including Water Quantity

This hydrology section provides an assessment of potential effects of the Meliadine Extension on hydrology and provides input to the effect assessment of other disciplines including (but not limited to) water quality, and fish and fish habitat. This section focuses on the potential effects of the Meliadine Extension on the receiving environment, beyond those from the 2014 FEIS. The main driver for the assessment is related to water management at the Meliadine Mine and thus focuses on updates to the site water balance.

The Meliadine Extension is not expected to change the magnitude of effects previously assessed for the 2014 FEIS but is expected to change the duration of effects previously assessed for the 2014 FEIS. There were no new primary pathways identified. Effects of the Meliadine Extension are primarily related to:

- the increased duration of the operations phase generating additional surface contact water requiring treatment and discharge to the receiving environment

The length of the closure and post-closure phases are not expected to be longer than those in the 2014 FEIS.

7.3.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ encompasses not only TK about land and resources, but also the skills to apply this knowledge to livelihoods, and a value system that is founded upon respect, sharing, collaboration, collective decision-making, skills development, and the responsible use of resources.

IQ for the Meliadine Extension (Section 3) did not highlight any new concerns related to the existing environment or baseline information regarding hydrology. The Meliadine Extension is consistent with TK/IQ integration from the 2014 FEIS and the 2018 and 2020 Addenda (Agnico Eagle 2014, 2018b, 2020a).

TK/IQ findings as they relate to the hydrology environment are summarized:

- In general ice on freshwater lakes in Nunavut is forming later in the year than in the past, ice does not get as thick as it did in the past, and there are areas that ice stays thin all winter (GN 2005).

- Ice melt in Nunavut has started earlier in the last few years, and that the duration of melt has been shorter (i.e., melt has been quicker) (GN 2005).
- The seasons are changing, and the streams are getting lower having an impact on fish. Some years are dry, and the water is low. Some years, the water is high when there is more rain (Section 3.6).
- Concerns regarding climate and meteorology include reference to low water levels same as for the 2014 FEIS (Section 3.6). Consumptive water withdrawal from approved water bodies are managed to maintain withdrawal flows in the approved limits, and to not impact water levels in the approved water bodies at any given moment or season (Section 3.6).
- Where available, Inuit concerns were taken into consideration while developing pathways including concerns relating to lower water levels, thin ice conditions, later freeze-up, and earlier and more rapid melt of lakes and rivers (GN 2005).
- While, IQ suggests that there have been recent changes to water characteristics in the region, including lower water levels, thin ice conditions, later freeze-up, and earlier and more rapid melt of lakes, the cumulative effects from climate change and the Meliadine Extension on surface water quantity over the short duration of the Meliadine Extension (approximately 20 years of construction, operations and closure activities) are not expected to result in significant deviations from natural variability (see Volume 7, Section 7.3.5.1 of the 2014 FEIS).

7.3.2 Existing Environment

The 2014 FEIS characterized the existing hydrology environment and baseline conditions through a combination of field studies and development of a water balance model to derive long-term mean characteristics and variability for key waterbodies. A detailed description is available in the 2014 FEIS (Volume 7, Section 7.3).

The Meliadine Mine is located within the Meliadine Lake watershed. Meliadine Lake has a water surface area of approximately 107 km^2, a maximum length of 31 km, features a highly convoluted shoreline of 465 km in length, and has over 200 islands. Unlike most lakes, it has 2 outflows that drain into Hudson Bay through 2 separate river systems. It has a drainage area of 560 km^2 upstream of its 2 outflows. Most drainage occurs via the Meliadine River, which originates at the south west end of the lake. The Meliadine River flows for a total stream distance of 39 km. The Meliadine River flows through a series of waterbodies, until it reaches Little Meliadine Lake and then continues into Hudson Bay. A second, smaller outflow from the west basin of Meliadine Lake drains into Peter Lake, which discharges into Hudson Bay through the Diana River system (a stream distance of 70 km) (visible on Figure 7.1-5 in Section 7.1). At its mouth, the Diana River has a drainage area of 1460 km^2.

Watersheds within the LSA (A, B, C, D, E, G, H, I, J, and P near the main Meliadine Mine footprint; and X and CH near Discovery) comprise an extensive network of waterbodies, and interconnecting streams. These watersheds have lake surface fractions (i.e., the ratio of lake area to land area) of up to 51%, and the hydrology of these watersheds is dominated by lake storage and evaporation.

The Meliadine Extension is located within the same footprint as the Meliadine Mine, and primarily within the A, B, H, and J watersheds (Figures 1.1-4 and 1.1-5 from Section 1). Additional information on hydrologic flows were obtained from routine monitoring done at the Meliadine Mine and as reported in the annual report (Agnico Eagle 2021c). Site water is monitored and a projection of surface flows were completed through an update to the monthly water balance. This model provides predicted monthly and annual water quantities reporting from the main site infrastructure (e.g., waste rock storage facilities, contact water ponds). Discharge volumes to the environment (i.e., to Meliadine Lake via monitoring station MEL-14 and to Itivia Harbour via monitoring station MEL-26) are recorded daily during discharge.

The previous assessments predicted quantities of water that would be withdrawn from Meliadine Lake for process or potable use, and quantities of water that would be managed and discharged to Meliadine Lake; these predictions are compared to measured data (Table 7.3-1). The previous assessments concluded that there would be negligible effects to water levels and flows in Meliadine Lake due to water withdrawal and water discharge (Agnico Eagle 2014 [Section 7.3.4]). The measured water withdrawal and discharge volumes are within the range of predictions.

Table 7.3-1: Summary of Predicted and Measured Annual Water Withdrawal and Discharge to Meliadine Lake for the Meliadine Mine

Source	Annual Withdrawal (m^3)	Annual Discharge (m^3)
Predictions		
2014 FEIS	2,168,100 (Volume 2, Table 2-27 from Agnico Eagle 2014)	392,507 to 2,630,600 (SD 2-6 from Agnico Eagle 2014)
2016 Water Licence	318,000 (Agnico Eagle 2015)	798,000 (Agnico Eagle 2015)
2020 Water Licence Amendment	741,706 Agnico Eagle (2020b)	598,209 to 883,631 Table 6 from Golder 2020b
Measured		
2016	0[a] (Agnico Eagle 2017)	177,376 (Agnico Eagle 2017)
2017	14,863 (Agnico Eagle 2018c)	0 (Agnico Eagle 2018c)
2018	29,255[b] (Agnico Eagle 2019b)	642,521 (Agnico Eagle 2019b)
2019	299,470[b] (Agnico Eagle 2020e)	306,773 (Agnico Eagle 2020)
2020	296,823[b] (Agnico Eagle 2021c)	1,031,178 (Agnico Eagle 2021c)

(a) No water under licence 2AM-MEL1631
(b) Withdrawn from Meliadine Lake and A8

Monitoring for natural flows outside of the Mine footprint is done to support specific studies when required, supplemental flows outside the Mine footprint and within the RSA were not collected for the Meliadine Extension. Since measured flows during operations are within the range of predictions, flows outside the Mine footprint and within the LSA and RSA would not be substantially different than data collected for the 2014 FEIS.

7.3.3 Assessment of Potential Meliadine Extension-related Effects

The Meliadine Extension activities represent a negligible change from the Approved assessment activities (Agnico Eagle 2014, 2018a, 2020a) and no new pathways were identified. This section provides a summary of the effects assessment for hydrology.

A pathway analysis to identify and assess linkages between activities included in the application and hydrology was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-5 of this Application and are also described in Volume 7, Section 7.3.2, Table 7.3-27 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC hydrology as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways may result in measurable environmental change that could contribute to residual effects. Primary pathways are provided in Table 7.3-2 of this Application and are also described in Volume 7, Section 7.3.2 and 7.3.3 of the 2014 FEIS. There are no new primary pathways for hydrology (Table 7.3-2). The Meliadine Extension does not change the size of the spatial boundary for the assessment, but there is an increase in the temporal boundary due to the extension of mine life. The extended temporal boundary does not change the results of primary pathways identified from the previous assessments; however, a summary of the effects analysis for the primary pathways are provided below.

Table 7.3-2: Potential Primary Pathways for Hydrology

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts – Meliadine Extension	Meliadine Extension Rationale
Meliadine Extension Footprint (e.g., dikes, mine pits, waste rock, access roads, mine plant)	Meliadine Extension footprint, which will physically alter watershed areas and drainage patterns, may change downstream flows, water levels, and channel/bank stability in streams, and affect water quality, fish habitat, and fish	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Access roads will be as narrow as possible, while maintaining safe construction and operation practices. Best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management), where needed.	Primary	Primary	Table 7.3-36 to Table 7.3-44 of 2014 FEIS Infrastructure development will modify the configuration of a watershed, including size of the watershed, and lake to land ratio of the watershed.	No change from the 2014 FEIS	This pathway and effects have been previously assessed The Meliadine Extension will be within the footprint that has been previously assessed; the footprint of the Meliadine Extension is more compact than the 2014 FEIS footprint for water management infrastructure The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS Mitigation measures outlined in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension
Site Water Management: Dewatering of Meliadine Extension Footprint Waterbodies to Downstream Receiving Waterbodies (e.g., to Lake A7, A1, B6, B34, Meliadine Lake)	Dewatering of waterbodies may change flows, water levels, and channel/bank stability in receiving and downstream waterbodies, and affect water quality, fish habitat, and fish	Pumped discharge will be directed to the lake environment, and not directly to outlets, to attenuate flow changes. Final discharge locations will be determined during the detailed design stage and may be modified based on monitoring results.	Primary	Primary	Table 7.3-36 to Table 7.3-44 of 2014 FEIS Dewatering of waterbodies will augment flows and water levels at receiving waterbodies.	No change from the 2014 FEIS	This pathway and effects have been previously assessed Pumped discharges for dewatering will be directed to a lake environment (not directly to outlets) or to a treatment facility and for discharge through the permanent diffusers The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS Mitigation measures outlined in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension
Site Water Management: Watershed Modification by Diversion of Water (e.g., Lake A8 to Lake A31, Upper B to D Watershed, Lower B to P Watershed)	Alteration of watershed flow paths may change flows, water levels, and channel/bank stability in downstream waterbodies, and affect water quality, fish habitat and fish	Shoreline areas susceptible to extensive erosion will be addressed by appropriate erosion protection measures to reduce erosion and associated re-suspension of fine sediment. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.	Primary	Primary	Table 7.3-36 to Table 7.3-44 of 2014 FEIS Diversion of waterbodies will augment flows of receiving waterbodies, and reduce flows of bypassed waterbodies.	No change from the 2014 FEIS	This pathway and effects have been previously assessed Water diverted around the mine footprint will be directed to waterbodies to augment changes in flows The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS Mitigation measures outlined in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension

The primary pathways for hydrology, which has no change from the 2014 FEIS, included:

- **Meliadine Extension footprint, which will physically alter watershed areas and drainage patterns, may change downstream flows, water levels, and channel/bank stability in streams, and affect water quality, fish habitat, and fish.**
- **Dewatering of waterbodies may change flows, water levels, and channel/bank stability in receiving and downstream waterbodies, and affect water quality, fish habitat, and fish.**
- **Alteration of watershed flow paths may change flows, water levels, and channel/bank stability in downstream waterbodies, and affect water quality, fish habitat and fish.**

For the 2014 FEIS, a site water balance model was used to predict the quantity and quality of water to be managed within the mine footprint (SD 2-6 of Agnico Eagle 2014). For each year, or group of years, the framework of the model was updated to reflect the developing Meliadine Mine footprint. The results of this model were inputs to a model that evaluated watersheds downstream of project activities (Volume 7, Section 7.3.3 of the 2014 FEIS); the effects of mine development on watershed areas and drainage patterns, dewatering of waterbodies, and alteration of watershed flow paths was assessed using this model. For the Meliadine Extension, a refinement of the site water balance model was developed (Appendix H-7). The spatial extent of the Meliadine Extension, for the purposes of water management including dewatering, diversion of flows, and alteration of watershed flow paths, has not changed from the 2014 FEIS. Changes to altered watershed areas, drainage patterns downstream flows, water levels, and channel/bank stability in streams has been previously assessed. There will be no change to these areas as a result of the Meliadine Extension.

As part of the 2020 FEIS, an assessment on the flow and water level in Meliadine Lake was completed (Golder 2020c). The assessment considered the diversion of runoff from the entire A and B sub-watersheds (Figure 7.1-3), and 741,706 m^3/yr (for potable and process water use) away from Meliadine Lake and toward Itivia Harbour. The diverted quantities are conservative as only a portion of the A and B sub-watersheds is expected to be diverted. The following baseline mean annual water yields were considered:

- Meliadine Lake: 91,700,000 m^3/yr
- Sub-Watershed A: 1,670,000 m^3/yr
- Sub-Watershed B: 4,000,000 m^3/yr

The total diverted quantity was assumed to be approximately 6,410,000 m^3/yr (inclusive of 5,670,000 m^3/yr for the A and B sub-watersheds and 741,000 m^3/yr for potable and process water use). This total diverted quantity corresponds to approximately 7% of the annual water yield of Meliadine Lake (i.e., 91,700,000 m^3/yr).

The potential impacts of this diversion, as compared to baseline conditions (i.e., pre-2014) on flow and water level in Meliadine Lake are summarized as follows:

- Mean monthly flows at the Meliadine Lake outlet could decrease by 6% to 8% during the open water.
- Mean monthly water levels could decrease by 1 cm during the open water season.

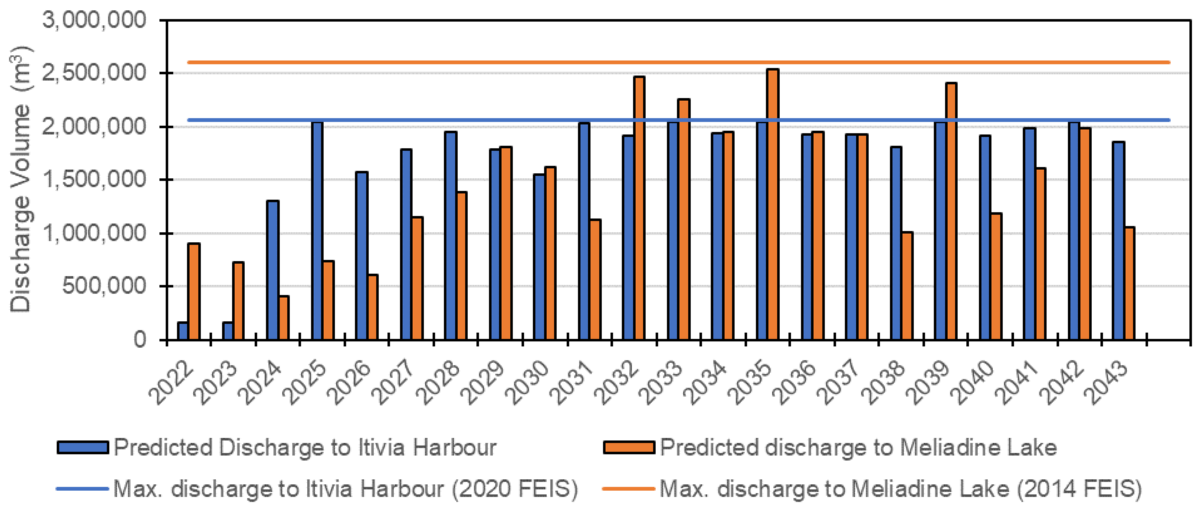
Based on the conservative assumptions in this model and assessment, it was concluded that the diversion will result in overall small reduction in flows, and negligible effects on the water levels in Meliadine Lake (Golder 2020c). The Meliadine Extension will be primarily within the A and B watersheds and thus, based on previous model results (Golder 2020c), if most or all of the flows from the A and B watersheds are diverted away from Meliadine Lake, the Meliadine Extension will have an overall small reduction in flows, and negligible effects on the water levels in Meliadine Lake. However, based on the updated site water balance model (Appendix H-7), some of the water diverted from the A, B, and H watersheds will be directed to Meliadine Lake as treated effluent, and some will be directed to Itivia Harbour (Figure 7.3-1). The total water diverted from Meliadine Lake and the total water discharged to Meliadine Lake through the diffuser will be within the ranges already assessed (Table 7.3-3). As a result, the Meliadine Extension will have an overall small reduction in flows, and negligible effects on the water levels in Meliadine Lake.

Table 7.3-3: Summary of Predicted Water Withdrawal and Discharge to Meliadine Lake for the Meliadine Extension (Operations)

Predictions	Annual Withdrawal (m^3)	Annual Discharge (m^3)
2014 FEIS	2,168,100 (Volume 2, Table 2-27 from Agnico Eagle 2014)	392,507 to 2,630,600 (SD 2-6 from Agnico Eagle 2014)
2016 Water Licence	318,000 (Agnico Eagle 2015)	798,000 (Agnico Eagle 2015)
2020 Water Licence Amendment	741,706 Agnico Eagle (2020b)	598,209 to 883,631 Table 6 from Golder 2020b
Meliadine Extension	2,168,100 Section 2.3.5.1 of this Application	404,267 to 2,533,350 (Table 5-3 from Appendix H-7)

As described in the 2014 FEIS, the pits will be actively flooded during closure with natural runoff and water from Meliadine Lake. In the 2014 FEIS, it was assumed that it would take ten years (with pumping of water from June to September each year) to flood the pits for a total volume of 170,600,000 m^3 (Volume 7, Section 7.3.3.10.1.1, Table 7.3-34; Agnico Eagle 2014). Through the Meliadine Extension, the pit shapes have been refined and it is predicted the flooding will take 7 years with a total volume of 115,027,859 m^3 (Table 7.3-4; Appendix H, Section 5). The active pumping rates will be managed to minimize effects to Meliadine Lake to ensure that the total annual discharge from Meliadine Lake does not drop below the 10-year dry conditions. If there are years where Meliadine Lake discharges are predicted to naturally fall below the 10-year dry condition, no pumping will occur.

Figure 7.3-1: Annual Effluent Volumes Discharged to Itivia Harbour (Waterline) and Meliadine Lake (Operations)



Source: Figure 5-9 from Appendix H-7

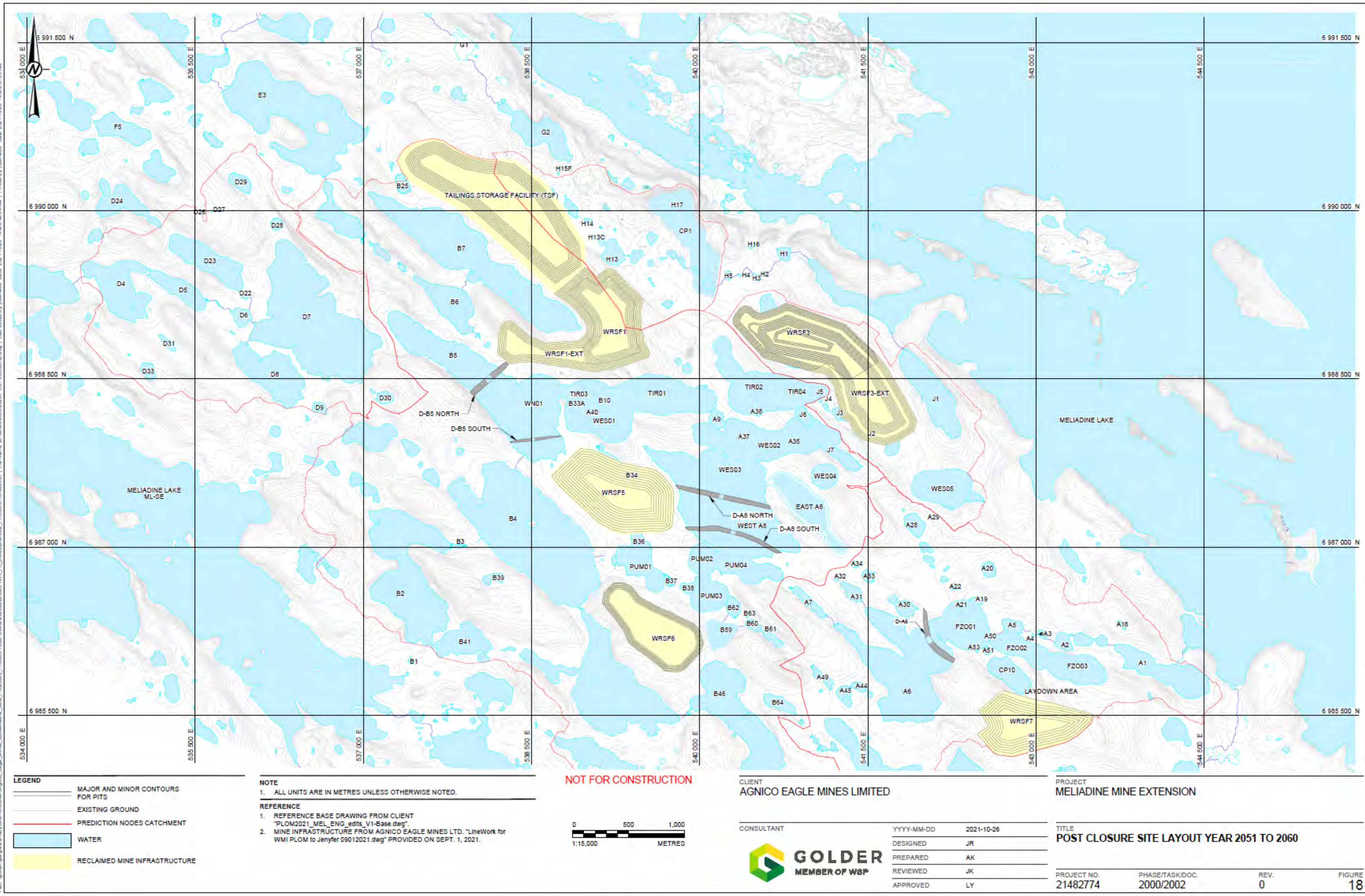
Table 7.3-4: Open Pit Water Balances in Active Closure

Year	Meliadine Lake Pumped (m³)	% Total	Contact Water (m³)	% Total
2044	13,429,100	81%	3,206,808	19%
2045	13,429,100	85%	2,408,437	15%
2046	13,429,100	76%	4,209,620	24%
2047	13,429,100	82%	3,020,466	18%
2048	13,429,100	76%	4,156,038	24%
2049	13,429,100	78%	3,868,357	22%
2050	10,142,420	75%	3,441,113	25%
Total	**90,717,020**	**79%**	**24,310,839**	**21%**
			115,027,859	

Source: Table 5-1 from Appendix H-7

As the open pits are filled, several pits will join to form a single waterbody. This was also evaluated in the 2014 FEIS. Pit lake volumes are stable on an interannual basis. As described in the 2014 FEIS, these new waterbodies represent a change to the landscape as compared to baseline conditions which will result in a net decrease in some sub-watersheds (e.g., B7) and a net increase in other sub-watersheds (e.g., A6) (Figure 7.3-2). Once the pits have flooded, and water is allowed to spill over to the next downstream waterbody, effects to downstream flows are expected to be negligible because flow rates will be moderated by the large and stable upstream pit lake (Volume 7, Section 7.3.3.11; Agnico Eagle 2014). At the outlets of the pit lakes, channels will be constructed to convey flows but also to allow fish passage. Outlet channels will be designed to approximate a natural hydrograph to the extent possible to manage water levels and to prevent erosion and sedimentation.

Figure 7.3-2: Post-Closure Site Layout (2051 to 2060)



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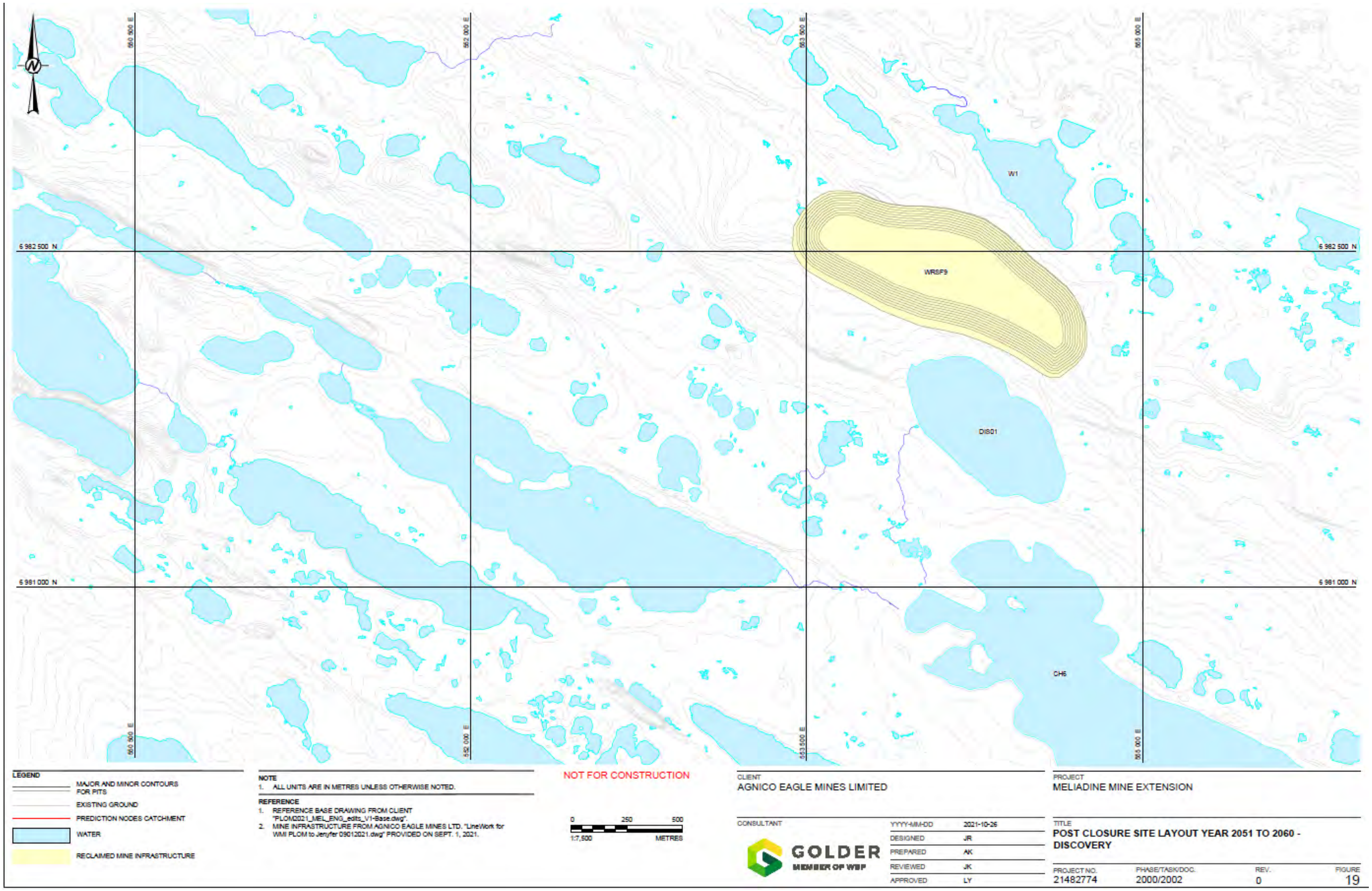

550 500 E
552 000 E
553 500 E
555 000 E
6 982 500 N
6 981 000 N
W1
WRSF9
DISO1
CH6
LEGEND
MAJOR AND MINOR CONTOURS FOR PITS
EXISTING GROUND
PREDICTION NODES CATCHMENT
WATER
RECLAIMED MINE INFRASTRUCTURE
NOTE
1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
REFERENCE
1. REFERENCE BASE DRAWING FROM CLIENT "PLOM2021_MEL_ENG_edits_V1-Base.dwg".
2. MINE INFRASTRUCTURE FROM AGNICO EAGLE MINES LTD. "LineWork for WMI PLOM to Jenyfer 09012021.dwg" PROVIDED ON SEPT. 1, 2021.
NOT FOR CONSTRUCTION
0
250
500
1:7,500
METRES
CLIENT
AGNICO EAGLE MINES LIMITED
CONSULTANT
GOLDER
MEMBER OF WSP
YYYY-MM-DD 2021-10-26
DESIGNED JR
PREPARED AK
REVIEWED JK
APPROVED LY
PROJECT
MELIADINE MINE EXTENSION
TITLE
POST CLOSURE SITE LAYOUT YEAR 2051 TO 2060 - DISCOVERY
PROJECT NO. 21482774
PHASE/TASK/DOC. 2000/2002
REV. 0
FIGURE 19

7.3.4 Residual Impact Classification

The Meliadine Extension will result in effects to the hydrology of watersheds in the LSA which will vary over time. These results were described in Volume 7, Section 7.3.4 of the 2014 FEIS. The effects to hydrology will be reduced through mitigations and environmental design features such as:

- Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation.
- Best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management), where needed.
- Pumped discharges will be directed to the lake environment, and not directly to outlets, to attenuate flow changes.
- Erosion protection will be used to reduce erosion and associated re-suspension of fine sediment.

Classification of the projected effects on hydrology including quantity is presented in Section 7.5 (fish and fish habitat), based on a residual impact classification system that utilizes assessment of effects on those VECs with assessment endpoints (i.e., key properties that should be protected for use by future generations).

7.3.5 Cumulative Effects Assessment

Potential residual effects to hydrology including water quantity from the 2014 FEIS were anticipated to be confined to the Meliadine Lake and Atulik watersheds (mine development) and to the Meliadine Lake, Atulik, Char River, Dry Cove, Meliadine River, and Thompson watersheds (AWAR); however, measurable changes are expected to be contained near to the mine development. No changes are expected for the Meliadine Extension. There are no other projects or RFFDs in these watersheds where there could be an overlap with the Meliadine Extension. As with the 2014 FEIS, the potential for cumulative effects is negligible.

7.3.6 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will affect water flows); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., erosion and sedimentation protection).

Therefore, any uncertainty with the Meliadine Extension is related to assumptions in the mitigations and site water balance model. This will be addressed through monitoring programs as described below.

7.3.7 Monitoring and Follow-up

Follow-up flow monitoring for the 2014 FEIS, and the 2018 and 2020 Addenda (Agnico Eagle 2014, 2018a, 2020a) and Meliadine Extension will be conducted in general accordance with required monitoring under Project Certificate No.006 and Type A Water Licence 2AM-MEL1631 and captured in existing monitoring plans including:

- Adaptive Management Plan (Appendix D-01)
- Aquatic Effects Monitoring Program (Appendix D-05)
- Environmental Management Protection Plan (Appendix D-12)
- Ocean Discharge Monitoring Plan (Appendix D-24)
- Roads Management Plan (Appendix D-30)
- Water Management Plan (Appendix D-35), with appendices:
  - Freshet Action Plan
  - Sediment and Erosion Plan
  - Water Quality and Flow Monitoring

For the Meliadine Extension, Agnico Eagle has updated the associated plans or reports for further guidance and mitigation. Agnico Eagle considers that existing T&C 27, 28, and 29 of Project Certificate No.006 are sufficient to protect, mitigate and monitor hydrology impacts associated with the Meliadine Extension.

Any new required mitigation measures related to primary effects for the Meliadine Extension are described in relation to the predicted effects and summarized in the primary pathway for hydrology (Table 7.3-2) and summarized in the no linkage and minor pathway table for hydrology provided in Appendix B-2, Table B-5 of this Application. Mitigation, management, and monitoring plans are summarized in Section 12 and provided in Appendix D of this Application. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

7.4 Surface Water and Sediment Quality

This section provides an assessment of potential effects of the Meliadine Extension on water quality (and indirectly sediment quality) and provides input to the effect assessment of other disciplines including (but not limited to) fish and fish habitat (Section 7.5), and human health and ecological risk assessment (Section 10). This section focuses on the potential effects of the Meliadine Extension on water quality in the receiving environment, beyond those from the 2014 FEIS. The main driver for the assessment is related to water management at the Meliadine Mine and thus focuses on updates to the predictions for the Mine and Meliadine Lake.

While the duration of potential effects may increase as a result of the Meliadine Extension, the magnitude of effects, and the spatial extent of effects previously assessed are not expected to change. There were no new primary pathways identified. Effects of the Meliadine Extension are primarily related to:

- the increased duration of the operations phase generating additional surface contact water requiring treatment and discharge to the receiving environment

The length of the closure and post-closure phases are not expected to be longer than those in the 2014 FEIS.

7.4.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ encompasses not only TK about land and resources, but also the skills to apply this knowledge to livelihoods, and a value system that is founded upon respect, sharing, collaboration, collective decision-making, skills development, and the responsible use of resources.

IQ for the Meliadine Extension (Section 3) did not highlight any new concerns related to the existing environment or baseline information regarding water quality. We did hear comments that people are interested in learning about the water quality results from the baseline (pre-mining) studies, understanding how mining may change water quality, understanding monitoring programs, and learning about the monitoring results.

The Meliadine Extension is consistent with IQ integration from the 2014 FEIS and the 2018 and 2020 Addenda (Agnico Eagle 2014, 2018b, 2020a).

IQ findings as they relate to water quality are summarized:

- Through public consultation and the Traditional Use Study (2014 FEIS Volume 9, Section 9.3), it is known that surface water in the Meliadine Mine area could be used as a drinking water source by the Inuit.
- Concentration of total and dissolved parameters in water (e.g., TDS, TSS, nutrients, total metals, dissolved metals, etc.) strongly influence the quality of water for aquatic organisms, wildlife, and the use of water as a drinking water source for Inuit or for recreational purposes.
- Through public consultation and the Traditional Use Study (2014 FEIS Volume 9, Section 9.3), Meliadine Lake has been identified as an important drinking water source and source of water for making tea by local residents.
- Domestic fishing is still an important part of the Inuit way of life, accounting for as much as 20% of the diet of the residents of Rankin Inlet and Chesterfield Inlet. Most of the waterbodies in the general Meliadine area, including Meliadine Lake, are fished for Lake Trout and Arctic Char, and cabins in the study area are used as a base during fishing and hunting trips (2014 FEIS Volume 9, Section 9.3).
- It is noted that the local communities identified fish resources in Meliadine Lake are important to them, but removal of fish and drainage of smaller waterbodies are of little concern (2014 FEIS Volume 9, Section 9.3).

- In addition to local communities expressing the importance to them of Meliadine Lake and fish resources within the lake, they also raised concern over discharge of contaminated water into Meliadine Lake and the effect of this on fish populations (2014 FEIS Volume 9, Section 9.3).
- Through the waterline application, we have heard community comments regarding discharge to Meliadine Lake. Those comments were aligned with previous TK/IQ collected and presented in the 2014 FEIS.
- Inuit concerns were taken into consideration while developing pathways, including concerns related to lower water levels and the quality of water for drinking.

The Meliadine Extension water management strategy and management plans have been developed based on those comments.

7.4.2 Existing Environment

7.4.2.1 Water Quality

Information on baseline (pre-2014) and existing conditions (post-2014) has been collected and summarized in a variety of documents including:

- Volume 7, Section 7.4.4 of the 2014 FEIS;
- Supporting document SD 7-1 (2009 Aquatic Synthesis Baseline) of the 2014 FEIS;
- Supporting document SD 7-2 (2011 Aquatic Synthesis Baseline) of the 2014 FEIS;
- Annual reports from 2016 to 2020 (Agnico Eagle 2017, 2018c, 2019b, 2020e, 2021c);
- Annual AEMP reports from 2016 to 2020 (Golder 2017, 2018d, 2019c; Azimuth 2020, 2021a);
- Environmental Effects Cycle 1 report (Golder 2019c);
- Environmental Effects Cycle 2 Study Design (Azimuth 2021b); and
- the Water Quality Management and Optimization Plan (Golder 2021i).

The 2014 FEIS (Section 7.4.4) provides a review of Meliadine Lake, small waterbodies on the peninsula of Meliadine Lake, regional waterbodies, and small and large watercourses on the peninsula of Meliadine Lake and along the AWAR. Section 7.4.4 of the 2014 FEIS provides a solid overview of baseline (i.e., pre-2014) conditions in the LSA and RSA. Monitoring has been conducted since 2014 that primarily reflects existing conditions since construction and early operation of Meliadine Mine. These monitoring programs focus mainly on Meliadine Lake and a few small waterbodies near the Meliadine Mine.

Seasonality is an important feature in lakes of northern Canada, where the seasonal production of ice can cause dissolved substances to concentrate in the unfrozen water, and in shallow systems, ice can form through the water column and freeze to the bottom in shallow waterbody and stream systems. Oxygen levels can be suppressed during the winter because oxygen is not replenished from the atmosphere and is consumed by sediments and organisms. During open water conditions, oxygen is replenished in waterbodies through exchange with the atmosphere. The open water season ranges from late May until early October, with ice cover the rest of the year.

Water quality in winter can often be high in TDS due to the formation of ice as pure water, which increases the concentration of dissolved solids in the remaining water. In spring, runoff from snowmelt and precipitation is often low in TDS which dilutes TDS in the lakes. In contrast, TSS tends to increase in spring as freshet flows can result in erosion and suspension of materials in the water column. As flows decrease, TSS settles and the water column clears.

Meliadine Lake is generally described as well oxygenated throughout the year, with circumneutral to slightly basic pH. Concentration of TDS, hardness, alkalinity, specific conductivity, nutrients, and metals were low and lower than relevant guidelines for aquatic life (CCME 1999) and drinking water (Health Canada 2020). Concentrations were generally higher in the peninsula lakes as compared to Meliadine Lake; for example, TDS was lowest in Meliadine Lake and the larger regional lakes and the rivers, and higher in the peninsula waterbodies (2014 FEIS, Volume 7, Section 7.4.4).

As per Term and Conditions of Project Certificate No.006 and Type A Water Licence 2AM-MEL1631, there is extensive water monitoring conducted on the mine site. These monitoring data are reported each year in the annual report. All water on the mine site is managed for eventual discharge to the receiving environment; treated surface contact water is discharged to Meliadine Lake (reviewed in this section), and treated saline water is discharged to Itivia Harbour (reviewed in Section 8). Quantity of water discharged to Meliadine Lake (predicted and measured) is provided in Table 7.3-1; measured discharge quantities have been less than predicted in the 2014 FEIS (Agnico Eagle 2014) and the 2020 Water Licence Amendment (Golder 2020b).

In the 2014 FEIS, discharge of treated effluent was identified as the main mine activity that could change water quality. As part of the annual AEMP reports, discharge quality is evaluated against the water licence criteria and the MDMER; all discharges have been less than the limits stipulated in 2AM-MEL1631 and the MDMER (Agnico Eagle 2021c).

Since 2014, water quality has been regularly monitored in Meliadine Lake in five areas (Figure 7.4-1):

- MEL-01: near-field area and the area where treated discharge enters Meliadine Lake.
- MEL-02: mid-field area, downstream of the near-field area and downstream of the water intake for the Mine.
- MEL-03: reference area 1, in the northeast portion of the lake, downstream of the mid-field area
- MEL-04: reference area 2, in the northwest portion of the lake, upstream of the secondary outlet to Peter Lake.
- MEL-05: reference area 3, in the southwest portion of the lake, upstream of the primary outlet to Little Meliadine Lake.

The water quality program is conducted four times per year with results presented in the annual AEMP report (Golder 2017, 2018d, 2019c; Azimuth 2020, 2021a) which is reviewed and commented upon by interveners and regulators. Comments on those water quality programs have been addressed and resolved through the annual report process.

This monitoring program is conducted to evaluate how water quality changes due to the effluent discharge, to confirm if measured conditions align with predictions, and to inform adaptive management or mitigation should conditions diverge from predictions. Water quality results are compared to normal range and AEMP benchmarks. The normal range is defined as the range of concentrations in water quality parameters before the mine, and AEMP benchmarks are derived from generic values used to evaluate water quality results for protection of aquatic life or for protection of human drinking water quality, and site-specific water quality objectives (SSWQOs) for protection of aquatic life. In 2020, results from all individual samples were less than the guidelines except for one under-ice sample from March 2020; in this one sample, copper was above the guideline. In 2020, no water quality parameters exceeded the AEMP action level (75% of the AEMP benchmark) in the near-field area of Meliadine Lake (i.e., the small mixing zone area that receives treated effluent discharge) or in any of the monitoring areas of Meliadine Lake (Figure 7.4-2).

Changes in water quality over time, from the various monitoring stations, are reported in the annual AEMP reports. Since 2015, some parameters have shown increasing concentrations, some have shown decreasing concentrations, and some have shown no change (Figures 7.4-3 and 7.4-4); however, all concentrations remain below the AEMP benchmark and the AEMP action level.

In the 2014 FEIS, it was predicted that water quality would change from baseline conditions but would remain below the guidelines. Modelling completed for the 2014 FEIS, and updated for 2020 Water Licence Amendment, predicted changes in water quality in the mixing zone and the east basin during operations (when seasonal discharge occurs) and then a reversal to baseline conditions in closure through post-closure (Figure 7.4-5). Changes in water quality measured in Meliadine Lake are in line with the FEIS predictions and the current concentrations of all parameters are well below water guidelines meant to protect aquatic life and drinking water quality for human consumption (Azimuth 2021a).

The Peninsula Lakes A8, B7, and D7 are sampled twice per year during open-water conditions and results are compared to the normal range (calculation based on pre-mining water quality), the 2014 FEIS predictions, and water quality guidelines. Water quality in Lakes A8, B7, and D7 are aligned with the 2014 FEIS predictions (i.e., change from baseline but less than guidelines) (Azimuth 2021a).

7.4.2.2 Sediment Quality

Information on baseline (pre-2014) and existing conditions (post-2014) has been collected and summarized in a variety of documents including:

- Volume 7, Section 7.4.4 of the 2014 FEIS;
- Supporting document SD 7-1 (2009 Aquatic Synthesis Baseline) of the 2014 FEIS;
- Supporting document SD 7-2 (2011 Aquatic Synthesis Baseline) of the 2014 FEIS;
- Annual AEMP reports from 2016 and 2018 (Golder 2017, 2019c);
- Environmental Effects Cycle 1 report (Golder 2019c); and
- Environmental Effects Cycle 2 Study Design (Azimuth 2021b).

Sediments are sinks for metals present in surface waters. Higher metal concentrations in surface water are usually associated with suspended sediments, which tend to settle out and accumulate on the lake bottom over time. Bioavailable metals in sediment can cause toxicity to aquatic organisms. Analysis of total metals in sediments does not necessarily reflect the bioavailability of metals, as often only a portion of the total metal is bioavailable. Total metal concentrations can be used to compare and assess variability between waterbodies.

The 2014 FEIS (Section 7.4.4) provides a review of sediment quality in Meliadine Lake, small waterbodies on the peninsula of Meliadine Lake, and regional waterbodies. Average metal concentrations were generally similar across the lakes with some exceptions:

- Metals that were higher in the peninsula lakes as compared to Meliadine Lake included cobalt, arsenic, nickel, chromium, copper, and zinc.
- Metals that were higher in Meliadine Lake as compared to the peninsula lakes included molybdenum, strontium, vanadium, titanium, and aluminum.

Sediment chemistry in Meliadine is typical of northern lakes, particularly those located in close proximity to highly mineralized areas. Arsenic, cadmium, and chromium concentrations are naturally elevated in the exposure and reference areas of Meliadine Lake (Azimuth 2021b).

Since 2014, sediment quality has been monitored following the AEMP design plan (i.e., collection of pre-construction data in 2016, and starting in 2018, collection of data every three years following the Environmental Effect Monitoring [EEM] requirements). In Meliadine Lake, samples are collected in five areas (Figure 7.4-1):

- MEL-01: near-field area and the area where treated discharge enters Meliadine Lake.
- MEL-02: mid-field area, downstream of the near-field area and downstream of the water intake for the Mine.
- MEL-03: reference area 1, in the northeast portion of the lake, downstream of the mid-field area
- MEL-04: reference area 2, in the northwest portion of the lake, upstream of the secondary outlet to Peter Lake.
- MEL-05: reference area 3, in the southwest portion of the lake, upstream of the primary outlet to Little Meliadine Lake.

Monitoring since 2014 primarily reflects existing conditions since construction and early operation of Meliadine Mine. Further analysis of the pre-2014, 2015, 2016, and 2018 sediment data examined the relationship between metal concentrations and sediment particle size because there is a propensity for most metals to accumulate in finer sediments (Golder 2019c).

In the 2014 FEIS, it was stated that sediment quality in Meliadine Lake could be affected through release of treated effluent from the diffuser, erosion and sedimentation at the diffuser, and erosion and sedimentation on the shore of Meliadine Lake near mining infrastructure. Erosion and sediment control measures as well as best management practices will be implemented at the site of the diffuser, and along the shore of Meliadine Lake, where appropriate, to minimize mobilization of suspended solids, and associated adsorbed chemicals, in the water column. Loading of particulate matter from treated effluent through the diffuser will be controlled, as TSS in the end-of-pipe effluent is predicted to be no more than 15 mg/L. In addition, the use of a diffuser aids development of a mixing ratio in Meliadine Lake so that water quality guidelines are met at the edge of the mixing zone. Since water quality in Meliadine Lake at the edge of the mixing zone predicted to not exceed aquatic life or drinking water guidelines, and TSS in the effluent released from the Project will be managed to meet the regulations, it was predicted that sediment quality near the diffuser would not change from baseline concentrations.

Based on sediment data collected in 2018, arsenic, cadmium, and chromium were above the Interim Sediment Quality Guidelines (ISQG) in the near-field and reference areas, and there was no indication that concentrations had increased in 2018 as compared to baseline/pre-construction (Azimuth 2021b). These monitoring results are consistent with the FEIS (Golder 2019c).

Figure 7.4-1: Meliadine AEMP Monitoring Areas

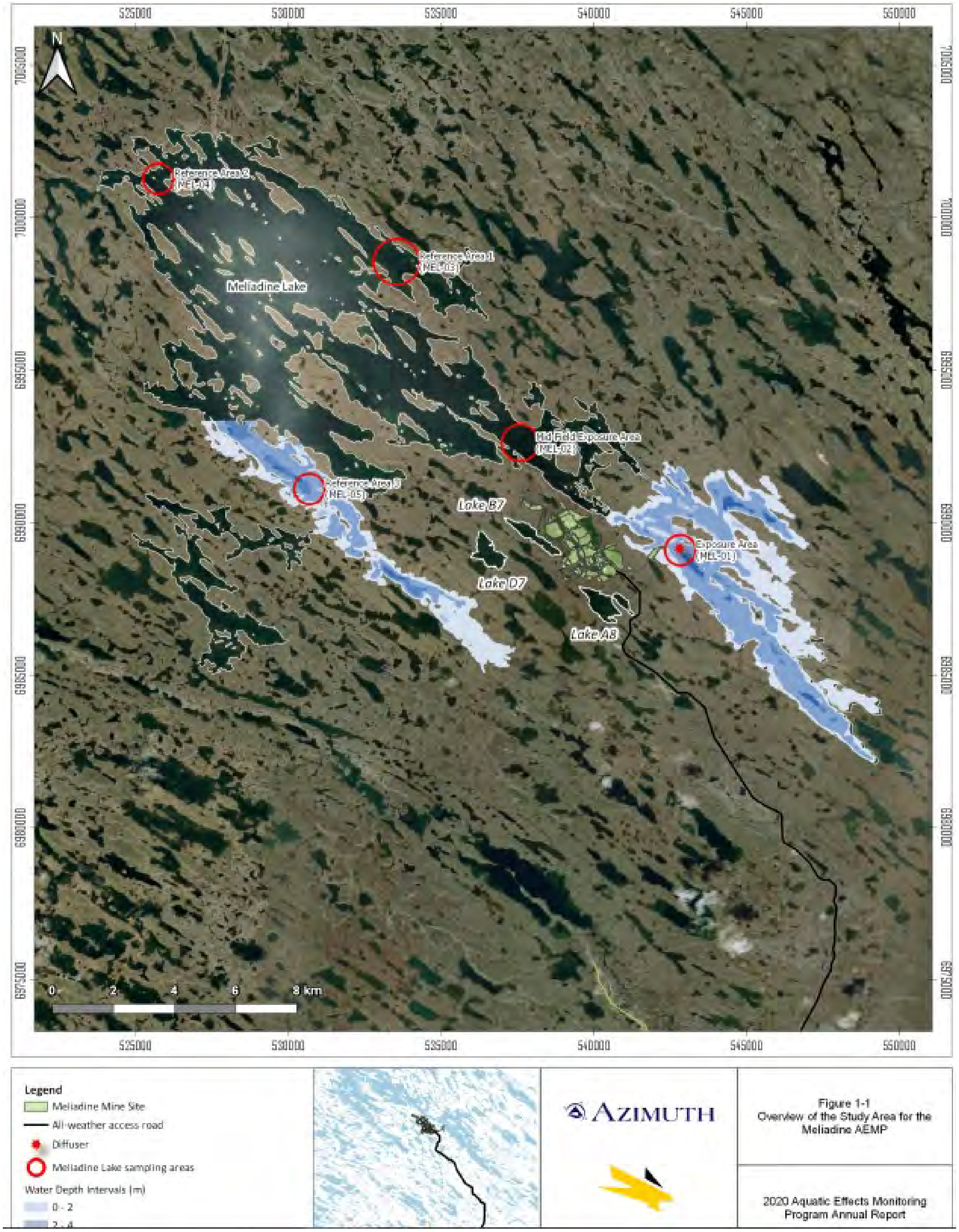
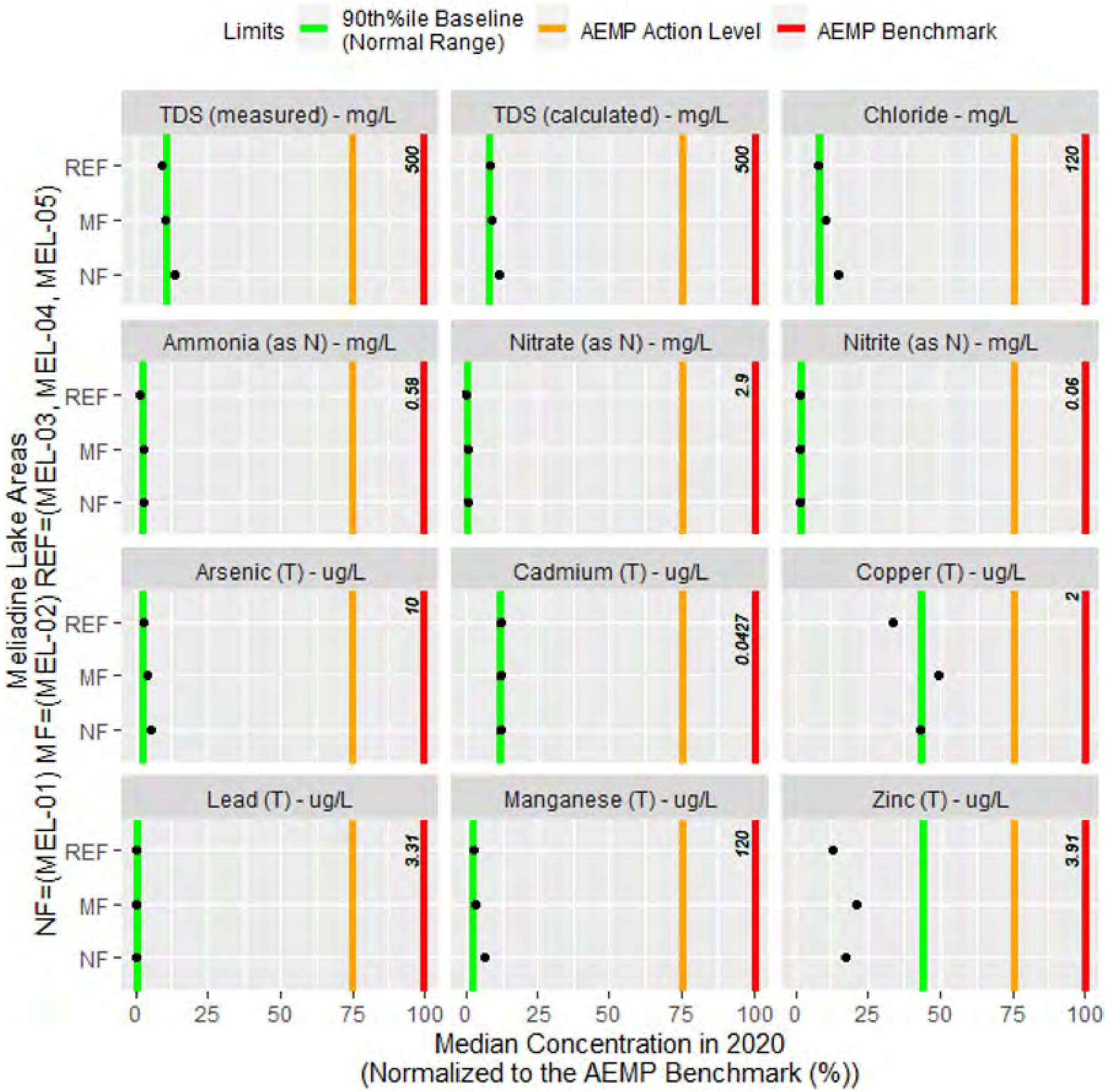


Figure 7.4-2: Water Quality in Meliadine Lake (2020) Relative to Normal Ranges, AEMP Action Levels, and AEMP Benchmarks

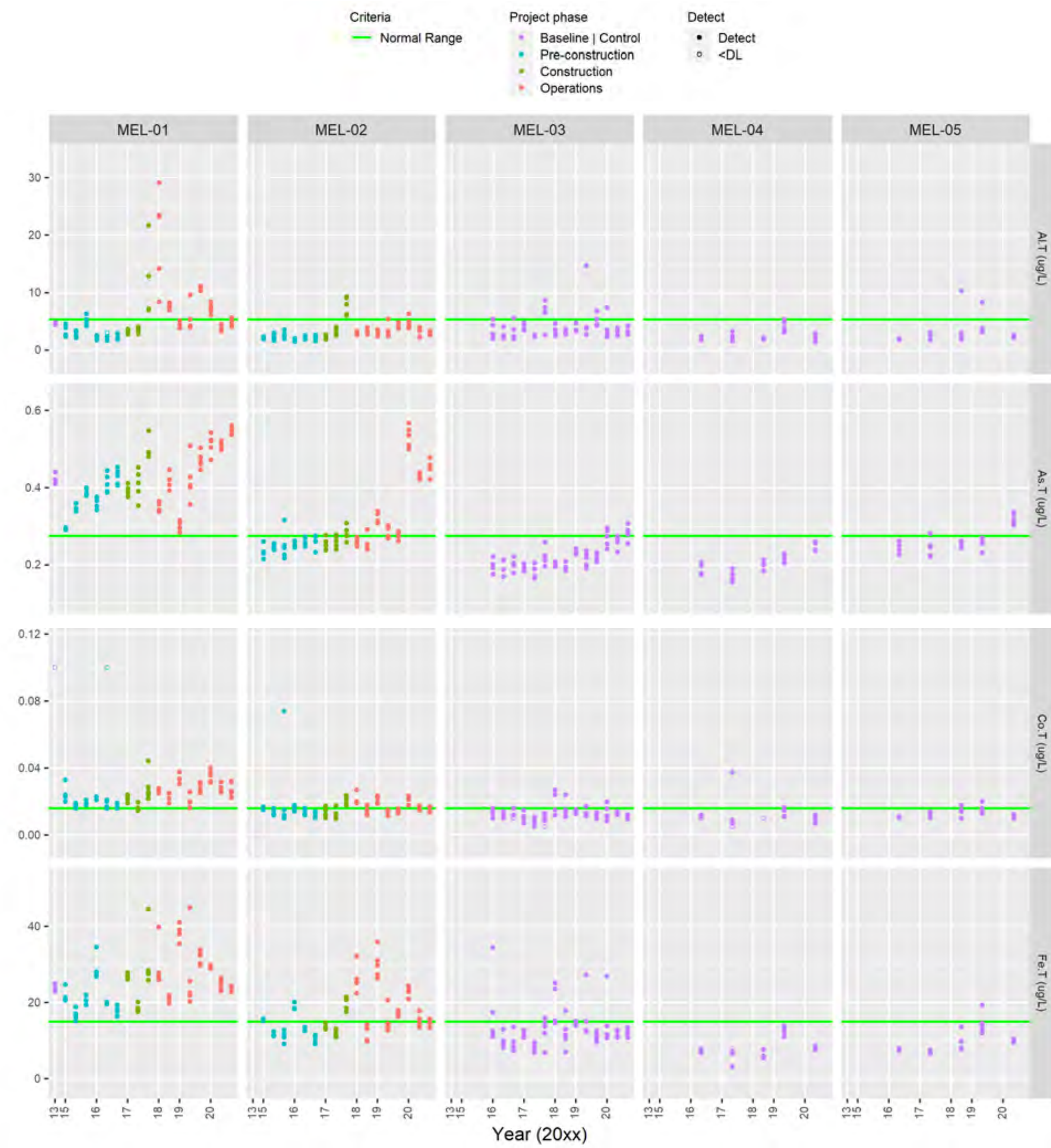


Source: Modified from Figure 5-7 from Azimuth (2021a)

Figure 7.4-3: Concentrations of TDS and Nutrients in Meliadine Lake (2013 to 2020)

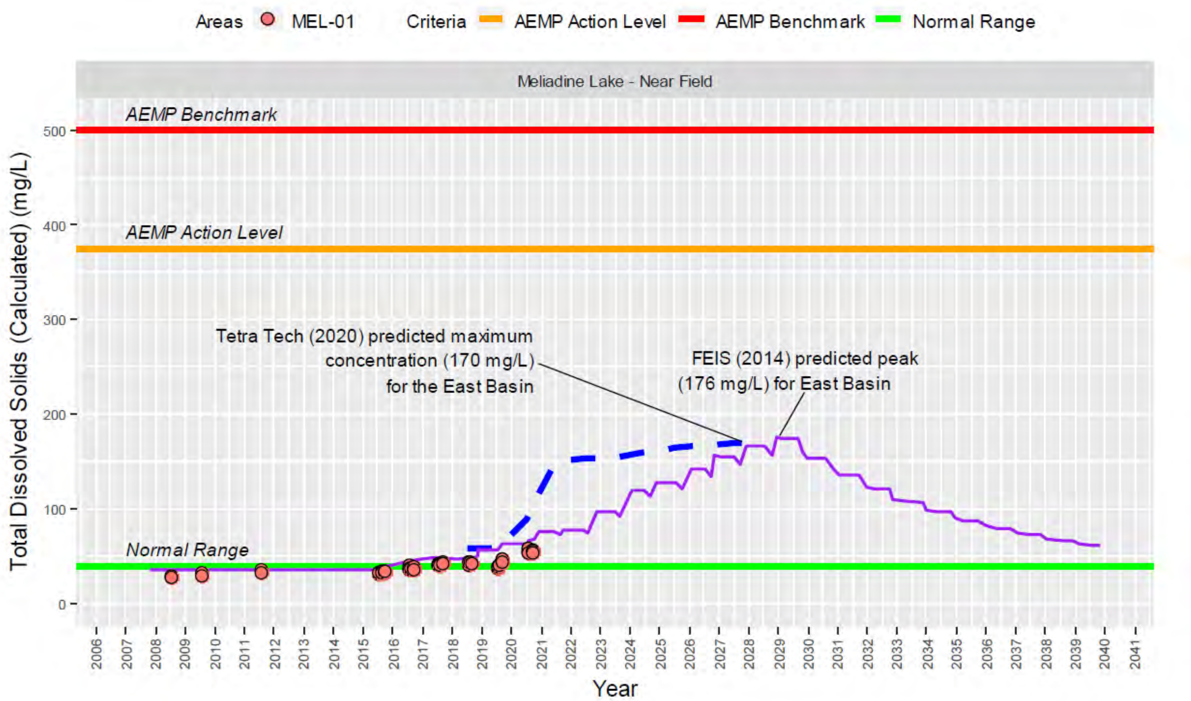
Source: Figure 5-5 and 5-6 from Azimuth (2021a)
Note: Meliadine Lake water quality, open-water. Concentrations are below guidelines. TDS guideline is 500 mg/L; Nitrate (NO3-N) guideline is 2.93 mg-N/L; Total phosphorus (TP) guideline is 0.01 mg/L.

Figure 7.4-4: Concentrations of Total Metals in Meliadine Lake (2013 to 2020)



Source: Figure 5-7 from Azimuth (2021a)
Note: Meliadine Lake water quality, open-water. Concentrations are below guidelines. Aluminum (Al) guideline is 100 µg/L; Arsenic (As) guideline is 25 µg/L; Cobalt (Co) guideline is 0.78 µg/L; Iron (Fe) guideline is 1,060 µg/L.

Figure 7.4-5: Summary of Predicted and Measured Total Dissolved Solids in Meliadine Lake



Source: Figure 5-11 from Azimuth (2021a)

7.4.3 Assessment of Potential Meliadine Extension-related Effects

The Meliadine Extension activities represent a negligible change from the Approved assessment activities (Agnico Eagle 2014, 2018a, 2020a) and no new pathways were identified. This section provides a summary of the effects assessment for water quality.

A pathway analysis to identify and assess linkages between activities and water quality was completed for the 2014 FEIS, and 2018 and 2020 Addenda. The previously assessed pathways were examined for the Meliadine Extension. For most project activities there was no change in the pathway from the previous assessments to the Meliadine Extension because the activity has already occurred (e.g., the AWAR has already been constructed), or the pathway was previously assessed and there will be no change to residual effects due to the Meliadine Extension.

Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-6 of this Application and are also described in Volume 7, Section 7.4.5, Table 7.4-16 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC water quality as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways may result in measurable environmental change that could contribute to residual effects. Primary pathways are provided in Table 7.4-1 of this Application and are also described in Volume 7, Sections 7.4.5 and 7.4.6 of the 2014 FEIS. There are no new primary pathways for water quality (Table 7.4-1). The Meliadine Extension does not change the size of the spatial boundary for the assessment, but there is an increase in the temporal boundary due to the extension of mine life. The extended temporal boundary does not change the results of primary pathways identified from the previous assessments; however, a summary of the effects analysis for the primary pathways are provided below. The primary pathways for water quality included:

- **Changes in water and sediment quality due to effluent discharge (operations)**
- **Changes in water and sediment quality due to physical alterations of the watersheds, dewatering of waterbodies, dust and air emissions (construction, operation, closure), and development of pit lakes (closure and post-closure)**

Table 7.4-1: Potential Primary Pathways for Water Quality

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Mining activities and water management during construction, operations, and closure.	Release of mine wastewater (including sewage) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations).	Treated sewage will be piped to the tailings storage facility. Mine wastewater will be treated and tested before release to Meliadine Lake. If water quality does not meet discharge limits, it will be circulated and re-treated. Water quality will meet CCME aquatic life objectives, site-specific water quality objectives, or water licence limits at the edge of the mixing zone in Meliadine Lake. Underground water will be collected, contained, monitored, re-used in the underground, or collected, contained, monitored, or treated, if required, to meet discharge limits for release to Meliadine Lake. A site Water Management Plan has been developed and describes containment of contact water through the use of diversions, attenuation ponds, and treatment facilities during construction, operations, and closure. Other applicable design features and mitigation, as identified in the project closure plan.	Primary	Primary	Section 7.4.6.1 and 7.4.7 of the 2014 FEIS The predictions indicate that concentration levels gradually increase during the construction and operations phases of the mine and that these maximum concentrations do not exceed guidelines. During closure and post-closure, concentrations are predicted to gradually return to background concentrations. Changes were predicted to be low in magnitude, local in extent, and reversible.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and nontraditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.	No change	This pathway has been previously assessed The Meliadine Extension does not change the results of the previous assessment The Meliadine Extension will be within the footprint that has been previously assessed In regards to water and waste management (the main project activities that could result in a change to water quality), the footprint of the Meliadine Extension is more compact than what was assessed and approved in 2014. Through refinement in the mine plan, the effluent discharge is predicted to be lower than previously assessed, and changes to water quality in Meliadine Lake will be less Mitigation measures and environmental design features outlined in the 2014 FEIS will be carried forward through the Meliadine Extension
Mine infrastructure footprint (e.g., open pits, dikes, mine pits, waste rock, mine plant, site roads, camps) during construction, operations, closure and post-closure	Project footprint, which will physically alter watershed areas and drainage patterns, rates and quantities of diverted non- contact water to new watersheds, may change downstream flows, water levels, channel/bank stability in streams and may affect water and sediment quality.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Access roads will be as narrow as possible, while maintaining safe construction and operation practices. Minimum haul road widths will follow that defined under the Mine Health and Safety Act. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed. Minimum setback distance of 31 m from the ordinary high water mark of waterbodies. Regular road inspections to check for ponding. Removal of snow at the culvert inlet prior to freshet. To reduce the potential for erosion in channels due to higher than normal water flows and levels, natural drainage courses will be surveyed to evaluate capacity and then modified if required. Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms. A site water management plan has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas. Monitoring during activities and use of adaptive management where necessary.	Primary (these five pathways are linked and were assessed together)	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS Water quality downstream of the mine may change due to diversion of water, dewatering, fugitive dust and aerial deposition. Contact water will not be released to the downstream small waterbodies. It was predicted there would be a negligible change in some water quality parameters from background. Changes were predicted to be low in magnitude, local in extent, and reversible (for larger waterbodies) to irreversible (for some small waterbodies).	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed The Meliadine Extension does not change the results of the previous assessment The Meliadine Extension will be within the footprint that has been previously assessed; the footprint of the Meliadine Extension is more compact than the 2014 FEIS footprint for water management infrastructure The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension
Site Water Management: Dewatering of Project Footprint Waterbodies to Downstream Receiving Waterbodies (e.g., to Lake A7, A1, B6, B34, Meliadine Lake)	Dewatering of waterbodies may change flows, water levels, channel/bank stability, and water quality (e.g., suspended sediments, nutrients, metals) in receiving and downstream waterbodies.	During dewatering activities, TSS will be monitored, and if necessary, treated before release downstream. Pumped water from the dewatered waterbodies will be directed through properly designed structures to the lake environment, and not to lake outlets, to prevent erosion in the receiving waterbodies and to attenuate flows. Shoreline areas susceptible to extensive erosion will be addressed by appropriate erosion protection measures to reduce erosion and associated re-suspension of fine sediment. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.							This pathway and effects have been previously assessed The Meliadine Extension does not change the results of the previous assessment Pumped discharges for dewatering will be directed to a lake environment (not directly to outlets) or to a treatment facility and for discharge through the permanent diffusers The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
during construction and operations.									monitoring plans will be carried through the Meliadine Extension
Mine and Supporting Infrastructure during construction and operations	Fugitive dust sources and deposition of dust (including from blasting during mining) can change water and sediment quality.	Best management practices to control fugitive particulate emissions from haul roads and material handling Use of water or dust suppressants to manage dust. Use of chemical suppressants will be in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of the Environment. Enforcing speed limits to suppress dust production. Design roads as narrow as possible while maintaining safe construction and operation practices. Crossings will be perpendicular to watercourse. The running surface of the road will be maintained thereby reducing the generation of dust. Enclosures and covers will be used in major ore handling areas and most crushing areas. For uncovered crushing areas, water or dust suppression will be used. Dust control systems will be used to limit dust emissions, for example, processing equipment with high efficiency bag houses will be used. Most personnel arriving at or leaving the site will be transported by bus, thereby reducing the amount of traffic (and dust). Operating procedures will be developed that reduce dust generation. For example, tailings deposition will be designed to limit dust generation.							This pathway and effects have been previously assessed The Meliadine Extension does not change the results of the previous assessment Monitoring conducted in 2020 were within air quality standards and 2014 FEIS predictions Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension
Mine and Supporting Infrastructure during construction and operations	Air emission of sulphur dioxide, nitrogen oxides and particulates may change water and sediment quality.	Construction equipment and trucks will be equipped with industry-standard emission control systems. Compliance with regulatory emission requirements will be met. Processing equipment will use dust collectors to limit emissions of particulate matter. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. SO_2 emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than15 ppm of sulphur. Operating procedures will be developed that reduce dust generation. Generator efficiencies and equipment will be tuned for optimum fuel-energy efficiency.							This pathway and effects have been previously assessed The Meliadine Extension does not change the results of the previous assessment No increase in emissions is predicted for the Meliadine Extension due to the production rate staying the same Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension
Pits (closure and post-closure)	Water quality in flooded pits may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality.	A Conceptual Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pits are designed to have stable slopes during mining and post-closure. The pits will be progressively reclaimed as excavation is completed. The pits will be flooded, with water from Meliadine Lake, over a 10 year period following completion of pit operations. Water quality in the pits will be monitoring continuously during the flooding process. All diversion dikes will be kept intact as a barrier between open pits and surrounding waterbodies until the pit water meets acceptable concentrations for release to the environment. Water will be treated if it is unacceptable for discharge.							This pathway and effects have been previously assessed The Meliadine Extension does not change the results of the previous assessment Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension

7.4.3.1 Changes in Water Quality Due to Effluent Discharge

As assessed in the 2014 FEIS, release of treated mine wastewater and effluent may cause a change in surface water quality of Meliadine Lake. For the 2014 FEIS, a site water balance model was used to predict the quantity and quality of water to be managed within the mine footprint and then discharged to Meliadine Lake (Agnico Eagle 2014 [SD 2-6]). For each year, or group of years, the framework of the model was updated to reflect the developing mine footprint. For the Meliadine Extension, a refinement of the site water balance model was developed (Appendix H-07). The overall objectives of the water management strategy has not changed since the 2014 FEIS (Water Management Plan [Appendix D-35]). Surface contact water will be intercepted and diverted to the contact water attenuation ponds during operations and closure (Water Management Plan [Appendix D-35]).

The water balance and water quality forecast for the Meliadine Extension was updated (Appendix H-07). This model provided updates to predicted quantity and quality of water to be managed on site, but also updates to quantity and quality of water to be discharged to Meliadine Lake. The model took into account minimizing discharges to Meliadine Lake when practical (predicted discharge illustrated in Figure 7.3-1) and aligning with the MDMER and water licence criteria. Predicted mine effluent water quality was compared to MDMER, water licence criteria, and acute aquatic life guidelines to determine if there were potential contaminants of concern that required further evaluation (Table 7.4-2). Water quality is predicted to be less than the approved Water Licence limits and the MDMER limits, plus less than acute aquatic life guidelines. Based on this screening, there are no contaminants of concern. These results have been evaluated further through the Human Health and Ecological Risk Assessment (Section 10) for use in determining significance to the VEC of water and sediment quality (Section 7.4.4).

Final mine effluent will be released to Meliadine Lake via the existing diffuser outfall. The mixing behaviour of mine effluent in the mixing zone and the east basin of Meliadine Lake was predicted with the Meliadine Lake 3D model (Appendix H-09) based on the predicted discharge quality and quantity from the mine site model (Appendix H-07). Predicted water quality in the mixing zone of Meliadine Lake was evaluated to determine if there were potential contaminants of concern that required further evaluation (Table 7.4-3).

Water quality in the mixing zone will be highest during operations (i.e., when there is seasonal discharge of treated water to Meliadine Lake). Water quality at the edge of the mixing zone is predicted to be less than guidelines for protection of aquatic life and continued traditional and non-traditional use of the lake during operations (Table 7.4-3). At the end of operations, discharge of treated water to Meliadine Lake will stop. As the point source discharge is removed, water quality concentrations that increased in operations will decrease in closure (Figure 7.4-6) and return to pre-mining conditions (Figure 7.4-5). These predictions are in alignment with the 2014 FEIS.

These results have been evaluated further through the Human Health and Ecological Risk Assessment (Section 10) for use in determining significance to the VEC of water and sediment quality (Section 7.4.4).

The main stressor that could change sediment quality is from release of treated effluent from the diffuser, erosion and sedimentation at the diffuser, and erosion and sedimentation on the shore of Meliadine Lake near mining infrastructure. Erosion and sediment control measures as well as best management practices will be implemented at the site of the diffuser, and along the shore of Meliadine Lake, where appropriate, to minimize mobilization of suspended solids, and associated adsorbed chemicals, in the water column. In addition, TSS in the effluent will be in compliance with the MDMER.

Based on these design features, and modelling predictions for the Meliadine Extension, water quality at the edge of the mixing zone is not predicted to exceed aquatic life, terrestrial life, and human health guidelines. As such, sediment quality is not predicted to change from pre-mining conditions. This is consistent with the 2014 FEIS. These predictions will be validated through the AEMP and EEM monitoring programs.

Table 7.4-2: Predicted End-of-Pipe Discharge Quality

Constituents	Unit:	Water Licence/MDMER	CCME Acute	End-of-Pipe Operations (2020-2043)		
				Minimum	Average	Maximum
Major Ions						
Total Dissolved Solids	mg/L	3,500	-	305.7	647.3	1846.3
Chloride	mg/L	-	-	141.8	307.4	915.6
Fluoride	mg/L	-	-	0.0	0.1	0.2
Sulphate	mg/L	-	-	39.2	98.9	238.3
Nutrients						
Ammonia	mg/L	14	-	1.08	3.51	13.13
Nitrate	mg/L	-	550	1.90	6.12	17.59
Nitrite	mg/L	-	-	0.03	0.09	0.22
Phosphorus	mg/L	2	-	0.05	0.27	1.41
Total Metals						
Aluminum	mg/L	2	-	0.946	0.949	0.956
Antimony	mg/L	-	-	0.0001	0.0008	0.0016
Arsenic	mg/L	0.3	-	0.004	0.008	0.031
Boron	mg/L	-	-	0.053	0.132	0.282
Barium	mg/L	-	-	0.016	0.030	0.097
Cadmium	mg/L	-	Equation	0.0000	0.0000	0.0001
Cobalt	mg/L	-	-	0.001	0.002	0.005
Chromium	mg/L	-	-	0.002	0.002	0.003
Copper	mg/L	0.2	-	0.002	0.003	0.004
Iron	mg/L	-	-	1.132	1.182	1.509
Lead	mg/L	0.1	-	0.0001	0.0003	0.0017
Mercury	µg/L	-	-	0.0069	0.0134	0.0232
Manganese	mg/L	-	Equation	0.099	0.250	0.621
Molybdenum	mg/L	-	-	0.001	0.002	0.003
Nickel	mg/L	0.5	-	0.004	0.009	0.017
Selenium	mg/L	-	-	0.0001	0.0003	0.0007

Constituents	Unit:	Water Licence/MDMER	CCME Acute	End-of-Pipe Operations (2020-2043)		
				Minimum	Average	Maximum
Silver	mg/L	-	-	0.000004	0.000008	0.000017
Strontium	mg/L	-	-	0.390	1.068	2.467
Thallium	mg/L	-		0.00002	0.00005	0.00014
Uranium	mg/L	-	0.033	0.001	0.001	0.004
Vanadium	mg/L	-	-	0.002	0.003	0.004
Zinc	mg/L	0.4	Equation	0.002	0.004	0.007

Source: Table E2 from Appendix H-07

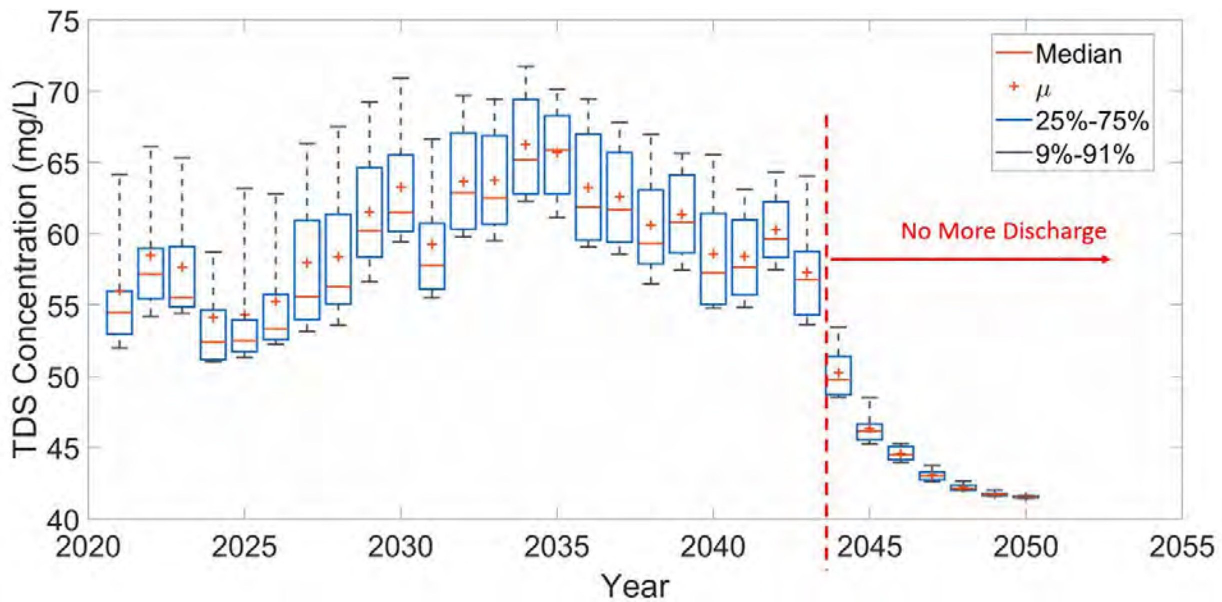
Table 7.4-3: Predicted Edge of Mixing Zone Water Quality

Constituents	Units	AEMP Benchmark			Edge of Mixing Zone Operations (2020-2043)		
		Aquatic Life	Drinking Water	Nutrient Enrichment	Minimum	Average	Maximum
Major Ions							
Total Dissolved Solids	mg/L	1,000	500	-	50.2	58.1	67.5
Chloride	mg/L	120	-	-	12.2	16.5	20.6
Fluoride	mg/L	2.8	1.5	-	0.0	0.0	0.0
Sulphate	mg/L	128	-	-	4.6	6.0	7.2
Nutrients							
Ammonia	mg/L	0.58	-	-	0.052	0.108	0.162
Nitrate	mg/L	2.93	10	-	0.106	0.196	0.287
Nitrite	mg/L	0.06	1		0.005	0.006	0.007
Phosphorus	mg/L	-	-	0.01	0.022	0.027	0.032
Total Metals							
Aluminum	µg/L	100	-	-	8.43	23.55	40.53
Antimony	µg/L	9	6	-	0.02	0.03	0.04
Arsenic	µg/L	25	10	-	0.40	0.52	0.61
Boron	µg/L	1,500	5,000	-	7.25	9.06	10.90
Barium	µg/L	1,000	2,000	-	7.18	7.51	7.86
Cadmium	µg/L	0.043	7	-	0.005	0.006	0.007
Cobalt	µg/L	0.78		-	0.03	0.06	0.09
Chromium	µg/L	5	50	-	0.08	0.11	0.16
Copper	µg/L	2		-	0.71	0.74	0.77
Iron	µg/L	1,060	300	-	14.67	33.28	54.17
Lead	µg/L	3.31	5	-	0.012	0.016	0.020
Mercury	µg/L	0.026	1	-	0.001	0.001	0.001
Manganese	µg/L	210	120	-	3.79	7.18	10.86
Molybdenum	µg/L	73	-	-	0.07	0.10	0.12

Constituents	Units	AEMP Benchmark			Edge of Mixing Zone Operations (2020-2043)		
		Aquatic Life	Drinking Water	Nutrient Enrichment	Minimum	Average	Maximum
Nickel	µg/L	25	-	-	0.61	0.74	0.87
Selenium	µg/L	1	50	-	0.04	0.05	0.05
Silver	µg/L	0.25	-	-	0.01	0.01	0.01
Strontium	µg/L	2,500	7,000	-	45.39	59.91	77.34
Thallium	µg/L	0.8	-	-	0.01	0.01	0.01
Uranium	µg/L	15	20	-	0.03	0.05	0.07
Vanadium	µg/L	120	-	-	0.07	0.11	0.16
Zinc	µg/L	3.91	-	-	0.82	0.87	0.91

Source: Appendix H-09

Figure 7.4-6: Range of TDS at the Edge of the Mixing Zone (Operations to Closure)



Source: Figure 3.21 from Appendix H-09

7.4.3.2 Changes in Water Quality Due to Alteration of Watersheds

Physical alterations of watersheds (including diversion of water, changes in watershed size and contributing areas, natural hydrological processes, and evaporation) and deposition of windborne particulates from mine facilities and exposed lake beds, and air emissions (including blasting particulates and residuals) from mine facilities, may result in a change in water and sediment quality in waterbodies and streams.

For the 2014 FEIS, predictions were made for small waterbodies downstream of the mine area. A mass balance approach was used to estimate water quality within selected small ponds and lakes (Volume 7, Section 7.4.6.2.1, Table 7.4-21 and Appendix 7.4-A in Agnico Eagle 2014). The spatial extent of the Meliadine Extension, for the purposes of water management including dewatering, diversion of flows, and alteration of watershed flow paths, has not changed from the 2014 FEIS. Changes to altered watershed areas, drainage patterns downstream flows, water levels, and channel/bank stability in streams has been previously assessed. There will be no change to this effects pathway as a result of the Meliadine Extension.

For the Meliadine Extension, a refinement of the site water balance model was developed (Appendix H-07). This model provides updates to the 2014 model for contact ponds and pits within the mine footprint area and for small waterbodies downstream of the mine footprint area. The prediction nodes used for this assessment are outlined in Table 7.4-4. Depending on the location of the waterbody (i.e., within our outside of the Mine area), and the mining phase (operations, closure, and post-closure), the predictions were evaluated with various water quality guidelines (aquatic life, terrestrial life, and human health). The following assumptions were made to determine which set of guidelines to consult for interpretation of the predictions:

- For waterbodies outside of the controlled mine footprint (e.g., B2), aquatic life and terrestrial life (small and large mammals, and waterfowl) would be able to access them. Predictions for these waterbodies were compared to aquatic life and terrestrial life generic guidelines for all mine phases (operations, closure, and post-closure). These waterbodies may be used for traditional activities after mine life and were compared to human health guidelines for post-closure.
- For contact water ponds inside the controlled mine footprint (e.g., A8 West), terrestrial life (small mammals, and waterfowl) would be able to access them, but these ponds would not support aquatic life. Predictions for these contact water ponds were compared to terrestrial life generic guidelines for operations, closure, and post-closure. After mine life, these ponds will be reclaimed and flooded and once water quality meets criteria, they will be reconnected to pit lakes and the downstream environment; they may also be used for traditional activities. Predictions for these areas were compared to aquatic life guidelines and human health guidelines.
- As part of the 2014 FEIS, contact Water Pond B4 and Saline Water Pond B7, located inside the controlled mine footprint, are two of the waterbodies affected by the Meliadine Extension and that may require listing under Schedule II of the Fisheries Act. The waterbodies identified for Schedule II include A52, B4, B7, B25, B34, B59, B61, D3, J2, J3, J8, J7, J6, J5, and J4. After mine life, Schedule II waterbodies will be reclaimed and flooded. Once water quality meets criteria, they will be reconnected to pit lakes and the downstream environment. Predictions for Schedule II contact water ponds were compared to terrestrial life generic guidelines for active closure, and post-closure. The waterbodies identified for Schedule II were part of the area of waterbodies and watersheds that were assessed through the 2014 FEIS. After mining, and during Active Closure, the pits will be flooded to create Pit Lakes. During this phase, waterfowl may access the pits. Water quality predictions of Pits TIR02, TIR04 and Discovery were deemed to be the most representative of all the pits during Active Closure; predictions are summarized in Table 7.4 4 and Table 7.4 7. These may be accessible to aquatic and terrestrial wildlife, and people may directly or indirectly use them. For post-closure, predictions for the Pit Lakes were compared to aquatic

life, terrestrial life, and human health guidelines.

For the 2014 FEIS, water management ponds in the controlled mine area were compared to terrestrial life guidelines (Volume 10, Section 10.1.8.3.1.1.4) and for wildlife, there were no constituents of potential concern (COPCs) for further evaluation. Water quality predictions were also compared to aquatic life guidelines, and COPCs were identified (Volume 7 Section 7.4.6.2.2; Volume 10, Section 10.1.8.3.1.1.4). A toxicity assessment and risk evaluation were conducted and three COPCs were retained but based on the predicted water quality (magnitude of concentrations and duration of concentrations above generic guidelines), impacts to aquatic life were expected to be not significant.

For the Meliadine Extension, predictions for water management ponds and pits in the controlled mine area have been updated (Appendix H-07; summarized in Tables 7.4-5 and 7.4-6). Following the process outlined for comparison to guidelines (Table 7.4-4), water quality is predicted to be less than the terrestrial guidelines (operations to post-closure), less than the aquatic life guidelines (post-closure), and less than human health guidelines (post-closure). These results are in alignment with those from the 2014 FEIS and thus impacts to aquatic life, terrestrial life, and traditional use are not expected.

In the 2014 FEIS, the closure plan included flooding the open pits with water from Meliadine Lake and natural drainage from the associated watershed (from the 2014 FEIS: SD 2-6; Section 7.4.5.3.2; Table 7.4-18), and in post-closure, these pits would be reconnected with downstream watersheds and Meliadine Lake once water quality objectives are met. Pit lake predictions have been updated for the Meliadine Extension (Appendix H-07). As with the 214 FEIS, the pits will be flooded with water from Meliadine Lake and natural drainage from the associated watershed. Water quality in the pit lakes is predicted to be less than guidelines for protection of aquatic life, protection of terrestrial life and for traditional and non-traditional use (Table 7.4-8; Figure 7.4-7).

Water quality predictions were also updated for small waterbodies outside of the controlled mine area for operations through post-closure (Table 7.4-9; Figure 7.4-8). Water quality predictions for these areas were below the guidelines for all phases. One of the small waterbodies modelled for the 2014 FEIS (Lake D7) is currently part of the AEMP monitoring program. Monitoring results suggest that changes to water quality are trending as predicted (i.e., higher than pre-mining but at concentrations that will not cause adverse effects to aquatic life, wildlife, or continued traditional and non-traditional use) (Azimuth 2021a). There will be no change to the effects assessment for small waterbodies as a result of the Meliadine Extension.

These results have been evaluated further through the HHERA (Section 10) for use in determining significance to the VEC of water and sediment quality (Section 7.4.4).

Table 7.4-4: Water Quality Prediction Nodes and Screening Framework

Location	Water Quality Prediction Node	Description	Operations (2024-2043)	Active Closure (2044-2050)	Post-Closure (2051-2119)
Inside the controlled mine footprint (contact ponds)	CP1	Operations and closure: Contact water pond Post-closure: Flooded and runoff to Meliadine Lake (Appendix H-07, Figure A.11)	TH[a]	TH[a]	AH, TH, HH
	A8 West	Operations and closure: Receive runoff from the disturbed area Post-closure: Flooded and a connection with WES Pit Lake (Appendix H-07, Figure A.11)	TH[a]	TH[a]	AH, TH, HH
	B7	Operations and closure: Saline water pond Post-closure: Flooded and runoff to Tiri Pit Lake (Appendix H-07, Figure A.11)	TH[a]	TH[a]	TH
	B4	Operations and closure: Contact water pond Post-closure: Flooded and runoff to Lake B2 (Appendix H-07, Figure B.11)	TH[a]	TH[a]	TH
Inside the controlled mine footprint (Pits)	TIR02	Closure: Active filling of pits	-	TH[b]	-
	TIR04	Closure: Active filling of pits	-	TH[b]	-
	NORWES Pit Lake	Post-closure: Pit lake in former B5 and WESNOR Pit	-	-	AH, TH, HH
	TIRI Pit Lake	Post-closure: Pit lake in former TIR01, TIR03, and WES01 pits	-	-	AH, TH, HH
	Pump Pit Lake	Post-closure: Pit lake in former PUMP01, PUMP02, PUMP03, and PUMP04 pits	-	-	AH, TH, HH
	F-Zone Pit Lake	Post-closure: Pit lake in former FZO01, FZO02, and FZO03 pits	-	-	AH, TH, HH
	Discovery	Closure: Active filling of pit Post-closure: Pit lake in former Discovery Pit	-	TH[b]	AH, TH, HH
Outside the controlled mine footprint	B45	Operations and closure: Receive natural runoff from watershed Post-closure: Receive natural runoff from watershed and runoff from WRSF6 (Appendix H-07, Figure B.11)	AH, TH	AH, TH	AH, TH, HH
	B2	Operations and closure: Receive natural runoff from watershed Post-closure: Receive natural runoff from watershed and runoff from B4 (Appendix H-07, Figure B.11)	AH, TH	AH, TH	AH, TH, HH
	A1	Operations and closure: Receive natural runoff from watershed Post-closure: Receive natural runoff from watershed and runoff from F Zone Pit Lake (Appendix H-07, Figure A.11)	AH, TH	AH, TH	AH, TH, HH
	CH6	Operations and closure: Receive natural runoff from watershed Post-closure: Receive flow from Discovery Pit Lake	AH, TH	AH, TH	AH, TH, HH

Note: AH = predictions compared to guidelines for protection of aquatic life; TH = predictions compared to guidelines for protection of terrestrial life; HH = predictions compared to human health guidelines
a) accessible by small terrestrial mammals and waterfowl
b) accessible by waterfowl

Table 7.4-5: Predicted Water Quality Inside the Mine Controlled Area for CP1 and A8 West

Constituents	Units	Aquatic Life	Terrestrial Life	Drinking Water	CP1						A8 West					
					Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)		Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)	
					Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Major Ions																
Total Dissolved Solids	mg/L	1,000	3,000	500	621.20	2,011.67	141.61	426.73	76.99	161.49	80.69	153.49	76.02	95.12	120.17	170.08
Chloride	mg/L	120	-	-	280.93	915.55	39.63	181.34	9.33	18.73	21.68	67.93	17.39	21.50	20.29	23.97
Fluoride	mg/L	2.8	2b	1.5	0.10	0.45	0.04	0.08	0.03	0.05	0.04	0.07	0.05	0.06	0.05	0.07
Sulphate	mg/L	128	1,000	-	87.50	238.26	40.68	76.78	31.07	77.39	10.09	22.33	13.66	19.90	46.00	71.50
Calcium	mg/L	-	1,000	-	43.02	747.89	20.00	28.36	16.59	26.18	21.57	36.09	19.83	28.71	23.53	33.54
Nutrients																
Ammonia	mg/L	0.58	-	-	15.24	38.88	1.52	15.47	0.03	1.03	0.15	0.41	0.15	0.25	0.04	0.13
Nitrate	mg/L	2.93	-	10	17.61	41.03	1.72	17.12	0.05	1.16	0.12	0.53	0.13	0.24	0.07	0.12
Nitrite	mg/L	0.06	10	1	0.08	0.22	0.01	0.06	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01
Total Metals																
Aluminum	µg/L	100	5,000	-	0.01	0.15	6.78	8.75	4.54	7.47	0.01	0.01	9.36	10.76	6.62	9.31
Antimony	µg/L	9	-	6	0.01	0.04	0.48	1.01	0.35	0.58	0.00	0.00	0.30	0.46	0.54	0.78
Arsenic	µg/L	25	25	10	0.11	0.28	3.40	7.77	3.50	8.71	0.02	0.09	1.54	1.91	4.54	7.37
Boron	µg/L	1,500	5,000	5,000	0.03	0.93	44.91	99.87	36.58	61.99	0.02	0.04	21.20	28.80	57.94	82.66
Barium	µg/L	1,000	-	2,000	0.00	0.00	15.62	27.93	15.82	21.65	0.00	0.00	19.59	33.83	21.86	30.03
Beryllium	µg/L	-	100	-	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01
Cadmium	µg/L	0.043	80	7	0.00	0.01	0.02	0.03	0.02	0.03	0.00	0.00	0.02	0.03	0.02	0.03
Cobalt	µg/L	0.78	1,000		0.00	0.01	0.53	1.20	0.41	0.73	0.00	0.00	0.48	0.67	0.61	0.92
Chromium	µg/L	5	50c	50	0.00	0.03	0.22	0.40	0.21	0.32	0.00	0.00	0.23	0.50	0.30	0.43
Copper	µg/L	2	500d		0.11	5.15	1.08	1.87	0.68	0.99	0.14	0.26	1.27	1.53	1.26	1.53
Iron	µg/L	1,060	-	300	0.00	0.00	77.41	147.90	75.71	112.08	0.00	0.00	113.64	192.90	87.71	128.08
Lead	µg/L	3.31	100	5	0.24	2.45	0.13	0.51	0.22	0.38	0.04	0.11	0.11	0.66	0.25	0.39
Mercury	µg/L	0.026	3	1	0.00	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.01	0.02	0.01	0.01
Manganese	µg/L	210	-	120	0.01	0.04	48.09	157.15	42.59	60.73	0.00	0.01	28.20	81.58	55.51	84.25
Molybdenum	µg/L	73	500	-	0.00	0.02	0.82	1.47	0.62	1.07	0.00	0.00	0.66	0.86	0.95	1.39
Nickel	µg/L	25	1,000	-	0.00	0.01	4.03	7.30	1.95	3.68	0.00	0.00	4.70	7.21	3.91	6.61
Selenium	µg/L	1	50	50	0.00	0.00	0.19	0.36	0.17	0.34	0.00	0.00	0.10	0.13	0.26	0.39
Silver	µg/L	0.25	-	-	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Strontium	µg/L	2,500	-	7,000	0.91	4.01	179.03	579.22	139.55	191.06	0.12	0.19	99.42	151.36	208.60	294.66
Thallium	µg/L	0.8	-	-	0.00	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01

Constituents	Units	Aquatic Life	Terrestrial Life	Drinking Water	CP1						A8 West					
					Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)		Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)	
					Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Uranium	µg/L	15	200	20	0.00	0.00	0.51	1.05	0.54	0.78	0.00	0.00	0.17	0.24	0.80	1.18
Vanadium	µg/L	120	100	-	0.00	0.03	0.60	0.95	0.48	0.71	0.00	0.00	0.63	1.13	0.64	0.94
Zinc	µg/L	3.91	50,000	-	0.00	0.04	1.66	2.25	1.09	1.92	0.00	0.00	1.93	2.82	1.59	2.06

Table 7.4-6: Predicted Water Quality Inside the Mine Controlled Area for B4 and B7

Constituents	Units	Terrestrial Life	B7						B4					
			Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)		Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)	
			Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Major Ions														
Total Dissolved Solids	mg/L	3,000	23,933	51,517	534.42	3,289.80	581.17	733.01	313.32	3,023.38	117.66	418.13	81.92	102.47
Fluoride	mg/L	2b	0.06	0.18	0.11	0.17	0.21	0.29	0.06	0.11	0.04	0.10	0.03	0.04
Sulphate	mg/L	1,000	1,432.48	2,947.00	152.93	349.93	335.93	432.11	53.13	197.94	28.17	99.23	12.99	16.43
Calcium	mg/L	1,000	724.54	1,491.30	49.49	177.35	82.47	104.38	26.67	103.00	18.38	35.25	24.15	30.31
Nutrients														
Nitrite	mg/L	10	0.79	2.43	0.03	0.16	0.04	0.06	0.02	0.12	0.01	0.03	0.00	0.00
Total Metals														
Aluminum	µg/L	5,000	0.02	0.04	10.37	24.19	13.84	18.61	0.01	0.01	7.08	9.15	8.01	9.57
Arsenic	µg/L	25	0.07	0.13	15.39	48.28	33.56	44.76	0.00	0.01	1.47	3.68	1.61	2.00
Boron	µg/L	5,000	0.62	1.13	191.32	295.45	390.17	525.44	0.07	0.15	35.26	131.76	17.30	21.33
Beryllium	µg/L	100	0.00	0.00	0.01	0.04	0.02	0.02	0.00	0.00	0.01	0.01	0.01	0.01
Cadmium	µg/L	80	0.00	0.00	0.04	0.07	0.07	0.10	0.00	0.00	0.02	0.04	0.02	0.02
Cobalt	µg/L	1,000	0.00	0.02	2.24	10.04	3.17	4.12	0.00	0.00	0.41	0.72	0.50	0.64
Chromium	µg/L	50c	0.00	0.01	0.40	1.00	0.70	0.90	0.00	0.00	0.23	0.45	0.39	0.52
Copper	µg/L	500d	0.00	0.01	1.85	2.81	2.78	3.75	0.00	0.00	1.20	2.55	1.24	1.54
Lead	µg/L	100	0.00	0.00	0.13	0.20	0.31	0.41	0.00	0.00	0.14	0.28	0.43	0.58
Mercury	µg/L	3	0.03	0.07	0.02	0.02	0.03	0.04	0.00	0.01	0.01	0.02	0.01	0.01
Molybdenum	µg/L	500	0.03	0.06	2.91	4.76	5.79	7.69	0.01	0.01	0.66	1.96	0.45	0.57
Nickel	µg/L	1,000	0.00	0.00	8.83	26.40	13.86	18.87	0.00	0.00	4.29	10.59	4.20	5.58
Selenium	µg/L	50	0.00	0.01	0.74	1.15	1.61	2.04	0.00	0.00	0.14	0.48	0.11	0.15
Uranium	µg/L	200	0.00	0.01	2.92	4.42	5.81	7.96	0.00	0.00	0.25	0.87	0.15	0.19
Vanadium	µg/L	100	0.01	0.01	0.84	2.38	1.40	1.83	0.00	0.00	0.66	1.16	0.96	1.22
Zinc	µg/L	50,000	0.02	0.04	2.17	4.44	2.75	3.68	0.00	0.00	1.81	2.34	1.99	2.36

Table 7.4-7: Predicted Water Quality in the Pits TIR02, TIR04, and Discovery

Constituents	Units	Terrestrial Life	Active Closure (2044-2050)					
			TIR02		TIR04		Discovery	
			Average	Maximum	Average	Maximum	Average	Maximum
Major Ions								
Total Dissolved Solids	mg/L	3,000	59.45	591.08	208.16	1375.16	86.66	724.44
Fluoride	mg/L	2	0.04	0.23	0.05	0.20	0.04	0.22
Sulphate	mg/L	1,000	21.37	301.64	39.82	214.77	16.77	154.73
Calcium	mg/L	1,000	10.53	70.61	18.02	51.32	9.20	34.85
Nutrients								
Nitrite	mg/L	10	0.002	0.010	0.014	0.091	0.004	0.040
Total Metals								
Aluminum	µg/L	5,000	3.44	14.22	6.38	13.64	3.657	4.389
Arsenic	µg/L	25	1.03	13.59	2.21	9.98	0.568	0.822
Boron	µg/L	5,000	26.73	379.46	57.70	320.98	19.387	28.786
Beryllium	µg/L	100	0.01	0.01	0.01	0.01	0.008	0.010
Cadmium	µg/L	80	0.01	0.09	0.02	0.08	0.007	0.008
Cobalt	µg/L	1,000	0.23	2.99	0.48	2.25	0.226	0.354
Chromium	µg/L	50	0.10	0.38	0.20	0.47	0.145	0.202
Copper	µg/L	500	0.84	2.21	1.20	3.11	0.868	0.967
Lead	µg/L	100	0.04	0.09	0.12	0.16	0.050	0.062
Mercury	µg/L	3	0.00	0.04	0.01	0.04	0.002	0.003
Molybdenum	µg/L	500	0.48	6.85	0.93	5.43	0.967	1.722
Nickel	µg/L	1,000	1.03	9.98	3.79	14.00	2.489	4.327
Selenium	µg/L	50	0.12	1.39	0.22	1.21	0.101	0.143
Uranium	µg/L	200	0.46	7.36	0.74	5.65	0.885	1.617
Vanadium	µg/L	100	0.09	0.64	0.51	0.96	0.265	0.455
Zinc	µg/L	50,000	0.88	2.06	1.58	2.10	1.033	1.240

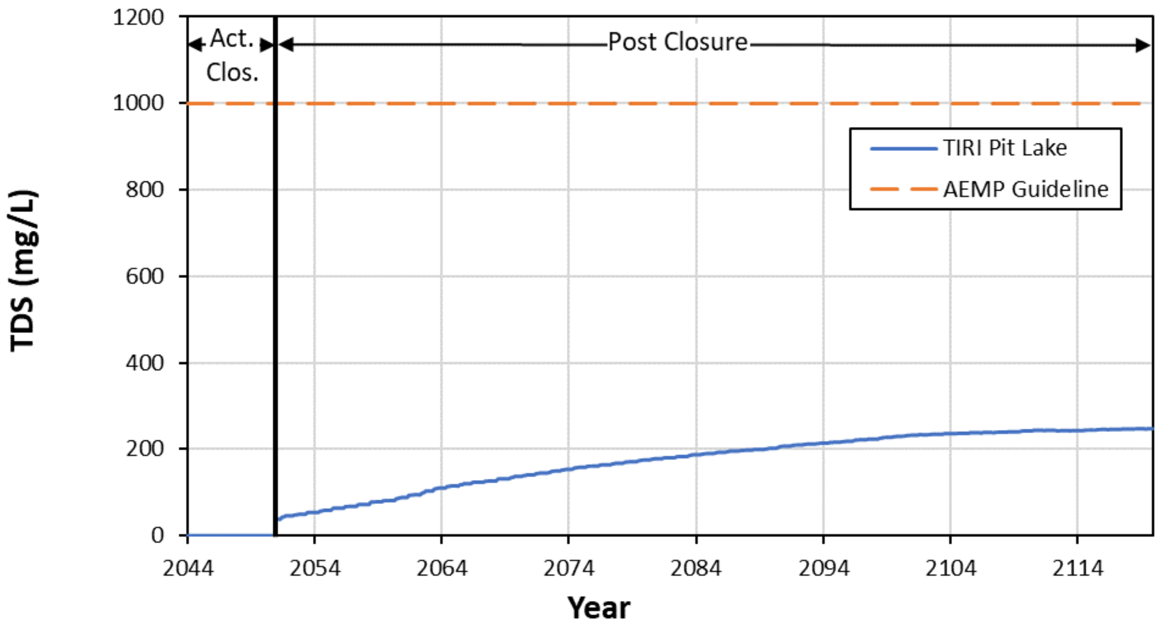
Table 7.4-8: Predicted Water Quality in the Pit Lakes

Constituents	Units	Aquatic Life	Terrestrial Life	Drinking Water	Post Closure (2051-2119)											
					NORWES Pit Lake		Tiri Pit Lake		Pump Pit Lake		F-Zone Pit Lake		Wes Pit Lake		Discovery Pit Lake	
					Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Major Ions																
Total Dissolved Solids	mg/L	1,000	3,000	500	64.29	84.15	175.90	248.33	147.72	193.24	98.76	133.39	62.24	66.71	52.48	68.79
Chloride	mg/L	120	-	-	16.38	19.97	20.92	25.14	28.81	34.91	18.54	21.33	21.06	26.66	16.27	19.08
Fluoride	mg/L	2.8	2b	1.5	0.03	0.03	0.08	0.09	0.04	0.05	0.04	0.05	0.03	0.03	0.03	0.03
Sulphate	mg/L	128	1,000	-	12.43	16.59	86.94	127.77	57.92	79.51	32.00	49.10	8.97	9.85	12.83	20.03
Calcium	mg/L	-	1,000	-	16.30	22.46	28.55	40.91	29.23	38.90	22.18	29.71	13.83	18.55	9.13	11.18
Nutrients																
Ammonia	mg/L	0.58	-	-	0.037	0.053	0.037	0.043	0.056	0.064	0.046	0.058	0.032	0.050	0.019	0.020
Nitrate	mg/L	2.93	-	10	0.018	0.020	0.124	0.170	0.041	0.054	0.042	0.056	0.019	0.022	0.025	0.026
Nitrite	mg/L	0.06	10	1	0.001	0.001	0.010	0.016	0.002	0.002	0.003	0.005	0.001	0.001	0.001	0.001
Total Metals																
Aluminum	µg/L	100	5,000	-	5.48	6.91	6.65	8.46	6.81	8.15	6.51	7.60	4.91	6.12	3.66	4.39
Antimony	µg/L	9	-	6	0.27	0.38	0.89	1.23	0.66	0.93	0.42	0.58	0.18	0.21	0.33	0.58
Arsenic	µg/L	25	25	10	1.08	1.54	8.33	12.95	1.50	2.01	2.78	4.46	0.86	1.19	0.57	0.82
Boron	µg/L	1,500	5,000	5,000	18.25	21.76	106.49	144.60	35.99	47.22	36.69	51.86	14.20	16.00	19.39	28.79
Barium	µg/L	1,000	-	2,000	17.24	23.68	22.62	30.54	19.27	24.43	21.19	27.24	15.06	21.03	9.63	11.22
Beryllium	µg/L	-	100	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cadmium	µg/L	0.043	80	7	0.01	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01
Cobalt	µg/L	0.78	1,000		0.35	0.54	**0.93**	1.35	0.61	**0.92**	0.49	0.72	0.19	0.29	0.23	0.35
Chromium	µg/L	5	50c	50	0.26	0.38	0.31	0.44	0.38	0.53	0.31	0.41	0.21	0.29	0.14	0.20
Copper	µg/L	2	500d		1.09	1.28	1.43	1.68	1.67	**2.10**	1.21	1.42	0.96	1.04	0.87	0.97
Iron	µg/L	1,060	-	300	82.63	126.89	59.02	97.03	100.75	133.69	99.99	130.85	69.16	109.86	15.90	18.95
Lead	µg/L	3.31	100	5	0.24	0.38	0.18	0.30	0.29	0.39	0.29	0.39	0.20	0.32	0.05	0.06
Mercury	µg/L	0.026	3	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Manganese	µg/L	210	-	120	37.13	57.93	69.20	103.97	63.15	89.92	51.48	73.84	27.45	42.80	10.50	15.88
Molybdenum	µg/L	73	500	-	0.35	0.51	1.64	2.28	0.87	1.24	0.69	1.01	0.24	0.34	0.97	1.72
Nickel	µg/L	25	1,000	-	3.48	5.31	5.18	7.46	6.75	10.27	3.45	4.90	1.76	2.20	2.49	4.33
Selenium	µg/L	1	50	50	0.10	0.13	0.45	0.63	0.20	0.26	0.18	0.26	0.08	0.09	0.10	0.14
Silver	µg/L	0.25	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Strontium	µg/L	2,500	-	7,000	95.71	128.08	329.08	442.67	130.54	169.79	152.67	210.11	78.29	101.73	86.48	123.89
Thallium	µg/L	0.8	-	-	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Uranium	µg/L	15	200	20	0.15	0.21	1.58	2.16	0.27	0.39	0.45	0.69	0.10	0.15	0.88	1.62
Vanadium	µg/L	120	100	-	0.60	0.92	0.61	0.95	1.05	1.51	0.69	0.94	0.40	0.62	0.27	0.46
Zinc	µg/L	3.91	50,000	-	1.44	1.75	1.55	1.93	2.03	2.46	1.64	1.86	1.27	1.51	1.03	1.24

Table 7.4-9: Predicted Water Quality outside of the Mine Controlled Area for A1, B2, B45 and CH6

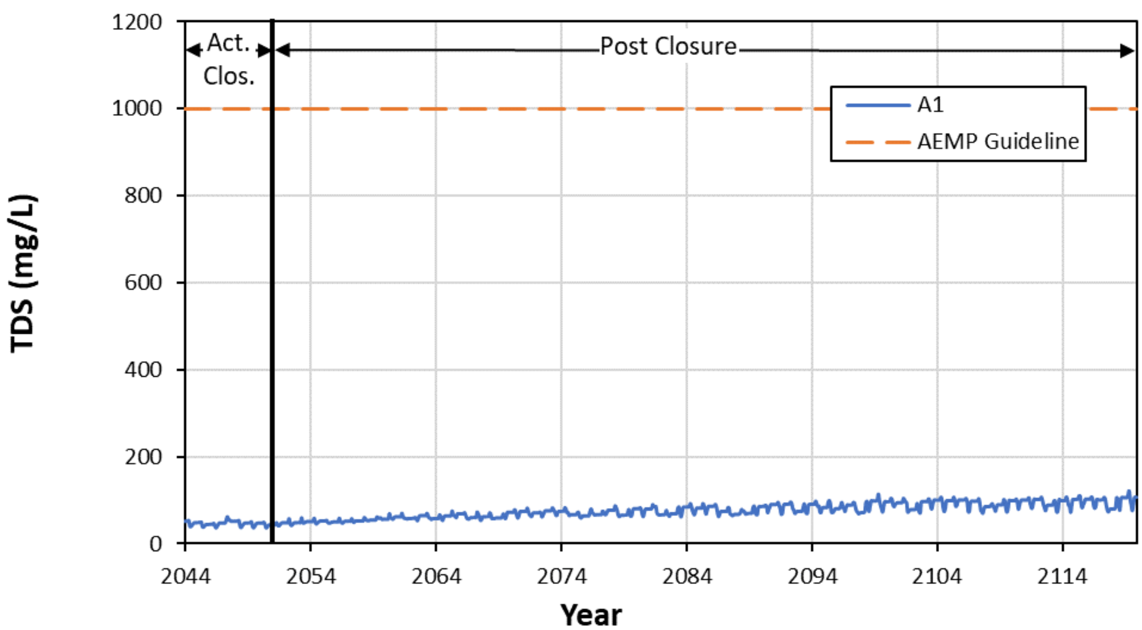
Constituents	Units	Aquatic Life	Terrestrial Life	Drinking Water	A1						B2						B45						CH6					
					Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)		Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)		Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)		Operations (2024-2043)		Active Closure (2044-2050)		Post Closure (2051-2119)	
					Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.
Major Ions																												
Total Dissolved Solids	mg/L	1,000	3,000	500	48	92	45	61	75	121	55	92	48	55	63	89	48	92	45	63	60	93	55	91	48	54	62	76
Chloride	mg/L	120	-	-	10.9	21.8	10.2	13.1	15.2	21.9	12.1	21.6	10.1	12.0	14.0	20.7	10.8	21.8	9.8	14.0	13.1	22.1	12.1	21.6	10.1	11.9	14.3	18.0
Fluoride	mg/L	2.8	2b	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sulphate	mg/L	128	1,000	-	4.1	7.4	3.8	4.9	18.9	35.3	4.3	7.4	3.6	4.3	7.1	11.1	4.0	7.4	3.6	4.8	8.3	15.3	4.3	7.4	3.6	4.3	5.3	6.7
Calcium	mg/L	-	1,000	-	15.0	34.5	13.9	20.8	19.1	31.9	18.3	34.2	15.1	17.8	20.8	31.4	15.3	34.5	13.8	22.1	18.7	33.7	18.2	34.2	15.0	17.7	20.9	26.7
Nutrients																												
Ammonia	mg/L	0.58	-	-	0.06	0.10	0.06	0.09	0.06	0.08	0.05	0.07	0.04	0.05	0.06	0.09	0.05	0.09	0.05	0.08	0.06	0.10	0.05	0.07	0.04	0.05	0.06	0.07
Nitrate	mg/L	2.93	-	10	0.01	0.02	0.01	0.01	0.03	0.05	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.02
Nitrite	mg/L	0.06	10	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Metals																												
Aluminum	µg/L	100	5,000	-	7.40	8.27	7.47	8.10	7.14	8.03	7.41	8.31	7.50	8.09	7.29	8.21	7.34	8.19	7.43	7.98	7.51	8.28	7.38	8.21	7.47	8.00	7.19	8.12
Antimony	µg/L	9	-	6	0.10	0.23	0.11	0.23	0.26	0.46	0.17	0.24	0.17	0.19	0.19	0.25	0.12	0.24	0.13	0.22	0.16	0.28	0.17	0.24	0.17	0.19	0.17	0.22
Arsenic	µg/L	25	25	10	1.11	1.88	1.06	1.31	2.02	3.60	1.25	1.86	1.12	1.25	1.34	1.80	1.12	1.88	1.06	1.36	1.26	1.84	1.24	1.86	1.11	1.24	1.34	1.59
Boron	µg/L	1,500	5,000	5,000	10.75	12.08	11.07	11.91	24.68	38.72	10.28	11.56	10.72	11.64	11.34	12.98	10.58	11.59	10.92	11.77	12.37	14.98	10.24	11.42	10.67	11.52	10.48	11.64
Barium	µg/L	1,000	-	2,000	17.09	42.97	15.54	25.41	19.48	33.18	21.72	42.58	17.62	20.95	23.98	37.76	17.62	42.96	15.61	26.92	20.56	40.93	21.58	42.52	17.51	20.82	24.96	32.39
Beryllium	µg/L	-	100	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cadmium	µg/L	0.043	80	7	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Cobalt	µg/L	0.78	1,000		0.21	0.46	0.20	0.31	0.36	0.64	0.27	0.46	0.24	0.27	0.32	0.45	0.22	0.46	0.21	0.32	0.29	0.47	0.27	0.46	0.24	0.27	0.30	0.37
Chromium	µg/L	5	50c	50	0.16	0.67	0.13	0.35	0.23	0.51	0.26	0.66	0.19	0.25	0.31	0.56	0.17	0.67	0.14	0.38	0.24	0.63	0.26	0.66	0.19	0.25	0.32	0.45
Copper	µg/L	2	500d		0.87	1.28	0.83	0.96	1.07	1.39	0.91	1.27	0.82	0.92	1.00	1.29	0.86	1.28	0.81	0.96	0.99	1.31	0.90	1.27	0.81	0.91	0.99	1.17
Iron	µg/L	1,060	-	300	101.13	237.49	92.88	150.96	101.22	169.24	129.96	235.53	109.34	127.47	138.49	209.83	105.48	237.50	95.19	157.12	118.77	223.14	129.18	235.18	108.70	126.67	142.42	179.74
Lead	µg/L	3.31	100	5	0.13	0.98	0.09	0.49	0.20	0.58	0.32	0.97	0.21	0.30	0.37	0.76	0.17	0.98	0.11	0.53	0.24	0.75	0.32	0.97	0.21	0.30	0.40	0.59
Mercury	µg/L	0.026	3	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Manganese	µg/L	210	-	120	19.58	113.13	14.97	58.65	35.23	89.21	40.35	112.01	27.58	38.13	47.77	92.86	23.28	113.07	17.43	62.50	33.99	105.39	40.01	111.84	27.36	37.96	49.78	72.25
Molybdenum	µg/L	73	500	-	0.36	0.54	0.35	0.49	0.56	0.87	0.25	0.30	0.24	0.27	0.32	0.49	0.32	0.49	0.31	0.43	0.40	0.61	0.25	0.30	0.24	0.27	0.30	0.39
Nickel	µg/L	25	1,000	-	1.07	1.84	1.04	1.36	2.32	3.90	1.26	1.83	1.16	1.28	1.69	2.26	1.10	1.84	1.06	1.39	1.73	2.46	1.25	1.83	1.15	1.27	1.38	1.64
Selenium	µg/L	1	50	50	0.05	0.13	0.05	0.08	0.12	0.21	0.07	0.13	0.06	0.07	0.08	0.12	0.05	0.13	0.05	0.09	0.07	0.12	0.07	0.13	0.06	0.07	0.08	0.10
Silver	µg/L	0.25	-	-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Strontium	µg/L	2,500	-	7,000	73	185	67	109	116	204	93	183	76	90	105	165	76	184	67	116	91	178	93	183	76	90	109	141
Thallium	µg/L	0.8	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uranium	µg/L	15	200	20	0.07	0.08	0.07	0.08	0.27	0.49	0.07	0.08	0.06	0.07	0.08	0.10	0.07	0.08	0.07	0.08	0.09	0.12	0.07	0.08	0.06	0.07	0.09	0.13
Vanadium	µg/L	120	100	-	0.35	1.33	0.31	0.85	0.51	1.08	0.63	1.32	0.52	0.64	0.69	1.14	0.41	1.33	0.37	0.87	0.54	1.24	0.62	1.32	0.51	0.63	0.69	0.92
Zinc	µg/L	3.91	50000	-	1.48	2.09	1.51	2.11	1.54	2.07	1.79	2.08	1.84	1.99	1.71	2.12	1.57	2.12	1.62	2.12	1.60	2.19	1.79	2.06	1.83	1.97	1.68	2.05

Figure 7.4-7: TDS in Tiri Pit Lake (Closure to Post-Closure)



Source: Figure 6-33 from Appendix H-07

Figure 7.4-8: TDS in Lake A1 (Closure to Post-Closure)



Source: Figure 6-49 from Appendix H-07

7.4.4 Residual Impact Classification

The purpose of the residual effect classification is to describe the residual effects from the Meliadine Extension on water and sediment quality using a scale of common words, rather than numbers or units. The criteria used to assess the residual effects are described in Section 4 and Table 4.5-1 of this Application.

The impacts that remain following mitigation, or residual impacts, for the environmental component were classified using criteria to determine the overall effect, termed the environmental consequence. For water and sediment quality, the measurement endpoint was concentration of a particular parameter, but the assessment endpoint is suitability of water to support a viable aquatic ecosystem. Measurement endpoints are quantifiable, while assessment endpoints are properties of the valued component that should be protected for use by future human generations or to support an aquatic ecosystem. Interpretation of the residual impacts and significance were supported by the HHERA (Section 10).

This Application has considered a suite of environmental design features that will reduce impacts to water and sediment quality (Table 7.4-1 and Appendix B, Table B-2 of this Application). Surface contact water will be pumped and/or directed through ditches and channels to the attenuation ponds, treated (where required) and discharged to Meliadine Lake. Based on the conceptual diffuser design, and the mine site water quality and quantity assessment, it is predicted that impacts from treated effluent discharge to Meliadine Lake will be negligible (Table 7.4-10). Indirect impacts to water and sediment quality from changes to downstream flows, a result of flow diversions and watershed alteration in upper regions of the LSA sub-basins, will be local in geographic extent, and will also be negligible (Table 7.4-10).

The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life, terrestrial life, and traditional and non-traditional uses of water. The evaluation of significance for biophysical VECs considers the entire set of pathways that influence, in this case, the opportunity for traditional and non-traditional use of fish, species health, and the continued opportunity for use of surface water for traditional and non-traditional uses. All pathways that impact water and sediment quality are used in these significance assessments. The relative impact from each pathway is discussed; however, pathways that are predicted to have the greatest influence on changes in opportunity for traditional and non-traditional use of fish, species health (including fish, waterbirds, benthic invertebrates, and plankton), and the continued opportunity for use of surface water for traditional and non-traditional uses, other than fishing, are assumed to contribute the most to the determination of environmental significance.

Changes in specific water and sediment quality parameters such as major ions or metals does not provide the full context to evaluate the standalone significance of the change for these VECs. For a change in a water or sediment quality parameter to be significant, it needs to be evaluated in terms of change perceived by the receptor including the ability to eat the fish (i.e., healthy invertebrate populations and healthy fish), the ability to drink the water, the continued opportunity for use of surface water for traditional and non-traditional uses, and continued healthy aquatic life.

The significance determination for the Meliadine Extension is the same as that determined for the 2014 FEIS. The Meliadine Extension should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the LSA and beyond (Section 7.5 of this Application), on the health of aquatic life (Section 10.2 of this Application), or on human health (Section 10.3 of this Application). Therefore, there will not be a significant adverse impact on water and sediment quality.

Table 7.4-10: Summary of Residual Impact Classification for Effects on Water and Sediment Quality

Effects Pathway	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Changes in water and sediment quality due to effluent discharge	Negative	Negligible to low	Local	Medium-term	Continuous	Reversible	Likely
Changes in water and sediment quality due to physical alteration of watersheds and air emissions	Negative	Negligible to low	Local	Medium-term to Permanent	Continuous	Reversible to Irreversible	Likely to Highly Likely

7.4.5 Cumulative Effects Assessment

From the 2014 FEIS, potential residual effects to water and sediment quality are anticipated to be confined to the Meliadine Lake watershed. No changes are expected for the Meliadine Extension. There are no other projects or RFFDs in these watersheds where there could be an overlap with the Meliadine Extension. As with the 2014 FEIS, the potential for cumulative effects is negligible.

7.4.6 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will affect water quality); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., erosion and sedimentation protection).

Therefore, any uncertainty with the Meliadine Extension is related to assumptions in the mitigations and site water balance model. This will be addressed through monitoring programs as described below.

7.4.7 Monitoring and Follow-up

Follow-up water quality monitoring for the 2014 FEIS and the 2018 and 2020 Addenda (Agnico Eagle 2014, 2018a, 2020a) and Meliadine Extension will be conducted in general accordance with required monitoring under Project Certificate No.006 and Type A Water Licence 2AM-MEL1631 and captured in existing monitoring plans including:

- Adaptive Management Plan (Appendix D-01)
- Aquatic Effects Monitoring Program (Appendix D-05)
- Environmental Management Protection Plan (Appendix D-12)
- Ocean Discharge Monitoring Plan (Appendix D-24)
- Water Management Plan (Appendix D-35), with appendices:
    - Freshet Action Plan
    - Sediment and Erosion Plan
    - Water Quality and Flow Monitoring

For the Meliadine Extension, Agnico Eagle has updated the associated plans or reports for further guidance and mitigation. Agnico Eagle considers that existing T&C 30, 31, and 32 of Project Certificate No.006 are sufficient to protect, mitigate and monitor water quality impacts associated with the Meliadine Extension.

Any new required mitigation measures related to primary effects for the Meliadine Extension are described in relation to the predicted effects and summarized in the primary pathway for water quality (Table 7.4-1) and summarized in the no linkage and minor pathway table for water quality provided in Appendix B-2, Table B-6 of this Application. Mitigation, management, and monitoring plans are summarized in Section 12 and provided in Appendix D of this Application. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

7.5 Fish and Fish Habitat

The purpose of this section is to describe the existing conditions for fish and fish habitat (i.e., aquatic habitat) and assess the effects of the Meliadine Extension on fish and the fish habitat environment in comparison to the 2014 FEIS, and the 2018 and 2020 FEIS Addenda. This includes potential changes resulting from Meliadine Extension-related components and associated activities, including potential changes to air quality, water quality (including sediments), and water quantity.

There are no new pathways for the fish and fish habitat assessment of the Meliadine Extension.

Factors considered when selecting VECs included the following (Salmo 2006):

- biophysical components identified by NIRB during 2014 FEIS scoping and Agnico Eagle community and stakeholder consultation;
- represent important ecosystem processes;
- territorial and federal listed (COSEWIC 2012; SARA 2012, CESCC 2001, 2006) species;

- communities or species that reflect the interests of regulatory agencies, Indigenous groups, and communities;
- can be measured or described with measurement endpoints;
- allow cumulative effects to be considered; and
- current experience with environmental assessments and effects monitoring programs in Nunavut and the Northwest Territories.

The effects assessment was updated with the appropriate Meliadine Extension phases, including construction, operation, temporary closure, final closure, and post-closure. Where applicable, any new indirect and cumulative effects have been incorporated throughout this section.

7.5.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ, TK, and concerns related to fish and fish habitat were provided by community members and incorporated into the Meliadine Extension fish and fish habitat assessment, which takes into account review of community engagement notes from focus group meetings, public consultations, the VMR and other consultation processes.

IQ encompasses not only TK about land and resources, but also the skills to apply this knowledge to livelihoods, and a value system that is founded upon respect, sharing, collaboration, collective decision-making, skills development and the responsible use of resources.

IQ for the Meliadine Extension (Section 3, of this Application) did not highlight new concerns related to the existing environment or baseline information regarding fish and fish habitat. The Meliadine Extension is consistent with IQ incorporation from the 2014 FEIS and the 2018 and 2020 Addenda (Agnico Eagle 2014, 2018b, 2020a).

The following highlights related IQ:

- Existing Inuit traditional societal value and principle of, respect for the land, no disruption of wildlife habitat, and no wastage of food harvested from the land or waters.
- The Meliadine area and river system is a significant area and historically important for many Inuit in the Kivalliq Region, and still is considered as a special place for annual fish and caribou harvest for supplementing Inuit households with healthy traditional foods.
- Arctic Char are an important food species for the residents of Rankin Inlet – residents have cabins on the north shore of Itivia Harbour and harvest Arctic Char, Sculpin, and Cod in the Itivia Harbour area (Nunami Stantec 2012; Appendix B). Itivia Harbour is heavily used by residents in the summer for launching boats (it’s the only place accessible during low tide), and in the winter for snowmobile travel in and out of the community (Nunami Stantec 2012; Appendix B).
- Women did and still do most of the fishing in the communities. Community members used to walk from Rankin Inlet to the area near Diana River to fish on the surrounding lakes. All fish at Meliadine go upstream to Peter Lake, and then go downstream to the ocean via Diana River.
- Seasons are changing, and the streams are getting lower having an impact on fish. Some years are

dry, and the water is low. Some years, the water is high when there is more rain. Fish have different sizes depending on the size of rocks in the streams and their location; they change accordingly. When the water becomes dirty, fish move somewhere else. The community fish using fishing nets, and they have observed different species of fish they have not seen before.

7.5.2 Existing Environment

Information on baseline (pre-2014) and existing conditions (post-2014) fish and fish habitat environment has been collected and summarized in a variety of documents including:

- Volume 7, Section 7.5.4 of the 2014 FEIS
- Supporting document SD 7-1 (1994-2009 Aquatic Synthesis Baseline) of the 2014 FEIS
- Supporting document SD 7-2 (2011 Aquatic Synthesis Baseline) of the 2014 FEIS
- Annual Aquatic Effects Monitoring Program reports from 2016 to 2020 (Golder 2017, 2018d, 2019; Azimuth 2020, 2021a);
- Environmental Effects Cycle 1 report (Golder 2019c)
- Environmental Effects Cycle 2 Study Design (Azimuth 2021b)
- Existing Conditions Report from 2020 and 2021 studies (Appendix G-07)

Additional information on sampling activities are provided in Appendix 7.5A and Appendix 7.5B of Appendix G-07. The existing and most recent data continues to remain generally consistent with those presented in previous baseline aquatic resources studies (Golder 2012, 2014).

The selection of highly valued fish species was based on a list of fish species present in the LSA, including the Meliadine Lake Peninsula. Nine species identified during baseline studies (SD 7-1 and SD 7-2) could be considered as VECs:

- Arctic Char
- Arctic Grayling
- Lake Trout
- Round Whitefish
- Cisco
- Burbot
- Slimy Sculpin
- Threespine Stickleback
- Ninespine Stickleback

Of these, none were classified as federally listed species or species with a designated conservation status. Furthermore, there were no 'basin endemic' species observed in the LSA, species that would be regarded as potentially sensitive or intolerant to environmental change (Segurado et al. 2011). Thus, additional criteria were used to select highly valued fish species as VECs for the assessment and were as follows:

- economic importance to traditional and non-traditional users;

- relative abundance in the Meliadine Lake and Peninsula;
- trophic position; and
- unique life history requirements.

Between 1997 and 2012, fish and fish habitat in the LSA and RSA were sampled in 10 different years. Investigations were focused on determining the distribution of fish species throughout the watersheds, movements of Arctic Char, Lake Trout, and Arctic Grayling using radio telemetry, and the timing and size of the Arctic Char run in the Meliadine River. Surveys also were conducted to identify habitat features with regard to their suitability for spawning, rearing, migration, and overwintering, and to characterize lower trophic communities (including periphyton, phytoplankton, zooplankton, and benthic invertebrate) (Golder 2014).

Meliadine Lake will continue to be monitored through the annual comprehensive the annual AEMP (Azimuth 2021a).

The AEMP is an integrated monitoring program designed to assess whether activities at the mine are causing changes in the aquatic environment. The actively involved groups with this annual monitoring program include the surrounding local communities, stakeholders, and various regulatory bodies.

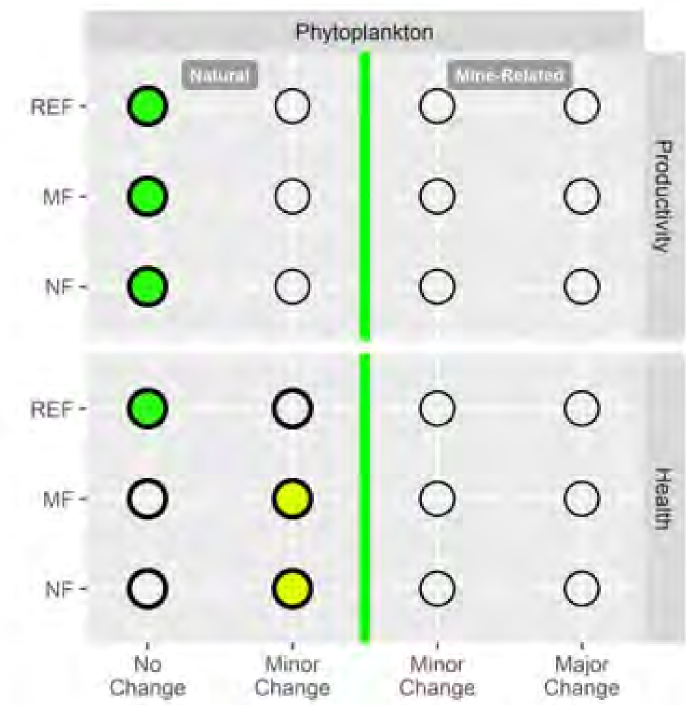
The AEMP was designed in consultation with the community, regulators, and other stakeholders. The AEMP incorporates IQ, including TK, and western science to assess water quality and the health of Meliadine Lake. Components monitoring under the AEMP include water quality, plankton, sediment quality, benthic invertebrates, and fish. Figure 7.4-1 illustrates the sampling stations within the LSA, which provides more information on the extent of the monitoring program.

Water quality results are compared to background concentrations and guidelines for protection of aquatic life and guidelines for protection of drinking water (referred to as AEMP Benchmarks).

The health of Meliadine Lake Watershed and the Peninsula Lakes Watershed is monitored through this program. Results from the 2020 monitoring in comparison to the normal range and benchmarks are presented in Figures 7.5-1 to 7.5-3. As illustrated below, concentrations of substances in the water from Meliadine Lake (in the near-field area around the diffuser, downstream in the mid-field area, and further downstream in the reference areas of the lake) are a fraction of the AEMP Benchmarks and a fraction of the AEMP low action levels (75% of the AEMP Benchmark) for adaptive management.

The phytoplankton community in the lake is healthy, but the community in the near-field area is naturally different than the community in other areas of Meliadine Lake (Figure 7.5-1). Phytoplankton monitoring was completed in 2021 to supplement water quality monitoring and to monitor for mine-related effects; results will be included in the 2021 annual report.

Figure 7.5-1: Report Card on Health of Meliadine Lake – Phytoplankton



Source: Agnico Eagle (2021b)

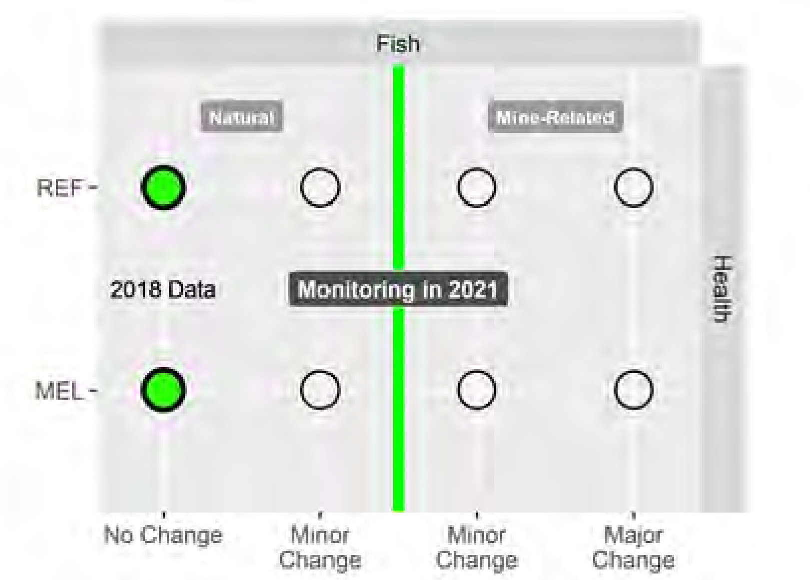
Results of the 2018 benthic invertebrate study confirmed that the diversity and abundance of the benthic invertebrate community is similar in different areas of the lake and the structure and ecological function of the community is not being affected by the Mine (Figure 7.5-2).

Figure 7.5-2: Report Card on Health of Meliadine Lake – Benthic Invertebrates

Source: Agnico Eagle (2021b)

Results of the 2018 fish program confirmed that survival, growth, reproduction, or energy use of fish living at the near-field area were not affected by the Mine (Figure 7.5-3). Toxicity testing conducted in 2020 confirmed that water in the near-field area is safe for benthic invertebrates and fish.

Figure 7.5-3: Report Card on Health of Meliadine Lake – Fish



Source: Agnico Eagle (2021b)

Results from 2020 demonstrate that changes in water quality at the Peninsula Lakes align with predictions in the 2014 FEIS: some parameters have increased relative to the baseline period, but current conditions support freshwater aquatic life and human uses. Importantly, the spatial extent of potential non-point source mine-related changes to water quality in lakes on the peninsula appears to be localized to the lakes in close proximity to mine, and do not extend farther out to Lake D7. Overall, the year-over-year changes in water quality that were detected in Lake B7 and Lake A8 for some parameters do not warrant management actions or mitigation based on the adaptative management strategy in the Response Framework. Continuation of the waste management and water management strategy, coupled with on-going efforts to control off-site dust migration, will help keep water quality within the range of minor changes predicted in the FEIS. Key findings from the 2020 assessment are presented below.

There were no exceedances of water quality guidelines for the protection of aquatic life, human health drinking water quality, or SSWQOs for water samples collected from Lake A8, Lake B7, and Lake D7 in 2020. Water quality guidelines were met for safe consumption in 2020. This provides an additional level of assurance with which to assess water quality in the other lakes further away from the site, on the peninsula.

Collectively, the phytoplankton community and nutrient data provide useful information to help detect potential effects to primary productivity resulting from nutrient enrichment in Meliadine Lake.

The various approaches to evaluating water quality (e.g., normal range assessment, spatial/temporal scatterplots) all point to changes in water quality in the east basin associated with effluent. The magnitude of the change is broadly consistent with predictions in the 2014 FEIS, specifically that water quality would change relative to baseline/reference conditions, but that water quality would continue to meet guidelines for the protection of aquatic life and human drinking water quality at 100 m from the diffuser.

7.5.3 Assessment of Potential Meliadine Extension-related Effects

The Meliadine Extension activities represent a negligible change from the Approved assessment activities (Agnico Eagle 2014, 2018a, 2020a) and no new pathways were identified. The waterbodies and watersheds influenced through the Meliadine Extension are primarily the same ones that were assessed through the 2014 FEIS. This section provides a summary of the effects assessment for fish and fish habitat.

A pathway analysis to identify and assess linkages between activities included in the application and fish and fish habitat was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage or minor are provided in Appendix B-2, Table B-7 and are also described in Volume 7, Section 7.5.5, Table 7.5-16 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC fish and fish habitat as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways may result in measurable environmental change that could contribute to residual effects. Primary pathways are provided in Table 7.5-1 of this Application and are also described in Volume 7, Section 7.5.5.3 of the 2014 FEIS. There are no new primary pathways for fish and fish habitat (Table 7.5-1). The Meliadine Extension does not change the size of the spatial boundary for the assessment, but there is an increase in the temporal boundary due to the extension of mine life. The extended temporal boundary does not change the results of primary pathways identified from the previous assessments; however, a summary of the effects analysis for the primary pathways are provided below:

- **The Mine footprint, including open pits, waste rock storage facilities, and infrastructure pads will remove waterbodies and alter watershed areas and drainage patterns, change flows, and water levels, all of which may directly affect the quantity of habitat for Arctic Char, Lake Trout, and Arctic grayling. The AWAR and Rankin Inlet bypass road will result in the direct loss of habitat at road crossings, potentially affecting Arctic Char, Lake Trout, and Arctic Grayling**
- **Residual ground and aquatic disturbances from the Mine footprint can cause permanent loss and alteration of waterbodies, drainage patterns and water levels, all of which may directly affect the quantity of habitat for Arctic Char, Lake Trout, and Arctic Grayling**
- **The active diversion of water from waterbodies to other locations either within or to adjacent subbasins during operation phases will decrease flows to downstream waterbodies and watercourses bypassed by the diversion, potentially leading to indirect (downstream) effects to habitat quantity for Arctic Char, Lake Trout, and Arctic Grayling (in Basins A and B)**
- **The Mine footprint will physically alter the size of watersheds, and alter existing flow paths**

within the LSA during Meliadine Extension operation phases, which may decrease downstream flows and water levels, potentially resulting in indirect (downstream) effects to habitat quantity for Arctic Char, Lake Trout, and Arctic Grayling (in Basins A, B, and H)

- **The permanent footprint may change the long-term hydrology of Basins A, B, and H, affecting fish habitat quantity for Arctic Char, Lake Trout, and Arctic Grayling**
- **Release of mine wastewater and sewage may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations), affecting habitat quality and the survival and reproduction of Arctic Char, Lake Trout, and Arctic Grayling in Meliadine Lake**
- **Air emissions (e.g., sulphur dioxide, nitrogen oxides) and fugitive dust deposition may change water and sediment quality in waterbodies of the LSA, affecting fish health and habitat quality for Arctic Char, Lake Trout, and Arctic Grayling**
- **Changes to the configuration of watersheds and flow paths from the Mine footprint may affect downstream water quality (e.g., metals, nutrients) in small lakes and streams, and affect aquatic health, and habitat quality for Arctic Char, Lake Trout, and Arctic Grayling**
- **Permanent changes to the configuration of watersheds and flow paths may affect downstream water quality (e.g., metals, nutrients) in small lakes and streams, and affect aquatic health, and habitat quality for Arctic Char, Lake Trout, and Arctic Grayling**
- **Water quality concentrations in flooded pits may be elevated above baseline concentrations for small lakes in the LSA (e.g., metals, nutrients), and if reconnected to pre-construction flow paths may affect downstream water and sediment quality, affecting fish health and habitat quality for Arctic Char, Lake Trout, and Arctic Grayling**
- **Increased access from the AWAR may lead to increased mortality of valued fish species in the Meliadine Lake-River system, as well as for streams crossed by the AWAR**

VEC selection identified the following species: Arctic Char, Lake Trout, and Arctic Grayling, because they are species of economic, domestic, and cultural importance to traditional users in Nunavut. They also represent important ecosystems processes (2014 FEIS). The fish habitat VEC addresses all species of fish, including forage species, with emphasis on habitat for species that are relatively abundant and with fishery value. Forage species did not meet the criteria used to select VECs; however, they were considered as a measurement endpoint as fish habitat and assessed as part of the Conceptual Fish Offsetting Plan. Refer to the Conceptual Fish Offsetting Plan for further details (Appendix D-26).

Table 7.5-1: Potential Primary Pathways for Fish and Fish Habitat

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
General construction and operation of mine infrastructure including AWAR	Meliadine Extension footprint will remove waterbodies and alter watershed areas and drainage patterns, change flows, and water levels and the road footprint will result in loss of fish habitat at road crossings, all of which may affect fish habitat quantity (including habitat units as defined by DFO) and the abundance and distribution of fish.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management), where needed. Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms. Use of design features to reduce changes to local flows, drainage patterns, and drainage areas. Roads aligned to cross streams of low quality habitat to the extent possible. Design roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.5.8 of the 2014 FEIS Assessment endpoints for fish and fish habitat include the maintenance of the abundance and distribution of populations of Arctic char, lake trout and Arctic grayling and continued opportunity for traditional and nontraditional use of these fish species. Project pathways influencing the abundance and distribution of fish were determined to be negligible to moderate in magnitude, local to regional in geographic extent, and medium-term to permanent in duration. The scale of impacts from the Project pathways, independently or combined, should not be large enough to cause irreversible changes at the population level, nor decrease the resilience of the VECs.	No change	This pathway has been previously assessed. The annual volume of water used will be the same as in the 2014 FEIS and thus there is no change from the previous assessment. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension. A baseline water balance model was modified to predict the effects of Meliadine Extension LSA watersheds during construction, operations, closure, and post-closure. The model considers each of LSA watersheds, which were divided into sub-watersheds including lake and land areas. Changes to the water balance model per sub-watershed are described for each phase of the Water Management Plan. For sub-basins where measurable effects were anticipated changes to surface areas of those waterbodies were calculated to understand potential loss of habitat for fish. Changes in surface areas corresponded to the maximum decrease in mean monthly water levels over the period of construction to closure and post-closure from baseline. Largest decreases in water levels were always observed during the month of June. Reporting of effects based on changes in June was deemed an environmentally conservative approach, and therefore, reported effects to fish was likely overestimated. Mitigation measures and environmental design features outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
	Fugitive dust sources and deposition of dust may change water and sediment quality, affecting fish health and fish habitat quality.	Dust will be actively suppressed from roads (water and/or other dust suppressants). Adhere to the Dust Management Plan and Roads Management Plan. Sheds, enclosures and covers will be used in crushing and major ore handling areas Operating procedures will be developed that reduce dust generation. For example, tailings deposition will be designed to limit dust generation.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Monitoring conducted in 2020 were within air quality standards and 2014 FEIS predictions. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
	Air emission of sulphur dioxide, nitrogen oxides and particulates may change water and sediment quality, affecting fish habitat quality and fish health.	Equipment and vehicles will comply with relevant emission criteria at the time of purchase. Regular maintenance of equipment and vehicles to meet emission standards.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. No increase in emissions is predicted for the Meliadine Extension due to the production rate staying the same. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
	Release of mine wastewater and sewage may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations), affecting aquatic habitat and the survival and reproduction of fish in Meliadine Lake.	Adhere to the Water Management Plan Contact water will be monitored and managed through the Attenuation Ponds Surface runoff and groundwater seeping into the open pits will be collected in in-pit sumps. The collected water will be used for dust control or pumped to the TSF for use as process water. Underground water will be re-cycled for re-use underground, where possible. Excess underground water with high salinity will be treated Discharge quality will meet MDMER at end of pipe and will meet CCME aquatic life standards within a 100 m wide mixing zone of the diffuser in Meliadine Lake. The rotary biological contactor sewage treatment plant for the camp facilities will be designed to meet the Nunavut effluent guidelines for wastewater discharge.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. The Meliadine Extension will be within the footprint that has been previously assessed. In regards to water and waste management, the footprint of the Meliadine Extension is more compact than what was assessed and approved in 2014. Through refinement in the mine plan, the effluent discharge is predicted to be lower than previously assessed, and changes to water quality in Meliadine Lake will be less. Fish populations exposed to highly variable environmental conditions, such as that in the Canadian Arctic, can be characterized by individuals with a range of adaptations that allow them to maintain positive fitness over the long term. Mitigation measures and environmental design features outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Lakes to Receiving Waterbodies	The active diversion of water from waterbodies to other locations either within or to adjacent subbasins will decrease flows to downstream waterbodies and watercourses bypassed by the diversion, potentially affecting	The Water Management Plan will be implemented. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The annual volume of water used will be the same as in the 2014 FEIS and thus there is no change from the previous assessment. A baseline water balance model was modified to predict the effects of Meliadine Extension LSA watersheds during construction, operations, closure, and post-closure. The model considers each of LSA watersheds, which were divided into sub-watersheds including lake and land areas. Changes to the water balance model per sub-watershed are described for each phase of the Water Management Plan.

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
	the availability of fish habitat (in Basin A and B).								For sub-basins where measurable effects were anticipated changes to surface areas of those waterbodies were calculated to understand potential loss of habitat for fish. Changes in surface areas corresponded to the maximum decrease in mean monthly water levels over the period of construction to closure and post-closure from baseline. Largest decreases in water levels were always observed during the month of June. Reporting of effects based on changes in June was deemed an environmentally conservative approach, and therefore, reported effects to fish was likely overestimated. Mitigation measures and environmental design features outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
	Changes to the configuration of watersheds and flow paths from the Project footprint may affect downstream water quality (e.g., metals) in small lakes and streams, and affect aquatic health, and fish habitat quality.	The Water Management Plan will be implemented.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The annual volume of water used will be the same as in the 2014 FEIS and thus there is no change from the previous assessment. A baseline water balance model was modified to predict the effects of Meliadine Extension LSA watersheds during construction, operations, closure, and post-closure. The model considers each of LSA watersheds, which were divided into sub-watersheds including lake and land areas. Changes to the water balance model per sub-watershed are described for each phase of the water management plan. For sub-basins where measurable effects were anticipated changes to surface areas of those waterbodies were calculated to understand potential loss of habitat for fish. Changes in surface areas corresponded to the maximum decrease in mean monthly water levels over the period of construction to closure and post-closure from baseline. Largest decreases in water levels were always observed during the month of June. Reporting of effects based on changes in June was deemed an environmentally conservative approach, and therefore, reported effects to fish was likely overestimated. Water quality data will be compared to the most recent CCME Canadian Water Quality Guidelines for the protection of aquatic life and Health Canada's Guidelines for Canadian Drinking Water Quality (CCME 2012a; Health Canada 2010). Water quality guidelines are nationally endorsed indicators of environmental quality for the protection of aquatic ecosystems and designated water uses (CCME 2012a; Health Canada 2010). Mitigation measures and environmental design features outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
	The Project footprint will physically alter the size of watersheds, and alter existing flow paths within the LSA, which may decrease downstream flows and water levels, affecting fish habitat quantity and the abundance and distribution of fish (in Basin A, B, and H).	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Use of design features to reduce changes to local flows, drainage patterns, and drainage areas.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. A baseline water balance model was modified to predict the effects of Meliadine Extension on LSA watersheds during construction, operations, closure, and post-closure. The model considers each of LSA watersheds, which were divided into sub-watersheds including lake and land areas. Changes to the water balance model per sub-watershed were then described. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Construction and operation of haul roads, AWAR and Rankin Inlet bypass road	Potential overexploitation of fish stocks due to improved road access can lead to changes in the abundance and distribution of fish.	Mining staff will not be allowed to hunt or fish while on their work rotation. Agnico Eagle enforces no hunting, trapping, harvesting or fishing.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. The proposed spatial extent at which the dynamics of the local population operate, based in part on baseline monitoring data that illustrate large movements of individual fish across multiple watersheds during their life history, would suggest that the impacted area is a very small proportion of the area or range for the population of species like Arctic char, lake trout, and Arctic grayling. Although there is a local change in the distribution of fish species, people that fish in the region, should not observe a major change in the availability of fish due to impacts from the Project, relative to current natural changes in population sizes.
Reclaimed Footprint	Water quality concentrations in flooded pits may exceed objectives, and if reconnected to preconstruction flow paths may affect downstream water and sediment quality, affecting fish health and habitat quality.	A preliminary Conceptual Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pits (and borrow pits) will be progressively reclaimed as excavation is completed; slopes will be designed to be stable during pit construction and operation.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
		The pits will be flooded, with water from Meliadine Lake, over a 10 year period following completion of pit operations. Pit Lakes will be designed to sequester contaminants of potential concern at depths so that they are biologically unavailable to higher trophic levels. All diversion dikes will be kept intact as a barrier between open pits and surrounding lakes until the pit water meets acceptable concentrations for release to the environment. Any acid-generating bedrock exposed in borrow pits will be covered with a minimum 2 m thick layer of non-acid generating and non-metal leaching soil or rock to direct water from the surface.							
	Permanent changes to the configuration of watersheds and flow paths may affect downstream water quality (e.g., metals) in small lakes and streams, and affect aquatic health, and fish habitat quality.	None	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
	The permanent footprint will remove waterbodies and alter watershed areas and drainage patterns, change flows, and water levels, all of which may affect fish habitat quantity (including habitat units as defined by DFO) and the abundance and distribution of fish.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Site infrastructure will be decommissioned and removed from site. All roads will be decommissioned and scarified. Hydraulic connections to the natural receiving environment will be re-established once water quality monitoring demonstrates the water meets water quality guidelines for direct release without further treatment. Drainage patterns will be re-established as close to pre-construction conditions as possible; select noncontact water diversion ditches will be retained to promote surface water drainage.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
	The Meliadine Extension will change the long-term hydrology of the LSA sub-basins.	Hydraulic connections to the natural receiving environment will be re-established once water quality monitoring demonstrates that water meets water quality guidelines for direct release without further treatment. Drainage patterns will be re-established as close to pre-construction conditions as possible, select noncontact water diversion ditches will be retained to promote surface water drainage.	Primary	Primary	Section 7.5.6.2 and 7.5.6.3 of the 2014 FEIS	This pathway has been previously assessed and the Extension does not change the assessment			This pathway and effects have been previously assessed The Meliadine Extension does not change the results of the previous assessment. Pumped discharges for dewatering will be directed to a lake environment (not directly to outlets) or to a treatment facility and for discharge through the permanent diffusers The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension

In some cases, both a source and a pathway exist, but the change caused by the Meliadine Extension is anticipated to result in a minor environmental change to fish habitat quality or quantity (e.g., lower trophic levels), and therefore would have a negligible residual effect to fish habitat units and fish relative to baseline or guideline values (e.g., a slight increase in a water quality parameter above CCME guidelines, but would not affect fish health).

Direct impacts from the 2014 FEIS footprint were projected to be local in geographic extent (2014 FEIS Table 7.5-33). As with the Meliadine Extension, the footprint with remain the same, thus any direct impacts will remain local in extent.

There are no other developments in the LSA that will contribute a measurable change (i.e., cumulative effects) to available habitat. Effects to waterbodies supporting VECs, at the scale of the LSA, are anticipated to maintain the level of moderate in magnitude for Arctic Char, Lake Trout, and Arctic Grayling, if the worst case scenario is observed. Impacts will be larger for streams than for lakes (2014 FEIS).

Furthermore, the majority of effects will continue to be reversible at closure through progressive reclamation of lost aquatic habitat and the reconnection of natural flows and drainages using channels designed for fish passage. Fish habitat losses will be compensated as part of the Conceptual Fish Offsetting Plan for the Meliadine Extension (Appendix D-26).

As stated above, the Meliadine Extension activities represent a negligible change from the Approved assessment activities with no new pathways identified. As referenced in the 2014 FEIS, the potential for loss of fish and fish habitat will remain within the same 2014 footprint for the Meliadine Extension.

The incremental changes to the quantity, quality, and spatial distribution of habitats should not have a significant impact on the structure and function of fish populations and lower trophic communities (i.e., fish habitat) in the ecosystem relative to natural factors occurring over the same period of time and space. Therefore, the Meliadine Extension should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond.

Any effects to fish and fish habitat will continue to be within the same footprint, which will be addressed through mitigation strategies and environmental design features. This is referenced below and within the Monitoring and Follow-up Section 7.5.7 in greater detail.

7.5.4 Residual Impact Classification

The Meliadine Extension will result in effects to fish and fish habitat in the LSA which will vary over time. These results were described in Volume 7, Sections 7.5.5, 7.5.6 and 7.5.7 of the 2014 FEIS. The effects to fish and fish habitat will be reduced through mitigations and environmental design features in the following documents:

- Conceptual Fish Offsetting Plan
- Habitat Evaluation Procedure

For additional information regarding potential effects on flows, water levels, and channel/bank stability from the Meliadine Mine pre-production phase to post-closure refer to the 2014 FEIS sections 7.3.3.3 to 7.3.3.11 which are summarized by each mining phase and the associated primary pathway.

7.5.5 Cumulative Effects Assessment

Potential residual effects to fish and fish habitat including water quantity were anticipated to be confined to the Meliadine Lake and Atulik watersheds (mine development) and to the Meliadine Lake, Atulik, Char River, Dry Cove, Meliadine River, and Thompson watersheds (all weather access road); however, measurable changes are expected to be contained near the mine development. No changes are expected for the Meliadine Extension. There are no other projects or RFFDs in these watersheds where there could be an overlap with the Meliadine Extension. The potential for cumulative effects from Meliadine Extension is negligible which is consistent with the 2014 FEIS.

7.5.6 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will affect fish and fish habitat); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., erosion and sedimentation protection).

Any uncertainty with the Meliadine Extension will be managed through the AEMP and the Conceptual Fish Offsetting Plan, as described below.

7.5.7 Monitoring and Follow-up

The Meliadine Extension will be conducted in general accordance with required monitoring under Project Certificate No.006 T&C 30 to 34 and Type A Water Licence 2AM-MEL1631. Agnico Eagle is actively engaged and involved in an AEMP pursuant to the aquatic effects assessment outlined in this section. The current AEMP takes into account the range of the Meliadine Extension activities and potential environment interactions identified as being of concern for the aquatic ecosystem. This includes effluent, water quality and biological monitoring as required under the EEM program of the MDMER of the *Fisheries Act*.

The AEMP provides an outline of aquatic monitoring in relation to the Meliadine Extension effects as they are predicted in this Application. The AEMP is designed to address predicted impacts to the aquatic environment related to changes in surface water quantity and quality, sediment quality, aquatic life, fish habitat and fish health due to physical alterations of the watersheds, and water and air emissions during construction, operations, and closure.

The effects to fish and fish habitat will be reduced through mitigations and environmental design features in the Conceptual Fish Offsetting Plan.

8 MARINE ENVIRONMENT

8.1 Introduction

The marine environment and wildlife section provides an update of the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a), in relation to the impacts of the changes made to the Meliadine Extension. This Application does not propose changes to shipping activities (volume, type) or to marine infrastructures in Rankin Inlet (including the discharge of treated groundwater into Itivia Harbour).

8.1.1 Comparison to Previous Assessments

The Meliadine Extension activities represent a negligible change from the previously assessed and Approved FEIS activities (Agnico Eagle 2014, 2018a, 2020a). The change is considered negligible because infrastructure and shipping activities, the submersed diffuser (both type and installation), discharge volume, discharge quality, and seasonality of discharge (i.e., from approximately late June to October) are the same as what has been previously assessed (Agnico Eagle 2014, 2018a, 2020a). For the Meliadine Extension, the only thing changing is the duration of operations.

No new pathways were identified. All effects have been previously assessed, and there is no change from the previous assessments.

Negligible changes to marine water quality were predicted in the previous assessments (Agnico Eagle 2018a, 2020a). The annual monitoring data collected support this prediction.

To address uncertainty, and validate assumptions, marine monitoring developed for the Approved activities (Agnico Eagle 2014, 2018a, 2020a), with updates as required for the Meliadine Extension will be conducted.

8.1.2 Valued Components

The identification of VECs and factors considered in their selection have not changed for this Application and are summarized in Section 4.3 of this Application, as well as the Section 4 of the 2014 FEIS (Agnico Eagle 2014), and Section 7.2 of the FEIS Addenda (Agnico Eagle 2018a, 2020a). The following VEC's for marine environment have been identified for this Application:

- marine environment; and
- marine wildlife.

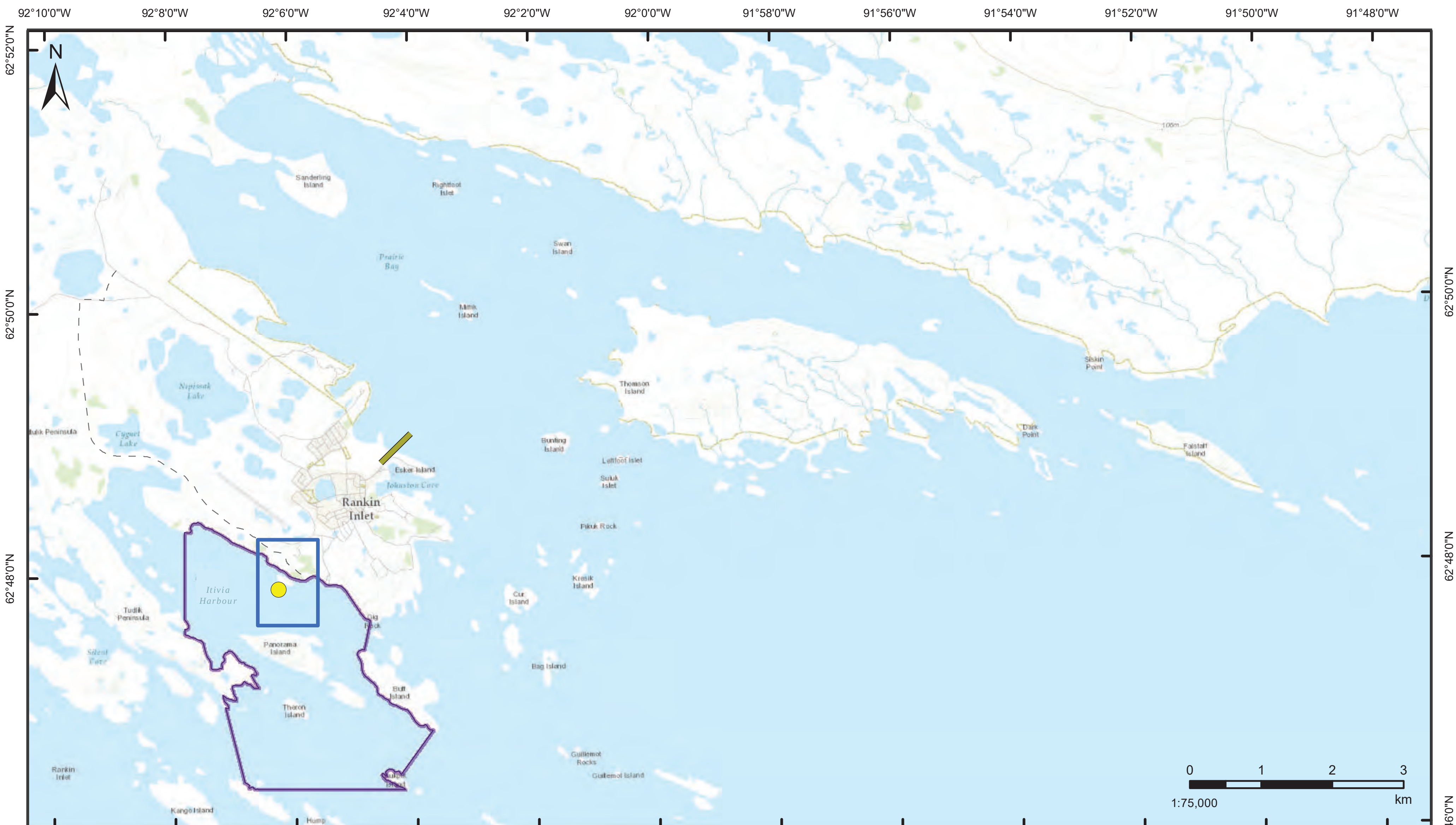
8.1.3 Spatial and Temporal Boundaries

The LSA and the RSA for this Application are consistent with those presented in the 2014 FEIS, and the 2018 and 2020 Addenda, with the exception of a preferred shipping corridor that has been added south of Coats Island since the 2020 FEIS Addendum. This corridor is now the primary one used by shipping companies. There are no other proposed changes related to the Meliadine Extension regarding shipping activities, shipping corridors, and marine infrastructures (including the discharge of treated groundwater into Itivia Harbour) in Rankin Inlet.

The LSA includes all areas in Itivia Harbour designated for marine infrastructure and vessel activities, as well as the proposed offshore shipping corridor area extending west to east from the Itivia Harbour to Eastern Hudson Strait prior to entry into the western Labrador Sea. As mentioned above, following discussions with the community of Coral Harbour and to reduce potential impacts of shipping activities on marine mammals, seabirds, and traditional land use activities in Coral Harbour, a preferred shipping corridor has been added south of Coats Island for the past years. This is now the primary one used by shipping companies. The shipping corridor north of Coats Island continues to be available should shipping conditions (e.g., weather or ice conditions) south of Coats Island prevent safe navigation. The LSA has been modified to account for this change made (refer to Figure 8.1-1).

The extent of the RSA includes a 5-km buffer area extending outside Itivia Harbour and on either side of the marine shipping corridor, which encompasses the potential regional extent of underwater noise effects from the Meliadine Extension (refer to Figure 8.1-2). Refer to Section 8 of the 2014 FEIS, and Section 7 of the 2018 and 2020 FEIS Addenda for additional details regarding the LSA and the RSA.

In the 2014 FEIS, it was estimated that the LOM would be 13 years with the potential of an extension depending on further exploration findings. With the Meliadine Extension, the LOM will be extended by 11 years with operations ending in 2043 instead of 2032. Closure will occur from 2044 to 2050, followed by post-closure from 2051 to 2060. For the Approved FEIS activities, closure was to last ten years and post-closure 5 years.



Meliadine Extension

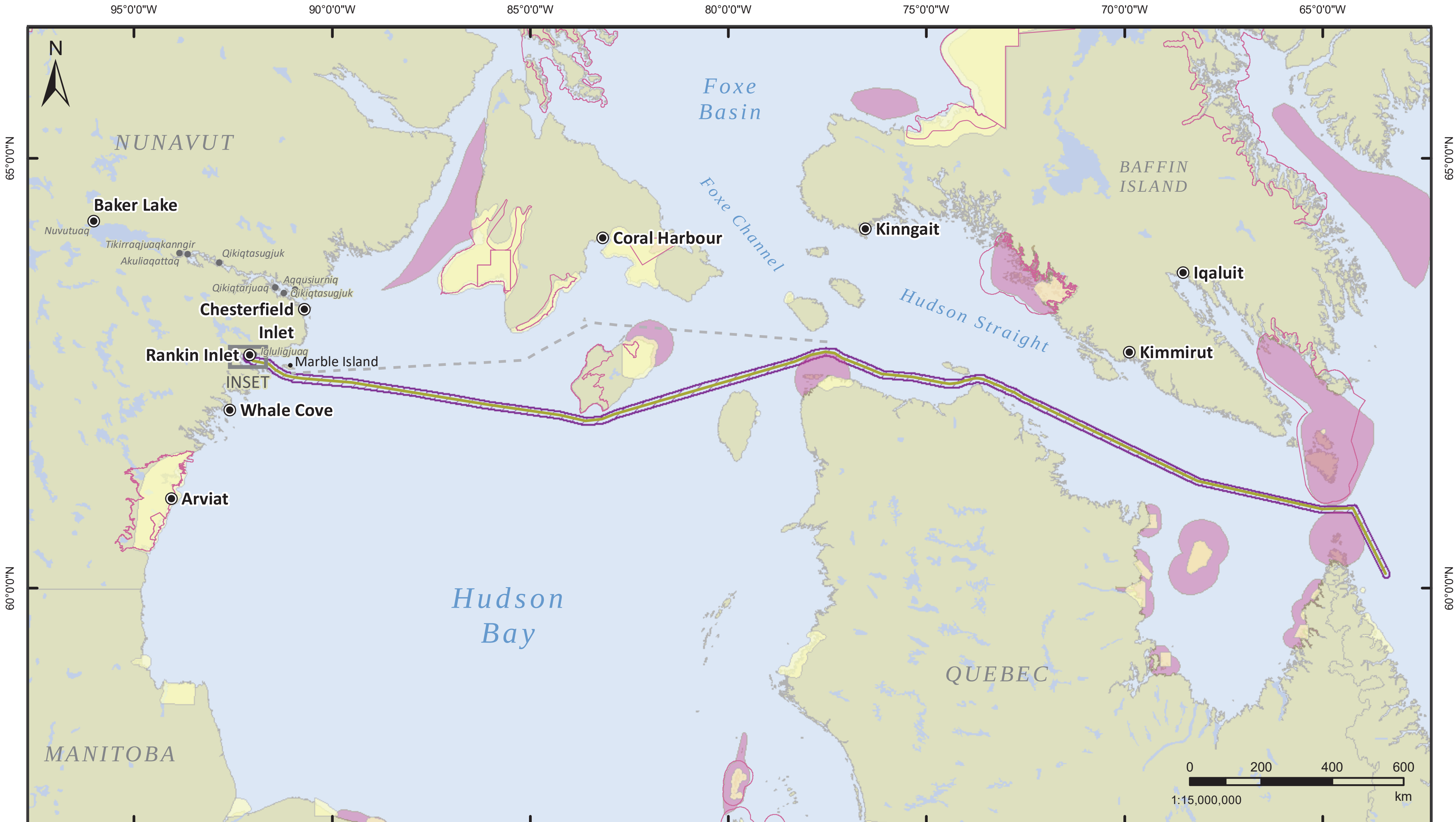
Local Study Area – Marine

Legend

- Diffuser Location
- Discharge Location into Itivia Harbour
- Marine Local Study Area (Marine LSA)
- Rankin Inlet Sewage Outfall Pipe (Approximate Location)
- Bypass Road

Date: 11/4/2021
Map Number: MEL-003
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

AGNICO EAGLE
ECOLOGIC



Meliadine Extension

Local and Regional Study Area – Shipping Corridor

Date: 11/4/2021
Map Number: MEL-004
Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS 1984

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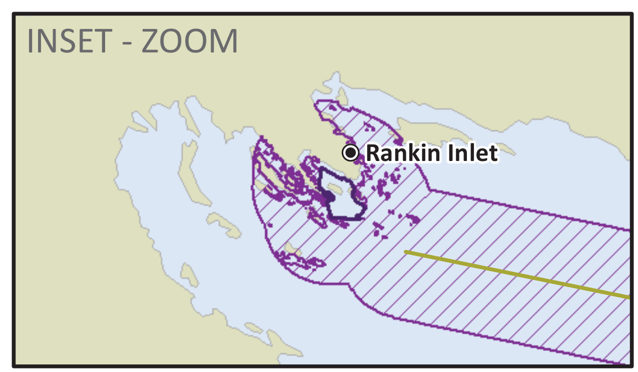
Legend

- Community
- Preferred Meliadine Shipping Route
- Secondary Shipping Route
- Important Bird Areas
- Key Marine Habitat Site
- CWS Key Marine Habitat Site
- Marine Local Study Area (Marine LSA)
- Marine Regional Study Area (Marine RSA)



8.2 Marine Environment

8.2.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ for Meliadine Extension did not highlight any new concerns related to the existing environment or baseline information regarding the marine environment. The Meliadine Extension is consistent with IQ incorporation of the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a).

Field programs in 2020 were guided by IQ, including the assistance of local field assistants when possible. Participation of local field assistants was limited during 2020 in consideration of COVID-19 health and safety protection measures for the local community (Agnico Eagle 2021c).

The additional sources of IQ and project concerns reviewed are listed below:

- FEIS Addendum Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2020 (Agnico Eagle 2018a).
- Waterline Consultations Report 2020 - Preliminary phase of consultation with Rankin Inlet key stakeholders for the Meliadine Waterline project from January - March and July 2020 (Agnico Eagle 2020c).
- Waterline Consultations Report 2020 - Consultation Plan for the Meliadine Waterline project Existing Environment and Baseline Information, August 2020 (Agnico Eagle 2020d).
- Final Written Submission for the Waterline FEIS Addendum – Meliadine Mine (Agnico Eagle 2021b).
- Community and public engagement for the Meliadine Extension (Section 3 of this Application).

Information gathered during engagement meetings has been considered and incorporated in this Application where relevant, including the effects assessment and mitigation measures. IQ findings as they relate to the marine environment are summarized:

- During interviews, Rankin Inlet participants explained that the ice floe edge normally reaches its maximum extension in March, stretching out about 30 to 40 miles (48 to 64 km) from Rankin Inlet.
- The ice begins to break up and flow south during the months of May, June, July, and August.
- During the May and September fish runs, cabins are still used by the people of Rankin Inlet to serve as a base for fishing, particularly on weekends.
- Arctic Char are an important food species for the residents of Rankin Inlet – residents have cabins on the north shore of Itivia Harbour and harvest Arctic Char, sculpin, and cod in the Itivia Harbour area (Nunami Stantec 2012; Appendix B).
- Fishing for both Arctic Char and Arctic Grayling continues to be important to the people in the region. There are remnants of stone fishing weirs near the mouth of the Meliadine River, and stone drying racks scattered throughout the river valley (Agnico Eagle 2014).
- Chesterfield Inlet Elders stated in interviews that Arctic Char migrate down to the sea from the lakes via rivers in spring and summer, and that in early fall they travel back upstream to the lakes.
- Itivia Harbour is heavily used by residents in the summer for launching boats (it's the only place

accessible during low tide), and in the winter for snowmobile travel in and out of the community (Nunami Stantec 2012; Appendix B).

- Areas near Rankin Inlet where people may harvest shellfish includes a local beach area (approximately 2 km northwest of the discharge area) and Aukpik Island (approximately 4 km southeast of the discharge area) (Agnico Eagle 2021b) (Figure 8.2-1).
  - The permanent diffuser evaluated through the 2020 FEIS Addendum (Agnico Eagle 2020a) will be in a water depth of 20 to 24 metres (depending on tidal fluctuation).
  - The area of predicted water quality change is limited to 100 metres from the discharge point.
  - There is a physical barrier between the location of the diffuser, the area of predicted change in water quality, and the areas where people may harvest shellfish.

Figure 8.2-1: Itivia Harbour – Location of Mussel Picking Areas

Note: Google Earth screen shot and identified mussel picking areas provided by the Kivalliq Wildlife Board on April 27, 2021. Mussel Picking area approximately 2 km northwest of the discharge area. Mussel Picking Island (Aukpik Island) approximately 4 km southeast of the discharge area.

8.2.2 Existing Environment

Information on baseline and existing conditions has been collected and summarized in a variety of documents including:

- Volume 8 of the 2014 FEIS, including marine baseline section of 2014 FEIS (Section 8.2.2) (Agnico Eagle 2014).
- Marine Baseline Report, Itivia Harbour, Rankin Inlet April 2012; Appendix B of the 2018 FEIS Addendum (Agnico Eagle 2018a).
- Marine Reconnaissance and Baseline Programs, 2018 Marine Reconnaissance Survey Data Report (Golder 2019a).
- 2019 Annual Report Section 7.3.1.24 (water quality monitoring in Itivia Harbour) (Agnico Eagle 2020e).
- Waterline Consultations Report July 2020 (Agnico Eagle 2020c).
- Itivia Bay Hydrodynamic Modelling and Characterization of the Fate and Behaviors of the Discharged Saline Effluent (Tetra Tech 2020a).
- Addendum to 3-D Hydrodynamic Modelling of Itivia Harbour to Characterize the Long-Term Mixing and Transport of the Released Effluent 2020 (Tetra Tech 2020b).
- Addendum to 3-D Hydrodynamic Modelling of Itivia Harbour to Characterize the Long-Term Mixing and Transport of a Low TDS Effluent 2021 (Tetra Tech 2021a).
- 2018 FEIS Addendum - Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2018 (Agnico Eagle 2018a).
- FEIS Addendum Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2020 (Agnico Eagle 2020a).
- Waterline Consultation Report August 2020 (Agnico Eagle 2020d).
- Final Written Submission for the Waterline FEIS Addendum – Meliadine Mine (Agnico Eagle 2021b).

Baseline data presented in the 2014 FEIS, and existing conditions data presented in the 2018 and the 2020 FEIS Addenda, plus the annual reports has been subject to review through the regulatory assessment and review process. A summary of the existing conditions, comparison to predictions (where available), and informed by IQ/TK for marine habitat, water quality, sediment quality, and biological environment is provided below.

8.2.2.1 Marine Habitat

Based on baseline data (pre-2014), the area near the discharge location in Itivia Harbour plus the LSA is characterized as follows:

- Water depths at Itivia Harbour are variable in depth.
- At the location of the diffuser discharge for the Waterline, water depth will vary between 16 metres (at low tide) to 20 metres (at high tide) (Agnico Eagle 2021b).

- At the entrance of Itivia Harbour just south of Rankin Inlet, in the navigation channel, velocities range between 0.1 m/s and 0.25 m/s near the surface (DFO Nautical Chart) heading towards the NW or the SE depending on the stage of the tide. Tidal range varies between 2.0 metres and 4.6 metres at about 1.85 km/h. Flow through the access passage is 0.93 km/h.
- Surface water temperatures vary spatially ranging from 4°C in nearshore areas to 11°C in offshore locations during the summer months (Anderson and Roff 1980; Prinsenberg 1986). At the deep-water offshore station in southeastern Hudson Bay, temperature at depths greater than 50 metres was relatively stable throughout the year and progressively decreased with depth; at approximately 100 metres water depth, mean water temperature was below -1.4°C (Ingram and Prinsenberg 1998).
- Lower nearshore temperatures compared to offshore areas are due to strong northwesterly wind effects causing upwelling of colder deep water to the surface.
- Hudson Bay, and particularly the area including Itivia Harbour, is usually ice-covered from November to June and ice-free from July to October (Stewart and Lockhart 2004; Cohen et al. 1994). Formation of ice increases the salinity of underlying water due to cryoconcentration processes, increasing its density and enhancing mixing of the water column (Prinsenberg 1988a,b).
- In nearshore areas, water column mixing and productivity is higher due to wind-driven mixing (upwelling) and stronger tidal energy (Freeman et al. 1982).

The existing conditions near the discharge area in Itivia Harbour in comparison to predictions are summarized as follows:

- No changes to marine habitat (including water temperature) were predicted in the previous assessments (Agnico Eagle 2018a, 2020a).
- Oceanographic conditions measured near the existing diffuser area (prior to first use of the diffuser) and in reference locations between September 10 to 20, 2018 were similar (Golder 2019a) and consistent with baseline data.
- In 2018 (September 10 to 20), water temperature ranged from 5.1 to 6.2°C (Golder 2019a).
- Mean surface water temperature (at 1 m depth, ± SD) at Itivia Harbour, near the location of the proposed permanent engineered marine outflow, was 8.9 ± 0.5°C; bottom water was slightly colder than surface water at 8.5 ± 0.6°C (Agnico Eagle 2020a).
- The first discharge to the marine environment started in 2019 (Agnico Eagle 2020e). This was the first seasonal discharge of treated saline water to Itivia Harbour through the temporary diffuser. This discharge location was also used in 2020 (Agnico Eagle 2020f) and 2021 (to be reported by March 2022).
- Water temperature in Itivia Harbour did not change due to the effluent discharge (Agnico Eagle 2020f).

8.2.2.2 Marine Water Quality

Based on baseline data (pre-2014), the area near the discharge location in Itivia Harbour plus the LSA is characterized as follows:

- Surface salinity in Hudson Bay ranges from 10 Practical Salinity Units (PSU) near the outlets of major rivers to 30 PSU in offshore locations of the bay (Anderson and Roff 1980; Prinsenberg 1986).
- In general, water salinity in Hudson Bay increases with distance from shore. Lower salinities in the inshore region as compared to the offshore region are due to dilution effects.

The existing conditions (post-2014) near the discharge area in Itivia Harbour in comparison to predictions are summarized as follows:

- Negligible changes to marine water quality were predicted in the previous assessments (Agnico Eagle 2018a, 2020a).
- Salinity was generally uniform throughout the water column and ranged between 30.7 and 30.9 PSU for all survey areas and depths. An exception was a surface (top 0 cm) measured at a single station (CTD-1, in Reference Area B) where salinity was slightly lower (30.5 PSU) (Golder 2019a).
- In surface water (at 1 m depth, ± SD) at Itivia Harbour, near the location of the proposed permanent engineered marine outflow, salinity was 29.32 ± 0.03 ppt and a pH was 8.08 ± 0.03; bottom water had similar salinity and pH values (Agnico Eagle 2020a).
- Total dissolved solids values were similar at all three sampling locations in Itivia Harbour (ranging from 34,200 to 34,300 mg/L). Approximately 78% of all analyzed metals (33 of 42) were below detection limits, and concentrations were lower than the CCME Protection of Marine Aquatic Life guidelines (Section 6.1.3 of Agnico Eagle 2020a).
- Dissolved oxygen concentrations were also vertically uniform at all survey locations and ranged from 6.5 mg/L to 8 mg/L (Golder 2019a).
- Concentrations of total suspended solids were low ranging from below the detection limit of 2 mg/L to 3.8 mg/L. Water quality results were screened against the CCME guidelines for the protection of aquatic life for marine environments (CCME 2014). None of the parameters exceeded CCME guidelines. (Golder 2019a).

8.2.2.3 Sediment Quality

Sediment quality data were collected to support the 2014 FEIS and to support the 2018 FEIS Addendum. Sediment quality data are not routinely collected during operations because the previous assessments predicted negligible changes to water quality and thus there would be negligible to no changes to sediment quality due to mine related activities in Itivia Harbour. Based on baseline data (pre-2014), and existing conditions data (post-2014) the area near the discharge location in Itivia Harbour is characterized as follows:

- Cobble and gravel were the dominant substrates in the nearshore environment in Itivia Harbour (Section 8.2.2.1.1 of Agnico Eagle 2014; Appendix B, Table 4-2 of Agnico Eagle 2018a).
- Sediment chemistry was similar across the LSA (Section 8.2.2.1.1 of Agnico Eagle 2014). Metal concentrations were variable and ranged from below analytical detection limits to exceeding CCME ISQCs. Chromium slightly exceeded the CCME ISQG of 52.3 milligrams per kilogram (mg/kg) at all sample stations, with average (±SD) concentrations in the marine LSA footprint measured at 55.8 ± 5.89 mg/kg.
- Sediment nutrient chemistry was relatively similar between sediment samples in Itivia Harbour, with total phosphorus ranging from 775 ± 28.15 mg/kg at the I1 sampling area to 850 ± 36.86 mg/kg at the R1 sampling area (Golder 2019a).
- Metal concentrations were variable, ranging from below analytical detection limits to detectable but lower than the CCME Interim Sediment Quality Guidelines for the protection of aquatic life in the marine environment. The exception was for chromium which exceeded the Interim Sediment Quality Guidelines of 52 mg/kg (CCME 2014) (Section 6.1.4 of Agnico Eagle 2020a).

8.2.2.4 Marine Biological Environment

Marine biological data (i.e., phytoplankton, macrophytes, and invertebrates) were collected to support the 2014 FEIS and to support the 2018 FEIS Addendum. To support the 2020 FEIS Addendum, additional information on areas where people harvest shellfish was collected. Marine biological data are not routinely collected during operations because the previous assessments predicted negligible changes to water quality and thus there would be negligible to no changes to marine biota due to mine related activities in Itivia Harbour. Based on baseline data (pre-2014), and existing conditions data (post-2014) the area near the discharge location in Itivia Harbour is characterized as follows:

Baseline conditions (pre-2014) are characterized as follows (summarized from Volume 8, Section 8.3.2 of Agnico Eagle 2014):

- Phytoplankton abundance, richness, and diversity were similar across all sites within the marine LSA, and a total of 33 taxa were recorded. Dinoflagellates, mainly represented by *Peridinium/Gonyaulax* spp. and *Dinophysis* spp., were the dominant taxonomic group at all sites. Zooplankton abundance, richness, and diversity varied among sites, and a total of 44 taxa were recorded.
- Nearshore macrophyte coverage was found to be sparse at all three sampling locations, in Itivia Harbour (ranging from 2 to 5% coverage).
- Seaweeds are not locally harvested in Itivia Harbour.
- Benthic invertebrate abundance, richness, and diversity varied amongst sites. Polychaete worms (class Polychaeta) of subclass Sedentaria (burrowing or tube-dwelling) families *Capitellidae, Cirratulidae* and/or Paraonidae were the most dominant taxonomic group.
- Benthic species are not thought to occupy the intertidal zone in Hudson Bay on a permanent basis; rather, they occur seasonally when the habitat is not influenced by ice (Stewart and

Lockhart 2005). Few invertebrate species were observed in the nearshore habitat, and abundance was low.

Existing conditions for marine biota are characterized as follows (based on a summary from Golder 2019a):

- The intertidal zone in the exposure area was characterized as a gently sloped flat topography. The length of intertidal transect in the exposure area was approximately 100 m. The substrate was predominantly hard and composed of boulders, coble and gravel, intermittent, at places, with sandy patches in the lower areas (Golder 2019a). This is consistent with data collected prior to 2014.
- Chlorophyll concentrations (a proxy for phytoplankton abundance) ranged from 0.4 to 1.5 µg/L corresponding to typical for Arctic waters oligotrophic (nutrient poor) to mesotrophic (with moderate level of nutrients) marine systems (CCME 2007 adopted from Vollenweider et al 1998). Chlorophyll maximums occurred at depths below 5 to 10 metres.
- In the LSA, three samples were collected at each of eight stations for analysis of benthic invertebrates. A total of 1,400 benthic infauna (benthos) organisms were observed, representing 52 unique taxa (species or genus level). Unique taxa for 83 organisms could not be determined and were identified to a higher taxonomic level (genus or family). Incidental organisms, including meiofauna (e.g., nematodes), plankton (Brachyura larvae) and fragments of indeterminate species, removed from benthos were reported separately; a total of 13 incidental organisms were found in benthic infauna samples.
- Benthic communities in the study areas were dominated by polychaete worms, which represented 63% of all organisms and 40% of identified unique taxa. Crustaceans were the second largest group of benthic invertebrates representing 31% of all organisms and 29% of identified unique taxa (Golder 2019a).
- Approximately 60 species of fish are known to inhabit estuarine waters of Hudson Bay and James Bay (CARC 1991). Fewer species are present in the northern limits of the RSA, where Arctic species predominate. Arctic Char, Arctic Cod, and other species contribute directly to the domestic fishery, and indirectly to the food chain of marine and terrestrial mammals and birds.
- Six species of marine fish (n=156) were identified during gill net and beach seine sampling in the marine LSA, including Greenland cod (*Gadus ogac*) (52%), slender eelblenny (*Lumpenus fabricii*) (27%), fourhorn sculpin (kanayok in Inuktitut) (*Myoxocephalus quadricornis* (15%), unidentified sculpin (possibly juvenile; 3%), Arctic staghorn sculpin (*Gymnocanthus tricuspis*) (2%), and Arctic sculpin (*Myoxocephalus scorpioides*) (1%).
- Arctic Char, Arctic Cod, and other species contribute directly to the domestic fishery, and indirectly to the food chain of marine and terrestrial mammals and birds. Those species with overlapping ranges with the RSA and considered important to the local commercial, recreational, and Aboriginal Fisheries fishery.

8.2.3 Assessment of Potential Meliadine Extension-related Effects

The Meliadine Extension activities represent a negligible change from the approved assessment activities (Agnico Eagle 2014, 2018a, 2020a) and no new pathways were identified. This section provides a summary of the effects assessment for the marine environment.

A pathway analysis to identify and assess linkages between activities included in the application and marine environment was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-9 of this Application and are also described in Volume 8, Section 8.2.3 of the 2014 FEIS, and Section 8.1 of the 2018 and 2020 FEIS Addenda. As no new or additional pathways were identified for minor and no linkage for the VEC marine environment as a result of Meliadine Extension, there is no change from the previous assessments.

There are no new primary pathways for the marine environment (Table 8.2-1). The Meliadine Extension does not change the size of the spatial boundary for the assessment, but there is an increase in the temporal boundary due to the extension of mine life. The extended temporal boundary does not change the results of primary pathways identified from the previous assessments; however, a summary of the effects analysis for the primary pathways are provided below.

Table 8.2-1: Potential Primary Pathways for Marine Environment

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - FEIS	Residual Impacts - Meliadine Extension	Assessed Significance - FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Marine fish	Installation of in-water structures (spud barge) and support activities	Change in fish habitat quality due to grounding of spud and cargo barges	Placement of spud barge and cargo barges will avoid sensitive natural habitats. Spud barge anchors will be removed during decommissioning.	Primary Section 8.3.6.3 of the 2014 FEIS	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No change to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Primary pathways are the same as those identified in the 2014 FEIS (Volume 8, Section 8.3.7.2.1) and are not assessed further here. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Water Quality	Vessel movements in the proposed shipping corridor and Itivia including nearshore transportation of fuel and dry goods (loading barges, barging, offloading)	Accidental spills from vessel activities and fuel transfer operations can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife.	Adherence to Shipping Management Plan. Adherence to Risk Management and Emergency Response Plan. Adherence to Oil Pollution Emergency Plan. Compliance with Shipboard Oil Pollution Emergency Plan (SOPEP). Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO 2008; MARPOL 73/78); Canada Shipping Act; and Arctic Waters Pollution Prevention Act. Operational activities have been engineered to use contained handling systems to minimize the risk of accidental spills into the marine environment.	Primary Section 8.2.3.4 of the 2014 FEIS	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No change to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension. Primary pathways are the same as those identified in the 2014 FEIS (Volume 8, Section 8.3.7.2.1) and are not assessed further here.
Fish	Vessel movements in the proposed shipping corridor and Itivia including nearshore transportation of fuel and dry goods (loading barges, barging, offloading)	Alteration in fish behavior due to underwater noise from vessel activities	Vessels will maintain 2-km distance from Marble Island. Vessels will follow established navigation lanes in LSA, maintaining a constant course and constant speed. Implementation of vessel speed restrictions: ≤2 knots in Itivia and <14 knots in shipping lanes. Avoidance of rapid accelerations. To the extent possible, vessel will shut-down vessel engines and propellers while anchored.	Primary Section 8.3.6.3 of the 2014 FEIS	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No change to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension. Primary pathways are the same as those identified in the 2014 FEIS (Volume 8, Section 8.3.7.2.1) and are not assessed further here.
Fish	Vessel movements in the proposed shipping corridor and Itivia including nearshore transportation of fuel and dry goods (loading barges, barging, offloading)	Accidental spills from vessel activities and fuel transfer operations can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife.	Adherence to Spill Contingency Plan. Adherence to Shipping Management Plan. Adherence to Oil Pollution Emergency Plan. Compliance with Shipboard Oil Pollution Emergency Plan (SOPEP). Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO, 2008; MARPOL 73/78); Canada Shipping Act; and Arctic Waters Pollution Prevention Act. Operational activities have been engineered to use contained handling systems to minimize the risk of accidental spills into the marine environment.	Primary Section 8.2.3.4 of the 2014 FEIS	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No change to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension. Primary pathways are the same as those identified in the 2014 FEIS (Volume 8, Section 8.3.7.2.1) and are not assessed further here.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - FEIS	Residual Impacts - Meliadine Extension	Assessed Significance - FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Water and Sediment Quality Benthic Invertebrates Marine Fish and Fish Habitat	Discharging treated groundwater effluent into marine environment	Accidental release of groundwater from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine fish Change in water and sediment quality due to discharge of treated groundwater effluent from the Meliadine Mine.	Operational activities will be engineered to use handling systems to minimize the risk of accidental spills into the marine environment. A Failure Modes Effects Analysis was completed to review all potential risks and develop mitigation for the discharge of saline water through the waterline (Golder 2020d). Visual inspections of equipment will be carried out regularly, and spills kits will be available Implementation of the Spill Contingency Plan and Risk Management and Emergency Response Plan. The Shipping Management Plan may also be implemented, as appropriate. Spills and leaks will be contained, cleaned-up and documented per applicable guidelines and regulations, spill kits will be restocked after use. Adherence to the Ocean Discharge Monitoring Plan. Implementation of a Risk Management and Emergency Response Plan specific to the potential release of treated groundwater. Operational activities will be engineered to use handling systems to minimize the risk of accidental spills into the marine environment. Discharge of effluent will meet regulatory requirements for both temperature and applicable water quality guidelines. If the treated groundwater effluent is not suitable for discharge, it will be stored at the Meliadine Mine and treated prior to discharge. Design, construct, and install a diffuser with the discharge pipe to aid in mixing. Monitoring program will be established, and adaptive management implemented if negative impacts are detected.	Primary Section 8.1.6 of the 2018 FEIS Addendum Section 8.1.3 of the 2020 FEIS Addendum	Primary	Table 15 of 2020 FEIS Addendum	No change	Not Significant	No Change	No change to marine activities as part of the Meliadine Extension. The effects pathway statement has been updated from the previous assessments to include controlled discharge of treated effluent in additional to accidental discharge of treated effluent This effect is considered previously assessed. Mitigation measures outlined in the 2020 FEIS Addendum will be carried forward through the Meliadine Extension. Primary pathways are the same as those identified in the 2020 FEIS Addendum (Section 8.1.2) and are not assessed further here.

- **Installation of in-water structures (spud barge) and support activities**
- **Vessel movements in the proposed shipping corridor and Itivia Harbour including nearshore transportation of fuel and dry goods (loading barges, barging, offloading)**

Dry cargo and diesel fuel will be required annually during construction and operation of the Meliadine Mine (Section 8.3.6.1, Agnico Eagle 2014). These materials will be brought to Rankin Inlet following established shipping lanes, with ships anchoring in deeper waters off Rankin Inlet, and barges and tugs used to bring supplies to offloading areas. A spud barge is not being used at this time but could be used in the future. Further details on shipping activities for the Meliadine Extension are provided below in Section 8.3.3.

No changes are proposed to these activities as part of the Meliadine Extension. This effect is considered previously assessed and the Meliadine Extension does not change the results of the previous assessment. Mitigation measures outlined in the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) will be carried forward through the Meliadine Extension. Primary pathways are the same as those identified in the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) and are not assessed further.

- **Discharging treated groundwater effluent into marine environment**

The previous assessments considered the potential effect of treated groundwater discharge to change water quality in Itivia Harbour. The previous assessments concluded that there would be negligible change in water quality (and subsequently sediment quality, benthic invertebrate habitat, and fish and fish habitat) in Itivia Harbour due to the following environmental design features and mitigations:

- Design, construct, and install a diffuser with the discharge pipe to aid in mixing.
- Discharge of effluent will meet regulatory requirements for both temperature and applicable water quality guidelines
- If the treated groundwater effluent is not suitable for discharge, it will be stored at the Meliadine Mine and treated prior to discharge.
- Monitoring program will be established, and adaptive management implemented if negative impacts are detected.

The same diffuser and discharge rate as assessed through the waterline application (Agnico Eagle 2020a) will be used for Meliadine Extension.

For the waterline application, a 3D water quality model was used to predict mixing, dispersion, and water quality concentrations in the immediate 100 metre mixing zone (Tetra Tech 2020a,b, 2021a). The results for Meliadine Extension are consistent with those for the waterline application because of the following:

- Effective mixing in the immediate discharge area (i.e., in Itivia Harbour at a water depth of 20 metre) due to the location and design of the discharge pipe and diffuser.
- Daily mixing of the LSA due to tidal and wind effects.

- Annual complete flushing of the LSA due to tidal and wind effects.

Current modelling investigated the transport and mixing of a discharged effluent in Itivia Harbour for Meliadine Extension (Appendix H-10; Tetra Tech 2021b). Effluent was discharged at the proposed diffuser location and at a depth of 20 metre. The discharge season is from June to October. The 20,000 m^3/d discharge rate was concluded to be well above the projected mean daily flow rates for each month over mine operation (i.e., 2020 to 2028) and therefore represents a very conservative scenario. A very low TDS concentration of 2,178 mg/L was chosen to represent a diversion flow from Meliadine Lake to Itivia Harbour. Effluent quality will not be substantially different, therefore there will be no effect.

No changes are proposed to these activities as part of the Meliadine Extension. This effect is considered previously assessed and the Meliadine Extension does not change the results of the previous assessment. Mitigation measures outlined in the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) will be carried forward through the Meliadine Extension.

8.2.4 Residual Impact Classification

The impacts that remain following mitigation, or residual impacts to the measurement indicators, for the assessment endpoint of the VEC are not anticipated to be different than those previously assessed. The key disturbance to the marine environment VEC is discharge of treated effluent. The model has indicated that this area will be effectively mixed on a daily basis during the discharge window (i.e., June to October) and effectively and completely flushed within a month after the annual cessation of discharge. Therefore, no residual trace of the discharge from the previous year is expected to remain in Itivia Harbour by the start of the next discharge season.

As a result, there is no change in the residual impact classification from the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a).

The Meliadine Extension activities represent a negligible change from the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) activities and no new pathways were identified.

8.2.5 Cumulative Effects Assessment

The Meliadine Extension is anticipated to have negligible effects on the marine environment outside of the mixing zone. The database of RFFDs (Appendix B-1) indicates that there are no planned development in the RSA (5 km on each side of the shipping corridor), and therefore there are no cumulative effects.

8.2.6 Uncertainty

The purpose of the uncertainty section is to identify the key sources of uncertainty in the impact assessment and to discuss how uncertainty has been addressed to increase the level of confidence that impacts are not worse than predicted. Confidence in the assessment of environmental significance is related to the following elements:

- adequacy of baseline data for understanding current conditions and future changes unrelated to the Meliadine Extension (e.g., extent of future developments, climate change, catastrophic events);
- understanding of Meliadine Extension-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., exactly how the Meliadine Extension will impact marine water quality); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., submersed diffuser to enhance mixing).

Therefore, any uncertainty with the Meliadine Extension is related to assumptions in the hydrodynamic model. This will be addressed through Commitment 39 made to the KivIA during the 2020 FEIS Addendum (*KivIA-TC-14: Conduct validation monitoring post discharge during a period of 3 years. This will be conducted for the first 3 years of the waterline operation*) and monitoring programs as described below.

8.2.7 Monitoring and Follow-up

Follow-up marine monitoring for the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) and Meliadine Extension will be conducted in general accordance with the regular marine monitoring currently being conducted as part of the Ocean Discharge Monitoring Plan (Appendix D-24) which includes end of pipe and receiving environment monitoring. In addition, extensive monitoring is conducted at the mine to monitor quantity and quality of water discharge through the waterline to Itivia Harbour. These monitoring plans include the Water Management Plan, the Groundwater Management Plan, the Water Quality and Flow Plan, the Adaptive Management Plan, the Spill Contingency Plan, the Shipping Management Plan, Oil Pollution and Emergency Plan, and the Ocean Discharge Management Plan.

For the Meliadine Extension, Agnico Eagle has updated the associated plans or reports for further guidance and mitigation. Agnico Eagle considers that existing T&C 76, 77, 78, 79, 80, and 86 of Project Certificate No.006 are sufficient to protect, mitigate and monitor marine impacts associated with the Meliadine Extension.

Any new required mitigation measures related to primary effects for the Meliadine Extension are described in relation to the predicted effects and summarized in primary pathway table (Table 8.2-1) and no linkage and minor pathways provided in Appendix B-2, Table B-9 of this Application. Mitigation, management, and monitoring plans are summarized in Section 12 and provided in Appendix D of this Application. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

8.3 Marine Wildlife

8.3.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

IQ and TK collected for the 2014 FEIS can be found in Section 8.3.2 of the 2014 FEIS. The Meliadine Extension is consistent with IQ incorporation of the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a).

The additional sources of IQ and project concerns reviewed are listed below:

- Whale Tail Pit – Expansion Project FEIS Addendum, Appendix 3-A Marine Resources Environmental Summary, December 2018.
- Whale Tail Pit – Expansion Project NIRB Public Hearing Transcripts, August 26, 2019.
- 2021 pre-sealift season meetings with Baker Lake (May 2021), Chesterfield Inlet (May 2021), and Rankin Inlet (June 2021)
- 2021 public engagement sessions and focus group meetings on Meliadine Extension.

Per Section 8.1.2, the shipping corridor, LSA, and RSA have been modified from the 2014 FEIS based on information shared by the community of Coral Harbour. Coats Island was identified as an important area for marine birds. Walrus Island has also been identified by community members as an important traditional hunting grounds and several marine mammals were identified as valuable resources to the community for subsistence, including seals, whale and walruses (Agnico Eagle 2018b). Finally, changes in marine mammal distribution because of ship traffic near Walrus Island have been observed by Coral Harbour community members.

Traditional place names have also been added where required in maps discussing shipping as requested during last pre-sealift season meetings.

8.3.2 Existing Environment

No marine mammals were observed in the LSA during baseline surveys for the 2014 FEIS. A desk-based literature review was completed to characterize the biological environment in the shipping corridor in Hudson Bay and Hudson Strait (the RSA, extending 5 km on each side of the shipping corridor). There were 11 species of marine mammals identified as being potentially present within the RSA for variable periods of time and at different times throughout the year (Table 8.3-4 of 2014 FEIS).

Two species of seabirds were observed in the LSA during the baseline field program in 2011 for the 2014 FEIS: a black guillemot (*Cepphus grylle*) and a pair of sandhill cranes (*Grus canadensis*). A desk-based literature review was completed to characterize the biological environment in the shipping corridor in Hudson Bay and Hudson Strait (the RSA). As presented in Table 8.3-3 of the 2014 FEIS, at least 43 species of seabirds, shorebirds, waterfowl, and marine-associated raptors frequent offshore, inshore, intertidal, or salt marsh habitats of the Hudson Bay marine ecosystem.

Additional existing conditions information has been included in this assessment including SARA and COSEWIC listing status, and results from vessel based monitoring of seabirds and marine mammals from

2017 and 2020 (ERM 2021a).

Table 8.3-1 outlines changes to the listing status of species identified in the 2014 FEIS have been made under the SARA or by the COSEWIC.

Table 8.3-1: Changes to the Listing Status Under SARA or COSEWIC

	SARA (2014 FEIS)	SARA (2021)	COSEWIC (2014 FEIS)	COSEWIC (2021)
Red-necked phalarope	No status	Special concern	Not assessed	Special concern
Peregrine falcon	No change		Special concern	Not at risk
Red knot *rufa*	Endangered	Endangered	Not on schedule 1	Special concern
Ringed seal	No change		Not at risk	Special concern
Beluga Whale	No change		Endangered – EHB Stock Special Concern – WHB Stock	Threatened – EHB Stock Not at Risk – WHB Stock

EHB = Eastern Hudson Bay; WHB = Western Hudson Bay

Species that were listed as potentially occurring species in the 2014 FEIS and observed during our Marine Mammal and Seabird Observer (MMSO) Program include killer whales, harp seals, harbour seals, ringed seals, walrus, polar bears, black-legged kittiwake, black guillemot, Canada goose, common eider, common loon, dovekie, glaucous gull, ivory gull, leach's storm petrel, least sandpiper, northern fulmar, parasitic jaeger, peregrine falcon, pomarine jaeger, ruddy turnstone, sabine's gull, snow goose, snowy owl, thayer's gull, and thick billed murre.

The following species were not listed as part of the potentially occurring species in the 2014 FEIS but were recorded during our MMSO Program:

- Marine Mammals:
  - One hooded seal was observed in 2017 in the Eastern Hudson Strait in the LSA.
  - One group of five humpback whales was recorded in 2017.
  - One group of pilot whale was recorded in 2017 between Walrus Island and Coats Island. Pilot whale are not typically observed at that latitude, so it could be an error in the identification or a result of climate change where species have been noted shifting to higher latitude in response to rising sea surface temperatures (van Weelden et al. 2021).
  - One group of 3-4 bowhead whales was recorded in 2019 in the Eastern Hudson Strait.
  - One fin whale was recorded in 2019 in the Eastern Hudson Strait. Fin whales are listed as "special concern" under SARA and COSEWIC.
  - One group of 15 white beaked dolphins were recorded in 2020 in the Eastern Hudson Strait.
- Marine birds that were recorded during the MMSO surveys (but not listed in the 2014 FEIS as potentially occurring) include the following: Bald eagle, black scoter, cormorant species, great skua, harlequin duck (listed as "special concern" under both COSEWIC and SARA, herring gull, Iceland gull, manx shearwater, razorbill, red-breasted merganser, sooty shearwater, white winged scoter, Wilson's storm petrel, and leach's storm petrel (listed as "Threatened" under COSEWIC).

Note that the species were recorded by vessel crew members assigned MMSO duties; some sightings may seem unlikely, but are reported here as recorded by the observers.

These species have been added to the list of potentially occurring species. There have been no additional sensitive or protected areas identified in the LSA or RSA since the 2014 FEIS.

To date, there have been no collisions or incidents between cargo and fuel ships and marine mammals or seabirds.

8.3.3 Assessment of Potential Meliadine Extension-related Effects

The Meliadine Extension activities represent a negligible change from the Approved assessment activities (Agnico Eagle 2014, 2018a, 2020a) and no new pathways were identified. This section provides a summary of the effects assessment for the marine wildlife.

A pathway analysis to identify and assess linkages between activities included in the application and marine environment was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-10 of this Application and are also described in Volume 8, Section 8.3.4 of the 2014 FEIS, and Section 8.1 of the 2018 and 2020 FEIS Addenda. As no new or additional pathways were identified for minor and no linkage for the VEC marine wildlife as a result of Meliadine Extension, there is no change from the previous assessments.

There are no new primary pathways for the marine wildlife (Table 8.3-2). The Meliadine Extension does not change the size of the spatial boundary for the assessment, but there is an increase in the temporal boundary due to the extension of mine life. The extended temporal boundary does not change the results of primary pathways identified from the previous assessments; however, a summary of the effects analysis for the primary pathways are provided below.

Table 8.3-2: Potential Primary Pathways for Marine Wildlife

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Marine mammals	Vessel movements in the proposed shipping corridor and Itivia Harbour including nearshore transportation of fuel and dry goods (loading barges barging, offloading)	Alteration in marine mammal due to underwater noise from vessel activities	Vessels will maintain 2-km distance from Marble Island. Vessels will follow established navigation lanes in LSA, maintaining a constant course and constant speed. Implementation of vessel speed restrictions: ≤2 knots in Melvin Bay and <14 knots in shipping lanes. Avoidance of rapid accelerations. To the extent possible, vessel will shut-down vessel engines and propellers while anchored. Vessels will not approach within 300 m of a walrus or polar bear on sea ice, or any marine mammal engaged in feeding activities. For all other marine mammal encounters, vessels will not approach within 500 m. If a marine mammal approaches within 500 m of a vessel, the vessel shall reduce its speed and, if possible, cautiously move away from the animal. If a vessel is unable to detour around a stationary marine mammal, it shall reduce its speed and wait until the animal(s) moves at least 500 m from the vessel prior to resuming speed. The vessel shall not be operated in such a way as to separate an individual member(s) of a group of marine mammals from other members of the group. Adherence to all other mitigation outlined in Agnico Eagle's Shipping Management Plan.	Primary	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No changes are proposed to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Marine mammals	Vessel movements in the proposed shipping corridor and Itivia Harbour including nearshore transportation of fuel and dry goods (loading barges barging, offloading)	Vessel movements in Itivia Harbour and the shipping corridor may result in collisions with marine mammals (change in health and survival)	Adherence to mitigation outlined in Shipping Management Plan (see above).	Primary	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No changes are proposed to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension. No collisions to date between ships and marine mammals.
Marine birds Marine mammals	Vessel movements in the proposed shipping corridor and Itivia Harbour including nearshore transportation of fuel and dry goods (loading barges barging, offloading)	Accidental spills from vessel activities and fuel operations can have direct adverse effects on marine water quality and associated indirect effects on marine wildlife.	Adherence to Spill Contingency Plan. Adherence to Risk Management and Emergency Response Plan. Adherence to Shipping Management Plan. Adherence to Oil Pollution Emergency Plan. Compliance with Shipboard Oil Pollution Emergency Plan (SOPEP). Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO, 2008; MARPOL 73/78); Canada Shipping Act; and Arctic Waters Pollution Prevention Act. Operational activities have been engineered to use contained handling systems to minimize the risk of accidental spills into the marine environment.	Primary	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No changes are proposed to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.
Marine Mammals Marine birds	Vessel movements in the proposed shipping corridor and Itivia Harbour including nearshore transportation of fuel and dry goods (loading barges barging, offloading)	Change in health and mortality risk of marine wildlife VECs due to exposure to accidental fuel spills	Adherence to Spill Contingency Plan. Adherence to Shipping Management Plan. Adherence to Oil Pollution Emergency Plan. Compliance with Shipboard Oil Pollution Emergency Plan (SOPEP). Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO, 2008; MARPOL 73/78); Canada Shipping Act; and Arctic Waters Pollution Prevention Act. Operational activities have been engineered to use contained handling systems to minimize the risk of accidental spills into the marine environment.	Primary	Primary	Table 8.3-12 of 2014 FEIS	No change	Not Significant	No Change	No changes are proposed to marine activities as part of the Meliadine Extension. This effect is considered previously assessed. Mitigation measures outlined in the 2014 FEIS will be carried forward through the Meliadine Extension.

- **Vessel movements in the proposed shipping corridor and Itivia Harbour including nearshore transportation of fuel and dry goods (loading barges, barging, offloading)**

The shipping route, shipping volumes, volume of fuel being transported, lightering activities, anchorage locations, marine infrastructures in Rankin Inlet and discharge of treated groundwater into Itivia Harbour will remain consistent with those identified for the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a). It should be noted that current cargo shipping activities are higher than presented in the 2014 FEIS, and new shipping activities for the Meliadine Extension will not exceed these numbers. Current shipping trips range from 6 to 10, compared to the 2014 FEIS that estimated 4 to 6 ships for cargo. The main reason explaining the change in the number of cargo ships is that those resupplying Meliadine are not always full loads dedicated to the Meliadine Mine. Most time, they are rather partial loads shared with the Meadowbank Gold Project and/or other Nunavut/Nunavik communities as part of their resupply activities.

There has been no collision to date between Agnico Eagle's resupply ships and marine mammals or birds. Mitigation measures outlined in the Shipping Management Plan (Appendix D-31) will continue to be followed. Ships will avoid sensitive bird and marine mammal areas, navigate south of Coats Island when safe to do so, lower speed when near marine mammals in high-use areas, and reduce lighting whenever possible.

Regarding the impacts of noise on marine mammals, conclusion from the 2014 FEIS remain unchanged as there has been no changes to marine activities. Agnico Eagle will continue to apply approved mitigation measures to minimize potential noise disturbance, including reducing speed within the Barrier Islands and reefs near Rankin Inlet.

Mitigation measures outlined in the Oil Preparation and Emergency Plan (Appendix D-25) will continue to be applied.

The Meliadine Extension activities represent a negligible change from the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) activities and no new pathways were identified. All effects have been previously assessed.

8.3.4 Residual Impact Classification

The impacts that remain following mitigation, or residual impacts to the measurement indicators, for the assessment endpoint of the VEC are not anticipated to be different than those previously assessed. The key disturbance to the marine wildlife VEC are shipping activities. They are not proposed to change with Meliadine Extension and existing conditions data confirm that the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) predictions are adequate.

As a result, there is no change in the residual impact classification from the 2014 FEIS and the 2018 and 2020 FEIS Addenda. The Meliadine Extension activities represent a negligible change from the 2014 FEIS and the 2018 and 2020 FEIS Addenda activities and no new pathways were identified.

8.3.5 Cumulative Effects Assessment

The Hudson Bay/Hudson Strait area is a critical corridor for marine transport into and out of Nunavut. Vessel traffic occurs mostly during the open-water season extending from June to early November. Table 8.3-3 provides the average annual number and anticipated of vessels in the Hudson Strait and Hudson Bay.

In addition to existing shipping activities, the following RFFD projects (refer to Appendix B-1) may involve vessel traffic that will likely overlap spatially and temporally with Meliadine Extension shipping activities in Hudson Strait and Hudson Bay:

- Kahuna Diamond Project, located between the communities of Rankin Inlet and Chesterfield Inlet.
- Meadowbank Gold Project, located north of the community of Baker Lake.
- Qilalugaq Diamond Project, located 9 km northeast of Naujaat.
- Pistol Bay Gold Project, located near Whale Cove.

Table 8.3-3: Yearly Current and Anticipated Vessel Traffic in Hudson Strait and Hudson Bay during the Meliadine Life of Mine

	Dry Cargo Return Trips	Fuel Cargo Return Trips	Total Number of Return Trips
Current Shipping Volumes			
Resupply Vessels for Arctic Communities	13	15	28
Research vessels			2
Tourist Cruise Ships			10
Meadowbank Gold Project	10	0[a]	10[a]
Meliadine Extension and RFFD Related Shipping Volumes			
Meadowbank Gold Project	10	0[a]	10[a]
Qilalugaq Project	6	4	10

(a) Traffic has been included in the Meliadine Gold Project traffic volume range (i.e., up to 6 ships for fuel) as ships resupply both Meadowbank and Meliadine Gold Projects during a single trip most of the time.

RFFD projects have a potential to generate cumulative effects on marine resources. However, the likelihood of significant cumulative effects from RFFD remains low, for several reasons. First, less than 1% of exploration projects in Canada advanced to production, so it is unlikely that many of the exploration camps identified will proceed to full development, or that there will be any temporal overlap in those that do (INAC 2010). Also, it is expected that most or all of the RFFD will undergo environmental assessment and will implement mitigation and monitoring (subject to regulatory requirements and societal expectations) to reduce their potential effects. Finally, valid pathways do not necessarily mean that cumulative effects will occur. No instances were identified where the potential for cumulative effects changed as a result of the Meliadine Extension. The changes identified were a result of revisions to the suite of RFFDs. Thus, cumulative effects from the RFFD may occur if most or all of the future projects proceed simultaneously. However, the likelihood of this occurring is low. Environmental monitoring and mitigation measures should nonetheless be diligently continued to minimize the cumulative effects between them.

8.3.6 Uncertainty

There are no changes to the uncertainties outlined in the 2014 FEIS (Volume 8, Section 8.3.10).

8.3.7 Monitoring and Follow-up

Follow-up marine wildlife monitoring will be conducted in general accordance with the regular monitoring conducted under the Ocean Discharge Monitoring Plan in Itivia Harbour, Oil Pollution Emergency Plan, Risk Management and Emergency Response Plan, Spill Contingency Plan, and Shipping Management Plan (including the Marine Mammal and Seabird Observer Program). There are no proposed changes to the currently approved plans based on Meliadine Extension changes with the exception of the addition of the shipping route south of Coats Island to the Shipping Management Plan. Existing plans are robust enough to cover Meliadine Extension's longer life of mine.

Agnico Eagle considers that T&C 76, 77, 78, 79, 80, 81, 82, 83, 84, 85 and 86 of Project Certificate No.006, as well as the existing mitigation and monitoring plans, are sufficient and robust enough to mitigate and monitor marine impacts associated with the Meliadine Extension.

9 SOCIO-ECONOMIC ENVIRONMENT

9.1 Introduction

The socio-economics section provides an update of the 2014 FEIS in relation to the impacts of the Meliadine Extension.

9.1.1 Valued Components

The VCs for the Meliadine Extension are consistent with those for the 2014 FEIS, and include:

- Population Demographic
- Economic Development and Opportunities
- Education and Training
- Individual and Community Wellness
- Community Infrastructure and Public Services
- Governance and Leadership
- Health and Safety
- Traditional Activity and Knowledge
- Non-Traditional Land and Resource Use
- Cultural, Archaeological and Paleontological Resources

9.1.2 Spatial and Temporal Boundaries

9.1.2.1 Spatial Boundaries Socio-Economic Environment

The spatial boundaries for the socio-economic effect's assessment are consistent with the 2014 FEIS. No changes are proposed for Meliadine Extension. The five communities of Arviat, Baker Lake, Chesterfield Inlet, Rankin Inlet, and Whale Cove make up the Meliadine Extension LSA for all VSECs listed in Section 9.1.2 except Traditional Land Use, Non-Traditional Land Use (NTLU), and Cultural, Archaeological and Paleontological Resources.

The five communities included with the LSA have the potential to experience socio-economic effects including (but not limited to) employment effects, use of infrastructure and services, population change and associated changes to demographics and social structures. Given their distance from the Meliadine Extension, Coral Harbour and Naujaat are not expected to provide goods and services to the Meliadine Mine and will not act as shipping ports for the Meliadine Extension. Overall, socio-economic effects to these communities are not anticipated. Therefore, they have not been considered in the socio-economic LSA.

The closest community to the Meliadine Mine is Rankin Inlet, approximately 25 km southeast of the mine site. Chesterfield Inlet is 80 km northeast of the Meliadine Mine, Whale Cove is approximately 80 km south of the Meliadine Mine, Arviat is approximately 220 km south of the Meliadine Mine, and Baker Lake is 234 km northwest of the Meliadine Mine. These five communities are closest to lands and natural resources with some potential to be affected by the Meliadine Extension, although some individuals in other Kivalliq communities do use, or have in the past used, potentially affected lands and resources.

Economic and social benefits are expected for all LSA communities and in Kivalliq more generally. Such benefits will largely derive from employment, education and training, and contracting opportunities.

Consistent with the 2014 FEIS, the regional study area is the territory of Nunavut. Effects on Nunavut are primarily related to the potential for benefit to the territory's economy. There will also be fiscal effects on the GN and on NTI. The RSA applies for all VSECs listed in Section 9.2 except Traditional Land Use, Non-Traditional Land Use and Cultural, Archaeological and Paleontological Resources.

9.1.2.2 Spatial Boundaries Traditional Activities and Knowledge

Consistent with the 2014 FEIS, the Traditional Land Use LSA includes the study area for the mine and the AWAR with a 500 metre buffer surrounding the area. The RSA consists of:

- Mine Development area;
- the AWAR;
- the communities of Rankin Inlet, Chesterfield Inlet, and Whale Cove; and
- the caribou study area.

The RSA was selected to include the caribou effects study area as caribou are considered an important species by the Inuit for sustenance and cultural purposes.

9.1.2.3 Spatial Boundaries Non-Traditional Land and Resource Use

The LSA and RSA for the NTLU are consistent with the 2014 FEIS. The LSA includes the terrestrial resources LSA, with a boundary modification to include the entire municipality of Rankin Inlet. The focus of the assessment is on the general area around Rankin Inlet, the AWAR and the mine site. As for the RSA, it consists of the caribou RSA, with the inclusion of Chesterfield Inlet and the surrounding lands bounded by the coast and the south shore of the inlet. The RSA was selected to include the caribou effects study area as caribou are considered an important species by the Inuit for sustenance and cultural purposes.

9.1.2.4 Spatial Boundaries Cultural, Archaeological and Paleontological Resources

The LSA and RSA for the Cultural, Archaeological and Paleontological Resources are consistent with the 2014 FEIS. The LSA is based on the anticipated spatial extent of the immediate direct impacts (e.g., Meliadine Extension footprint) and a buffer of 500 m surrounding the footprint. For Rankin Inlet, the footprint was limited to the footprint within the hamlet boundary (i.e., the outward limit of Rankin Inlet infrastructure) only and did not include a buffer, beyond the legislated 30 m protection zone.

The RSA, consist of the Agnico Eagle Lease area plus a 7 km buffer; which includes the Iqalugaarjuup Nunanga Territorial Park.

9.1.2.5 Temporal Boundaries

Meliadine Extension activities will extend the LOM by 11 years and postpone mine closure to 2043 instead of 2032. In total, the Meliadine LOM will be 24 years. However, some effects will be transferable beyond the end of mining operations at Meliadine, such as newly gained transferable skills throughout employment and training and economic growth. Strengthening community and individual capacities can lead to the diversification of local economies.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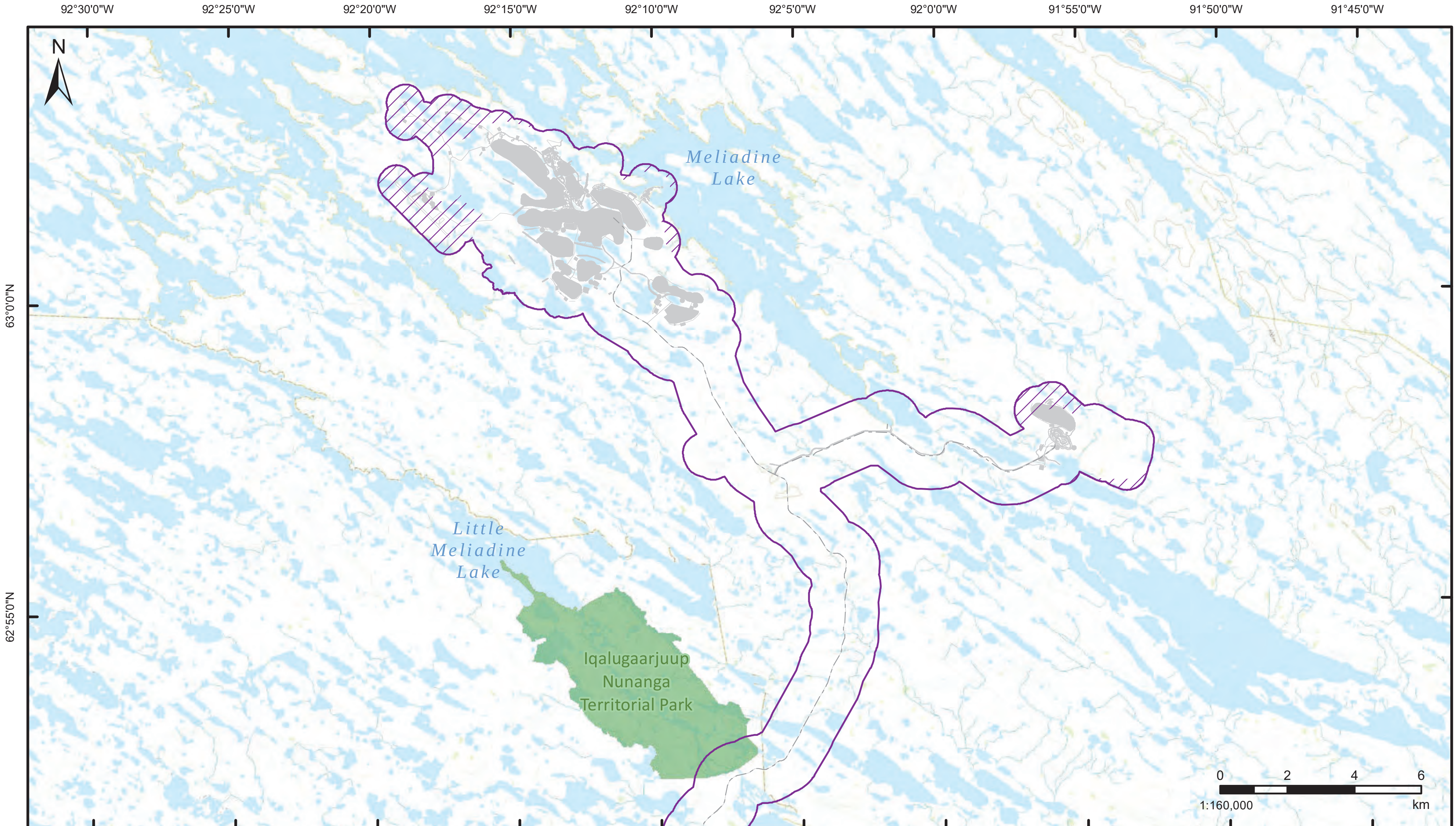
80°0'0"W
66°0'0"N
64°0'0"N
62°0'0"N
60°0'0"N
N
Naujaat
Coral Harbour
Baker Lake
Chesterfield Inlet
Meliadine Project
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
0 50 100 150
1:4,210,656.8
km
Meliadine Extension
Local Study Area –
Socio-Economic Environment
Date: 11/1/2021
Map Number: MEL-020
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983
AGNICO EAGLE
ECOLOGIC
Legend
Project Location
Community
Local Study Area (LSA) Community
All-Weather Access Road (AWAR)



Meliadine Extension

Local Study Area – Traditional Activity and Knowledge

Legend

- Local Study Area (LSA)
- Extension Area
- Territorial Park
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Existing Road

Date: 11/2/2021
Map Number: MEL-021
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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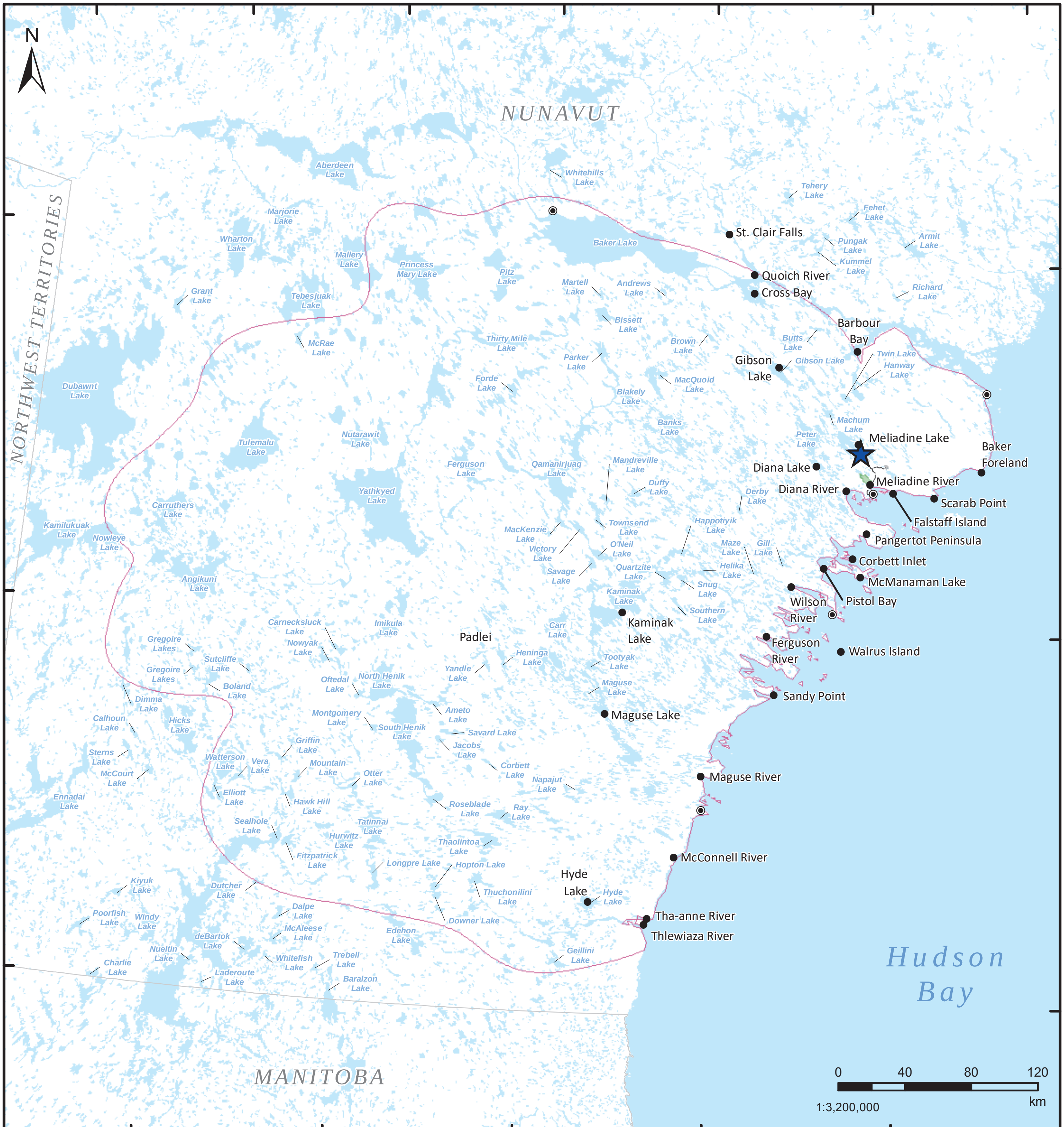

Meliadine Extension

Regional Study Area – Traditional Land Use

Legend

- Community
- Place Name
- Project Location
- All-Weather Access Road (AWAR)
- Territorial Park
- Waterbody

Date: 11/3/2021

Map Number: MEL-028

Coordinate System: NAD 1983 UTM Zone 15N

Projection: Transverse Mercator

Datum: North American 1983

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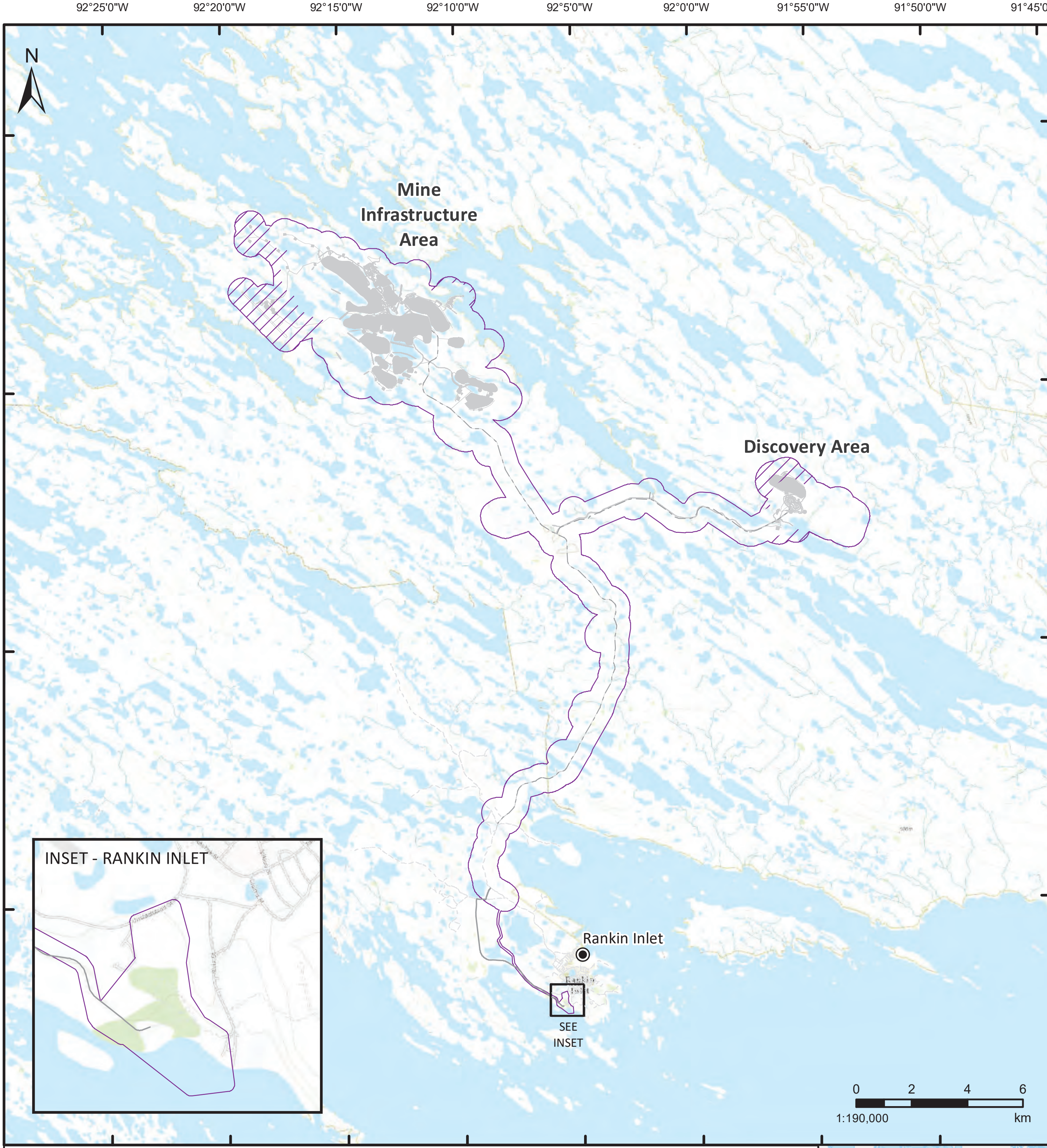
ECOLOGIC



Meliadine Extension

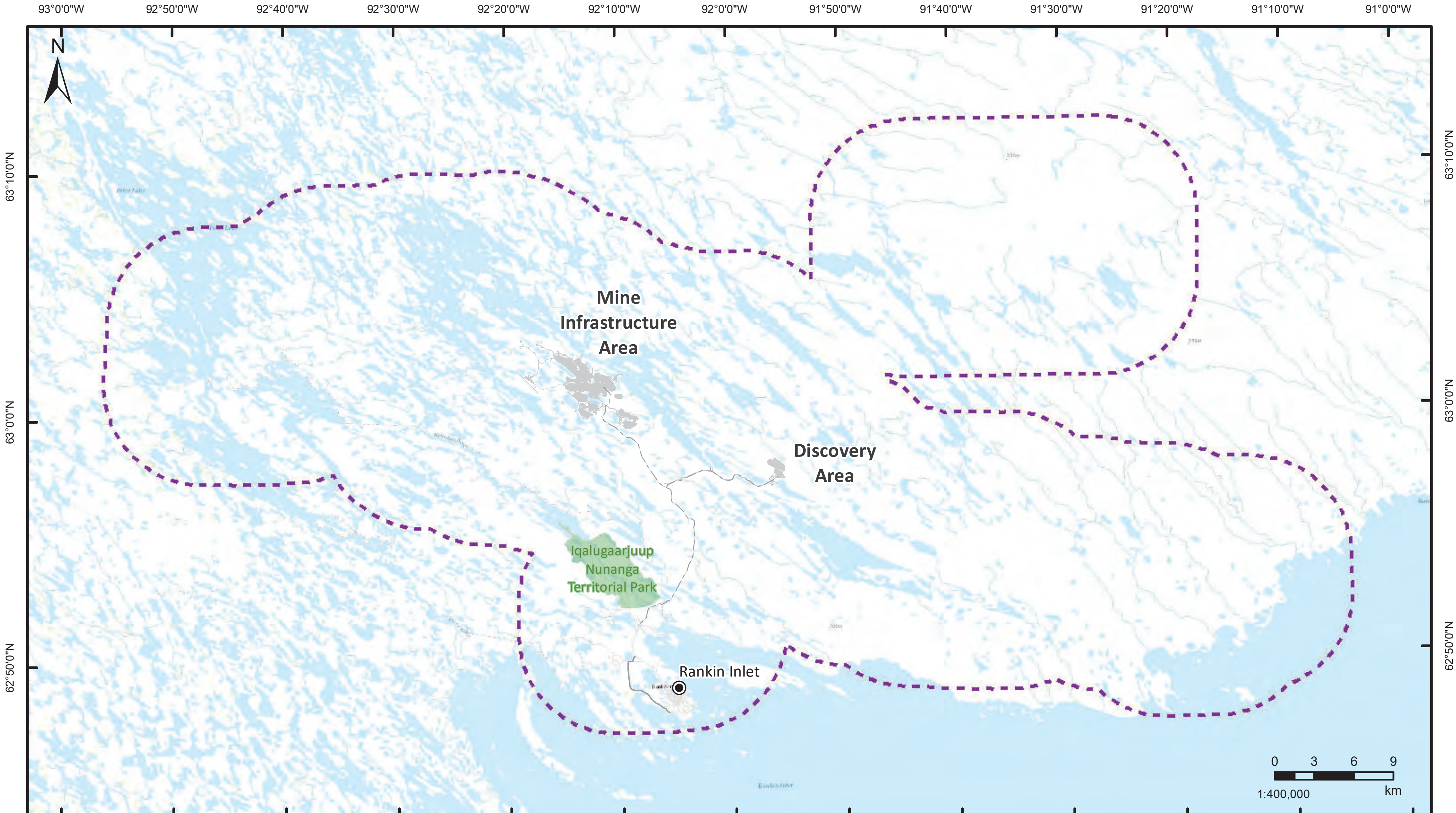
Local Study Area – Cultural, Archaeological and Paleontological Resources

Legend

- Meliadine Extension
- Extension Area
- Local Study Area (LSA)
- All-Weather Access Road (AWAR)
- Bypass Rd.
- Existing Road

Date: 11/2/2021
Map Number: MEL-017
Coordinate System:
NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

AGNICO EAGLE
ECOLOGIC



Meliadine Extension

Regional Study Area – Cultural Resources

Legend

- Regional Study Area (RSA)
- Territorial Park
- Meliadine Extension
- All-Weather Access Road (AWAR)
- Bypass Road
- Existing Road

Date: 11/2/2021
Map Number: MEL-024
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

AGNICO EAGLE ECOLOGIC

9.1.3 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

Since the 2014 FEIS, additional IQ, TK, and comments/concerns related to the Socio-economic Environment were provided by community members and incorporated into the Meliadine Extension assessment, which takes into account the review of the following sources:

- FEIS Addendum Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2020 (Agnico Eagle 2018a).
- Water Licence Amendment Consultation and Engagement Report, December 2020 (Agnico Eagle 2020).
- Waterline Consultations Report 2020 - Preliminary phase of consultation with Rankin Inlet key stakeholders for the Meliadine waterline project from January – March and July 2020 (Agnico Eagle 2020c).
- Waterline Consultations Report 2020 - Consultation Plan for the Meliadine Waterline project Existing Environment and Baseline Information, August 2020 (Agnico Eagle 2020d).
- Community and public engagement for the Meliadine Extension (Section 3 of this Application).

Information gathered during engagement meetings has been considered and incorporated in this Application where relevant, including the effects assessment and mitigation measures. Information as it pertains to the Meliadine Extension Socio-Economic Environment have been summarized below:

- Educational development is important especially for the future of the younger generation
- Importance of using Inuktitut traditional place names
- The Meliadine and Itirlak areas have historical significance for the community and are still actively being used as part of Traditional Activities

9.1.4 Existing Environment

The socio-economic baseline from the 2014 FEIS has been updated where applicable with additional up-to-date existing information in Appendix G-08.

9.2 Population Demographics

9.2.1 Abstract

No primary pathway was identified as a result of the Meliadine Extension. Primary pathways identified in the 2014 FEIS assessment are no longer assessed significant considering most recent data coming from the Socio-Economic monitoring report.

9.2.2 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and population demographics was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.2.2, Table 9.2-10 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC population demographics as a result of Meliadine Extension, there is no change from the previous assessment.

No primary pathways were identified for the Meliadine Extension Population Demographics assessment.

The following mitigation measures will continue to be applied for Meliadine Extension:

- Points of hire in all Kivalliq communities
- Fully contained accommodation camp, fly in/fly out
- Local hiring and contracting priorities
- Clear communication on recruitment procedures

As there are no primary pathways that were identified as a result of Meliadine Extension, there should be no residual effects and, therefore, no need for further mitigation measures.

9.3 Economic Development and Opportunities

9.3.1 Abstract

Overall, Meliadine Extension will continue positive economic development and opportunities effects outlined in the 2014 FEIS by way of the extended life of mine and increased employment opportunities. This will result in extending disposable income for employees. Positive effects on investment, Gross Domestic Product (GDP) and public revenue will persist throughout the life of mine. Contracting and entrepreneurship opportunities and supply of goods will continue to maximize opportunities for local businesses to develop business. Predictions presented as part of this assessment takes into consideration CAPEX and OPEX assumptions based on current knowledge of planned mining activities and as a result are subject to fluctuation. However, given the extended LOM and additional employment, significant positive economic effects will continue throughout the Meliadine Extension.

A summary of key changes to the assessment of the Economic Development and Opportunities for the Meliadine Extension, compared to the FEIS developed for the 2014 FEIS, is provided in Table 9.3-1 of this Application.

9.3.2 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and economic development and opportunities was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.4.2, Table 9.4-19 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC economic development and opportunities as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below:

- Employment: Meliadine Extension would increase the demand for labour during construction and operational phases.
- Gross Domestic Product and Economic Growth: Meliadine Extension would temporarily expand the “size” of the economies of Nunavut and the Kivalliq region.
- Business Development and Contracting: Meliadine Extension would increase demand for goods and services, which should lead to growth in several sectors. Expenditure would add to the economic activity in Nunavut
- Government Fiscal Situation: Meliadine Extension would increase public revenue.
- Income: Meliadine Extension would directly and indirectly contribute to disposable income of employees and other local people.

Five updated primary pathways have been identified as a result of the Meliadine Extension and are assessed in more details below.

Table 9.3-1: Potential Primary Pathways Economic Development and Opportunities

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Construction and operations	Employment	Maximize the employment of people in Kivalliq communities through training. Culturally sensitive workforce programs aimed to improve workplace, employment, and retention	Primary	Primary	Table 9.4-34 2014 FEIS	No change	Significant	Significant	Additional employment opportunities from 2014 FEIS (increase of 205 positions) and extended life of mine until 2043.
Meliadine Extension spending on goods and services.	Gross Domestic Product and Economic Growth	Economic development (new projects) would minimize the "bump" when the Project ramps down.	Primary	Primary	Table 9.4-34 2014 FEIS	No change	Significant	Significant	The Meliadine Extension longer life of mine will continue to contribute to the GDP and Economic growth of Nunavut and the Kivalliq.
Capital Expenditure and spending on labour, goods and services	Business Development and Contracting Meliadine Extension would increase demand for goods and services, which should lead to growth in several sectors. Expenditure would add to the economic activity in Nunavut, including investment.	Strategies that increase capacity of local businesses to supply the Meliadine Extension (i.e IIBA Procurement Process). Maximize local spending through various measures, consult with local business.	Primary	Primary	Table 9.4-34 2014 FEIS	No change	Significant	Significant	The Meliadine Extension longer life of mine will extend business and contracting opportunities and associated expenditures will continue to add to the economic activity in Nunavut.
Payment of taxes	Government Fiscal Situation: Project would increase public revenue.	None required.	Primary	Primary	Table 9.4-34 2014 FEIS	No change	Significant	Significant	The Meliadine Extension longer life of mine will continue to positively contribute to public revenue.
Payment of salaries and other local spending	Income: Project would directly and indirectly contribute to disposable income of employees and other local people.	Maximize the employment of people in Kivalliq communities. Offer Financial Literacy Training and Financial Management Training during pre-employment.	Primary	Primary	Table 9.4-34 2014 FEIS	No change	Significant	Significant	The Meliadine Extension will continue to contribute to disposable income of employees and other local people by adding 205 positions compared to the 2014 FEIS and extending the life of mine until 2043.

9.3.2.1 Analytical Method

To estimate the direct, indirect, and induced benefits of the Project, an input-output model (IO-model), or economic impact model, was used to imitate potential chain of economic events that might take place (Appendix H-11).

9.3.2.2 Employment

The Meliadine Extension will continue to have positive effects on employment in the region. Table 9.3-2 below compares employment predictions for the 2014 FEIS and this Application.

Table 9.3-2: Predicted Employment Opportunities

	2014 FEIS	Meliadine Extension FEIS Addendum
Unspecialized (un-skilled/semi-skilled) (%)	55	60
Management (%)	2	8
Skilled (%)	30	25
Supervisor and professionals (%)	13	7
Total Employment	700	905
Percentage to be filled by Inuit Workforce (%)	20	20

Meliadine Extension will continue employment opportunities for a longer period of time until 2043 and ramp up to around 905 positions (additional 205 positions from the 2014 FEIS) in 2031, mainly due to construction activities at the Discovery deposit. Most of the new employment opportunities generated by Meliadine Extension will be in the skill level identified in the 2014 FEIS as 'unspecialized'. From the 385 positions in 2014, an additional 155 workers will be required in unskilled and semi-skilled level positions. Management and professional, and skilled level positions will respectively be increased by approximately 30 and 15 more positions.

Consistent with the 2014 FEIS predictions, a 20% Inuit workforce is a conservative estimate of what is achievable for Meliadine Extension. This would translate into 180 local workers an increase of 40 employees. Based on the most recent Socio-Economic monitoring report, a continued prediction of 20% of local workforce is also aligned with current available data. In 2019, Inuit full time employees represented 16% of the workforce.[2]

The Extension activities longer LOM would provide a total of 35,129 person-years direct jobs for Agnico Eagle employees and contractors working directly on site. In addition, 42,005 person-years of employment would be created further down in supply chain (indirect jobs). An estimated 28,926 person-years jobs would be created in industries that benefit from the direct and indirect workers spending their wages. The total job impact is estimated at 106,059 person-years of employment. Table 9.3-3 presents

[2] The year 2020 was not utilize as a reference due to the impact of COVID-19 restrictions on Inuit employment numbers.

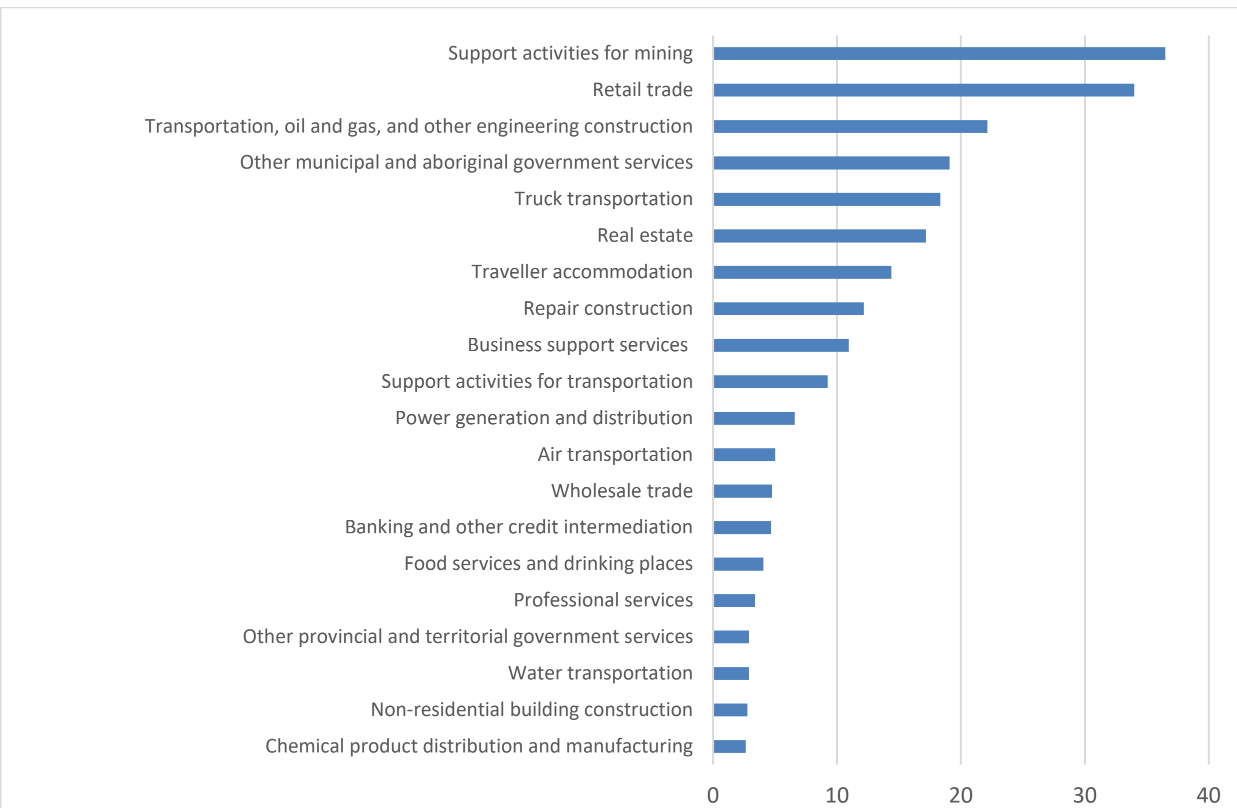
employment impact for Meliadine Extension.

Table 9.3-3: Employment Impacts for Meliadine Extension (Person-Years)

Impact	Kivalliq	Rest of Nunavut	Rest of Canada	Total
Direct	7,024	0	28,105	35,129
Indirect	2,699	1,517	37,789	42,005
Induced	1,203	582	27,141	28,926
Total	**10,926**	**2,098**	**93,035**	**106,059**

In addition to the jobs created in gold mining in the territory, Figure 9.3-1 shows the total annual impact on jobs in Nunavut in other industries. As shown, majority of jobs would be created in support activities for mining, retail trade, transportation and other engineering construction, and public administration.

Figure 9.3-1. Approximate Annual Job Impact (Direct, Indirect, and Induced) in Top 20 Industries in Nunavut (Number of Jobs)



9.3.2.3 Gross Domestic Product and Economic Growth

The Meliadine Extension will continue to expand territorial economic growth and expansion of Nunavut's GDP beyond the scheduled closure of the 2014 FEIS.

Total GDP impact for Meliadine Extension is estimated at $15,604.6 million over the life of the mine (Table 9.3-4); this impact includes labour income impact. An estimated 31.2% of that impact would be realized from direct Project activities (direct spending and employment), while 41.0% would be realized from indirect and 27.8% from induced economic activities. Regionally, $1,739.8 million in GDP would benefit the Kivalliq Region, and another $386.4 million would benefit the rest of Nunavut.

Table 9.3-4: GDP Impacts for Meliadine Extension (CDN millions, 2021 current dollars)

Impact	Kivalliq	Rest of Nunavut	Rest of Canada	Total
Direct	$1,022.2	$16.7	$3,822.5	$4,861.3
Indirect	$498.0	$273.2	$5,631.1	$6,402.3
Induced	$219.6	$96.6	$4,024.8	$4,341.0
Total	**$1,739.8**	**$386.4**	**$13,478.3**	**$15,604.6**

9.3.2.4 Business Development and Contracting

Meliadine Extension is expected to continue to increase demand for goods and services, which should lead to growth in several sectors. Expenditure would add to the economic activity in Nunavut.

It is expected that Meliadine Extension will continue to source goods and services from Nunavut-and Rankin Inlet-registered companies, and that existing contracts with local businesses will be extended based on an as needed basis.

In 2017 with the signing of the IIBAs for Meadowbank and Whale Tail, as well as the revision of the Meliadine IIBA, all three sites are following a prequalification procurement process and NTI registered companies are eligible for preference points.

There has been an almost continual rise in procurement going to Inuit firms as a proportion of total spend. Two reasons for this include the preferred contract provisions outlined in the IIBA with Sakku Investments Corporation companies, as well as the IIBA procurement and tendering process which advantages Inuit owned firms (Agnico Eagle 2020g).

Meliadine spending at NTI-registered companies increased in 2020 to $269M, which was 66% of total spend. This increase was also part of an overall trend since procurement began in 2015. Spending during the construction phase of Meliadine significantly exceeded the prediction of $866M, as that value was based on a 3.5- year time period and it was exceeded in just two years (2017 and 2018) (Agnico Eagle 2020g).

By industry, beyond GDP impacts in mining, other top industries to benefit from Meliadine Extension would include transportation and warehousing, manufacturing, real estate and rentals, wholesale, retail, and construction (Table 9.3-5).

Table 9.3-5: Total GDP Impact for Meliadine Extension by Industry (CDN millions, 2021 current dollars)

Impact	Kivalliq	Rest of Nunavut	Rest of Canada	Total
Agriculture, Forestry, Fishing and Hunting	$2.5	$1.8	$264.7	$269.1
Mining, Quarrying, and Oil and Gas Extraction	$1,113.7	$159.8	$4,400.9	$5,674.4
Utilities	$5.4	$1.6	$341.1	$348.1
Construction	$199.0	$17.9	$339.5	$556.3
Manufacturing	$11.8	$1.1	$1,146.9	$1,159.8
Wholesale Trade	$8.9	$12.8	$874.5	$896.2
Retail Trade	$21.1	$9.5	$582.2	$612.8
Transportation and Warehousing	$76.6	$20.0	$1,446.1	$1,542.7
Information	$0.1	$15.1	$284.9	$300.1
Finance and Insurance	$19.9	$6.7	$731.6	$758.3
Real Estate and Rental and Leasing	$215.8	$87.8	$976.8	$1,280.4
Professional, Scientific, and Technical Services	$4.5	$10.2	$648.6	$663.3
Management of Companies and Enterprises	$1.2	$4.0	$52.8	$58.0
Administrative and Support and Waste Management and Remediation Services	$13.1	$8.5	$316.3	$338.0
Educational Services	$1.2	$0.4	$87.9	$89.6
Health Care and Social Assistance	$1.8	$2.4	$205.5	$209.7
Arts, Entertainment, and Recreation	$0.1	$0.2	$58.9	$59.1
Accommodation and Food Services	$14.4	$4.1	$233.1	$251.6
Other Services (except Public Administration)	$5.0	$3.8	$253.2	$262.0
Public Administration	$26.4	$15.9	$233.0	$275.3
Total	**$1,739.8**	**$386.4**	**$13,478.3**	**$15,604.5**

9.3.2.5 Government Fiscal Situation

It is expected that Meliadine Extension will continue to increase government revenues, both on a federal and territorial level through direct, indirect, and induced impacts and through various types of taxes. Table 9.3-6 presents tax revenue impacts for Meliadine Extension over the life of the mine. As a comparison, the 2014 FEIS predicted a total of 160M$ (27M$ towards the territorial government) during the Construction phase and a total of 55M$ (26M$ towards the territorial government) during the Operations phase. Positive effects are higher than the 2014 FEIS primarily due to the longer LOM.

Table 9.3-6: Tax Revenue Impacts for Meliadine Extension (CDN millions, 2021 current dollars)

Impact	Nunavut	Rest of Canada	Total
Direct (CDN M$)	$386.4	$1,093.5	$1,479.9
Indirect (CDN M$)	$200.4	$627.8	$828.2
Induced (CDN M$)	$46.6	$867.4	$914.0
Total	**$633.3**	**$2,588.7**	**$3,222.0**

9.3.2.6 Income

It is expected that Meliadine Extension will continue to directly and indirectly contribute to disposable income of employees and other local people. Table 9.3-7 presents labour income impacts for Meliadine Extension over the life of the mine. In the 2014 FEIS, it was predicted that labour income would be around 35.9 M$ for the Construction phase and 297.2M$ for the Operations phase. Positive effects are higher than the 2014 FEIS primarily due to the longer LOM.

Table 9.3-7: Labour Income Impacts for Meliadine Extension (CDN millions, 2021 current dollars)

Impact	Kivalliq	Rest of Nunavut	Rest of Canada	Total
Direct (CDN M$)	$948.1	$0.0	$3,793.9	$4,742.1
Indirect (CDN M$)	$304.1	$207.5	$3,285.0	$3,796.7
Induced (CDN M$)	$145.7	$64.6	$2,291.0	$2,501.3
Total	$1,398.0	$272.1	$9,369.9	$11,040.0

9.3.3 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The residual impact classification for primary effect pathways identified is summarized in Table 9.3-8. Similar to the 2014 FEIS, quantitative results need to be considered with some caution, the margin of error would have to be extremely high to conclude anything other than that the Project will have significant positive economic effects. Meliadine Extension's economic impacts in Nunavut are significant and will remain significant for the life of the mine.

Table 9.3-8: Economic Development and Opportunities Residual Impacts

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Employment	Positive	High	Regional	Long-term	Significant
Gross Domestic Product and Economic Growth	Positive	High	Regional	Long-term	Significant
Business Development and Contracting	Positive	High	Mostly local	Long-term	Significant
Government Fiscal Situation	Positive	High	Regional	Long-term	Significant
Income	Positive	Moderate	Mostly local	Long-term	Significant

9.4 Education and Training

9.4.1 Abstract

As outlined in the 2014 FEIS predictions, the Meliadine Extension will continue to significantly improve educational achievement, training in existing education system and skill level of the local workforce by the extended life of mine and additional employment and on the job training opportunities.

A summary of key changes to the assessment of the Education and Training for the Meliadine Extension, compared to the FEIS developed for the 2014 FEIS, is provided in Table 9.4-1 of this Application.

9.4.2 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and education and training was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.5.2, Table 9.5-3 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC education and training as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below.

The following primary effect pathways for the Meliadine Extension's Education and Training assessment:

- Improvement in Education Achievement, dropout rates, school attendance
- Improvement in available training in existing education system
- Improvement on Education and skill levels of local workforce

Three updated primary pathways have been identified as a result of the Meliadine Extension and are assessed in more details below.

Table 9.4-1: Potential Primary Pathways for Education and Training

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Requirements for skills and education.	Improvement in education achievement, dropout rates, school attendance	Providing training opportunities Working with local education authorities Support efforts to upgrade education Provide career counselling	Primary	Primary	Table 9.5-4 2014 FEIS	No change from 2014 FEIS	Significant	No change	Consistent with the 2014 FEIS, Meliadine Extension is anticipated to contribute positively to the regional graduation rate by providing additional employment opportunities for an extended period of time (until 2043).
Requirements for skills and education.	Improvement in available training in existing education system and funding	Establish a Workforce Development Plan Establish training programs in collaboration with hamlet governments Cooperating with appropriate agencies in Nunavut in entrepreneurial training programs for Inuit businesses Cooperating with appropriate educational authorities and institutions in Nunavut in the development and implementation of high school and college courses with mining sector content providing a scholarship fund for post-secondary education	Primary	Primary	Table 9.5-4 2014 FEIS	No change from 2014 FEIS	Significant	No change	Consistent with the 2014 FEIS, the Meliadine Extension will continue to have positive effects on the existing education system by maintaining contributions and building capacity in the regional and local study area.
Requirements for skills and education.	Improvement on education and skill levels of local workforce	Providing training opportunities Working with local education authorities Support efforts to upgrade education Provide career counselling	Primary	Primary	Table 9.5-4 2014 FEIS	Change in magnitude from High to moderate.	Significant	No change	The Meliadine Extension will continue the workforce training in place at Meliadine. Continuing existing programs is expected to provide benefits consistent with the 2014 FEIS. Additionally, on the job training and education are expected to provide opportunities for Nunavummiut employees to advance to more skilled level position and build capacities.

9.4.2.1 Improvement in Education Achievement, Dropout Rates, School Attendance

Recent data indicates that educational achievement in the Kivalliq region increased significantly since 2008, which is consistent with the 2014 FEIS Volume 9, Section 9.5.2 prediction that Agnico Eagle would have a positive impact on educational achievement in the region.

As presented below in the secondary school graduation rate by region, the Kivalliq has higher educational rate achievement that the two other regions with an upward trend that coincides with the opening of the Meadowbank mine.

Figure 9.4-1: Secondary school graduation rate by region

Source: Department of Education, 2020 as presented in as presented in Agnico Kivalliq Projects (2021)

As shown by the current educational trend, the Meliadine Extension is anticipated to contribute positively to the regional graduation rate by providing additional employment opportunities for an extended period of time which can potentially motivate student to achievement higher level of education to obtain a position at the Meliadine Mine.

Agnico Eagle will continue to apply existing management and mitigation measures throughout the Meliadine Extension.

Agnico Eagle offers a number of programs intended to increase general educational and skills attainment among Kivalliq residents as well as training, career development and upward mobility programs for existing employees. Agnico Eagle developed a portfolio summarizing all the education initiatives that are available for Kivalliq schools. The portfolio was presented to and approved by Kivalliq School Operations. This portfolio includes the following initiatives: TASK (Trades Awareness Skills and Knowledge Week), role model visits, careerfair, life skills workshops, take our kids to work, regional summer camp, local summer camps, summer employment opportunities, financial workshops, scholarships and Mining Matters programs. All of the initiatives within the portfolio are linked to the required curriculum and some of the initiatives provide an opportunity for students to receive a credit (Agnico Eagle 2020g).

9.4.2.2 Improvement in Available Training in Existing Education System and Funding

Meliadine Extension will have positive effects on the existing education system by maintaining contributions and building capacity in the regional and local study area until the end of the extended mine life.

Agnico Eagle has maintained a regional contribution at a minimum of $3.68M in annual mine training / education spending as per the IIBA since 2016. Since 2017, there is also an additional $1M of spend on any initiative that serves to assist in achieving 50% minimum Inuit employment, of which half ($500k) is given to the Kivalliq Inuit Association to spend and half ($500k) is spent by Agnico Eagle (Agnico Eagle 2020g).

As shown below, since the beginning of operations, Agnico Eagle has contributed over $2.4 million to school-based initiatives.

Table 9.4-2: Agnico Eagle Investments in Education-based Initiatives (In thousands of dollars)

Program	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
TASK weeks									$25	$40	$20
Internal Education Programs (Hiring of Adult Educator and Academic Material)									$90	$170	$90
Internal Education Programs (Take Our Kids to Work Day)									$2	$2	
Kivalliq Science Educators Community Programs		$15	$15	$25	$25	$25	$25	$25	$25	$25	$50
Mining Matters Science Program		$90	$80	$70	$70				$35	$40	$30
MOU with GN Department of Education		$175	$175	$175	$175						
Non-IIBA bursaries/scholarships									$2	$10	
Nunavut Literacy Council program									$100	$200	
Nunavut Literacy Council contribution for Rankin Inlet programming space										$250	
Scholarships (including KIA scholarship fund)	$14	$14	$14	$14	$14	$14	$14	$30	$30	$30	$30
Other education and social investments									$5	$29	
TOTAL	**$14**	**294**	**284**	**284**	**284**	**$39**	**$39**	**$55**	**$314**	**$796**	**$220**

Source: Agnico Eagle Mines, 2020a as presented in as presented in Agnico Kivalliq Projects (2021)

As such, the Meliadine Extension life of mine is expected to continue to have positive effects on the existing education system.

9.4.2.3 Improvement on Education and Skill Levels of Local Workforce

The Meliadine Extension will continue the workforce training in place at Meliadine. Continuing existing programs is expected to provide benefits consistent with the 2014 FEIS. Continued on the job training and education is expected to provide opportunities for Nunavummiut employees to advance to more skilled level position and build capacities which can be applied elsewhere when the Meliadine operational life comes to an end. Also, with the increase of 205 workers at the mine site, the Meliadine Extension will consequently reach a higher number of employees enrolled into training programs.

Following the 2014 FEIS, in September 2017, Agnico Eagle and the Government of Nunavut established a Memorandum of Understanding that identifies 10 priority areas for collaboration, including education (Agnico Eagle 2020g) The Meliadine Extension will continue to provide training opportunities.

Mandatory health and safety, general training and emergency response team training will continue.

Agnico Eagle's training department offers job-specific training such as the Underground Trainee Program. Agnico Eagle also operates the Career Path Program, which identifies the incremental steps that an employee is required to complete to advance in their chosen career of interest. The objective of the Career Path Program is to achieve 100% internal promotions for Inuit and no external candidates (southerners) hired to fill a position that is part of the program. Specific training will also continue, aligned with individual career path progression.

The Apprenticeship Program started at Meliadine in 2018. It combines on-the-job learning and in-school technical instruction to allow Inuit employees the opportunity to be educated and trained in the trade of their choice. By the end of the program, the apprentice can challenge their Certificate of Qualification (COQ) to become a Journeyperson and will also have the opportunity to challenge their Red Seal Exam. Currently, Agnico Eagle offers apprenticeships in nine trades up from two offered programs in 2013. In 2019, the program was adjusted to substantially increase support to apprentices while they are at school for their technical instruction; logistical, material, educational, and financial support is provided to apprentices (Agnico Eagle 2020g).

Additionally, in 2018, an Underground Trainee Program has been developed by the Nunavut Arctic College and supported by Agnico Eagle Mines. The following year, Agnico Eagle developed its own 28-days Underground Trainee Program as the entry level of the Meliadine Underground Career Path. Between 2019 and 2021, 4 cohorts started the Underground Trainee Program for a total of 16 graduates.

In 2020, there were 14 Inuit employees working at Agnico Eagle projects in positions classified as 'skilled' or 'management and professional', the same as there were in 2019. Most (10, or 71%) of the Inuit in these positions work at Meliadine. The total number of semi-skilled Inuit employed by Agnico Eagle has generally increased over time (Agnico Eagle 2020g).

Despite numerous training opportunities increasing the number of Kivalliq Inuit, labour in higher skilled positions remains a challenge. The Inuit Workforce Barriers and Strategies (IWBS) suggested a number of measures including fast tracking a manageable number of Inuit workers through existing career paths (including designating a small number of positions for Inuit advancement in semi-skilled or skilled occupations and providing individualized development support to Inuit workers who are moving into or preparing for advanced positions) (Agnico Eagle 2020g).

Along with the several educational programs mentioned above, Agnico Eagle has initiated the Rapid Inuit Specific Education (RISE) program to allow for upward working opportunities.

The RISE program aims to deliver educational instruction and support to bridge Inuit employee's educational gaps. The RISE program will help to increase an employee's education skills to allow for upward growth within their work at Agnico Eagle. The RISE program has three main streams: Trades, Upward Mobility, and Workplace Essential Skills.

The Leadership Development Program (LDP) was also put in place at the Meliadine site after the 2014 FEIS to develop workforce for leadership roles. So far, 3 Nunavummiut have enrolled into the LDP program. It is anticipated that the additional 11 years of the Meliadine Extension will allow workers that are currently in the semi-skilled level to move towards skilled level positions and consequently being eligible to enroll to the LDP program developing further leadership skills.

9.4.3 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS. No changes to the methodology are proposed as a result of the Meliadine Extension.

The residual impact classification for the three primary effect pathways identified is summarized in Table 9.4-3.

Table 9.4-3: Education and Training Residual Impacts

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Likelihood	Significance
Improvement in Education achievement, dropout rates, school attendance	Positive	High	Regional	Long-term	Irreversible	High	Significant
Improvement on Available training in existing education system	Positive	High	Local to regional	Long-term	Reversible	High	Significant
Improvement on Education and skill levels of local workforce	Positive	Moderate	Local to regional	Long-term	Irreversible	High	Significant

Residual effects on education, training, and capacity in the RSA and LSA should be positive and long lasting.

The Meliadine Extension is expected to continue to contribute to educational achievement in the region and to enhance training available in existing education system by the extended life of mine and additional employment opportunities. Those effects are assessed to be of high magnitude, local to regional in extent, and long-term duration.

The Meliadine Extension will continue to offer on the job training opportunities, while those programs are consistent with the 2014 FEIS, the extended life of mine will contribute positively to build capacity in the workforce. Newly gained skills are transferable beyond the end of mining operations at Meliadine. However, it is unsure how Inuit workers will respond to training opportunities offered or supported by the Meliadine Extension, as interest depends from an individual to another. This effect is assessed to be of moderate magnitude, local to regional in extent and long-term duration.

Overall, the Meliadine Extension positive effects on education and training are assessed as significant.

9.5 Individual, Family, and Community Wellbeing

As outlined in the 2014 FEIS predictions, the Meliadine Extension will continue to have positive effects on nutrition and safety by the extended life of mine and associated employment and training opportunities.

Furthermore, primary pathways identified in the 2014 FEIS are no longer considered significant considering most recent data coming from the Socio-Economic Monitoring Report (SEMR) indicating that there is no mining induced in-migration as predicted in the 2014 FEIS.

A summary of key changes to the assessment of the Individual and Community Wellness for the Meliadine Extension, compared to the 2014 FEIS.

9.5.1 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and individual, family, and community wellbeing was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.6.3, Table 9.6-14 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC individual, family, and community wellbeing as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below.

- Nutrition: Meliadine Extension employment may increase time and resources available for harvesting nutritious country foods
- Safety: Meliadine Extension health and safety training may improve health and safety at mine site and outside of the workplace

Table 9.5-1: Potential Primary Pathway Individual, Family, and Community Wellbeing

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Employment	Nutrition: Meliadine Extension employment may increase time and resources available for harvesting nutritious country foods	Provide long-term employment with opportunities for advancement and growth. Provide Financial Literacy Training and Financial Management Training during pre-employment Use a rotation schedule to maximize time at home. Accommodate traditional pursuits of Inuit employees within work schedules where practicable and with appropriate notice, in balance with operational needs of the Project. Access to Country Food.	Primary	Primary	Table 9.6-18 2014 FEIS	No change from 2014 FEIS	Significant	No change	Meliadine Extension is expected to continue to have an effect on nutrition by increasing employment up to 905 employees throughout a longer period of time (closure in 2043).
Employment	Safety: Meliadine Extension health and safety training may improve health and safety at mine site and outside of the workplace	Provide H&S training to all Project employees. Provide core policies in Inuktitut as well as English. Provide a mine orientation program for all new employees. Provide First Aid / CPR, SHE, ERT and WHMIS training.	Primary	Primary	Table 9.6-18 2014 FEIS	No change from 2014 FEIS	Significant	No change	By creating additional employment opportunities and extending the duration of employment beyond the period assessed in the 2014 FEIS, Meliadine Extension-related training, education and on-site services will reach a larger number of workers, for a longer period of time, further enhancing this beneficial effect on community health and safety.

9.5.1.1 Nutrition

Meliadine Extension employment may increase time and resources available for harvesting nutritious country foods

The Meliadine Extension is expected to continue to have an effect on nutrition by increasing employment to a maximum of 905 employees throughout a longer period of time (closure in 2043). Current employees will continue to benefit from income, time to go on the land due to rotational schedule and healthy food choices at the mine site. The number of workers having access to those positive effects will increase with the Meliadine Extension.

The Nunavut Food Security Coalition outlines the four components of food security as "*availability* (enough wildlife on the land or groceries in the store), *accessibility* (adequate money for hunting equipment or store-bought food, and the ability to obtain it), *quality* (healthy food that is culturally valued), and *use* (knowledge about how to obtain, store, prepare, and consume food)."

Employment through the mine site is expected to provide the necessary financial resources to harvest the land.

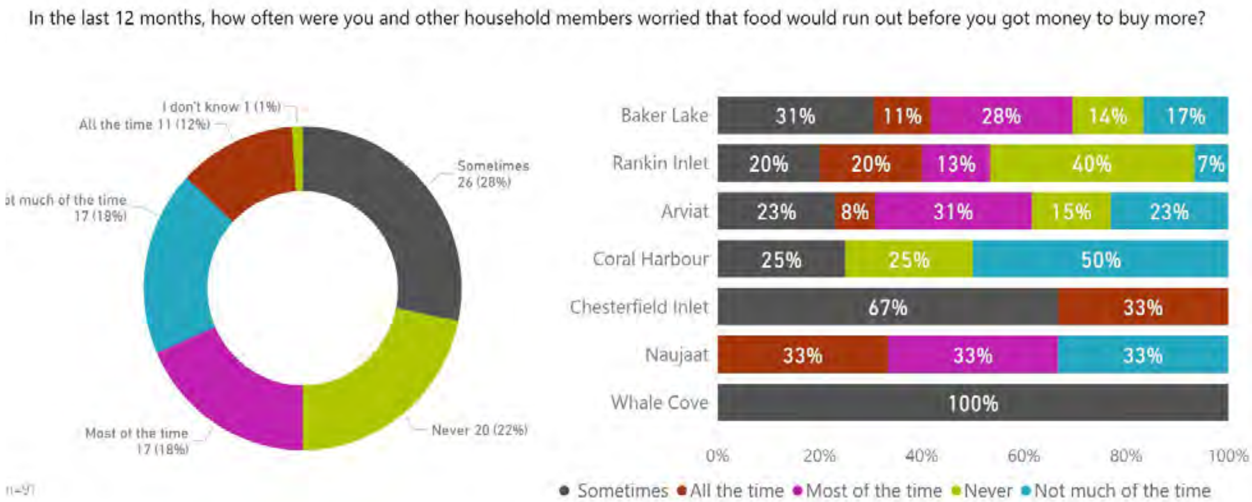
While at the mine site, a variety of services to support use of country food will continue to be available, including country food nights, country food events, and a country food kitchen for use by Inuit employees. Meliadine served an estimated 8,900 meals featuring country foods so far. The Meliadine country food kitchen was used by 82 attendees in 2018, 500 attendees in 2019, and 127 attendees in 2020 (Agnico Eagle 2020g).

As part of the revised Socio-Economic Monitoring Program (SEMP), Agnico Eagle developed an Inuit employee survey to gather data and insights on employees' perceptions of the projects' impacts on culture and traditional lifestyle, along with other topics (Figure 9.5-1). This survey was undertaken during the summer of 2019.

Nearly all survey participants indicated that they had participated in some form of traditional and cultural activities in the last 12 months, with nearly one quarter participating in family get-togethers, hunting, trapping and fishing, and traveling on the land. 7% indicated that they participated in gathering plants and berries (Agnico Eagle 2020g).

While a large majority of Inuit employees stated that the flexibility of their work schedule was not a barrier to conducting cultural or traditional activities, almost a third felt they had participated less as a result of working for the mine. Results of the survey also indicated that 11% of the respondent were worried in the last 12 months about running out of food all the time, 18% most of the time and 28% sometimes (Agnico Eagle 2020g).

Figure 9.5-1: Survey Results Pertaining to Food Security



Agnico Eagle Inuit Survey, 2019 as presented in Agnico Kivalliq Projects

Nunavut has consistently had the highest rates of food insecurity. The latest data in Nunavut – for 2014 – indicated that 46.8% of households were food insecure, nearly four times the national average at the time. However, there is currently no source of annual government data on food security in the Kivalliq region or for individual Kivalliq communities (Agnico Eagle 2020g).

Overall, the Meliadine Extension is expected to continue to have a positive effect on providing financial means for harvesting and time to go on the land with the nature of rotational work while providing healthy choices and country food at site. Although, current available data from the Inuit employee survey tend to indicate that food insecurity persist among Nunavummiut workers. There is no available year-over-year data on food security in Kivalliq communities.

However, Agnico Eagle projects may positively impact food security in the Kivalliq by providing employees with healthy food choices while on site, increasing household incomes, allowing for greater food purchasing, and enhancing availability and accessibility of country food (Agnico Eagle 2020g).

As the Inuit employee survey continues, it will provide a good representation of the level of food insecurity of Agnico Eagle employees in future years (Agnico Eagle 2020g).

9.5.1.2 Safety

Meliadine Extension health and safety training may improve health and safety at mine site and outside of the workplace

The Meliadine Extension is expected to have a positive effect on safety by providing health and safety training to employees. Health and Safety awareness will potentially improve safety knowledge outside of the workplace.

In 2019, over 80% of Inuit employees that participated to Agnico Eagle's Inuit & Nunavummiut Employee Survey, report that they have discussed important work values (working hard, being on time, being safe) with children and youth in their homes and communities (Agnico Eagle 2020g).

By creating additional employment opportunities and extending the duration of employment beyond the period assessed in the 2014 FEIS, Meliadine Extension-related training, education and on-site services will reach a larger number of workers, for a longer period of time, further enhancing this beneficial effect on community health and safety.

9.5.2 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The residual impact classification for these primary effect pathways is summarized in Table 9.5-2.

Table 9.5-2: Individual and Community Wellness Residual Impact

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Nutrition	Positive	Low to Moderate	Local	Medium	Significant
Safety	Positive	Moderate	Local	Long-term	Significant

Meliadine Extension's overall effect on nutrition by continued income, access to nutritious food and country food is expected to be positive. The magnitude is low to moderate as there is no clear findings due to the lack of yearly food security monitoring for the Kivalliq communities. In the future, the Inuit Employee Survey might prove to be a useful tool to assess the effect of the Meliadine Extension on employee's food security if continued. The geographic extent is local as employment will emanate from the LSA. The duration is medium as it will last throughout the life of the Meliadine Extension and considered significant.

As predicted in the 2014 FEIS, the Meliadine Extension is expected to continue positive effect on health and safety at mine site and outside of the workplace. The magnitude is moderate, the extent to which this benefit will be realized is difficult to predict, as it may influence the behavior and decision making of some more than others, and because it is not known how individuals will react. The extent is local and long-term as the effect does not end with the closure of a project, but instead continues to influence people's behavior into the future. Therefore, the Meliadine Extension positive effect on safety is considered significant.

9.6 Community Infrastructure and Public Services

As outlined in the 2014 FEIS predictions, the Meliadine Extension will continue to have effects on local and regional transport by the extended life of mine. As a result of most recent data from the SEMR indicating that there is no mining induced in-migration as predicted in the 2014 FEIS and the completion of the by-pass road and existing mitigation measures the effects are deemed to be only positive as part of this application.

A summary of key changes to the assessment of the Individual and Community Infrastructure and Public Services for the Meliadine Extension, compared to the 2014 FEIS is provided in Table 9.6-1 of this Application.

9.6.1 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and community infrastructure and public service was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.7.2, Table 9.7-4 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC community infrastructure and public service as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below.

- The construction of the AWAR may increase access to areas outside of Rankin Inlet by local residents.
- Meliadine Extension-related traffic may increase traffic on local roads.

Table 9.6-1: Potential Primary Pathway Community Infrastructure and Public Services

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment – Meliadine Extension	Residual Impacts – 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Construction and operations	Local and Regional transportation: The construction of the AWAR may increase access to areas outside of Rankin Inlet by local residents. Meliadine Extension-related traffic may increase traffic on local roads.	Construct a bypass road around Rankin Inlet to allow fuel, freight and other equipment to be transported from the port to the mine site without passing through the built-up populated section of Rankin Inlet Project Personnel will be flown between their home communities and Rankin Inlet, then transported on a company shuttle bus service to the mine site, minimizing time spent in Rankin Inlet Recruitment and hiring practices will be communicated clearly to discourage people from moving to Rankin Inlet without secure employment	Primary	Primary	Table 9.7-5 2014 FEIS	Change in direction to positive only.	Significant	No change	Change in the direction to only positive for the Extension. Predictions from the 2014 FEIS believed that we would see project induced in-migration to Rankin Inlet and out-migration from other Kivalliq communities to Rankin Inlet. Although, based on available and current data, there is no indication of mining-induced in-migration. Traffic on local roads not expected due to completion of by-pass road. Continued positive effects from usage of the AWAR.

9.6.1.1 Local and Regional Transportation

The construction of the AWAR may increase access to areas outside of Rankin Inlet by local residents.

The Meliadine Extension effects on increase access to areas outside of Rankin Inlet by local residents are consistent with the 2014 FEIS positive effects. The extended life of mine will allow local residents a continued usage of the AWAR until closure and will enhance access to Iqalugaarjuup Nunanga Territorial Park and the surrounding areas for local residents.

Meliadine Extension-related traffic may increase traffic on local roads.

Construction of the bypass road has been completed and will be in use until end of the Meliadine Extension mine life. Current traffic in Rankin Inlet is limited as workers and goods are directly transported to the mine site using the Bypass road. Meliadine Extension does not propose changes to traffic on the Bypass road, AWAR and in Rankin Inlet. Existing mitigations measure such as signage and speed limits will continue to be followed by Agnico Eagle whenever in Rankin Inlet.

Agnico Eagle will operate the Meliadine Extension to the highest standard of health, safety and risk management. Planning traffic and shipment schedules to avoid public traffic and communication with hamlets, in addition to driver safety training, will help to minimize the risk of traffic accidents.

9.6.2 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The residual impact classification for primary effect pathways identified is summarized in Table 9.6-2.

Table 9.6-2: Community Infrastructure and Public Services Residual Impact

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Local and Regional Transport	Positive	Moderate	Local	Long-term	Significant

The Meliadine Extension's overall effect on local and regional transport is expected to be positive. The continued usage of the AWAR will enhance accessibility. A significant increase of traffic level on local roads is not expected as mitigations measures such as the usage of the by-pass road are already in place coupled with abiding signage and speed limits. As for project induced in-migration, the data currently available shows no linkages. As such, the direction is assessed positive. The magnitude of this effect is assessed as moderate, as it will result in a noticeable change in land use opportunities for local residents. The effect will persist with the Meliadine Extension until closure. Despite the fact that the road will be removed in the interest of reclamation post-closure, this effect is considered significant given its moderately positive long-term nature.

9.7 Governance and Leadership

Consistent with the 2014 FEIS, the Meliadine Extension will continue to have significant positive effects on the fiscal performance of Governments by continued payment of taxes and royalties throughout the extended life of mine and additional employment.

9.7.1 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and governance and leadership was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.8.2, Table 9.8-2 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC governance and leadership as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below:

- Fiscal performance of Government: The Meliadine Extension would add substantially to the income of government (e.g., through taxes and royalties). However, it will also lead to increased costs, since demand for various services will go up. Given that its fiscal burden (costs) will be smaller than the public revenues it generates, Meliadine Extension would lead to a better fiscal position of all levels of government.
- Operational, regulatory and monitoring capacities of government: The Meliadine Extension would increase demand on various public services, putting additional pressure on resources. This would have a negative effect on users. However, increased training of the labour force could have a beneficial effect on capacities in the long-term.

Two updated primary pathways have been identified as a result of the Meliadine Extension and are assessed in more details below.

Table 9.7-1: Potential Primary Pathway Governance and Leadership

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Payment of taxes and royalties. Use of various public services.	Fiscal performance of government	None required.	Primary	Primary	Table 9.8-3 2014 FEIS	No change	Significant	No change	The Meliadine Extension will continue to add substantially to the income of government, for a longer period of time until 2043.
Various applications and other undertakings that draw from public services.	Operational, regulatory, and monitoring capacity of government	None required.	Primary	Primary	Table 9.8-3 2014 FEIS	No change	Significant	No change	The Meliadine Extension will continue to put pressure on public services to review permitting application and complete compliance monitoring. However, the Meliadine Extension would also have long-term beneficial effects on capacities of government institutions in Nunavut and the Kivalliq region.

9.7.1.1 Fiscal Performance of Government

The Meliadine Extension would add substantially to the income of government, (e.g., through taxes and royalties) However, it will also lead to increased costs, since demand for various services will go up. Given that its fiscal burden (costs) will be smaller than the public revenues it generates, the Project would lead to a better fiscal position of all levels of government.

Consistent with the 2014 FEIS, the Meliadine Extension would lead to increased expenses of all levels of government. As an example, the approval process could put significant strain on various agencies and boards. However, this negative effect would be more than mitigated with taxes and royalties generated from the Meliadine Extension.

In addition to the fiscal effect, positive socio-economic effects of the Meliadine Extension from, for example, raised employment levels, should lead to decreased demand for various social assistance programs. Additionally, usage of Agnico Eagles on-site clinic indicates that it serves as an important function in addressing community needs on top of work needs, lessening the pressure on the region's health infrastructure. Since they have initially been offered, approximately 70% of visits to Agnico Eagle clinic at the Meliadine mine have been for non-work-related conditions (Agnico Eagle 2020g). This should free up fiscal resources, leading to an even more positive effect on the finances of government.

9.7.1.2 Operational, Regulatory, and Monitoring Capacity of Government

Consistent with the Approved Project, continued taxes and royalties generated by the Meliadine Extension would mitigate for any added demand for government services by, for example, allowing government to add staff and other resources to respond to added demand.

In practice, however, this process is more complicated. For example, the Meliadine Extension might draw from the same labour pool as government, leading to increased competition for qualified workers. This could, in a worst-case scenario, lead to reduced government service levels and longer processing times.

Agnico Eagle will continue to facilitate the regulatory and monitoring process by ensuring good and proactive communication, transparent reporting, plain language summaries and working together with government on initiatives wherever possible; as well as complying with procedures and requirements that government requests.

On the positive side, the Meliadine Extension would also have long-term beneficial effects on capacities of government institutions in Nunavut and the Kivalliq region. For example, Agnico Eagle's education and training initiatives of its own employees could, with time, add considerably to the qualifications of the local and regional workforce (Section 9.4). Newly gained skills would be transferable beyond the end of mining operations at Meliadine to fill available positions in the region, including positions in the public sector. These employees, given their elevated skill levels, will be better equipped to take on various tasks that these jobs might require.

Overall, the positive effects on government in Nunavut and the Kivalliq region should outweigh the negative effects.

9.7.2 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The following updated primary effect pathways were identified for the Meliadine Extension:

- Fiscal performance of Government

The residual impact classification for these primary effect pathways is summarized in Table 9.7-2.

Table 9.7-2: Governance and Leadership Residual Impacts

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Fiscal Performance of Government	Positive	High	Region and Local	Long-term	Significant
Operational, regulatory and monitoring capacities of government	Negative and Positive	High	Region and Local	Long-term	Significant

Consistent with the 2014 FEIS, residual effects on fiscal performance of government are expected to be positive and long lasting. Continued payment of taxes and royalties will increase government income will additional employment at the mine site will reduce pression on social services. The geographic extent is local to regional because positive benefits will be extended for both local (i.e., Hamlet) and regional (i.e., GN) governmental bodies.

Residual effects on operational, regulatory, and monitoring capacities of government are both negative and positive. On the negative side, various applications could put a strain on public services by adding pressure on government services. However, increased local capacity and experience should lead to more cost-effective public services and increased service levels. This should make government better equipped to handle any future industrial projects and other economic activities. The magnitude of the effect is assessed high and local to regional as effects extend for both local (i.e., Hamlet) and regional (i.e., GN) governmental bodies.

Effects on Governance and Leadership are assessed to be long-term and significant given the extended life of mine and skills being transferable beyond the Meliadine Extension.

No mitigation measures would be required for effects on governance since overall, the effects would be both significant and positive.

9.8 Public and Worker Health and Safety

A summary of key changes to the assessment of Public and Worker Health and Safety for the Meliadine Extension, compared to the 2014 FEIS, is provided in Table 9.8-1 of this Application.

9.8.1 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and public and worker health and safety was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.10.2, Table 9.10-1 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC public and worker health and safety as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below:

- Good Health and Safety Performance for the Meliadine Extension: Health and Safety training may result in increased health and safety capacity for Meliadine Extension Activities
- General Public, Workers: Meliadine Extension activities, including the release of emissions, may result in changes to the environment and people’s perception of the environmental quality, which can in turn affect human health

Table 9.8-1: Potential Primary Pathways Public and Worker Health and Safety

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
All activities in all phases of the Meliadine Extension Transportation of employees, contractors, good and services for Project activities	Good Health and Safety Performance for the Project: Health and Safety training may result in increased health and safety capacity for Project Activities	No mitigation required	Primary	Primary	Table 9.10-2 2014 FEIS	No change	Not significant	Significant	Aligned with the 2014 FEIS assumptions, the Meliadine Extension is expected to have an overall positive effect on health and safety performance for the Meliadine Extension by continued provision of training and on-site health services.
All activities in all phases of the Meliadine Extension	General Public, Workers: Project activities, including the release of emissions, may result in changes to the environment and people's perception of the environmental quality, which can in turn affect human health.	Strategies that manage the release of emissions into the environment. Worker and public education on potential human health effects from the Meliadine Extension.	Primary	Primary	Table 9.10-2 2014 FEIS	No change	Not significant	No change	The Meliadine Extension activities represent a negligible change from the previously assessed and approved FEIS activities (Agnico Eagle 2014, 2018a, 2020a). The change is considered negligible because infrastructure and shipping activities, the submersed diffuser (both type and installation), discharge volume, discharge quality, and seasonality of discharge (i.e., from approximately late June to mid-September) are the same as what has been previously assessed (Agnico Eagle 2014, 2018a, 2020a). For the Meliadine Extension, the only thing changing is the duration of operations.

9.8.1.1 Good Health and Safety Performance for the Meliadine Extension

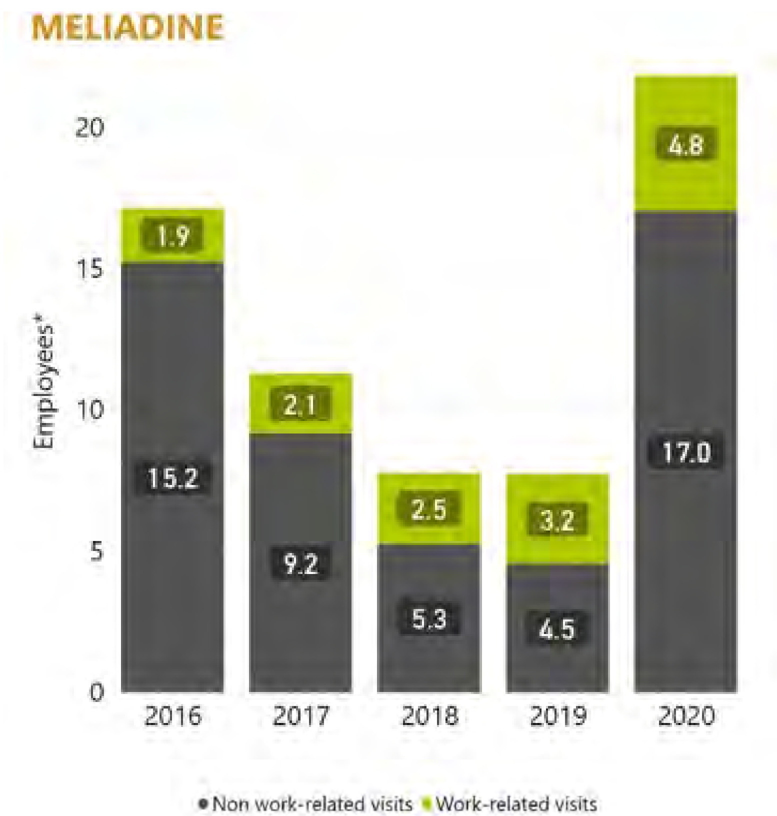
Health and Safety training may result in increased health and safety capacity for Meliadine Extension Activities

Aligned with the 2014 FEIS assumptions, the Meliadine Extension is expected to have an overall positive effect on health and safety performance for the Meliadine Extension by continued provision of training and on-site health services.

As presented in Section 9.5 of this Application, the Meliadine Extension is anticipated to continue enhancing health and safety at the mine site and outside of the workplace by continued on the job health and safety training programs.

Furthermore, the level of health and safety training of Inuit employees has been rising over time across Agnico Eagle projects. By 2020, there were ten Inuit Emergency Response Team members (Agnico Eagle 2020g). Also, the current available data shows that visits to the Agnico Eagle clinic where most of the time non work-related, which could tend to indicate that health and safety training are contributing positively to the Meliadine Extension.

Figure9.8-1: Average (per-FTE) Visits by Meliadine Employees to Clinic for Work-related or Other Reasons



Agnico Eagle Mines, 2020a as presented in Agnico Kivalliq Projects

Overall, with current available data, the Meliadine Extension is expected to continue positive effects on health and safety capacity for Meliadine Extension Activities. The extended life of mine will allow to further health and safety awareness which can be transferable to the community level as covered in the Individual, Family, and Community Wellbeing assessment.

9.8.1.2 General Public, Workers

***Meliadine Extension activities, including the release of emissions, may result in changes to the environment and people's perception of the environmental quality, which can in turn affect human health*.**

The Meliadine Extension activities represent a negligible change from the previously assessed and approved FEIS activities (Agnico Eagle 2014, 2018a, 2020a). The change is considered negligible because infrastructure and shipping activities, the submersed diffuser (both type and installation), discharge volume, discharge quality, and seasonality of discharge (i.e., from approximately late June to mid-September) are the same as what has been previously assessed (Agnico Eagle 2014, 2018a, 2020a). For the Meliadine Extension, the only thing changing is the duration of operations.

An HHERA was completed as part of the 2014 FEIS (Agnico Eagle 2014). As discussed in Section 10.1.1, the 2014 FEIS assessed the entire Meliadine Project, which included not only the Tiriganiaq deposit and the associated infrastructure, which was approved as part of the Type A Water Licence in 2016, but also the F Zone, Wesmeg, Pump, and Discovery deposits of the Meliadine Mine and the associated infrastructure, which is part of the Meliadine Extension. Thus, the HHERA in the 2014 FEIS already assessed most of the Meliadine Extension activities to be considered in this Application.

Table 10.1-3 of this Application provides a summary of Meliadine Extension components as a comparison to the approved 2014 FEIS and the 2018 and 2020 FEIS Addenda, focused on those components related to potential for adverse effects on ecological and human health.

9.8.2 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The following new primary effect pathways were identified for the Meliadine Extension:

- Good Health and Safety Performance for the Project
- General Public, Workers

The residual impact classification for these primary effect pathways is summarized in Table 9.8-2.

Table 9.8-2: Public and Worker Health and Safety Residual Impacts

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Good Health and Safety Performance	Positive	Moderate	Local	Long-term	Significant

As presented in Section 9.5 of this Application, the Meliadine Extension is expected to continue positive effect on health and safety at mine site and outside of the workplace. The magnitude is moderate, the extent to which this benefit will be realized is difficult to predict, as it may influence the behavior and decision making of some more than others, and because it is not known how individuals will react. The extent is local and long-term as the effect does not end with the closure of a project, but instead continues to influence people's behavior into the future. Therefore, the Meliadine Extension positive effect on safety is considered significant.

Consistent with the 2014 FEIS, the HHERA considers all residual impacts on human health to be not-significant (refer to Section 10.3.8 of this Application).

9.9 Socio-economic Cumulative Effect Assessment

The approach to cumulative social and economic effects is, in some respects, different from that taken by the physical and biological disciplines. When describing conditions and trends beyond present day, the socio-economic impact assessment considers all RFFDs. Only projects with proven economics (e.g., financing, some approvals) and a strong likelihood of proceeding are considered in the interest of providing a meaningful projection of future social and economic conditions. The socio-economic assessment considers the RFFDs in the Kivalliq Region potentially coinciding to have cumulative socio-economic effects (Golder 2018c).

The following projects have been assessed for potential cumulative effects: Meadowbank Complex and potential future developments, Kivalliq Hydro Fiber Link, existing employment opportunities with the KivIA and GN. Those without approval, or that do not temporally overlap with the Meliadine Extension are not considered as RFFDs from a socio-economic perspective. Kivalliq Inuit workforce appears to be sufficient. By 2019, there were almost 5,400 Inuit in Kivalliq of working age (20-64 years), and this is expected to grow to 6,083 over the next five years (Agnico Eagle 2020g).

Data regarding the current Meliadine Mine operation demonstrates that most of the Inuit workforce is from the Kivalliq Region. Of the Inuit workforce in 2020 (73), only one employee resided outside the Kivalliq Region. 58% of Meliadine's Kivalliq-based employees were from Rankin Inlet (Agnico Eagle 2020g). Agnico Eagle prioritizes the Kivalliq workforce for employment opportunities and, as noted above, provides fly-in fly-out services in Kivalliq communities. Agnico Eagle does not provide fly-in fly-out services in Kitikmeot or Baffin communities, and does not target the workforce in these regions for employment to the extent done in Kivalliq. Similarly, Agnico Eagle targets Kivalliq suppliers for contracting and procurement opportunities (Agnico Eagle 2016).

The 2014 FEIS and Meliadine Extension are expected to extend the prioritization of Kivalliq employment candidates and businesses, and the commitments regarding procurement identified in the IIBA. As a result, potential for overlapping employment demand from developments in other regions is considered limited to none.

9.10 Socio-Economic Uncertainty

There is inherent uncertainty in assessing the significance of some socio-economic effects given the reliance of effect realization on the responses of individuals, families and communities to effect stimuli, mitigation, and benefit enhancement measures. Forces outside the control of a single Meliadine Extension can further this uncertainty by undermining the effectiveness of mitigation and benefit enhancement measures.

The expectation is that an effect brought forward for assessment will in fact occur, at least to some degree. The SEMR monitors against the predicted impacts described in the FEIS of each project, as well as the concerns and priorities identified by the Kivalliq Socio-Economic Monitoring Committee (Kivalliq SEMC). Results collected to date as part of the SEMR reduced uncertainties as general trends can be observed on a yearly basis (i.e., in-migration, Inuit employee survey, etc.).

Confidence in the prediction of whether an effect is significant or not is often high, regardless of all the uncertainties in describing the detail of that effect. This may at times seem to be a contradiction. For example, effects on GDP and labour income are only an approximation based on Input/Output modelling. Even in the event of large errors in the approximation, however, the Meliadine Extension's effects on GDP and labour income will necessarily be significant.

In addition, responding to community-level changes in demand for housing, schools, healthcare, and policing is under the purview of local, territorial, and federal authorities with a mandate to ensure that services are provided to the community. Given this point, confidence in the assessment of effects on infrastructure and services is moderate.

9.11 Socio-Economic Monitoring and Follow-up

Consistent with the 2014 FEIS, the SEMCs will monitor the socio-economic impacts of projects in each of the Territory's regions against Project Certificate T&C specified by the NIRB. The SEMC's Terms of Reference state that the committees will assist proponents in developing project monitoring programs and prepare reports and publish information on the impact of major development projects on the health and well-being of communities and residents in the region.

Agnico Eagle considers that T&Cs 87, 88, 89, 93, 95, 96, 97, 98, 99, 100, 101, 108, 109, 110, 111, 112, 113, 114, 115, 116 of Project Certificate No.006, is sufficient to monitor the predicted impacts outlined in the 2014 FEIS, as well as protect and mitigate impacts associated with the Meliadine Extension. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

The Agnico Kivalliq Projects SEMP which provides the framework for socio-economic monitoring of Agnico Eagle's mineral projects in the Kivalliq Region of Nunavut has been provided in Appendix D-32 to support this Application.

9.12 Traditional Activity and Knowledge

Consistent with the Approved Project, the Meliadine Extension will continue to have both positive and negative effects on traditional and commercial harvesting as well as land use and mobility. The sustainability of traditional harvesting is not expected to be affected due to Extension-related changes in the availability of traditional resources. The Meliadine Extension will result in changes to noise and visual effects from the 2014 FEIS Land Use and Mobility due to the addition of a windfarm and the airstrip alternative. The extended life of mine will allow local residents a continued usage of the AWAR until closure and will enhance access to Iqalugaarjuup Nunanga Territorial Park and the surrounding areas for local residents.

A summary of key changes to the assessment of the Traditional Activity and Knowledge for the Meliadine Extension, compared to the FEIS developed for the 2014 FEIS, is provided in Table 9.12-1 of this Application. Primary pathways are consistent with the 2014 FEIS and no new pathways were identified due to the Meliadine Extension.

9.12.1 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and traditional activity and knowledge was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.3.2, Table 9.3-17 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC traditional activity and knowledge as a result of Meliadine Extension, there is no change from the previous assessment.

The following primary pathways were identified for the Meliadine Extension Traditional Activity and Knowledge assessment:

Traditional and Commercial harvesting

- Meliadine Extension activities may affect availability of terrestrial and marine wildlife for harvesting.

Land Use and Mobility

- Meliadine Extension footprint may change usage and access to culturally important areas

Two updated primary pathways have been identified as a result of the Meliadine Extension and are assessed in more details below.

Table 9.12-1: Potential Primary Pathways Traditional Activity and Knowledge

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
All	Traditional and commercial harvesting	Traditional pursuits of Inuit employees accommodated within work schedules and coordinated with the operational needs of the Project. Use minimal size footprint. Use of AWAR for access to traditional harvesting areas. Other mitigation measures related to terrestrial and marine wildlife and vegetation components	Primary	Primary	Table 9.3-18 2014 FEIS	No change	Not Significant	No change	The sustainability of traditional harvesting is not expected to be affected due to Extension-related changes in the availability of traditional resources and as a result this effect was assessed as not significant.
All	Land Use and Mobility	Use minimal sized footprint. Use of AWAR for access to traditional use areas.	Primary	Primary	Table 9.3-19 2014 FEIS	No change	Significant	No change	The Meliadine Extension will continue to enhance access to the LSA and local areas. The Extension noise level effect on traditional activities will be enhanced (low to negligeable) due to the addition of a windfarm and the airstrip alternative. Visual disturbance will be enhanced by the addition of an on-site windfarm.

9.12.1.1 Traditional and Commercial Harvesting (updated)

Meliadine Extension activities may affect availability of terrestrial, marine wildlife and vegetation for harvesting

Terrestrial Wildlife

Consistent with of the 2014 FEIS Section 6.6.8, no changes in availability of wildlife for harvesting effects from the Meliadine Extension are predicted. People that hunt in the region should not observe a change in the availability of wildlife due to effects from the Meliadine Extension. Refer to Section 6.6 of this Application.

Vegetation

Meliadine Extension-related effects on the traditional use of plants were assessed as part of the 2014 FEIS Section 6.5.10. Consistent with the 2014 FEIS, the overall effect from the Meliadine Extension on the use of vegetation resources is expected to be within the range of baseline conditions. The incremental direct vegetation loss due to the Meliadine Extension is expected to be 227 ha or 2% of the Meliadine Extension LSA (refer to Table 6.5-5 of this Application). Dust deposition is expected to result in low and localized changes to vegetation along the right-of-way for the access roads. Concentrations of air emissions from increased truck traffic may result in a local indirect change on the quality of vegetation and associated wildlife habitat within the Meliadine Extension LSA (refer to Section 6.5.4).

Freshwater Fish

Consistent with the 2014 FEIS Volume 7, Section 7.5.6.3, the anticipated overall decrease in the availability of fish for harvesting is predicted to be within the range of baseline values. As a result, people that fish in the LSA should not observe a change in the availability of fish due to effects from the Meliadine Extension, relative to current natural changes in population sizes.

Marine Wildlife

Availability of marine species for harvesting is not expected to change from what was assessed as part of the 2014 FEIS and there is no residual effect, refer to Section 8 of this Application.

9.12.1.2 Land Use and Mobility

Meliadine Extension footprint may change usage and access of culturally important land use areas

An assessment of the Meliadine Extension’s effects on land use and mobility considers the interactions between Meliadine Extension development and land use activities. Consistent with the 2014 FEIS effects can either be on usage or access to culturally important areas.

As part of this assessment a viewshed analysis was conducted for the Meliadine Extension. The purpose of a viewshed model is to identify any locations within the LSA that have a line-of-sight to any proposed infrastructure for the Meliadine Extension, including the wind turbines. To reduce the complexity of the model, it is assumed that all locations in the LSA that have a view of any component also have a view of at least one WRSF, at least one wind turbine, or the TSF. This assumption is reasonable given that the region has very little topographic relief and that all components are in close proximity to the TSF or to a WRSF.

The viewshed was modelled under two scenarios:

- Out to the extent of the LSA (a 30 km buffer of the Extension covering 4,243 km^2), where all infrastructure was included; and
- Within a 4 km buffer (clearly visible within eyesight) of the Extension infrastructure (total area of 227.4 km^2). A buffer of this size creates two distinct areas around the main mine site (163.2 km2) and the Discovery site (64.2 km^2), so the viewshed model was calculated to include only the Extension components that fell within each buffer area (i.e., locations within the 4 km buffer around Discovery could not "see" any components in the main mine site, and vice versa).

Some portion of the Meliadine Extension is visible from 49% (2,094 km^2) of the LSA 30 km buffer area, including from locations in Rankin Inlet and Iqalugaarjuup Nunanga Territorial Park (Figure 9.12-1). Locations with a line-of-sight are uniformly spread throughout the LSA except for areas to the east and north, where the relief (i.e., hills up to 330 m in elevation) fully obscures the mine.

Within the 4 km buffer (163.2 km^2 around the Mine Site and 64.2 km^2 around Discovery deposit), Meliadine Extension is likely visible from all surrounding locations with few exceptions due to the flat local relief (Figure 9.12-2). Around the Mine Site, 94% (153.6 km^2) of the area has a view of the Meliadine Extension, and around Discovery, 86% (54.9 km^2) of the area has a view of Discovery infrastructure.

Overall, the Meliadine Extension will increase visual disturbance compared to the Approved by the addition of the wind turbines to the mine infrastructures. Elevations of the top of wind turbines (defined as pylon height plus blade length) were determined by assuming a standard height of 144.5 m for each turbine that was then added to the ground elevation at the location of each individual turbine.

However, the Extension is not anticipated to significantly increase noise level from what was predicted in 2014. Low increase in sound level is predicted at 3 cabin locations and 17 negligible. More details are provided in Table 5.5-2 of this Application.

People who are able to see the windfarm and hear Meliadine Extension-related noise may experience a diminished sense of wilderness character while in these areas. However, this is not significantly different from the current operation.

Figure 9.12-1: Viewshed of the Meliadine Extension Infrastructure within a 30 km Radius

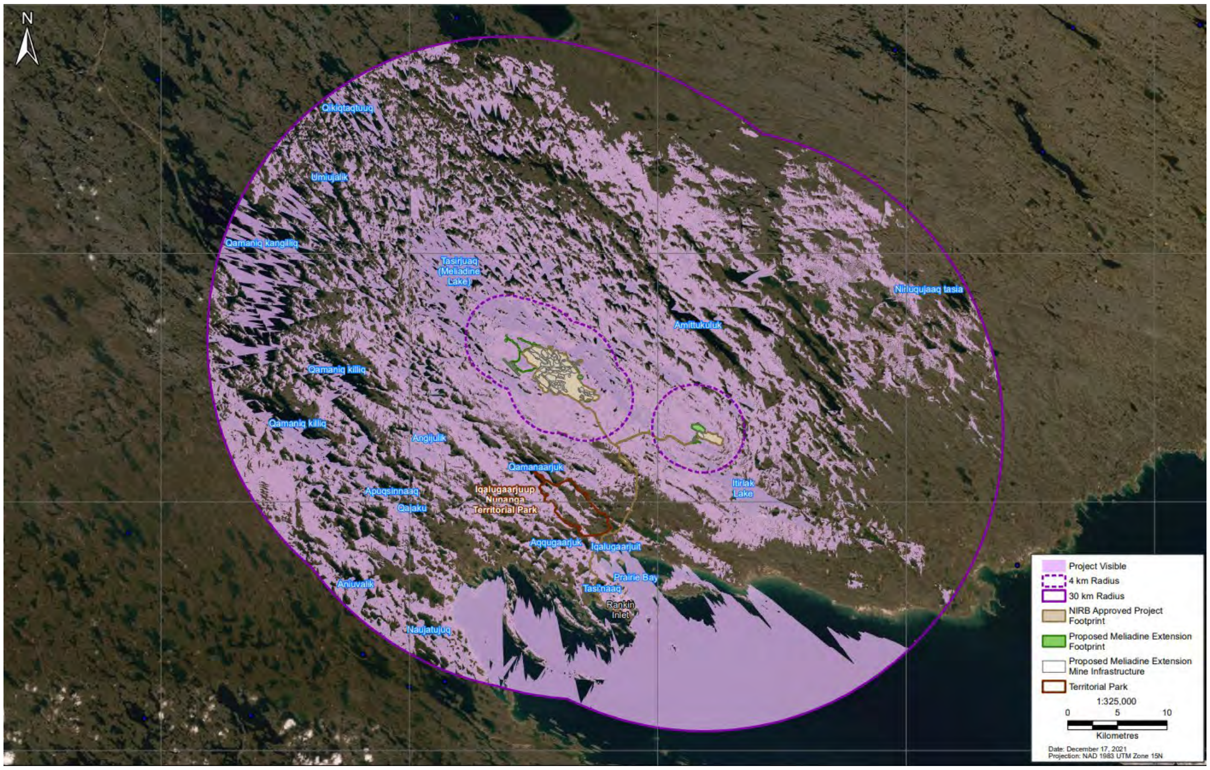
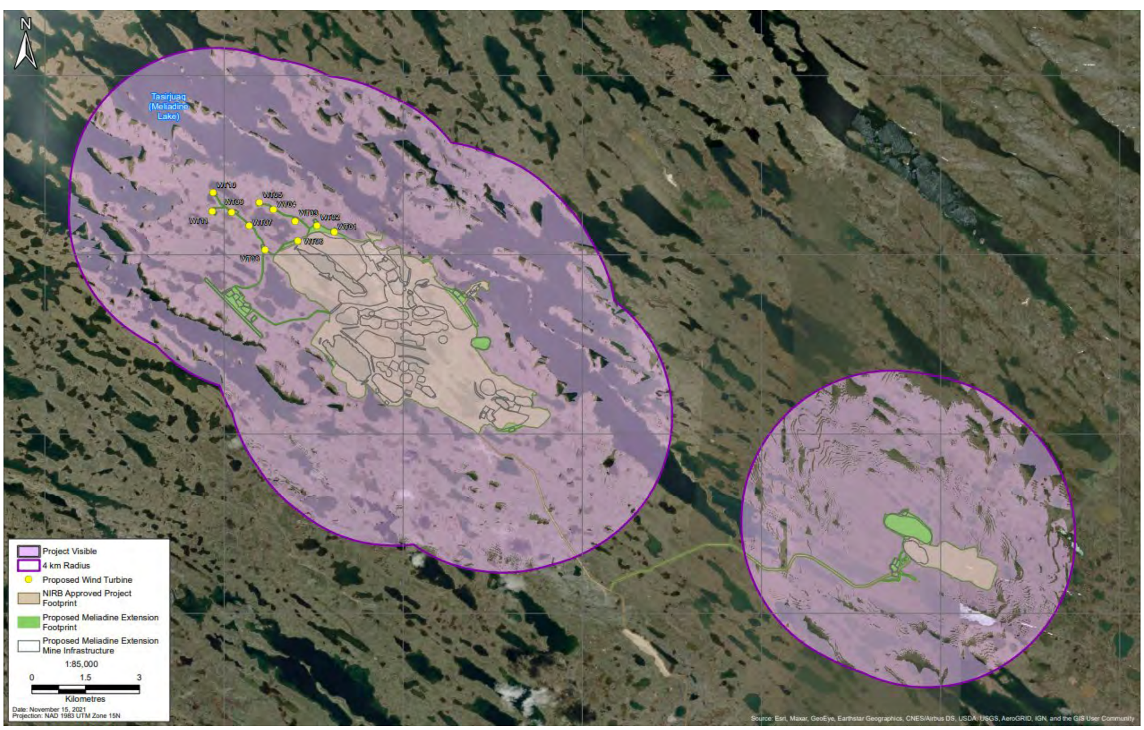


Figure 9.12-2: Viewshed of the Meliadine Extension Infrastructure within a 4 km Radius



An assessment of the Meliadine Extension's effects on heritage resources was completed in Section 9.14. There are 139 archaeological sites identified within the LSA of those 52 were mitigated. Since all sites which will be impacted by the Meliadine Extension either have, or will be mitigated using standard archaeological methods, none of the impacts to the archaeological sites are considered to contribute to significant residual effects on the overall archaeological record baseline because a record of the site has been documented and will be preserved in permit reports.

Meliadine Extension will continue to enhance access to culturally important areas such cabins, and Iqalugaarjuup Nunanga Territorial Park by using the AWAR.

Consistent with the 2014 FEIS, effects to land use and mobility are considered both positive and negative. The Meliadine Extension will have a negative effect on the use of culturally important areas (visual and noise disturbance) and a positive effect on access to land use areas with the AWAR, resulting in a significant effect on land use and mobility.

9.12.2 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The following updated primary effect pathways were identified for the Meliadine Extension:

- Traditional and Commercial harvesting
- Land Use and Mobility

The residual impact classification for these primary effect pathways is summarized in Table 9.12-2.

Table 9.12-2: Traditional Activity and Knowledge Residual Impacts

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Traditional and Commercial Harvesting	Positive and Negative	Low	Local to Regional	Long term	Not significant
Land Use and Mobility	Positive and negative	Moderate	Local and Regional	Long-term	Significant

Consistent with the 2014 FEIS, the Meliadine Extension effects to Traditional and Commercial Harvesting are considered both positive and negative. The Meliadine Extension will continue to positively enhance access to harvesting areas by allowing continued usage of the AWAR. While no change from the 2014 FEIS is anticipated from the Meliadine Extension on the availability of terrestrial and marine wildlife for harvesting, the direction remains negative. The magnitude is considered low as the Extension is anticipated to be within the range of baseline conditions assessed as part of the 2014 FEIS. The geographic extent for vegetation and freshwater fish is local while it is regional for terrestrial and marine wildlife.

Effects will persist during the Meliadine Extension and are thus considered long-term. The sustainability of traditional harvesting is not expected to be affected due to Extension-related changes in the availability of traditional resources and as a result assessed not significant.

The Meliadine Extension effects to land use and mobility are considered both positive and negative. The Meliadine Extension will have a negative effect on the use of culturally important areas and a positive impact on access to land use areas, resulting in a significant effect on land use and mobility. Consistent with the 2014 FEIS, noise and changes to the visual environment are considered negative. The magnitude of the effect is considered moderate. While noise effects are limited to the LSA, the visual effect extends beyond the LSA, and is considered to be regional. Effects will persist during the Meliadine Extension and are thus considered long-term.

9.12.3 Cumulative Effects Assessment

Traditional and Commercial Harvesting

Cumulative effects from changes in availability of wildlife, vegetation, freshwater fish and marine species were assessed and summarized in the below section:

- Marine Environment, Section 8.3.5.
- Terrestrial Environment, Section 6.6.7.

Land Use and Mobility

There are no other developments within the LSA and limited development in the RSA. However, a general increasing trend in the number of cabins and trail development and usage beyond the LSA has been observed (refer to Figure 1.8-1 in Appendix G-08) which may contribute in the long-term to a diminished sense of wilderness if this effect continues overtime.

Effects from noise and usage of the AWAR will be limited to the LSA, and no other projects are identified within the LSA. As a result, there are no cumulative effects.

Visual effects from the windfarm won’t persist beyond the life of the Meliadine Extension. As a result, cumulative effects are not anticipated.

9.12.4 Monitoring and Follow-up

The Agnico Kivalliq Projects SEMP provides the framework for socio-economic monitoring of Agnico Eagle’s mineral projects in the Kivalliq Region of Nunavut. SEMP Existing Management and Mitigation (Program and Initiatives) related to Culture and Traditional Activities are listed in Appendix D-32 of this Application.

Agnico Eagle considers that T&C 102 and 103 of Project Certificate No.006, are sufficient to protect, mitigate and monitor potential impacts associated with the Meliadine Extension.

Monitoring and follow-up plans for traditional activities relate to monitoring activities developed for the underlying valued components. Monitoring and follow-up plans for the various components related to traditional activities can be found as follows:

- TEMMP (Appendix D-34)
- AEMP (Appendix D-05)
- Shipping Management Plan (Appendix D-31)

9.13 Non-Traditional Land and Resource Use

Consistent with the 2014 FEIS, the Meliadine Extension will continue to have both positive and negative effects on hunting and fishing as well as tourism, recreation, and protected areas. Changes to noise effects related to the Meliadine Extension will be limited to the LSA and as such no incremental changes are anticipated for the RSA. Visual disturbance will be regional in extent by the addition of an on-site windfarm. The extended life of mine will allow local residents a continued usage of the AWAR until closure and will enhance access to Iqalugaarjuup Nunanga Territorial Park and the surrounding areas for local residents.

A summary of key changes to the assessment of the Individual and Community Wellness for the Meliadine Extension, compared to the 2014 FEIS, is provided in Table 9.13-1 of this Application. No new primary pathway were identified due to the Meliadine Extension.

9.13.1 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and non-traditional land and resource use was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.9.2, Table 9.9-1 of the 2014 FEIS. As no new or additional pathways were identified for minor and no linkage for the VEC non-traditional land and resource use as a result of Meliadine Extension, there is no change from the previous assessment.

Primary pathways that require further effects analysis to determine the environmental significance from the Meliadine Extension are provided below:

Hunting and Fishing

- The Meliadine Extension may increase access to non-traditional hunting and fishing opportunities, outfitting and guiding businesses in the RSA via the AWAR.
- The Meliadine Extension may affect the availability of wildlife for hunting and fish for fishing in the RSA.
- Meliadine Extension-related noise and visual effects may have an effect on hunting and fishing in the RSA

Tourism, Recreation, and Protected Areas

- The Meliadine Extension may enhance access to Iqalugaarjuup Nunanga Territorial Park, a major tourist attraction and recreation area in the RSA, and surrounding areas via the AWAR
- Meliadine Extension-related noise and visual effects may have an effect on tourism in the RSA

Two updated primary pathways have been identified as a result of the Meliadine Extension and are assessed in more details below.

Table 9.13-1: Potential Primary Pathway Non-Traditional Land and Resource Use

Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment – 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts - Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance - Meliadine Extension	Meliadine Extension Rationale
Construction and operations	Hunting and Fishing: The Meliadine Extension may increase access to non-traditional hunting and fishing opportunities, outfitting and guiding businesses in the RSA via the AWAR. The Project may affect the availability of wildlife for hunting and fish for fishing in the RSA. Meliadine Extension-related noise and visual effects may have an effect on hunting and fishing in the RSA	Employ mitigation measures associated with wildlife habitat, fish and fish habitat and noise pathway analysis Where possible, minimize the above-ground visibility of waste rock piles.	Primary	Primary	Table 9.9-2 2014 FEIS	No change	Not Significant	No change	The Meliadine Extension will continue to enhance access to non-traditional hunting and fishing by using the AWAR for an additional 11 years. Project-related noise effect related to hunting and fishing in the RSA are consistent with the 2014 FEIS. Changes to noise effects related to the Meliadine Extension will be limited to the LSA and as such no incremental changes are anticipated for the RSA. Visual disturbance will be enhanced by the addition of an on-site windfarm.
Construction and operations	Tourism, recreation, parks and protected areas: The Project may enhance access to Iqalugaarjuup Nunanga Territorial Park, a major tourist attraction and recreation area in the RSA, and surrounding areas via the AWAR. Project-related noise and visual effects may have an effect on tourism in the RSA	Employ mitigation measures for noise pathway analysis Where possible, minimize the above-ground visibility of waste rock piles.	Primary	Primary	Table 9.9-2 2014 FEIS	No change	Not significant	No change	The Meliadine Extension will continue to enhance access to the Iqalugaarjuup Nunanga Territorial Park by using the AWAR for an additional 11 years. The Extension noise level effect on tourism, recreation, parks and protected areas remains consistent with the 2014 FEIS. Although, visual disturbance will be enhanced by the addition of an on-site windfarm.

9.13.1.1 Hunting and Fishing

The Meliadine Extension may increase access to non-traditional hunting and fishing opportunities

Consistent with the 2014 FEIS, the Meliadine Extension may improve non-traditional hunting and fishing opportunities and outfitting and guiding businesses in the RSA in that the AWAR will provide enhanced access to wilderness areas. Enhanced access to resources and recreational areas for NTLU is considered to be a positive effect. Given the limited amount of non-traditional land uses, this effect is assessed to have a low effect.

The Meliadine Extension may affect the availability of wildlife for hunting and fish for fishing in the RSA.

Affect to the availability of wildlife for non-traditional harvesting and fish for non-traditional fishing are consistent with the 2014 FEIS and were assessed in Volume 6, Sections 6.6 and FEIS Volume 7, 7.5 respectively (Agnico Eagle 2014).

Meliadine Extension-related noise and visual effects may have an effect on hunting and fishing in the RSA

Meliadine Extension-related noise effect related to hunting and fishing in the RSA are consistent with the 2014 FEIS. Changes to noise effects related to the Meliadine Extension will be limited to the LSA and as such no incremental changes are anticipated for the RSA. Details on noise and points of reception are provided in Section 5.5 of this Application.

However, the visual effects from the Meliadine Extension are considered regional as it extends beyond the LSA. Some portion of the Meliadine Extension is visible from 49% (2,094 km^2) of the LSA buffer area, including from locations in Rankin Inlet and Iqalugaarjuup Nunanga Territorial Park (Figure 12.1-1). Locations with a line-of-sight are uniformly spread throughout the LSA except for areas to the east and north, where the relief (i.e., hills up to 330 m in elevation) fully obscures the mine. Refer to Section 9.12.1.2 of this Application for the complete Meliadine Extension viewshed analysis.

Overall, the Meliadine Extension will increase visual disturbance compared to the Approved Project by the addition of the wind turbines to the mine infrastructures. Elevations of the top of wind turbines (defined as pylon height plus blade length) were determined by assuming a standard height of 144.5 m for each turbine that was then added to the ground elevation at the location of each individual turbine.

9.13.1.2 Tourism, Recreation, and Protected Areas

Meliadine Extension may enhance access to Iqalugaarjuup Nunanga Territorial Park, a major tourist attraction and recreation area in the RSA, and surrounding areas via the AWAR

Meliadine Extension will continue to enhance access to Iqalugaarjuup Nunanga Territorial Park, a major tourist attraction and recreation area in the RSA and surrounding areas via the AWAR. Enhanced access to the Iqalugaarjuup Nunanga Territorial Park is considered a positive effect.

Meliadine Extension-related noise and visual effects may have an effect on tourism in the RSA

Meliadine Extension-related noise effect related to tourism, recreation, and protected areas in the RSA are consistent with the 2014 FEIS. Changes to noise effects related to the Meliadine Extension will be limited to the LSA and as such no incremental changes are anticipated for the RSA. Details on noise and points of reception are provided in Section 5.5 of this Application.

The visual effect from the Meliadine Extension extends beyond the LSA, and is considered to be regional. Overall, the Meliadine Extension will increase visual disturbance compared to the Approved Project by the addition of the wind turbines to the mine infrastructures. Elevations of the top of wind turbines (defined as pylon height plus blade length) were determined by assuming a standard height of 144.5 m for each turbine that was then added to the ground elevation at the location of each individual turbine (refer to Section 9.12.1.2).

9.13.2 Residual Impact Classification

Residual impact classification definitions and the effects criteria and level for determining significance are summarized in Section 4.5.2 of this Application and described in detail in Volume 4, Section 4.5.3-4.5.5 of the 2014 FEIS.

The following updated primary effect pathways were identified for the Meliadine Extension:

- Hunting and Fishing
- Tourism, recreation and protected areas

The residual impact classification for these primary effect pathways is summarized in Table 9.13-2.

Table 9.13-2: Non-Traditional Land and Resource Use Primary Pathway

Effect Pathways	Direction	Magnitude	Geographic Extent	Duration	Significance
Hunting and Fishing	Positive and negative	Negligible to moderate	Regional	Long-term	Not Significant
Tourism, recreation and protected areas	Positive and negative	Negligible to moderate	Regional	Long-term	Not Significant

Consistent with the 2014 FEIS, the Meliadine Extension effects to Non-Traditional Land and Resource Use are considered both positive and negative. Continued access of the AWAR to hunting, fishing and recreation areas is considered positive. Changes to noise effects related to the Meliadine Extension will be limited to the LSA and as such no incremental changes are anticipated for the RSA from the 2014 FEIS assessment. The visual effect from the Meliadine Extension extends beyond the LSA, and is considered to be regional and negative. While the magnitude of the effect does not change the direction remains negative. The effects will persist throughout the Meliadine Extension LOM and is thus considered long-term in duration.

As assessed in the 2014 FEIS (Section 9.9.4), Non-Traditional hunting, fishing, and tourism activities are not prevalent in the RSA as such the effects are assessed not significant. No changes from the 2014 FEIS to the availability of wildlife for hunting and fish for fishing in the RSA is anticipated with the Meliadine Extension.

9.13.3 Cumulative Effects Assessment

There are no other developments within the LSA and limited development in the RSA

Effects from noise and usage of the AWAR will be limited to the LSA, and no other projects are identified within the LSA. As a result, there are no cumulative effects.

Visual effects from the windfarm will not persist beyond the life of the Meliadine Extension. As a result, cumulative effects are not anticipated.

9.13.4 Uncertainty

Not applicable

9.13.5 Monitoring and Follow-up

Agnico Eagle considers that T&C 104 and 105 of Project Certificate No.006, are sufficient to protect, mitigate and monitor potential impacts associated with the Meliadine Extension.

9.14 Cultural, Archaeological and Paleontological Resources

Consistent with the 2014 FEIS and the 2018 and 2020 Addenda, potential direct effects to heritage resources are associated primarily with the construction and operations phase during ground altering activities and the removal of soil, vegetation, and bedrock. Direct effects could potentially occur during the closure phase in the event activities extend beyond the existing footprint. Heritage resources are non-renewable and can be permanently damaged or destroyed during these activities.

9.14.1 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge, and Engagement

Since the 2014 FEIS, additional IQ additional IQ, TK, and comments/concerns did not highlight any new concerns related to the existing environment or baseline information regarding the Cultural, Archaeological and Paleontological Resources. The Meliadine Extension does not change IQ, TK and comments/concerns integration from the 2014 FEIS (Volume 9 Section 9.11.2.5).

The additional sources of IQ, TK, and engagement reviewed are listed below:

- FEIS Addendum Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2020 (Agnico Eagle 2018a)
- Water License Amendment Consultation and Engagement Report, December 2020 (Agnico Eagle 2020)

- Waterline Consultations Report 2020 - Preliminary phase of consultation with Rankin Inlet key stakeholders for the Meliadine Waterline project from January-March and July 2020 (Agnico Eagle 2020c)
- Waterline Consultations Report 2020-Consultation Plan for the Meliadine Waterline project Existing Environment and Baseline Information, August 2020 (Agnico Eagle 2020d)
- Community and public engagement for the Meliadine Extension (Section 3 of this Application).

9.14.2 Existing Environment

The first recorded archaeological study for the Meliadine Mine was conducted in 1998 (Hart 1998). As summarized in the Archaeology Site Status Report (Nunami Stantec 2021), subsequent archaeological studies were conducted in 2008, 2010, 2011, 2012, 2014, 2016, 2017, 2018, and 2019.

As a result of baseline studies, a total of 101 archaeological sites were identified within the LSA and two adjacent to the LSA in the Rankin Inlet (refer to the 2014 FEIS Volume 9, Sections 9.11-2, 9.11-3, 9.11-4). The possible cultural affiliations for the archaeological sites that have been identified within the LSA include Pre-Dorset, Dorset, and Neoeskimo (Thule and Inuit). There may also be a connection with the Taltheilei tradition, but the nature of this connection has not been explored. According to baseline IQ studies, it was during the period between 1956 and 1974 that Meliadine and Diana lakes and rivers became important camping areas; however, there are archaeological sites in the LSA which suggest a longer use by Thule-Inuit (Agnico Eagle 2014).

In summary, the types of heritage resources documented in baseline studies include:

- 52 recorded archaeological sites within the mine infrastructure LSA. These sites are associated with Pre-Dorset, Dorset, and Thule - Inuit. There is diversity of feature types including tent rings, cache (both square and round interiors), semi-subterranean houses (winter sod-house), qarmaq (fall to early winter house), traps, hearths, kayak caches, hunting blinds, and stone markers. Brief descriptions of these sites are contained in the 2014 FEIS Appendix 9-11-A.
- 48 recorded archaeological sites within the AWAR LSA. These sites are associated with Thule, Inuit, and possibly Pre-Dorset. There is diversity of feature types including tent rings, cache, traps (leg hold and beehive construction), hearths, hunting blinds, and Inuksuit/stone markers.
- 1 archaeological campsite located in the Rankin Inlet LSA.

Impact assessments for the Meliadine Extension were conducted over a two-year period; 2020 and 2021. Methods are consistent with the 2014 FEIS and are detailed in Section 9.11.3 (Agnico Eagle 2014). In summary, methods included:

- Record review and gap analysis on previously conducted studies for the Meliadine Mine and site status update.
- Field studies including ground reconnaissance of potential development areas to identify and record archaeological sites, if present.

Identified archaeological sites were documented in the following manner:

- Archaeological sites were assigned a Borden Number by the Archaeological Survey of Canada, Canadian Museum of Civilization and recorded using the Universal Transverse Mercator (UTM)
- Digital Photographs were taken, and sketch map were prepared to illustrate the sites setting.

Table 9.14-1: Current Archaeological Sites within the LSA Compared to the 2014 FEIS and 2018 and 2020 FEIS Addenda

LSA	Approved Project (2014 FEIS, and 2018 and 2020 Addenda	Meliadine Extension
Mine Infrastructure	76 sites includes: • 52 sites recorded as part of the 2014 FEIS • 1 new site recorded after the Approved Project	23 new sites recorded related to the Meliadine Extension.
AWAR	62 sites includes: • 10 sites recorded prior to the 2014 FEIS located in the LSA • 48 sites recorded as part of the 2014 FEIS • 4 new sites identified after the Approved Project.	No change
Rankin Inlet	1 site • consistent with Approved Project FEIS	No change
Total	**116**	**23**

A total of 139 archaeological sites were recorded in the LSA area, out of those, 23 are in the development area of the Meliadine Extension. The cultural affiliation of archaeological sites recorded as part of the Meliadine Extension are affiliated to the Neoskimo period and consist of hunting blind, campsite, cache and inuksuk. Within the LSA, a total of 39 sites were mitigated around the Mine Infrastructure and 13 along the AWAR. Continued avoidance by 30 meters will be continued for the sites not mitigated and mitigations measures implemented prior to development when required.

Since the 2014 FEIS submission, 28 new sites were identified throughout archaeological assessment conducted for the Meliadine Mine. Additionally, 10 sites recorded prior to the 2014 FEIS (1970s-80s) were included to the current total as they are located within the LSA area.

Given the confidential nature of archaeological sites, their locations are not provided in this document (e.g., on figures).

9.14.3 Assessment of Potential Meliadine Extension-related Effects

A pathway analysis to identify and assess linkages between activities included in the application and cultural, archaeological, and paleontological resources use was completed for the Meliadine Extension. Pathways determined to have no linkage, or those that are considered minor, are not predicted to result in environmentally significant effects and are not assessed further. Pathways defined as no linkage and minor are provided in Appendix B-2, Table B-8 of this Application and are also described in Volume 9, Section 9.11.5, Table 9.11-1 of the 2014 FEIS, and Section 8.1 of the 2018 and 2020 FEIS Addenda. As no new or additional pathways were identified for minor and no linkage for the VEC cultural, archaeological, and paleontological resources use as a result of Meliadine Extension, there is no change from the previous assessment.

Consistent with the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a), there are no primary pathways anticipated for heritage resources. A pathway may have primary linkage if the pathway is likely to result in a measurable environmental change that could contribute to significant residual effects on archaeological record baseline. Since all sites which will be impacted by the Meliadine Extension either have, or will be mitigated using standard archaeological methods, none of the impacts to the archaeological sites are considered to contribute to significant residual effects on the overall archaeological record baseline because a record of the site has been documented and will be preserved in permit reports. Therefore, no primary linkages are anticipated, and a residual effects assessment and classification is not required with respect to Meliadine Extension impacts on the archaeological record.

9.14.4 Cumulative Effect Assessment

Consistent with the 2014 FEIS, pathways for cultural, archaeological, and paleontological resources have been assessed as minor and are not assessed further. In addition, cultural, archaeological, and paleontological resource components are localized close to Meliadine Extension and do not interact with other disturbances regionally.

The Iqalugaarjuup Nunanga Territorial Park was included in the 2014 FEIS cultural and heritage resources RSA because of its relevance to culture and heritage resources and has a high potential for archaeological sites. Meliadine Extension does not propose impacts within the footprint of the Iqalugaarjuup Nunanga Territorial Park that would result to a change the effects assessment. All project infrastructures will be outside the boundaries of the park.

9.14.5 Uncertainty

Consistent with the 2014 FEIS and the 2018 and 2020 FEIS Addenda, future proposed changes to Meliadine Extension footprint, if contemplated, or other ancillary activities will be assessed relative to the cultural, archaeological, and paleontological resources VEC through desktop review and field studies (where warranted) by a qualified archaeologist. Any data gaps will be addressed prior to ground disturbance activities by a qualified archaeologist. Agnico Eagle is committed to providing ongoing consultation with the community of Rankin Inlet (specifically Elders and the HTO Members) and to provide opportunities for participation in heritage resource surveys and mitigation measures. These activities will address uncertainty with respect to potential Meliadine Extension effects to the cultural, archaeological, and paleontological resources VEC.

9.14.6 Monitoring and Follow-up

Agnico Eagle has an approved Cultural and Heritage Resources Protection Plan that will continue to be implemented to limit effects to heritage resources (Appendix D-10). The principal goal of the Cultural and Heritage Resources Protection Plan is to continue to actively manage potential damages to heritage resources.

Agnico Eagle provides an education program (i.e., online training) for all of its employees, contractors, and visitors before coming to site that provides general awareness training and includes general guidelines for the appropriate response to the inadvertent discovery of known or suspected archaeological sites. This will aid in limiting direct and indirect effects to the heritage resources VEC during construction, operations, and closure of the Meliadine Extension.

Implementation of appropriate mitigation measures that are acceptable to the regulators, such as site avoidance or further investigation at archaeological sites that cannot be avoided, will reduce or eliminate impacts to archaeological sites as a result of Meliadine Extension.

Agnico Eagle considers that existing T&C 106 and 107 of Project Certificate No.006 are sufficient to protect, mitigate and monitor potential impacts associated with the Meliadine Extension. Agnico Eagle is committed to incorporating any new mitigation measures in the applicable management plan.

10 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Section 10 focuses on the human health and ecological risk assessment (HHERA) for the Meliadine Extension. The purpose of the HHERA is to evaluate the potential for adverse health effects to terrestrial wildlife (i.e., mammals and birds), aquatic life, and human health associated with changes in environmental quality due to chemical releases from the Meliadine Extension.

10.1 Overview

10.1.1 Meliadine Regulatory Background

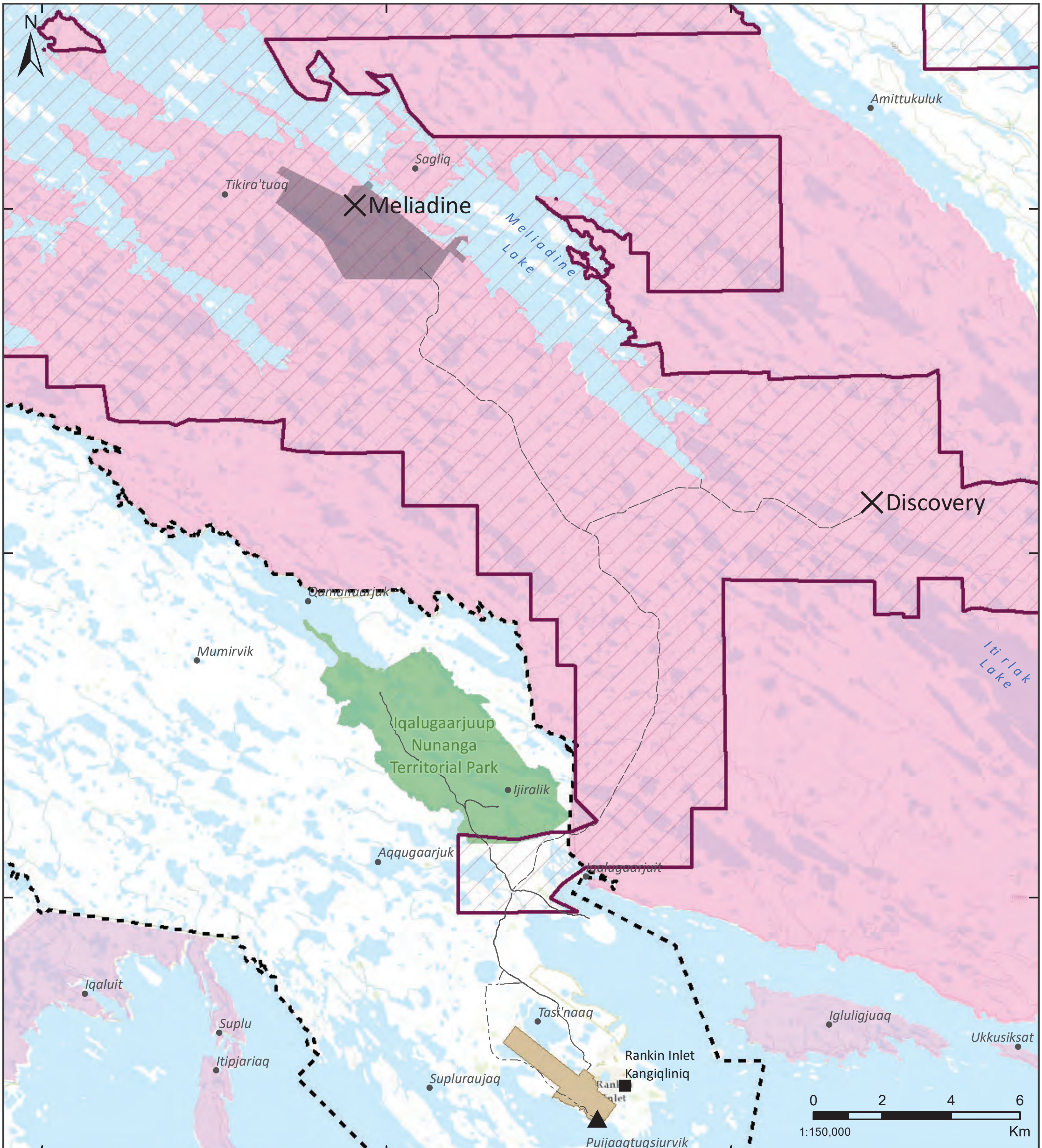
Agnico Eagle Mines Limited (Agnico Eagle) is operating the Meliadine Mine, located approximately 25 km north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut (Figure 10.1-1 and 10.1-2) as described in Section 1.1.1.

The Meliadine Mine was subject to the environmental and socio-economic impact assessment and permitting processes established under the Nunavut Agreement as described in Section 1.1.5. Article 12, Part 5 of the Nunavut Agreement sets out the environmental and socio-economic review and assessment requirements managed by the Nunavut Impact Review Board (NIRB), one of five Institutions of Public Government established under the Nunavut Agreement.

Following a Part 5 public review, the NIRB provided the Minister with the Final Hearing Report and recommended Terms and Conditions for the Meliadine Project on October 10, 2014. The Minister accepted the NIRB's recommendation on January 27, 2015 and Project Certificate No.006 was issued on February 26, 2015. This included the approval of the Tiriganiaq deposit and the F Zone, Wesmeg, Pump, and Discovery deposits of the Meliadine Mine and the associated infrastructure.

As described in Section 1.1.1, on May 19, 2016, the Minister approved the Type A Water Licence 2AM-MEL1631 to begin construction and operation of the Meliadine Mine. At that time, Agnico Eagle only applied for the Type A Water Licence required to proceed with the Tiriganiaq deposit. As indicated at that time, amendments are required to proceed with the other deposits, as part of this application (Meliadine Extension) included in Project Certificate No.006.

Since the Project Certificate was issued, the Meliadine Mine has been subject to two reconsiderations by NIRB (Figure 10-1.3). On February 26, 2019, the NIRB provided a positive decision to amend the Project Certificate to include discharge of saline effluent to the marine environment via diffuser at Itivia Harbour and to convey via truck saline effluent along the All Weather Access Road (AWAR) to Itivia Harbour (i.e., Melvin Bay). On January 31, 2022 the Minister provided a positive decision to amend the Project Certificate to include the conveyance of saline effluent via a waterline along the AWAR (instead of via truck), to accommodate an increased volume of discharge at Itivia Harbour.



Meliadine Project

Project Description - Leases

Date: 10/6/2021
Map Number: MEL-005
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

AGNICO EAGLE
ECOLOGIC

- Itivia Laydown
- Traditional Place Names
- Bypass Road
- AWAR
- Municipal Road
- Meliadine Claim Blocks
- Production Lease
- Municipal Boundary
- Nunavut Airport Boundary

Inuit Owned Lands

- Surface
- Surface-Subsurface
- Territorial Park

Figure 10.1-2: Itivia Site Location

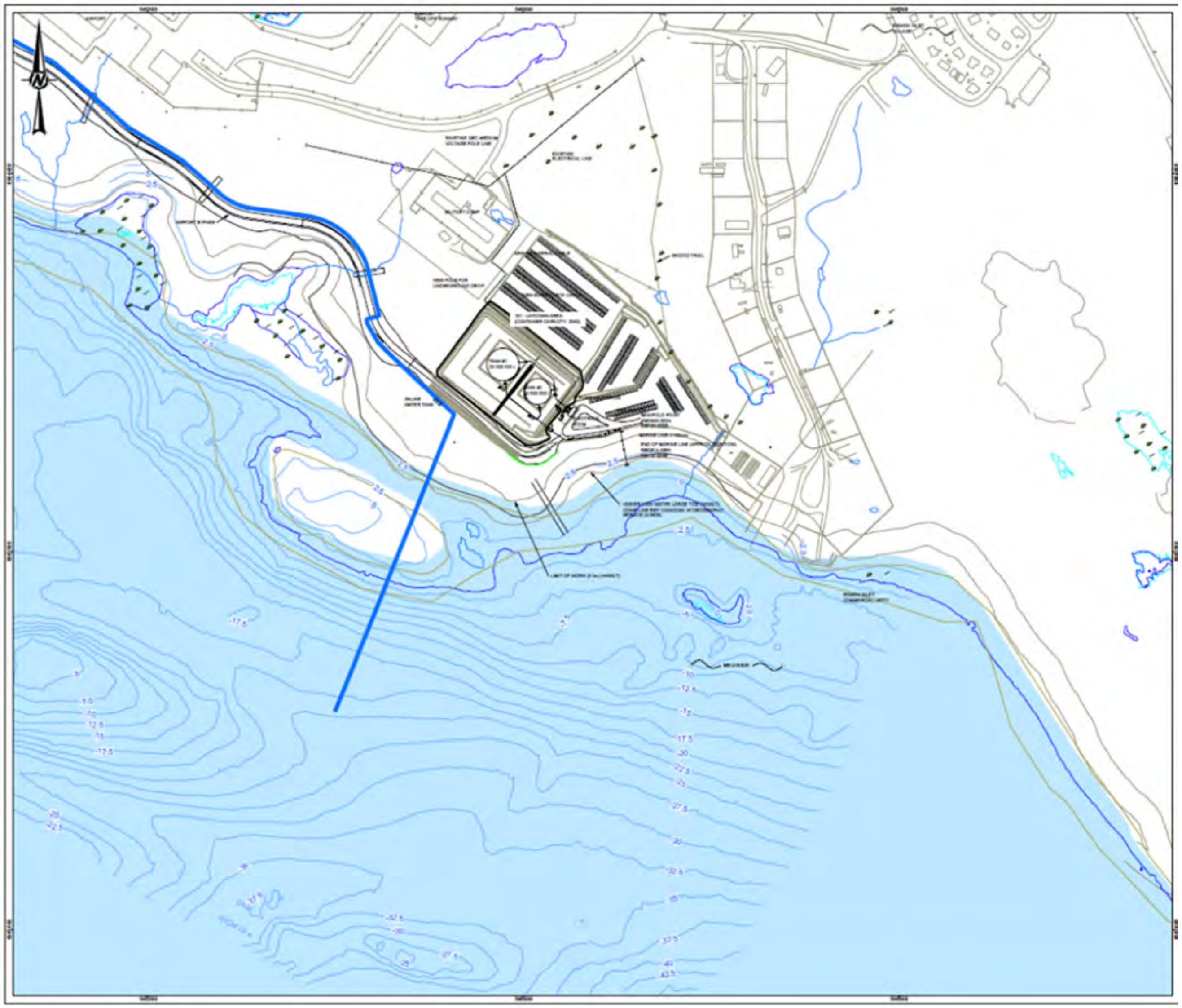


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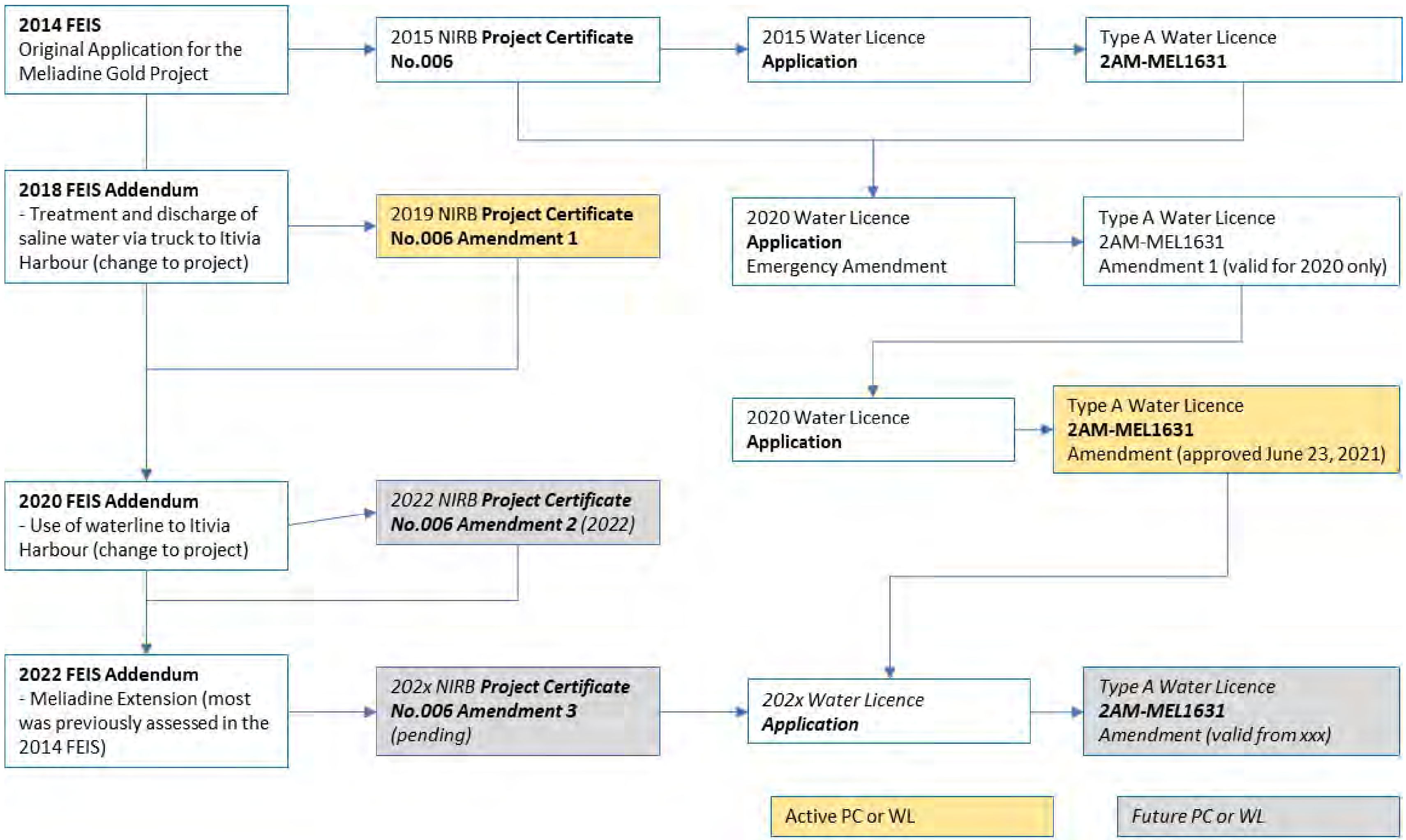
Figure 10.1-3: Timelines and Linkages Between Environmental Assessments, Project Certificate, and Water Licence Approvals



On June 23, 2021, the Minister approved the Type A Water Licence 2AM-MEL1631 Amendment, which included updated total dissolved solids (TDS) thresholds to Meliadine Lake, increase of annual freshwater consumption, additional laydown area, additional landfarm, updated waste management strategy, construction of access roads, and an updated Interim Closure and Reclamation Plan (ICRP).

At this time, Agnico Eagle is seeking approvals and permits required to proceed with mining of the deposits that were not included in the Water Licence (Meliadine Extension) and associated approved activities. As mentioned above, NIRB Project Certificate No.006, including the Meliadine Extension deposits, has been issued in 2015. Based on additional geological investigations conducted, lessons learned since NIRB approval in 2015, and to continue developing the Meliadine Mine in a sustainable way, Agnico Eagle is seeking approval to add the following activities:

- underground mining and associated saline water management infrastructures at the Pump, F zone, and Discovery deposits that were previously assessed and approved for open pit mining activities by NIRB;
- development of a new portal and associated infrastructures in the Tiriganiaq-Wolf mining area to improve access to and expand the existing Tiriganiaq underground mine;
- construction and operation of a windfarm to reduce greenhouse gas (GHG) emissions (NIRB Project Certificate No.006 Term and Condition [T&C] 9);
- use of additional borrow pits and quarries to replace depleted sources and build a road to the windfarm, Tiriganiaq-Wolf mining area, airstrip, road to Discovery and other deposits; and
- extension of the operation phase (i.e., mine life) by 11 years to 2043.

Agnico Eagle is also seeking approval for the following options/alternatives should it be required:

- construction and operation of an on-site airstrip to increase site access flexibility;
- use of exhausted pits to store tailings to complement the current waste management strategy; and
- use of exhausted pits to store waste rock to complement the current waste management strategy.

Collectively, this is referred to as Meliadine Extension.

10.1.2 Meliadine Mine – Approved Life of Mine Description

As described in Section 1.1 of this Application, the Mine is located in the Kivalliq District of Nunavut near the western shore of Hudson Bay, in Northern Canada. The nearest community is Rankin Inlet (coordinates: 62°48’35’’N; 092°05’58’’W), located approximately 25 km south of the Tiriganiaq deposit (coordinates: 63°01’03’’N, 92°12’03’’W). The Mine is located within the Meliadine Lake watershed of the Wilson Water Management Area (Nunavut Water Regulations Schedule 4). Rankin Inlet is an Inuit hamlet on the Kudlulik Peninsula located between Chesterfield Inlet and Arviat. It is the regional centre and the largest community of the Kivalliq region, and the second most populated community in Nunavut after the capital of Iqaluit.

The approved life of mine (LOM) includes open-pit and underground mining methods for the development of the Tiriganiaq gold deposit, with two open pits (Tiriganiaq Pit 1 and Tiriganiaq Pit 2) and one underground mine (Figure 10.1-4; updated Water Management Plan in Appendix D-35). Resources will be extracted over an approximate 13-year period from 2019 to 2032. The mine will produce approximately 15.4 million tonnes (Mt) of ore, 31.4 Mt of waste rock, 7.0 Mt of overburden waste, and 15.4 Mt of tailings. The four development phases of Tiriganiaq gold deposit include three and a half years of construction (Q4 Year-5 to Q2 Year-1), eight and a half years mine operation (Q3 Year -1 to Year 8), three years closure (Year 9 to Year 11), and post-closure (Year 11 forwards). Pre-construction activities were completed at the Mine between January 2015 and June 2017, and construction activities were initiated in July 2017. Commercial production and operations began as planned in Q2 2019.

Ore processing, handling, treatment, and disposal occurs at the Meliadine Mill and tailings are stored in the footprint of the existing approved Tailings Storage Facility. Operations for the approved Tailings Storage Facility is addressed under Type A Water Licence 2AM-MEL1631. Mill rate is approximately 8,500 tonnes per day. Tailings generated by mill production are dewatered by pressure filtration to a solids content of approximately 85% by weight. The filtered tailings (consistency of damp, sandy silt) are transported by haul truck to either the paste plant for use underground as backfill or for placement and storage in the TSF in a process conventionally referred to as “dry stacking”.

Water management structures have been and will continue to be built (e.g., dikes/berms, and diversion channels) as needed to manage water from areas within the Mine site. Surface contact water and saline water and managed separately. Contact water originating from developed areas (e.g., pits, WRSF, TSF) is intercepted and conveyed to the various collection ponds for temporary storage. All contact water is eventually conveyed to Collection Pond 1 (CP1). Contact water collected within CP1 is used to satisfy mill process water make-up requirements, with any excess water treated using the Effluent Water Treatment Plant, if required, and discharged to Meliadine Lake. Saline ponds are used to collect underground water. After treatment, water is conveyed to Itivia Harbour (currently by trucking [Agnico Eagle 2018a], and in the future by the waterline [Agnico Eagle 2020a]) for discharge to the receiving environment. Effluent Water Treatment Plant (total suspended solids [TSS]), Sewage Treatment Plant (biological oxygen demand [BOD], TSS, bacteria), and the Saline Effluent Treatment Plant (TSS, ammonia) are used to treat water.

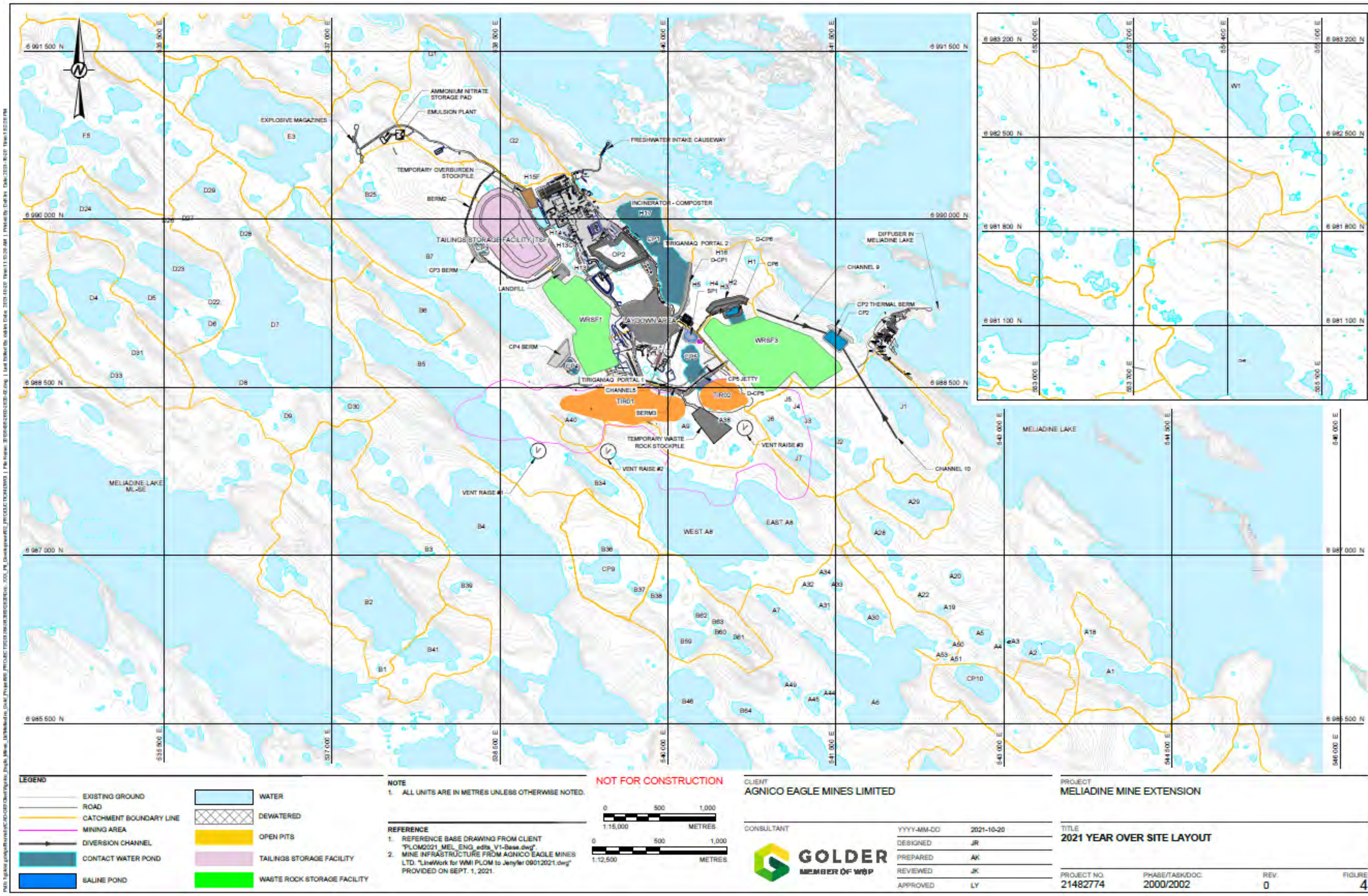
The Mine is accessed by the AWAR and bypass road, and marine barging where applicable. Currently, Rankin Inlet’s airstrip is used for transportation of “fly-in/fly-out” employees. There is a camp complex at the Mine site with a total of 680 beds. On-site domestic waste management facilities include: landfill incorporated within waste rock storage facility, incinerator, and landfarms. Hazardous material is segregated at site and shipped to an approved disposal location in the south. The power plant is diesel-fuel generated. Freshwater for use in the camp and dust suppression at the Mine site is sourced from Meliadine Lake.

At Rankin Inlet, the infrastructure to support mine operations include:

- A spud barge (floating dock) to serve as a dock for offloading containers, materials, and equipment from barges.
- A fuel tank farm to store up to 80 million litres of diesel fuel in 8 x 10-million litre tanks.
- A laydown yard area (14 hectares) to store incoming and outgoing containers, materials, and equipment pending truck delivery to the Mine site by road.
- A saline effluent diffuser to allow discharge at Itivia Harbour.

A total of 4 to 6 vessels annually deliver dry goods, and 4 to 6 tankers annually deliver diesel fuel for the Meliadine Mine through marine transport. All shipping is carried out during the open water season (typically from early August to late October) and follows established shipping lanes that are presently in use for the annual sealift to Rankin Inlet and other communities. There is no ice breaking to extend the shipping season. Ships are not serviced in Rankin Inlet and arrive with enough fuel for the return voyage south.

Figure 10.1-4: Footprint of the Meliadine Gold Mine as of 2021



10.1.3 Meliadine Extension Project Description

The full project description is provided in Section 2 of this Application. Included in this section is an overview of the project description focusing on aspects related to the HHERA.

10.1.3.1 Meliadine Extension Design

The Meliadine Extension primarily consists of amending the Water Licence 2AM-MEL1631 to include the mining of Pump, F Zone, Wesmeg, and Discovery deposits that were previously assessed and approved for open pit mining activities by NIRB. Proposed changes to the footprint approved through the 2014 FEIS, and the 2018 and 2020 FEIS Addenda are illustrated on Figure 10.1-5.

Based on the additional geological information collected since the 2014 FEIS, Agnico Eagle refined the open pit and underground mine designs and reviewed the infrastructure required to support mining activities.

As part of this Application, Agnico Eagle is proposing the following changes:

- underground mining and associated saline water management infrastructures at the Pump, F zone, and Discovery deposits that were previously assessed and approved for open pit mining activities by NIRB;
- development of a new portal and associated infrastructures in the Tiriganiaq-Wolf mining area to improve access to and expand the existing Tiriganiaq underground mine;
- construction and operation of a windfarm to reduce GHG emissions (Project Certificate No.006 T&C 9);
- use of additional borrow pits and quarries to replace depleted sources and build a road to the windfarm, Tiriganiaq-Wolf mining area, airstrip, road to Discovery and other deposits; and
- extension of the operation phase (LOM) by 11 years to 2043.

Agnico Eagle is also seeking approval for the following options/alternatives should it be required:

- construction and operation of an on-site airstrip to increase site access flexibility; and
- use of exhausted pits to store tailings and waste rock to complement the current waste management strategy.

The Meliadine Extension, other than the proposed alternatives (airstrip and use of pits for waste storage), was previously assessed by NIRB in the 2014 FEIS and should not be included within the scope of any NIRB reconsideration. Updates to the mine plan triggers inclusion of water and waste management infrastructures, which is reviewed as part of the Water Licence Amendment process. As part of Meliadine Extension, Agnico Eagle will continue to conduct design studies with both the cold northern climate and remote location as the principal engineering considerations for successful design, construction, and operations. Consistent with the 2014 FEIS, and other Agnico Eagle mines in Nunavut, the planned activities to Meliadine Extension as described in the 2014 FEIS were designed to minimize the areas of surface disturbance, stabilize disturbed land surfaces against erosion, and return the land to a post-mining use for traditional pursuits and wildlife habitat.

In designing the Meliadine Extension activities, Agnico Eagle has worked to optimize the overall footprint of its proposed operation and its associated facilities.

The most current concepts have been selected for Meliadine Extension design and are an extension of current practices (i.e., mining, processing, and effluent treatment). The technologies are considered state-of-the-art, and the Meliadine project team have adapted to difficult climatic conditions and have designed infrastructure accordingly and used up-to-date technology to solve problems.

Agnico Eagle intends to continue using familiar, proven approaches seen at many mining operations in production today and will be continually addressing problems using proven newest technologies to improve mining efficiency, production efficiency, reduce fuel consumption, and ultimately reduce emissions.

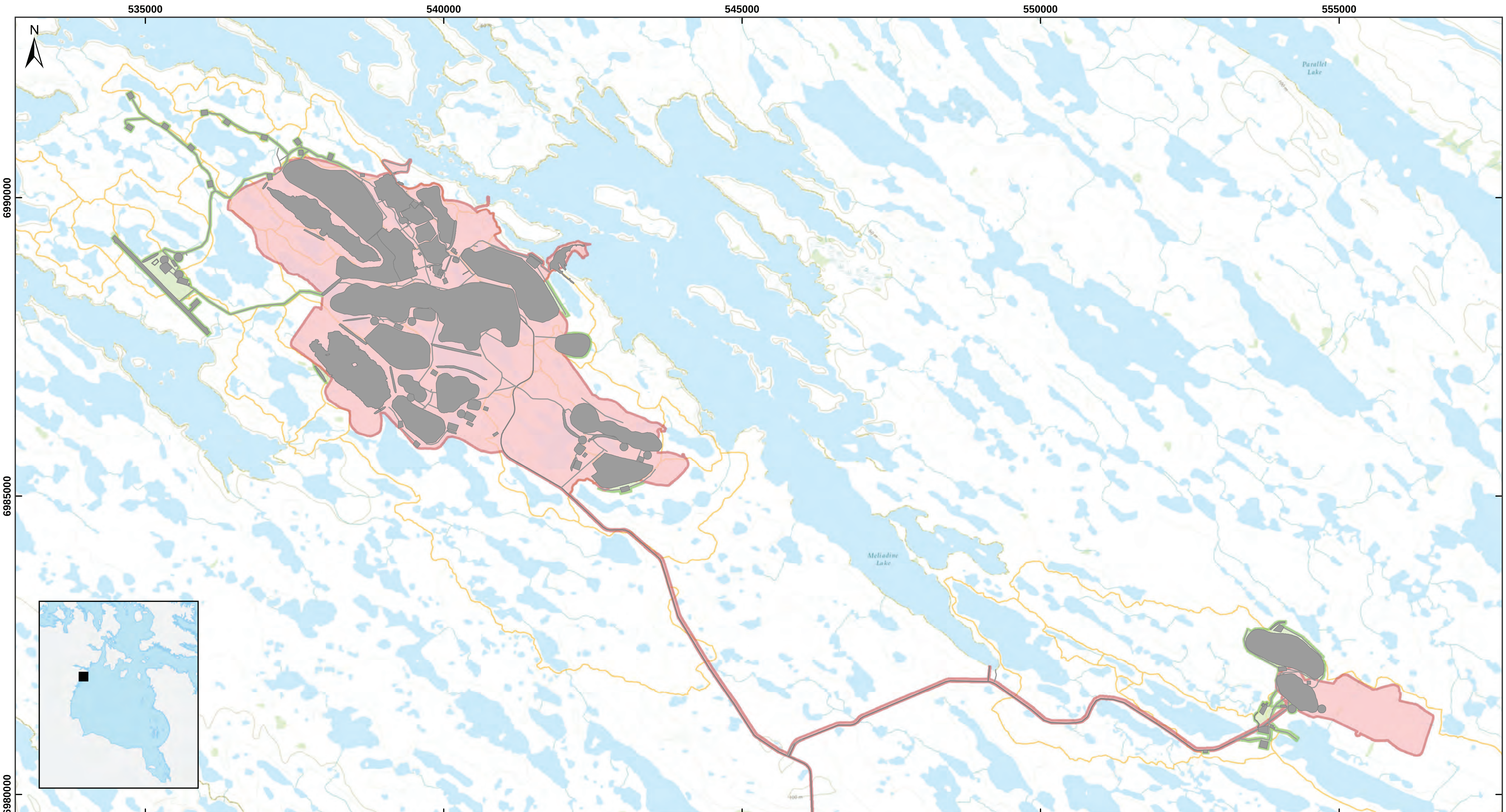
10.1.3.2 Meliadine Extension Phases

The initial construction phase for the Meliadine Extension will commence in 2024 upon reception of permits and approvals. Construction will continue through the operation phase to prepare for mining of new deposits. The mine development sequence and LOM summary for all deposits are presented in Tables 10.1-1 and 10.1-2.

The NIRB approved Meliadine Mine was scheduled to be completed in 2032. With the Meliadine Extension, it is proposed to extend the LOM (i.e., operation phase) until 2043. Agnico Eagle will continue exploration activities with the objective to extend mine life beyond 2043.

Closure will extend for 7 years as pits are being re-flooded, from 2044 to 2050. Similar to the 2014 FEIS, most removal or demolition of buildings and infrastructure will occur at the end of the operation phase, and would be done in the first two years of decommissioning. Reclamation work should be completed within 3 to 4 years of the closure. The filling of open pits with water would extend until the end of the closure phase. During closure, all saline water will be pumped to the underground and surface contact water, as well as local runoff and precipitation will be stored in the pits to enhance reflooding activities. Active reflooding will be conducted with water to be pumped from Meliadine Lake. There will be no discharge into Meliadine Lake or to Itivia Harbour during this phase.

Post-closure will be initiated when flooded pits are reconnected to the surrounding environment and will last 10 years, from 2051 to 2060.



Meliadine Extension

Site Overview

Date: 4/10/2022
Map Number: MEL-032
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

NIRB Approved Project Footprint
Meliadine Extension Footprint
Mine Infrastructure
Catchment Boundary Line

0 1 2 3
1:60,000 Km

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Table 10.1-1: Meliadine Extension Mine Development Sequence

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047-2050	2051-2060
Approved Mining																													
Tiriganiaq Deposit																													
Construction																													
Infrastructure																													
Dewatering & Fish out																													
Tiriganiaq Deposit																													
Open Pit																													
Underground																													
Wesmeg Deposit																													
Open Pit																													
Pump Deposit																													
Open Pit																													
Underground																													
F Zone Deposit																													
Open Pit																													
Underground																													
Discovery Deposit																													
Open Pit																													
Underground																													
Tiriganiaq-Wolf Mining Area																													
Underground																													
Closure																													
Infrastructure																													
Flooding																													
Post-Closure																													
Monitoring																													

Table 10.1-2: Life of Mine Summary for All Deposits

Year	Total Ore Open Pit (t)	Total Waste Rock Open Pit (t)	Total Ore Underground (t)	Total Waste Rock Underground (t)	Total Saline WRSF (t)	Total Tailings Stored in TSF (t)	Total Overburden (t)
2020	201,105	2,424,133	1,722,231	832,179	-	857,637	693,226
2021	209,456	1,506,696	1,853,757	708,224	-	1,043,775	3,349,130
2022	805,698	2,593,910	1,795,949	668,700	-	1,036,149	1,221,917
2023	522,170	4,268,265	1,784,634	791,648	-	1,258,243	1,194,525
2024	1,162,317	4,680,005	1,914,255	836,442	-	1,439,030	623,602
2025	1,335,751	5,333,152	1,875,054	872,577	113,528	1,446,644	787,056
2026	1,682,088	3,062,755	1,830,249	979,387	161,238	2,354,955	2,225,166
2027	869,780	6,916,269	2,021,221	1,174,276	389,231	2,334,117	2,087,886
2028	777,060	9,286,915	2,509,795	1,125,163	55,128	2,273,527	1,918,261
2029	919,527	10,669,542	2,621,861	1,067,906	(191,571)	2,319,689	350,370
2030	1,227,191	8,313,774	2,304,465	1,209,051	178,681	2,339,819	2,432,426
2031	788,971	9,470,241	2,193,953	1,108,828	171,541	2,290,915	1,716,222
2032	741,908	9,583,821	2,391,155	1,006,758	111,522	2,338,642	1,655,221
2033	613,935	10,383,475	2,226,433	677,785	215,335	2,333,300	989,498
2034	793,675	11,206,325	2,167,472	512,589	112,344	2,350,769	-
2035	695,610	8,978,764	2,265,949	601,856	171,049	2,361,679	2,217,665
2036	1,479,607	8,636,056	2,479,570	521,334	58,783	2,366,867	1,818,870
2037	567,985	5,949,811	2,390,134	587,040	(111,623)	2,541,827	5,373,987
2038	1,252,010	10,728,043	1,335,433	297,488	(560,472)	3,102,500	19,947
2039	1,676,609	10,323,391	1,171,605	96,872	(523,102)	3,102,500	-
2040	1,727,495	7,379,533	546,805	153,786	-	3,102,500	2,790,454
2041	670,280	10,152,255	540,649	41,862	-	3,102,500	1,171,814
2042	1,098,670	10,791,759	419,008	-	-	3,093,632	-
2043	631,021	1,936,032	176,847	-	-	808,256	-
Total (t)	**22,449,918**	**174,574,923**	**42,538,482**	**15,871,751**	**351,609**	**51,599,471**	**34,637,243**
Total Meliadine Extension (Mt)	**22.4**	**174.6**	**42.5**	**15.9**	**1.1**	**51.6**	**34.6**
2014 FEIS Total (Mt)	**27.0**	**373.3**	**11.1**	**5.3**	**0**		**57.0**

WRSF = waste rock storage facility; TSF = tailings storage facility; FEIS = final environmental impact statement.

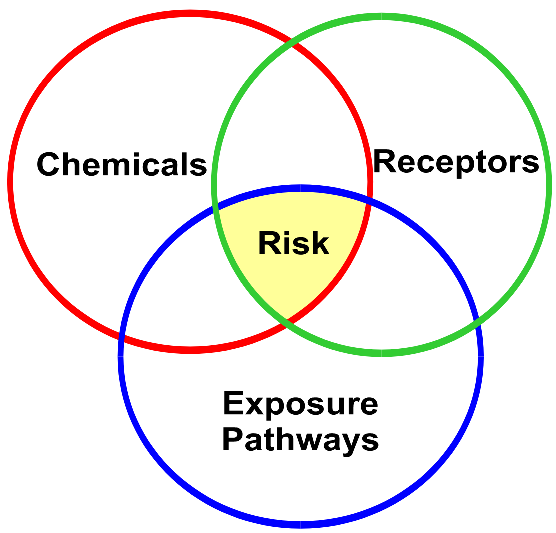
10.1.4 Risk Assessment Framework and Guidance

Risk assessment is a scientific tool used to characterize the nature and magnitude of potential risks, if any, associated with the exposure of receptors (i.e., terrestrial wildlife, aquatic life, humans) to chemicals. For there to be a potential risk, the following three conditions must be met:

- a chemical must be present at levels that could be harmful;
- a receptor must be present; and
- there must be an exposure pathway by which the receptor can come into contact with the chemical.

These three conditions are illustrated in Figure 10.1-6, where risk is anticipated to occur when the three necessary conditions are met.

Figure 10.1-6: Venn Diagram Showing the Three Conditions that must Exist for There to be a Potential Risk to Ecological or Human Health



Note: modified from CCME 1996

The HHERA follows the risk assessment framework endorsed by federal and provincial regulatory agencies. It is completed based on guidance provided by the Health Canada (2017a, 2021b), Canadian Council of Ministers of the Environment (CCME 2020), the United States Environmental Protection Agency (USEPA 1989, 1993, 1998), and other applicable risk assessment guidance documents (e.g., Sample et al. 1996). The risk assessment framework includes four components:

- **Problem Formulation**: The problem formulation identifies the chemicals released by the Mine that may be harmful to terrestrial and aquatic life (i.e., chemicals of potential concern [COPCs]), the terrestrial and aquatic life expected to occur in the Mine area (i.e., receptors), and the plausible exposure pathways between terrestrial and aquatic life and humans and chemicals released by the Mine. The potential for effects on the ecological and human health from chemicals released by the Mine is predicated on the coexistence of these three elements. Chemicals must be present at harmful levels, receptors must be present, and there must be a way for receptors to come into contact with the chemicals released by the Mine. The problem formulation focuses the risk assessment on the chemicals, receptors, and exposure pathways of greatest concern (i.e., chemicals with the greatest toxic potential, receptors with the greatest likelihood of being exposed and the greatest susceptibilities, and exposure pathways that account for the majority of exposure to the chemicals released by the Mine. If no potential health effects are predicted for these chemicals, receptors, and exposure pathways, it is unlikely that there would be potential health effects for other chemicals, receptors, and exposure pathways. The information from the problem formulation is summarized in a conceptual site model (CSM), which illustrates the sources of COPCs, the pathways of exposure, and the receptors that are evaluated in the risk assessment.

- **Exposure Assessment**: The exposure assessment determines the amount of COPC to which each of the receptors is exposed. For terrestrial life and humans, exposure is expressed as the estimated daily intake (EDI) of the COPC from all identified exposure pathways (e.g., from diet, drinking water, and direct ingestion of soil or sediment for terrestrial life). The EDI is expressed as milligrams of a COPC per kilogram body weight per day (mg/kg-d). This permits the evaluation of exposure relative to the toxicity reference values (TRVs) for mammals and birds that are also expressed in this way. For aquatic life, exposure is expressed as the concentrations of the COPCs in the media to which the receptor is exposed (e.g., in micrograms per litre [µg/L] in water). This permits the evaluation of exposure relative to the toxicity benchmarks that are also expressed in this way.
- **Toxicity Assessment**: The toxicity assessment determines the dose (for terrestrial wildlife or humans) or concentration in water/sediment (for aquatic life) that a receptor can be exposed to without experiencing adverse health effects. This value is called the TRV or toxicity benchmark. For terrestrial wildlife or humans, the TRV is expressed as mg/kg-d. For aquatic life, the toxicity benchmark is expressed as an acceptable concentration of the COPC in the media to which the receptor is exposed (e.g., µg/L in water). These values are used as benchmarks for comparison with exposure (EDI for terrestrial wildlife and humans and concentration in water for aquatic life) during risk characterization.
- **Risk Characterization**: The risk characterization determines the potential for adverse health effects on receptors to occur. This is assessed by comparing the estimated exposures (from the exposure assessment) with those exposures that are associated with no adverse health effects (from the toxicity assessment). The characterization of risks includes consideration of the uncertainty and conservatism in the risk assessment.

The effects analysis evaluates all Mine phases, including construction, operations, closure, and post-closure. For ecological receptors, the assessment includes potential changes to soil quality, water quality, sediment quality, and the quality of food (vegetation, prey) for consumption by wildlife. For human receptors, the assessment includes the direct effects on air quality, water quality, sediment quality, fish quality, and noise, and indirect effects to soil quality and country food quality (e.g., berries, caribou).

Cumulative effects on the health of terrestrial and aquatic life and of humans have also been evaluated.

10.1.5 Comparison to Previous Assessments

Table 10.1-3 provides a summary of Meliadine Extension components as a comparison to the approved 2014 FEIS and the 2018 and 2020 FEIS Addenda, focused on those components related to potential for adverse effects on ecological and human health.

The Meliadine Extension activities represent a negligible change from the previously assessed and approved FEIS activities (Agnico Eagle 2014, 2018a, 2020a). The change is considered negligible because infrastructure and shipping activities, the submersed diffuser (both type and installation), discharge volume, discharge quality, and seasonality of discharge (i.e., from approximately late June to mid-September) are the same as what has been previously assessed (Agnico Eagle 2014, 2018a, 2020a). For the Meliadine Extension, the only change is the duration of operations.

An HHERA was completed as part of the 2014 FEIS (Agnico Eagle 2014). As discussed in Section 10.1.1, the 2014 FEIS assessed the entire Meliadine Project, which included not only the Tiriganiaq deposit and the associated infrastructure, which was approved as part of the Type A Water Licence in 2016, but also the F Zone, Wesmeg, Pump, and Discovery deposits of the Meliadine Mine and the associated infrastructure, which is part of the Meliadine Extension. Thus, the HHERA in the 2014 FEIS already assessed most of the Meliadine Extension activities to be considered in this FEIS addendum.

This is the third addendum to the 2014 FEIS. There was an addendum in 2018 to assess the treatment and discharge of saline water via truck to Itivia Harbour (Agnico Eagle 2018a; Figure 10.1-2). There was an addendum in 2020 to assess the use of a waterline to Itivia Harbour (instead of transport via truck). An HHERA was prepared for this 2020 FEIS Addendum in response to Health Canada's request (Golder 2021k).

Table 10.1-3: Summary of the Meliadine Extension Relative to the Approved Meliadine Mine (Project Certificate No.006)

	Approved Meliadine Mine	Meliadine Extension
Life of Mine	The Meliadine Mine resources will be extracted over an approximate 13-year period from 2019 to 2032.	Extension activities will extend the Life of Mine by 11 years and postpone mine closure to 2043 instead of 2032. In total, the Meliadine Life of Mine will be 24 years.
Site Access	Meliadine Mine is accessed by the All Weather Access Road (AWAR) and bypass road, and marine barging where applicable. Use Rankin Inlet's airstrip for transportation of "fly-in/fly-out" employees.	No change. There is a potential that in future, as an option/alternative Agnico Eagle will construct and operate an on-site airstrip near the Tiriganiaq-Wolf mining area.
Rankin Inlet Infrastructure – Fuel Storage, Port Facility, Laydown	A spud barge (floating dock) to serve as a dock for offloading containers, materials, and equipment from barges. A fuel tank farm to store up to 80 million litres of diesel fuel in 8 x 10-million litre tanks. A laydown yard area (14 hectares) to store incoming and outgoing containers, materials, and equipment pending truck delivery to the Mine site by road. A saline effluent diffuser to allow discharge at Itivia Harbour.	No change.
Domestic Waste Management	On-site facilities include: landfill incorporated within waste rock storage facility, incinerator, landfarms	Some changes as described below (note that these changes are not considered "significant" under the Project Certificate but it is anticipated they will require consideration as part of the Type A Water Licence amendment process): • Addition of landfarms at the Wesmeg and Discovery deposits. • Change in soil reclamation criteria for landfarm soil. • Inclusion of a landfill at the Discovery deposit and located within the WRSF. • Inclusion of a second smaller capacity incinerator to accommodate increased number of workers and support during planned maintenance on the primary incinerator. • Addition of a composter to divert away organic matter from the incinerator.

	Approved Meliadine Mine	Meliadine Extension
Power	Power plant is diesel-fuel generated.	No change to power plant. New: • Construction of a windfarm composed of 11 turbines. The purpose is to provide general power, reduce reliance on diesel fuel, and reduce Greenhouse Gas emissions. This will provide a sustainable, long-term, "green" energy supply to the Life of Mine during operations and closure.
Mine Infrastructure	Open pit mining assessed: Tiriganiaq, Wesmeg, Pump, F Zone, and Discovery. Although all five pits were assessed, only Tiriganiaq has advanced mining activity. Underground mining assessed: Tiriganiaq. Phase 1 included the assessment of access roads to Discovery, Pump, F Zone, and Wes-Normeg deposits; and was included with the Type A Water Licence Amendment as the access roads are within the previously assessed footprint of the FEIS.	New: • Extension of existing deposit; Tiriganiaq-Wolf (underground mining). • Underground mining at Pump, F Zone, and Discovery. No change except for additional small (i.e., approximately 10 km) access roads to the Tiriganiaq-Wolf area and to the windfarm.
Water Management	**Infrastructures:** Water management structures will be built (e.g., dikes/berms, and diversion channels) as needed to manage water from areas within the mine site. Surface contact water and saline water are managed separately. **Contact Water:** Contact water originating from developed areas (e.g., pits, WRSF, TSF) will be intercepted and conveyed to the various collection ponds for temporary storage. All contact water will eventually be conveyed to Collection Pond 1 (CP1). Contact water collected within CP1 will be used to satisfy mill process water make-up requirements, with any excess water treated using the Effluent Water Treatment Plant, if required, and discharged to Meliadine Lake.	No material changes. Note berms built on land and retaining water only during peak flows will be preferred over dikes built in water and retaining water permanently when possible. Additional water management structures will be built as needed to manage water from areas within the mine site. **Surface Contact and Saline Water:** No change to overall water management strategy. Surface contact water and saline water from the underground mines will be separated. Water management at site will be optimized by using the waterline to minimize discharge to Meliadine Lake. Water collected at the Discovery site will be conveyed through a waterline to the SETP, where it will be treated and discharged into the receiving environment (Itivia Harbour) using the approved waterline.

	Approved Meliadine Mine	Meliadine Extension
	Saline Water: Use of saline ponds to collect underground water. After treatment, water is conveyed to Itivia Harbour for discharge into the receiving environment. **Treatment:** Effluent Water Treatment Plant (TSS), Sewage Treatment Plant (BOD, TSS, bacteria), Saline Effluent Treatment Plant (TSS, ammonia) and Reverse Osmosis (TDS) Plant are used to treat water.	Addition of saline ponds at F Zone, Tiriganiaq-Wolf, Pump and Discovery to collect water originating from underground mine activities. As proposed during Amendment No. 002 to the Project Certificate No.006, saline water will be eventually conveyed to the SETP, where it will be treated and discharged to the receiving environment (Itivia Harbour). Capacity of the Sewage Treatment Plant will be increased to accommodate increased number of employees.
Employment	The total workforce during operations was assessed at 700 employees.	The total workforce during operations will be expanded to a maximum of 905 employees. Additional employment at Meliadine will gradually ramp up from 2024 to 2031. 2031 will be the peak employment year due to mining activities occurring simultaneously at various deposits. Employment will remain above the 2014 FEIS workforce until 2040 and will then gradually decrease until closure.
Camp	A total of 680 beds was proposed for the camp complex.	Three wings will be added to accommodate the increase in the number of employees.

Note: Modified from Table 1.1-1 in Section 1 to focus on components relevant to the assessment of effects on ecological and human health.

The objective of this HHERA addendum is to focus on the changes from the 2014 FEIS (Agnico Eagle 2014), the 2018 FEIS Addendum (Agnico Eagle 2018a), and the 2020 FEIS Addendum (Agnico Eagle 2020a) and new pathways triggered by the changes of Meliadine Extension. A summary of the changes is noted in Table 10.1-4. To support the Application, the following new fate and transport modelling was completed:

- **Nitrogen dioxide (NO_2) and sulfur dioxide (SO_2):** Although no increase in emissions is predicted due to the production rate staying the same, NO_2 and SO_2 were re-assessed because of the change in guidance from the Canadian Ambient Air Quality Standards (CAAQS) for these two constituents, which have lower thresholds starting in 2020 and 2025. Air quality modelling methods and results are presented in Appendix H-01.
- **Major ions and metals in effluent and surface water:** The overall objectives of the water management strategy have not changed since the 2014 FEIS (i.e., surface contact water will be intercepted and diverted to contact water attenuation ponds and treated before discharge). However, changes to the water management and infrastructure on site required a refinement of the site water balance model (Appendix H-07). This model provided updates to predicted quantity and quality of water to be managed on site, but also updates to quantity and quality of water to be discharged to Meliadine Lake. Final mine effluent will be released to Meliadine Lake via the existing diffuser outfall. The mixing behaviour of mine effluent in the mixing zone and the east basin of Meliadine Lake was predicted with the Meliadine Lake three-dimensional (3D) model (Appendix H-09) based on the predicted discharge quality and quantity from the mine site model (Appendix H-07). As assessed in the 2018 and 2020 FEIS Addenda, saline groundwater will also be collected and discharged to Itivia Harbour. The same diffuser and discharge rate as assessed through the waterline application (2020 FEIS Addendum; Agnico Eagle 2020a) will be used for Meliadine Extension. For the waterline application, a 3D water quality model was used to predict mixing, dispersion, and water quality concentrations in the immediate 100 metre mixing zone (Tetra Tech 2020a,b, 2021a); this model was updated for this Application (Tetra Tech 2021b).

No new pathways were identified compared to the previous assessments, with the exception of noise emissions related to the Meliadine Extension's alternatives of the airstrip operation and windfarm operations (see Section 5 of this FEIS Addendum). All effects have been previously assessed, and there is no change from the previous assessments.

Negligible changes to marine water quality were predicted in the previous assessments (Agnico Eagle 2018a, 2020a). The annual monitoring data collected support this prediction.

To address uncertainty and validate assumptions, monitoring will be conducted as developed for the Approved activities (Agnico Eagle 2014, 2018a, 2020a), with updates as required for the Meliadine Extension, as necessary.

Table 10.1-4: Summary of Changes Between the Assessment Approach Used in the 2014 FEIS and this Application

Topic	No Change	Change
VEC / VSECs	No change to the VEC / VSECs as established for the 2014 FEIS.	
Assessment endpoints	No change to the endpoints established for the 2014 FEIS.	
Spatial boundaries	No change to LSAs for the following VEC/VSEC: • atmospheric environment (air and noise) • freshwater environment (hydrology, surface water quality, fisheries) No change to RSAs for the following VEC/VSEC: • atmospheric environment (noise) • terrestrial environment (soil and terrain, vegetation, wildlife, and birds) • freshwater environment (hydrology, surface water quality, fisheries)	Change to mine SSA to account for a minor adjustment to include the extended footprint (i.e., wind turbine locations): • atmospheric environment (air and noise) Change to LSA for the following VEC/VSEC to account for a minor adjustment to include the extended footprint (i.e., wind turbine locations and the waste rock storage facility at the Discovery deposit): • terrestrial (soil and terrain, vegetation, wildlife, and birds) Change to RSA for the following VEC to expand the area in which predicted concentrations are available for assessing potential impacts: • air quality
Temporal boundaries		Increase of 11 years of mine life
Pathway analysis	No new primary pathways were identified for the following VEC/VSEC: • terrestrial- soil and terrain, vegetation, wildlife • freshwater environment (hydrology, surface water quality, fisheries) • marine environment and wildlife	New primary pathways were identified for the following VEC/VSEC: • air (to assess the windfarm) • noise (to assess the windfarm and airstrip)
Residual effects analysis and classification	No change; there are no residual impacts for the following VEC/VSEC: • atmospheric environment (air and noise) • terrestrial environment (soil and terrain, vegetation, wildlife, birds) • freshwater environment (hydrology, surface water quality, fisheries) • marine environment and wildlife	
Cumulative effects	No change to the boundary.	Updated to reflect current conditions.
Uncertainty	No change as uncertainty is remains part of science; however, existing conditions are more certain than at the development of the 2014 FEIS.	
Monitoring and follow-up	No change to the monitoring developed for approved activities. The Management and Monitoring Plans are robust enough to carry forward for Meliadine Extension.	Updated to include the Meliadine Extension, where applicable.

Note: Modified from Table 4.1-1 in Section 4 to focus on items relevant to the assessment of effects on ecological and human health.

10.1.6 Valued Components

Valued ecosystem components (VECs) and valued socio-economic components (VSECs) represent physical, biological, cultural, social, and economic properties of the environment that are either legally, politically, publicly, or professionally recognized as important to a particular region, community, or by society as a whole.

The identification of VECs and VSECs and factors considered in their selection have not changed for the FEIS Addendum; the methods used to select the VECs are summarized in Section 4.3 of this Application as well as Section 4.2 of the 2014 FEIS. The VECs and VSECs selected for the HHERA include:

- Ecological health:
    - Wildlife
    - Upland birds
    - Raptor
    - Freshwater fish
    - Freshwater plankton and benthos
    - Marine aquatic organisms
- Human health:
    - Public and worker safety

Further description on the VECs and VSECs and the rationale for their selection are provided in Section 10.2.1 (ecological health) and 10.3.1 (human health).

10.1.7 Spatial and Temporal Boundaries

For the Meliadine Extension, the study area boundaries were developed based on the same criteria as the 2014 FEIS (Agnico Eagle 2014). These areas are described as follows:

- The Local Study Area (LSA) is the area where there exists the potential for measurable impacts due to Mine activities.
- The Regional Study Area (RSA) is the area within which there exists the potential for residual effects, including direct and indirect effects, as well as incremental effects from the Mine and cumulative effects from historical, existing, and RFFDs, including the Mine.
- The temporal boundary is defined as the amount of time between the start and end of a relevant Mine activity or stressors (which are related to development phases), plus the duration required for the effect to be reversed (NIRB 2012).

In general, the spatial area under assessment includes the mine site area (defined as the disturbed site footprint, which consists of the area surrounding the mine site including the Discovery deposit), the AWAR, the town of Rankin Inlet, and Itivia Harbour. A summary of the 2014 FEIS boundaries in comparison to Meliadine Extension are provided in Table 10.1-5. Figures of the spatial boundaries for VEC/VSEC for Meliadine Extension are provided in Sections 5 to 9 (Atmospheric, Terrestrial, Freshwater, Marine Environment and Socio-Economic).

Table 10.1-5: Meliadine Extension Study Areas

Valued Component	Site Study Area (SSA)		Local Study Area (LSA)		Regional Study Area (RSA)	
	2014 FEIS, 2018 and 2020 FEIS Addenda	Meliadine Extension	2014 FEIS, 2018 and 2020 FEIS Addenda	Meliadine Extension	2014 FEIS, 2018 and 2020 FEIS Addenda	Meliadine Extension
Air Quality (Section 5)	A Site Study Area (SSA) was defined for the Mine Site (and associated infrastructure) that encompasses all of the operational areas, the open pits, and the interconnecting mine roads. This includes the direct area of physical disturbance associated with the construction and operation of the Project (disturbance footprint), and extends outward a distance of 500 m. This is the area where non-Project related activities would be restricted during the life of the Project, and public access to these areas would be limited. Site Study Areas were not defined for the AWAR, Rankin Inlet activities, or marine shipping.	The SSA is slightly changed to include new infrastructure presented in Meliadine Extension using the same methodology (500 m setback distance)	Mine Site: A rectangle 21×30 km in size, generally centered on the Mine Site activities. AWAR: A band 3 km in width, extending 1.5 km either side of the travel surface of the roadway. The AWAR LSA is considered to start at the edge of the mine LSA and extend south into Rankin Inlet. Rankin Inlet: The boundaries of the community of Rankin Inlet.	No change.	Defined for the mine site (and associated infrastructure), the AWAR, and Rankin Inlet activities. The RSA is 40×45 km in size, generally centered on the mine site, and includes the area where the dispersion modelling predictions were made.	Change to expand the area in which predicted concentrations are available for assessing potential impacts
Noise (Section 5)	A single SSA was defined to include the Mine Site (and associated infrastructure), the AWAR, and Rankin Inlet activities. Within the Mine Site area, the SSA encompasses the operational area of the Project; including the direct area of physical disturbance associated with the construction and operation of the Project (disturbance footprint), and extends outward a distance of 500 m. This is the area where non-Project related activities would be restricted during the life of the Project, and public access to these areas would be limited. Along the AWAR and in Rankin Inlet, the extent of the SSA is limited to the disturbance footprint. The SSA does not include marine shipping activities due to the relative distance of these activities to Point(s) of Reception (POR).	The SSA is slightly changed to include new infrastructure presented in Meliadine Extension using the same methodology (500 m setback distance)	Extends approximately 5 km from the SSA, and encompasses identified sensitive PORs, and does not include marine shipping activities due to the large distance between these activities and identified PORs.	No change.	Not explicitly defined as the potential Project noise effects limited to the SSA and LSA. However, any noise effects that extend beyond the LSA are considered to extend into the RSA. Marine Shipping activities generally occur within the RSA.	No change.
Soil / Vegetation (Section 6)	Not defined	n/a	Mine Site: 500 m buffer surrounding the mine footprint; where potential changes were greater than 500 m from the mine footprint, the LSA was expanded AWAR and Discovery Road: buffered by 1,000 m on either side Rankin Inlet: limited to the Project footprint within the hamlet boundary (i.e., the outward limit of Rankin Inlet infrastructure) and did not include a buffer. The total area of the LSA is 10,598 ha.	Mine Site: the 500 m buffer surrounding the mine footprint remains but is slightly adjusted to account for wind turbines. No change to AWAR and Discovery Road and Rankin Inlet	280,000 ha (i.e., radius of 28 km centered on the proposed mine site). The RSA extends an additional 14 km beyond the Zone of Influence so that effects from the mine can be assessed through wildlife monitoring. The RSA encompasses the entire Project footprint, including the AWAR and Rankin Inlet infrastructure.	No change.

Valued Component	Site Study Area (SSA)		Local Study Area (LSA)		Regional Study Area (RSA)	
	2014 FEIS, 2018 and 2020 FEIS Addenda	Meliadine Extension	2014 FEIS, 2018 and 2020 FEIS Addenda	Meliadine Extension	2014 FEIS, 2018 and 2020 FEIS Addenda	Meliadine Extension
Surface Water Quality / Fish (Section 7)	Not defined	n/a	Mine site: LSA includes waterbodies and watercourses within watersheds on the Peninsula of Meliadine Lake (including Basins A, B, C, D, E, F, G, H, I, J, and P), the CH watershed, as well as Meliadine Lake itself. AWAR: same as that defined for hydrology, and includes watercourses crossed by the Meliadine and Discovery road corridors and the area 100 m to either side of the centre line of the corridor at all watercourse crossings.	No change.	Includes the Atulik, Char River, Dry Cove, Meliadine Lake, Meliadine River, Rankin Inlet, and Thompson watersheds.	No change.
Marine Environment (Section 8)	Not defined	n/a	Includes all areas in Itivia Harbour designated for marine infrastructure (spud barge installation) and vessel activities, including the in-shore barge and small tanker route where delivery barges and small tankers transport offloaded materials and fuel from the cargo and tankers vessels anchored outside Itivia Harbour, as well as the proposed offshore shipping corridor area extending west to east from Itivia Harbour to Eastern Hudson Strait prior to entry into the western Labrador Sea. Also includes the marine discharge location.	No change at Itivia Harbour. A preferred shipping corridor has been added south of Coats Island	Includes a 5 km buffer area extending outside Itivia Harbour and on either side of the marine shipping corridor, which is considered sufficient to encompass the potential regional extent of underwater noise effects from the Project.	No change at Itivia Harbour. A preferred shipping corridor has been added south of Coats Island

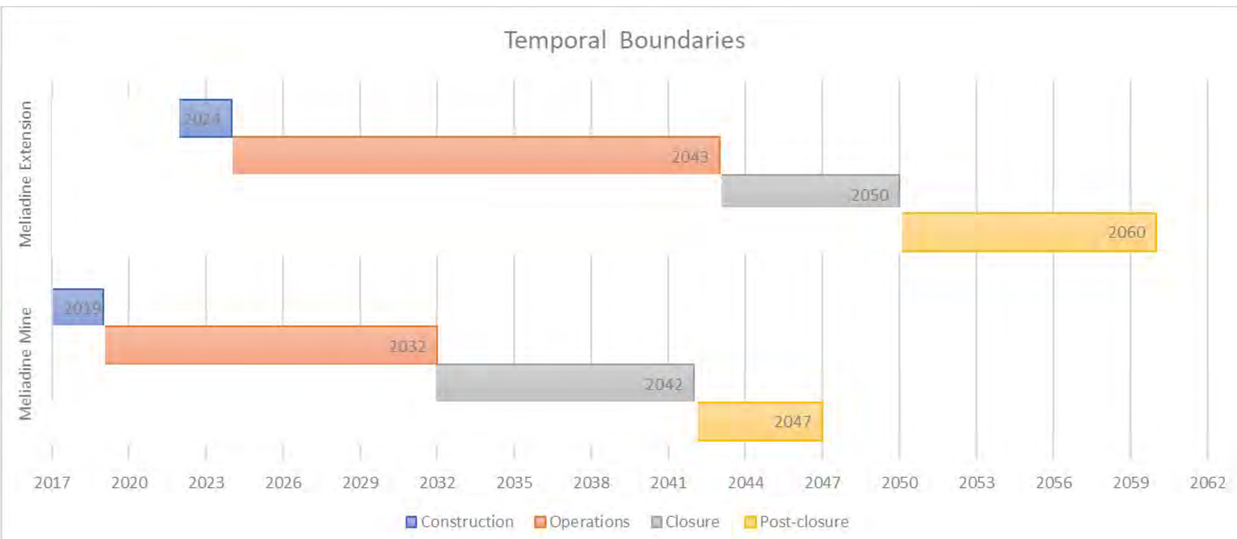
Note: Modified from Table 4.4-1 in Section 4 to focus on valued components relevant to the assessment of effects on ecological and human health.

The approach used to determine the temporal boundaries of potential effects was similar to the approach used to define spatial boundaries and are linked to two concepts:

- the development phases (i.e., construction, operation, and closure), focused on Meliadine Extension changes
- the predicted duration of effects from Meliadine Extension changes on a VEC or VSEC, which may extend beyond closure (i.e., post-closure)

The Meliadine Mine has a current LOM of 13 years, with operations that commenced in 2019 running to 2032. Meliadine Extension will extend the LOM for an additional 11 years to 2043. Closure will extend for 7 years (i.e., to 2050) as pits are being re-flooded. Post-closure will be initiated when flooded pits are reconnected to the surrounding environment, and will last 10 years until 2060. Refer to Figure 10.1-7 for an overview of temporal boundaries.

Figure 10.1-7: Temporal Boundaries – Approved and Meliadine Extension



Notes:

Construction will continue through operations to prepare for mining of new deposits.

Post-closure duration is consistent with the Meliadine ICRP Update 2020 (SNC 2021) submitted as part of the Type A Water Licence 2AM-MEL1631 Amendment and includes the waterline.

10.1.8 Existing Monitoring Plans

Through terms and conditions identified in Project Certificate No.006 and Water Licence 2AM-MEL1631, Agnico Eagle has prepared and follows numerous monitoring plans. Agnico Eagle has updated management and monitoring plans to support the NIRB review process for the Meliadine Extension FEIS Addendum. The purpose of monitoring is to support management of the site, to manage risk, compare monitoring data to predictions, identify if there are issues, and implement additional mitigation (if required). The full list of plans is provided in Table 10.1-6, and all plans are provided in Appendix D. The monitoring plans most relevant to the HHERA are shaded.

Table 10.1-6: List of Monitoring, Mitigation, and Monitoring Plans for Meliadine Extension

Management Plan Title for Meliadine Extension FEIS Addendum NIRB Submission	Current Plan		FEIS Addendum Appendix Reference	Note
	Project Certificate No. 006	Type A Water Licence 2AM-MEL1630		
Adaptive Management Plan-v2_NIRB		February 2021, v1	D-01	
Air Quality Monitoring Plan-v4_NIRB	June 2020; v3		D-02	
Airstrip Use Management Plan-v1_NIRB			D-03	Developed to support the option/alternative of an on-site airstrip
Ammonia Management Plan-v4_NIRB		March 2021, v3	D-04	
Aquatic Effects Monitoring Plan-v2_NIRB		June 2016, v1	D-05	
ARD-ML Testing Plan-v1_NIRB			D-06	Developed to support Meliadine Extension
Blast Monitoring Plan-v4_NIRB		March 2021, v3	D-07	
Borrow Pits and Quarries Management Plan-v7_NIRB		March 2018, v6	D-08	
Bulk Fuel Storage Facility: Environmental Performance Monitoring Plan-v2_NIRB		August 2019, v1	D-09	
Business Development Plan	April 2014, v3		n/a	Superseded by IIBA
Community Involvement Plan	April 2014, v3		n/a	Superseded by IIBA
Cultural and Heritage Resources Protection Plan-v2_NIRB	April 2012, v1		D-10	
Dust Management Plan-v7_NIRB		June 2020, v6	D-11	
Environmental Management Protection Plan-v10_NIRB		March 2019, v9	D-12	
Explosives Management Plan-v8_NIRB	March 2021, v7		D-13	
Greenhouse Gas Reduction Plan-v2_NIRB	January 2019, v1		D-14	
Hazardous Materials Management Plan-v6_NIRB		March 2018, v5	D-15	
Human Resources Plan	April 2014, v3		n/a	Superseded by IIBA
Incineration and Composter Waste Management Plan-v7_NIRB		February 2019, v6	D-16	
Itivia Bulk Fuel Storage Facility Management Plan-v2_NIRB		August 20190, v1	D-17	
Conceptual Closure and Reclamation Plan		2020	D-18	
Landfarm Management Plan-v4_NIRB		February 2019, v3	D-19	
Landfill and Waste Management Plan-v8_NIRB		March 2019, v7	D-20	
Mine Waste Management Plan-v9_NIRB		August 2021, v8	D-21	
Noise Abatement and Monitoring Plan-v4_NIRB	March 2020, v3		D-22	
Occupational Health and Safety Plan	April 2014, v3		D-23	Provided for NIRB reference.
Ocean Discharge Monitoring Plan-v5_NIRB	October 2021, v4	n/a	D-24	

Management Plan Title for Meliadine Extension FEIS Addendum NIRB Submission	Current Plan		FEIS Addendum Appendix Reference	Note
	Project Certificate No. 006	Type A Water Licence 2AM-MEL1630		
OPEP/OPPP-v5	June 2021, v5	n/a	D-25	Provided for NIRB reference.
Conceptual Fish Offsetting Plan_NIRB		April 2014, v0	D-26	
Ore Storage Management Plan-v4_NIRB		March 2021, v3	D-27	
Quality Assurance / Quality Control-v4_NIRB		March 2019, v3	D-28	
Risk Management and Emergency Response Plan includes Accident and Malfunctions-v5_NIRB		April 2015, v4	D-29	
Roads Management Plan-v9_NIRB		December 2019, v8	D-30	
Shipping Management Plan-v9_NIRB	March 2019, v8		D-31	
Socio-Economic Management Plan	April 2014, v1		n/a	Superseded by IIBA
Socio-Economic Monitoring Program	May 2019, v3		D-32	Provided for NIRB reference.
Spill Contingency Plan-v12_NIRB		December 2019, v10	D-33	
Terrestrial Environment Management and Monitoring Plan-v4_NIRB	June 2020, v3		D-34	
Wildlife Protection and Response Plan-v9_NIRB	January 2019, v8			Appendix to Terrestrial Environment Management and Monitoring Plan
Water Management Plan-v12_NIRB		August 2021, v11	D-35	
Groundwater Management Plan-v8_NIRB		August 2021, v7		Appendices to Water Management Plan
Freshet Action Plan-v7_NIRB		March 2020, v6		
Sediment and Erosion Management Plan-v4_NIRB		March 2021, v3		
Water Quality and Flow Monitoring Plan-v3_NRIB		March 2020, v2		
Water Quality Management and Optimization Plan		August 2021, v4b	n/a	Plan was recently submitted to NWB to address Water Licence Amendment Part F, Item 9
Windfarm Management Plan-v1_NIRB			D-36	Developed to support windfarm as part of Meliadine Extension

Note: shaded rows indicate monitoring plan that are most relevant to the HHERA.

10.2 Ecological Health

10.2.1 Valued Components

The identification of VECs and factors considered in their selection have not changed for this FEIS Addendum and are summarized in Table 10.2-1 as well as the Section 10.1.3 of the 2014 FEIS. Where applicable, traditional knowledge was incorporated into the selection of VECs for the ecological health risk assessment. Therefore, impact predictions and significance of impacts for these VECs incorporated traditional knowledge.

Table 10.2-1: List of Monitoring, Mitigation, and Monitoring Plans for Meliadine Extension

Valued Ecosystem Component	Rationale for Selection
Caribou	Suggested as a VEC by NIRB; selected as a VEC by the Terrestrial Wildlife and Wildlife Habitat component (FEIS Volume 6, Section 6.6); important subsistence, cultural, and economic species; primary prey species for large carnivores in northern environments; documented in the project area so potential for exposure to chemicals released by the Mine
Arctic fox	Play a key role in the food web (carnivore); trapped for their fur; common in the project area so potential for exposure to chemicals released from the Mine; used as a surrogate for other carnivores documented in the project area, including the northern gray wolf; the gray wolf is a VEC suggested by NIRB and selected by the Terrestrial Wildlife and Wildlife Habitat component (FEIS Volume 6, Section 6.6); however, it is infrequently observed in the project area and has a large home range, which would minimize exposure to chemicals released from the Mine in comparison to the Arctic fox
Less conspicuous species *Brown lemming*	Key prey species for carnivores; documented in the project area so potential for exposure to chemicals released from the Mine; used as a surrogate for other small mammals documented in the project area, including the Arctic hare and Arctic ground squirrel; high potential for exposure to chemicals released from the Mine due to life history
Raptors *Short-eared owl*	Raptors suggested as a VEC by NIRB; raptors identified as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); territorial and federal status; play a key role in the food web (carnivore); short-eared owls documented in the project area and nest observations indicate that they are likely breeding so potential for exposure to chemicals released from the Mine; used as a surrogate for other raptors documented in the project area, including the peregrine falcon (the diet of the peregrine falcon cannot be accurately modelled and, thus, was not selected as a VEC)
Migratory birds *American tree sparrow*	Migratory birds suggested as a VEC by NIRB; upland breeding birds (including migratory birds) selected as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); American tree sparrows incidentally observed in the project area so potential for exposure to chemicals released from the project; conservation status in Nunavut (“sensitive”); considered to be representative of other migratory/upland breeding birds documented in the project area; information available to allow calculations of exposure and risk
Waterbirds *Red-breasted merganser*	Waterbirds identified as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); red-breasted merganser documented in the project area so potential for exposure to chemicals released from the Mine; considered to be representative of other fish-eating birds in the project area (i.e., the Pacific loon, which is a regular breeding summer resident); information available to allow calculations of exposure and risk
Waterbirds *Lesser scaup*	Waterbirds identified as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); lesser scaup documented in the project area so potential for exposure to chemicals released from the Mine; considered to be representative of other aquatic invertebrate-eating waterbirds documented in the project area, including those with conservation status; information available to allow calculations of exposure and risk
Waterbirds *Least sandpiper*	Waterbirds, including shorebirds, identified as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); least sandpiper documented in the project area so potential for exposure to chemicals released from the Project; conservation status in Nunavut ("sensitive"); considered to be representative of other shore birds documented in the project area; information available to allow calculations of exposure and risk
Waterbirds *Canada goose*	Waterbirds identified as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); Canada goose is an important subsistence and cultural species; common in the project area so potential for exposure to chemicals released from the project; considered to be representative of other terrestrial plant-eating birds; information available to allow calculations of exposure and risk

Valued Ecosystem Component	Rationale for Selection
Waterbirds *Tundra swan*	Waterbirds identified as a VEC by the Birds and Bird Habitat component (FEIS Volume 6, Section 6.7); tundra swans are regular breeding summer residents of the project area so potential for exposure to chemicals released from the Mine; considered to be representative of other aquatic plant-eating birds; information available to allow calculations of exposure and risk
Fish *Arctic char, Arctic grayling, lake trout*	Fish suggested as a VEC by NIRB; fish selected as a VEC by the Fish and Fish Habitat component (FEIS Volume 7, Section 7.5); documented in the project area; important to communities for subsidence use (lake trout, Arctic grayling, Arctic char); popular sport fish in Nunavut (lake trout, Arctic grayling); focus of commercial and subsistence fishery in Hudson Bay (Arctic char)
Benthic Invertebrates	Benthic invertebrates suggested as a VEC by NIRB; play a vital role in nutrient cycling and the breakdown of detritus in the aquatic environment; important food source for fish; sensitive to contamination; various species identified in the project area
Other Aquatic Organisms *Plankton*	Other aquatic invertebrates suggested as a VEC by NIRB; includes phytoplankton and zooplankton; important food source for fish; various species identified in the project area

10.2.2 Spatial and Temporal Boundaries

The spatial and temporal boundaries for the ecological health risk assessment were aligned with the boundaries that will predict or provide input to the prediction of potential Meliadine Extension-related changes to the atmospheric environment (Section 5.1.2; Figure 5.1-1), the terrestrial environment and quality of food (vegetation, prey) for consumption by wildlife (Section 6.1.4; Figure 6.1-1 and Figure 6.1-2), the freshwater aquatic environment (Section 7.4 and 7.5; Figure 7.1-4 and Figure 7.1-5), and marine water quality (Section 8.1-1; Figure 8.1-2).

For the 2014 FEIS, the temporal boundary for the HHERA was about a 19-year LOM, with the construction phase (3 years), operations phase (13 years), closure phase (3 years), and post-closure phase of the Project. The Meliadine Extension construction activities are proposed from 2023 to 2024, operations from 2024 to 2043, and closure from 2044 to 2050, followed by post-closure from 2051 to 2060.

10.2.3 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge and Consultation

Since the 2014 FEIS, additional Inuit Qaujimajatuqangit (IQ), Traditional Knowledge (TK), and comments/concerns related to the HHERA were provided by community members and incorporated into the Meliadine Extension assessment, which considers the review of the following sources:

- FEIS Addendum Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2020 (Agnico Eagle 2018a)
- Water License Amendment Consultation and Engagement Report, December 2020 (Agnico Eagle 2020)
- Waterline Consultations Report 2020 - Preliminary phase of consultation with Rankin Inlet key stakeholders for the Meliadine waterline project from January – March and July 2020 (Agnico Eagle 2020c).

- Waterline Consultations Report 2020- Consultation Plan for the Meliadine Waterline project Existing Environment and Baseline Information, August 2020 (Agnico Eagle 2020d)
- Community and public engagement for the Meliadine Extension (Section 3 of this Application)

Information gathered during engagement meetings has been considered and incorporated in this Application where relevant, including the effects assessment and mitigation measures. The following IQ, TK, comments and concerns have been expressed by community members related to effects of the Meliadine Extension on ecological health:

- Dust from the road can affect vegetation and activities, such as berries.
- Impact of noise on wildlife, including caribous and birds (Agnico Eagle 2014).
- Existing Inuit traditional societal value and principle of, respect for the land, no disruption of wildlife habitat, and no wastage of food harvested from the land or waters.
- Concentration of total and dissolved parameters in water (e.g., total dissolved solids, total suspended solids, nutrients, total metals, dissolved metals, etc.) strongly influence the quality of water for aquatic organisms and wildlife.
- It is noted that the local communities identified fish resources in Meliadine Lake are important to them, but removal of fish and drainage of smaller waterbodies are of little concern (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014).
- In addition to local communities expressing the importance to them of Meliadine Lake and fish resources within the lake, they also raised concern over discharge of contaminated water into Meliadine Lake and the effect of this on fish populations (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014).
- Seasons are changing, and the streams are getting lower having an impact on fish. Some years are dry, and the water is low. Some years, the water is high when there is more rain. Fish have different sizes depending on the size of rocks in the streams and their location; they change accordingly. When the water becomes dirty, fish move somewhere else. The community fish using fishing nets, and they have observed different species of fish they have not seen before.
- Arctic Char are an important food species for the residents of Rankin Inlet – residents have cabins on the north shore of Itivia Harbour and harvest Arctic Char, sculpin, and cod in the Itivia Harbour area (Nunami Stantec 2012; Appendix B).
- Fishing for both Arctic Char and Arctic Grayling continues to be important to the people in the region. There are remnants of stone fishing weirs near the mouth of the Meliadine River, and stone drying racks scattered throughout the river valley (Agnico Eagle 2014).
- Itivia Harbour is heavily used by residents in the summer for launching boats (it’s the only place accessible during low tide), and in the winter for snowmobile travel in and out of the community (Nunami Stantec 2012; Appendix B).
- Areas near Rankin Inlet where people may harvest shellfish includes a local beach area (approximately 2 km northwest of the discharge area) and Aukpik Island (approximately 4 km southeast of the discharge area) (Agnico Eagle 2021b) (Figure 10.2-1).

- The permanent diffuser evaluated through the 2020 FEIS Addendum (Agnico Eagle 2020a) will be in a water depth of 20 to 24 metres (depending on tidal fluctuation).
- The area of predicted water quality change is limited to 100 metres from the discharge point.
- There is a physical barrier between the location of the diffuser, the area of predicted change in water quality, and the areas where people may harvest shellfish.

Figure 10.2-1: Itivia Harbour – Location of Mussel Harvesting Areas

Note: Google Earth screen shot and identified mussel picking areas provided by the Kivalliq Wildlife Board on April 27, 2021. Mussel Picking area approximately 2 km northwest of the discharge area. Mussel Picking Island (Aukpik Island) approximately 4 km southeast of the discharge area.

The concerns as they pertain to the Meliadine Extension have been incorporated into Section 5 (Atmospheric Environment – air quality), Section 6 (Terrestrial Environment), Section 7 (Freshwater Environment) and Section 8 (Marine Environment) of this Application.

10.2.4 Existing Environment

As stated in Section 4.2, for this Application it is important to distinguish between baseline information and existing environment and how it was used in the assessment. **Baseline** conditions are defined as previously collected data that was used in the 2014 FEIS; thus, has been previously assessed. **Existing conditions** are defined as data collected post commencement of construction of the Meliadine Mine. The data from supplemental studies (i.e., existing conditions) conducted by Agnico Eagle since 2014 has been incorporated into the Meliadine Extension design and this Application. A summary of baseline data reports (as provided in the 2014 FEIS) describe conditions pre-construction of the Meliadine Mine, are listed in Appendix F. Appendix G provides existing conditions reports used to support this Application. Technical studies and modelling reports completed to support this Application are provided in Appendix H.

Baseline data presented in the 2014 FEIS and the 2018 and 2020 FEIS Addenda have been subject to review through the assessment processes and through review of annual monitoring reports. As the documents listed in Appendix F have been previously reviewed by regulatory agencies and communities, it is not anticipated that detailed consideration of these baseline data will be required as part of this process. Consistent with 2018 and 2020 FEIS Addenda approach, a summary of key points relevant to Meliadine Extension are provided within each section of this Application.

For the ecological health risk assessment, baseline and existing conditions with respect to chemical concentrations in soil, water, sediment, and tissue (plant and fish) are summarized in the following sections:

- Soil and terrain (Section 6.4.3);
- Vegetation (Section 6.5.3);
- Freshwater and sediment quality (Section 7.4.2) and fish and fish habitat (Section 7.5.2); and
- Marine water and sediment quality, and biological environment (Section 8.2.2).

The following baseline and existing conditions data are available for the Meliadine Extension to support the ecological health risk assessment:

- Metal concentrations in soil for the mine site and along the AWAR
- Metal concentrations in plants for several plant types, including shrubs, forbs, grasses, and sedges, as well as non-vascular plants (plants were collected from the mine site and along the AWAR)
- Metal concentrations in surface water and sediment for various waterbodies, including the following:
  - Meliadine Lake;
  - Waterbodies on the peninsula of Meliadine Lake plus waterbodies near the Discovery area;
  - Larger, regional lakes including a reference lake, Peter Lake, and Little Meliadine Lake;
  - Streams on the peninsula of Meliadine Lake, streams near the Discovery area, and streams along the AWAR;
  - Rivers including Meliadine River and Char River; and
  - Itivia Harbour.
- Metal concentrations in fish tissue for several species, including Arctic char (*Salvelinus alpinus*), Arctic grayling (*Thymallus arcticus*), cisco (*Coregonus artedi*), lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindraceum*), and threespine stickleback (*Gasterosteus aculeatus*); fish were collected from waterbodies around the mine site, including Meliadine Lake, Meliadine

River, Little Meliadine Lake, Parallel Lake (a reference lake), and Lake B5.

10.2.4.1 Soil

Soil samples were collected in 2008 and 2009 for total metals analysis to measure background metal concentrations in soils. Most of the metal concentrations in soil were within acceptable guidelines, except for arsenic, which exceeded guidelines values in a few locations near the main mine site. Additional soil sampling was completed to assess moisture content, pH, and metal concentrations in 2017 and 2019 as part of on-going soil and vegetation monitoring. Soil concentrations from this monitoring were found to be within the natural range of variability for the area. Detailed methods and results of this sampling are outlined in the respective Terrestrial Environment Management and Monitoring Plan (TEMMP) annual reports.

10.2.4.2 Vegetation

Vegetation sampling for plant tissue (i.e., leaves) chemistry was completed in 2008 and 2009 to provide baseline data for the 2014 FEIS. Soil samples were also obtained from the vegetation sampling locations. Sample sites were selected to represent a range of vegetation types in the vicinity of the proposed mine site and road. Plant species for tissue analysis samples were selected based on a high relative abundance in the area and their importance to human and/or wildlife consumption.

The results of the plant tissue metals analyses indicated that there was a wide variability in the range of metal concentrations (see Section 4.3.3; Tables 4-12 and 4-13 of SD 6-2 2009 Terrestrial Synthesis Baseline Report, Agnico Eagle 2014). Kablaqutit (bearberry, *Arctous alpina* or *Arctostaphylos alpina*) and nirnait (snow lichen, *Flavocetraria nivalis*) tissue were found to have some of the highest concentrations of aluminium and iron in both 2008 and 2009 sample plots, with pauungait (crowberry, *Empetrum nigrum*) also showing high levels of aluminium in the 2009 plots. In the 2008 samples, nickel concentrations were found to be highest in airaq or airait (bell's crazyweed, *Oxytropis arctica* var. *belliii*) whereas flat-leaved willow (*Salix planifolia* and *S. lanata* ssp. *richardsonii*) and kakautit (lingonberry, *Vaccinium vitisidaea*) had some of the highest levels for zinc and manganese, respectively. This contrasts with the 2009 samples taken along the proposed Discovery Road alignment, which showed high levels of nickel. The highest levels of arsenic were found in kablaqutit (bearberry) along with water sedge (*Carex aquatilis*) on two plots located near the proposed Meliadine main site.

At the time of sampling, there were no indications of vegetation disease or phytotoxicity in the areas studied, with the exception of a fungus infection called "rust" affecting swamp birch (*Betula* sp.). This condition is seen throughout the mainland arctic (P. Burt, 2008, pers. comm.), and is not particular to this area.

Concentrations of metals in berry producing plants, sedges, and lichen, and soil chemistry under existing conditions were completed in 2017 and 2019 as part of the TEMMP to evaluate the potential for adverse health effects to terrestrial life associated with changes in environmental quality due to chemical releases from the Mine. Vegetation samples had concentrations of most metals below laboratory detection limits, except for levels of antimony, beryllium, bismuth, selenium, silver, and tin. All vegetation samples had no signs of plant illness, such as chlorosis.

10.2.4.3 Surface Water – Freshwater Environment

The 2014 FEIS (Section 7.4.4) provides a review of Meliadine Lake, small waterbodies on the peninsula of Meliadine Lake, regional waterbodies, and small and large watercourses on the peninsula of Meliadine Lake and along the AWAR. Section 7.4.4 of the 2014 FEIS (Agnico Eagle 2014) provides a thorough overview of baseline (i.e., pre-2014) conditions in the LSA and RSA. Monitoring has been conducted since 2014 that primarily reflects existing conditions since construction and early operation of Meliadine Mine. These monitoring programs focus mainly on Meliadine Lake and a few small waterbodies near the Meliadine Mine (i.e., Lakes A8, Saline Pond B7, and D7).

Seasonality is an important feature in lakes of northern Canada, where the seasonal production of ice can cause dissolved substances to concentrate in the unfrozen water, and in shallow systems, ice can form through the water column and freeze to the bottom in shallow waterbody and stream systems. Oxygen levels can be suppressed during the winter because oxygen is not replenished from the atmosphere and is consumed by sediments and organisms. During open water conditions, oxygen is replenished in waterbodies through exchange with the atmosphere. The open water season ranges from late May until early October, with ice cover the rest of the year.

Surface water in winter can often be high in total dissolved solids (TDS) due to the formation of ice as pure water, which increases the concentration of dissolved solids in the remaining water. In spring, runoff from snowmelt and precipitation is often low in TDS which dilutes TDS in the lakes. In contrast, total suspended solids (TSS) tend to increase in spring as freshet flows can result in erosion and suspension of materials in the water column. As flows decrease, TSS settles and the water column clears.

Meliadine Lake is generally described as well oxygenated throughout the year, with circumneutral to slightly basic pH. Concentrations of TDS, hardness, alkalinity, specific conductivity, nutrients, and metals were below relevant guidelines for aquatic life (CCME 1999a) and drinking water (Health Canada 2020). Concentrations were generally higher in the peninsula lakes as compared to Meliadine Lake; for example, TDS was lowest in Meliadine Lake and the larger regional lakes and the rivers, and higher in the peninsula waterbodies (2014 FEIS, Volume 7, Section 7.4.4; Agnico Eagle 2014).

As per T&C of Project Certificate No.006 and Type A Water Licence 2AM-MEL1631, there is extensive water quality monitoring conducted on the mine site. These monitoring data are reported each year in the annual report. All water on the mine site is managed for eventual discharge to the receiving environment; treated surface contact water is discharged to Meliadine Lake, and treated saline water is discharged to Itivia Harbour.

In the 2014 FEIS, discharge of treated effluent was identified as the main mine activity that could change water quality. As part of the annual Aquatic Effects Monitoring Plan (AEMP) reports, discharge quality is evaluated against the water licence criteria and the MDMER; all discharges have been less than the limits stipulated in 2AM-MEL1631 and the MDMER (Agnico Eagle 2021c). Key findings from the 2020 effluent chemistry data (as summarized in Azimuth 2021a) are as follows:

- All discharge quality was less than the water licence limits.
- Concentrations of key parameters of concern (i.e., some metals and nutrients) were typically higher at the onset of discharge in June compared to late-season sampling.
- Total dissolved solids concentrations were below the authorized limit of 3,500 mg/L in 2020. The highest measured TDS concentrations coincided with peak discharge periods in June (2,500 to 3,090 mg/L) and mid-to-late September (2,300 to 2,600 mg/L). The temporal pattern of concentrations changes for constituent analytes such as chloride, sulphate, and hardness followed a predictably similar pattern as TDS.

Since 2014, water quality has been regularly monitored in Meliadine Lake in five areas (Figure 10.2-2):

- MEL-01: near-field area and the area where treated discharge enters Meliadine Lake.
- MEL-02: mid-field area, downstream of the near-field area and downstream of the water intake for the Mine.
- MEL-03: reference area 1, in the northeast portion of the lake, downstream of the mid-field area
- MEL-04: reference area 2, in the northwest portion of the lake, upstream of the secondary outlet to Peter Lake.
- MEL-05: reference area 3, in the southwest portion of the lake, upstream of the primary outlet to Little Meliadine Lake.

The water quality monitoring program is conducted four times per year with results presented in the annual AEMP report (Golder 2017, 2018d, 2019c; Azimuth 2020, 2021a). This monitoring program is conducted to evaluate how water quality changes as a result of the effluent discharge, to confirm if measured conditions align with predictions, and to inform adaptive management or mitigation should conditions diverge from predictions. Water quality results are compared to normal range and AEMP benchmarks. The normal range is defined as the range of concentrations in water quality parameters before the mine (i.e., baseline) and in reference areas, and AEMP benchmarks are derived from generic values used to evaluate water quality results for protection of aquatic life or for protection of human drinking water quality, and site-specific water quality objectives for protection of aquatic life. In 2020, results from all individual samples were less than the guidelines except for one under-ice sample from March 2020; in this sample, the copper concentration was above the guideline. In 2020, no water quality parameters exceeded the AEMP action level (75% of the AEMP benchmark) in the near-field area of Meliadine Lake (i.e., the small mixing zone area that receives treated effluent discharge) or in any of the monitoring areas of Meliadine Lake (Figure 10.2-2).

Changes in water quality over time, from the various monitoring stations, are reported in the annual AEMP reports. Since 2015, some parameters have shown increasing concentrations, some have shown decreasing concentrations, and some have shown no change (Figures 10.2-3 and 10.2-4); however, all concentrations remain below the AEMP benchmark and the AEMP action level.

In the 2014 FEIS, it was predicted that water quality would change from baseline conditions but would remain below the guidelines. Modelling completed for the 2014 FEIS, and updated for 2020 Water Licence Amendment, predicted changes in water quality in the mixing zone and the east basin during operations (when seasonal discharge occurs) and then a reversal to baseline conditions in closure through post-closure (Figures 10.2-5 and 10.2-6). Changes in water quality measured in Meliadine Lake are in line with the FEIS predictions and the current concentrations of all parameters are well below water guidelines meant to protect aquatic life and drinking water quality for human consumption (Azimuth 2021a).

The Peninsula Lakes A8, Saline Pond B7, and D7 are sampled twice per year during open-water conditions and results are compared to the normal range, the 2014 FEIS predictions, and water quality guidelines. Water quality in Lakes A8, Saline Pond B7, and D7 are aligned with the 2014 FEIS predictions (i.e., change from baseline but less than guidelines) (Azimuth 2021a).

Figure 10.2-2: Meliadine AEMP Monitoring Areas

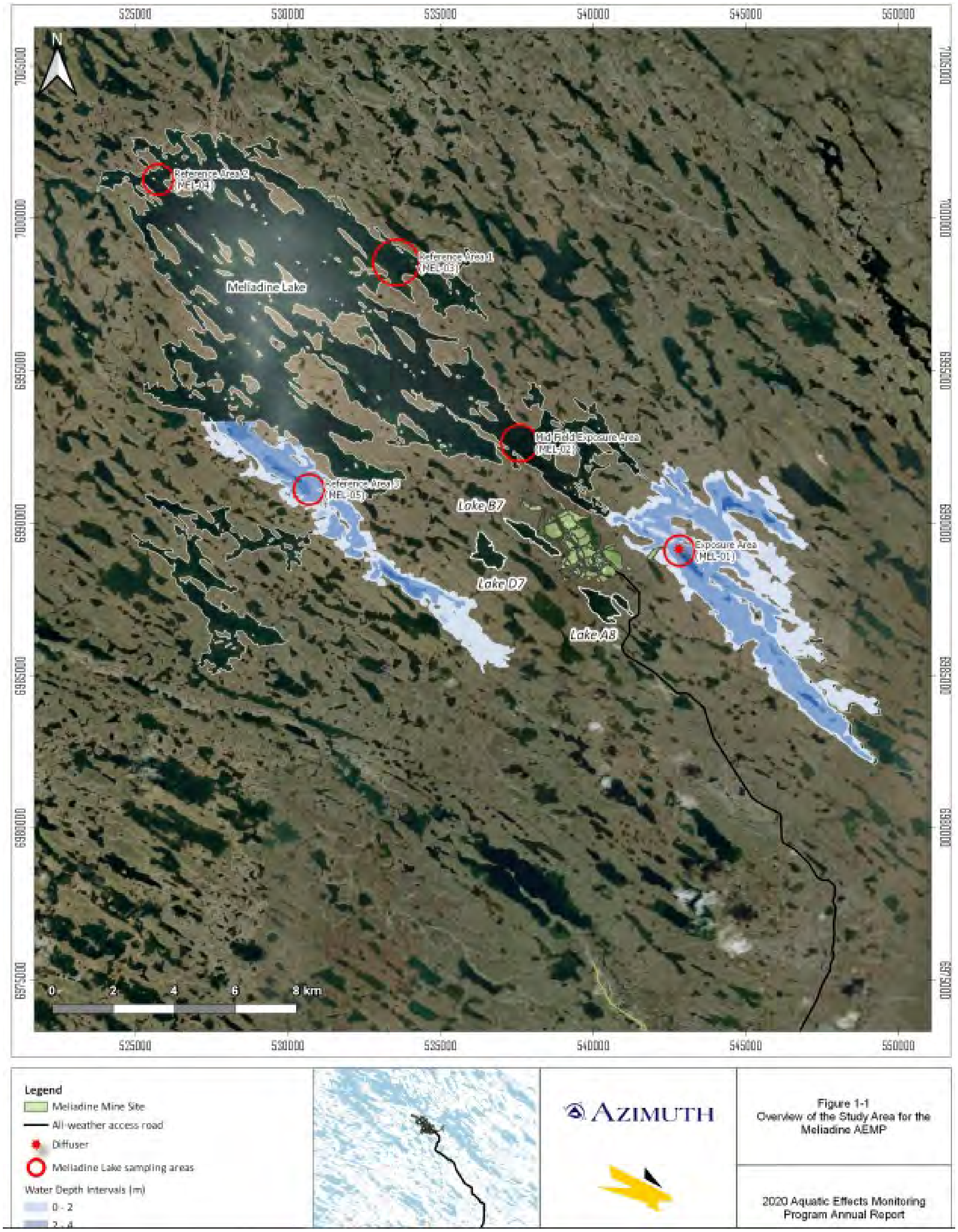
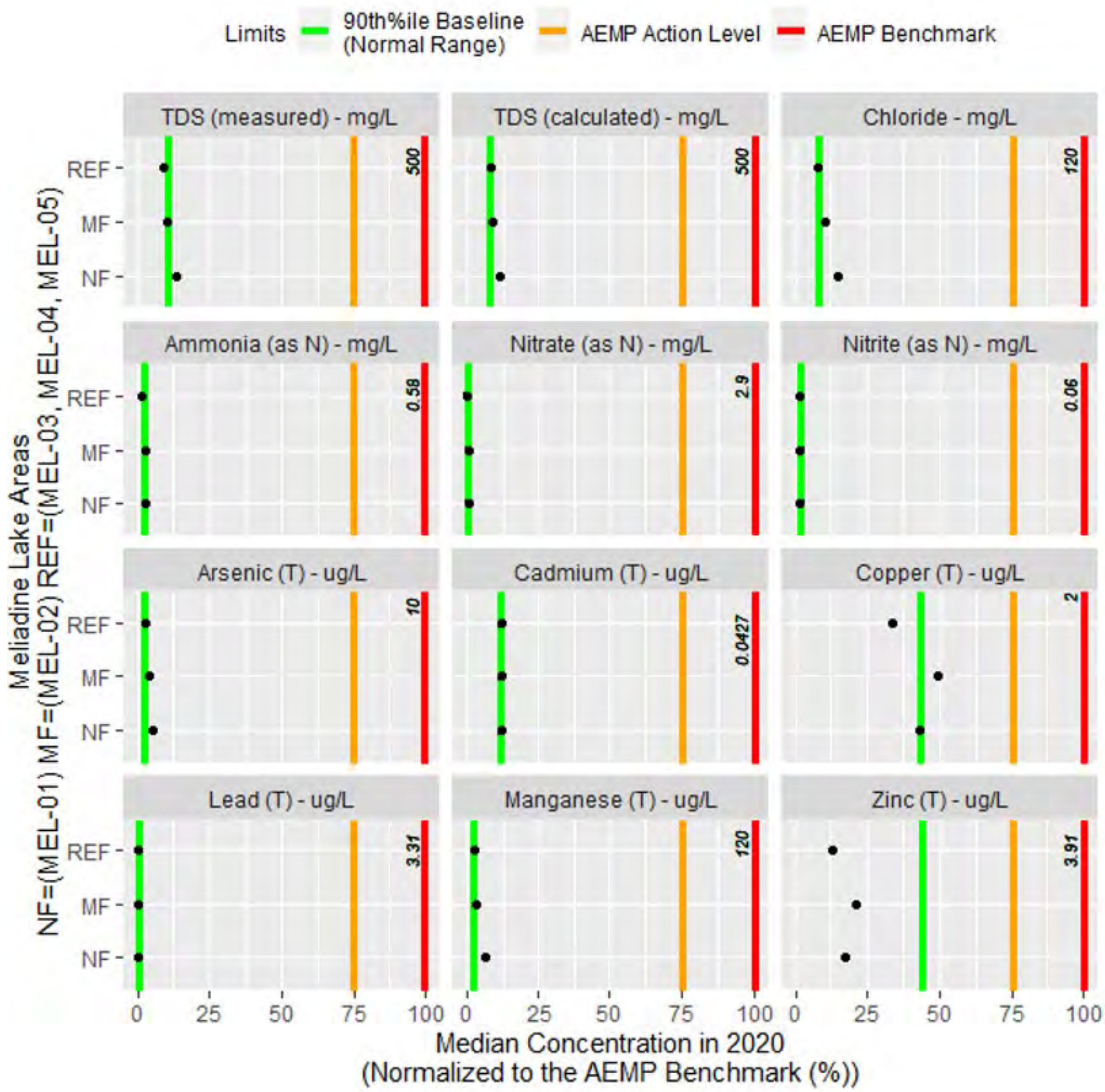


Figure 10.2-3: Water Quality in Meliadine Lake (2020) Relative to Normal Ranges, AEMP Action Levels, and AEMP Benchmarks

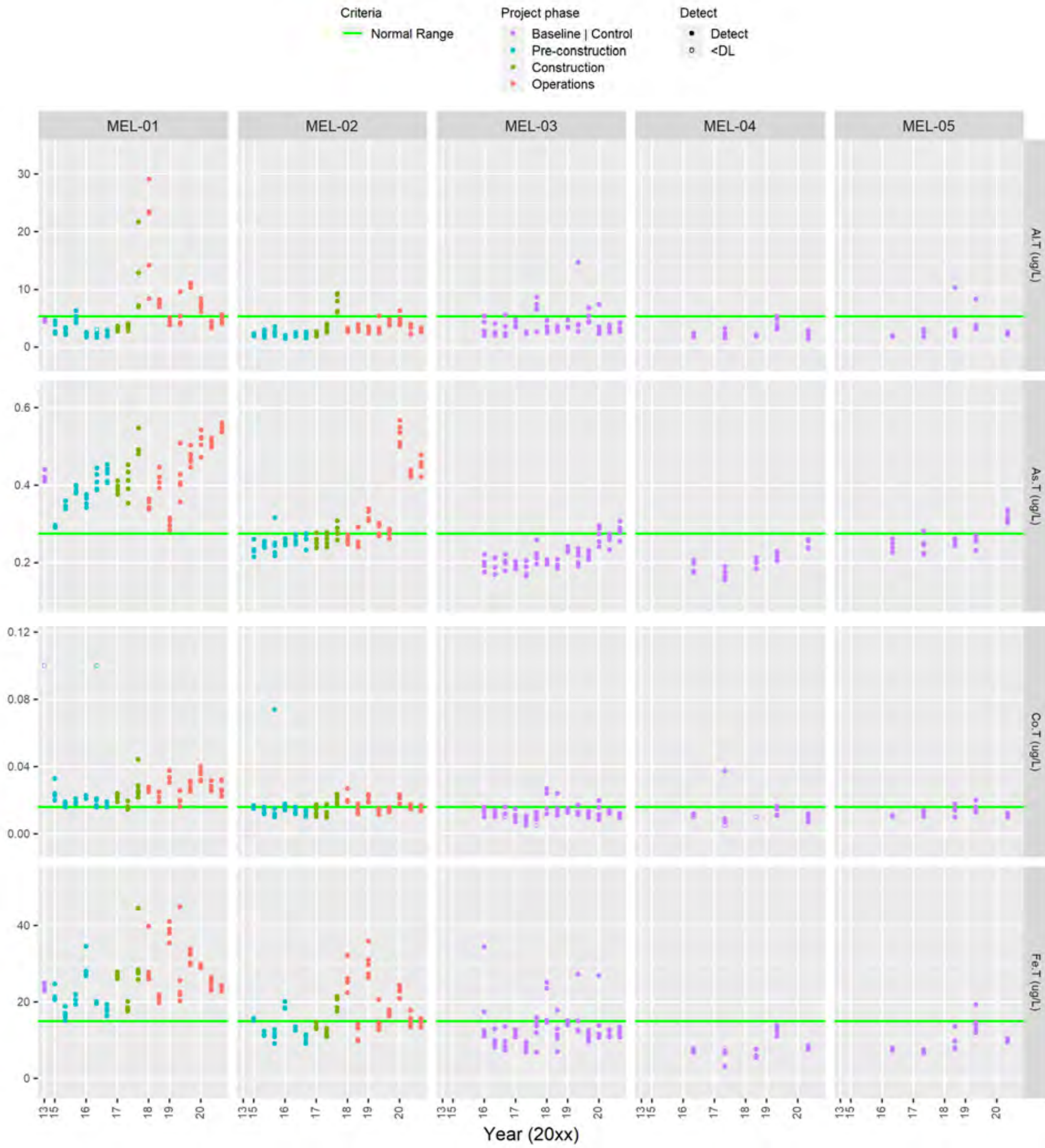


Source: Modified from Figure 5-7 from Azimuth (2021a)

Figure 10.2-4: Concentrations of TDS and Nutrients in Meliadine Lake (2013 to 2020)

Source: Figure 5-5 and 5-6 from Azimuth (2021a)
Note: Meliadine Lake water quality, open-water. Concentrations are below guidelines. TDS guideline is 500 mg/L; Nitrate (NO3-N) guideline is 2.93 mg-N/L; Total phosphorus (TP) guideline is 0.01 mg/L.

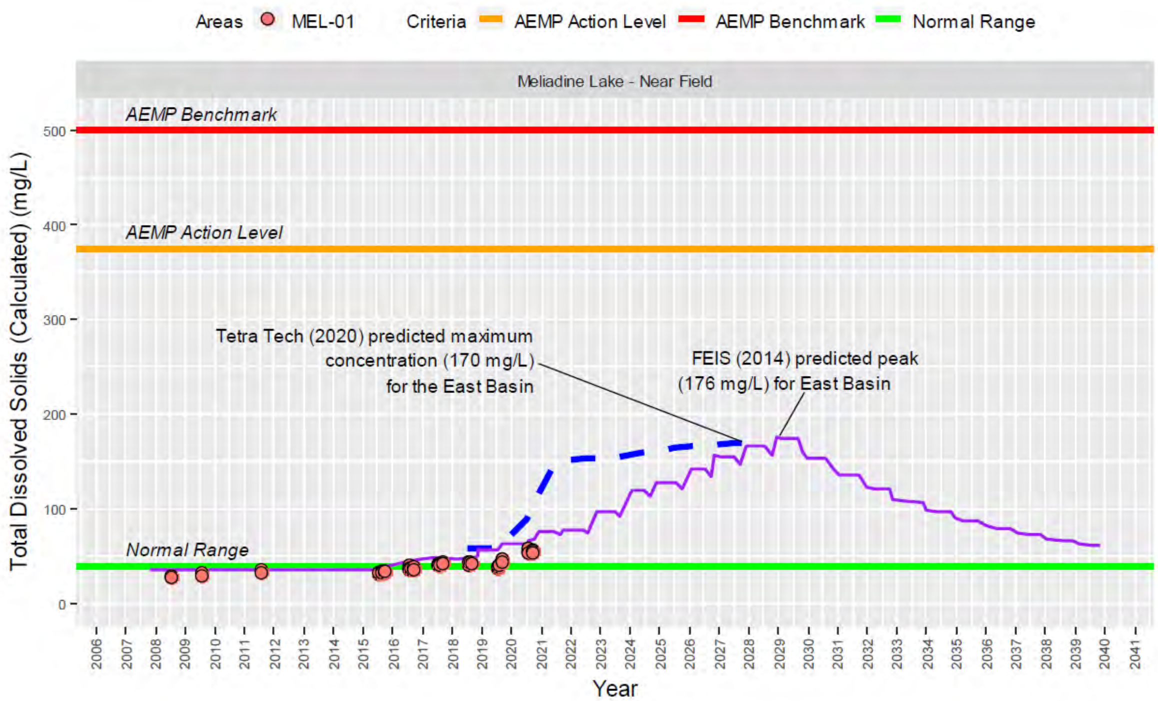
Figure 10.2-5: Concentrations of Total Metals in Meliadine Lake (2013 to 2020)



Source: Figure 5-7 from Azimuth (2021a)

Note: Meliadine Lake water quality, open-water. Concentrations are below guidelines. Aluminum (Al) guideline is 100 µg/L; Arsenic (As) guideline is 25 µg/L; Cobalt (Co) guideline is 0.78 µg/L; Iron (Fe) guideline is 1,060 µg/L.

Figure 10.2-6: Summary of Predicted and Measured Total Dissolved Solids in Meliadine Lake



Source: Figure 5-11 from Azimuth (2021a)

10.2.4.4 Sediment – Freshwater Environment

The 2014 FEIS (Section 7.4.4) provides a review of baseline sediment quality in Meliadine Lake, small waterbodies on the peninsula of Meliadine Lake, and regional waterbodies. Average metal concentrations were generally similar across the lakes with some exceptions:

- Metals that were higher in the peninsula lakes as compared to Meliadine Lake included cobalt, arsenic, nickel, chromium, copper, and zinc.
- Metals that were higher in Meliadine Lake as compared to the peninsula lakes included molybdenum, strontium, vanadium, titanium, and aluminum.

Sediment chemistry in Meliadine is typical of northern lakes, particularly those located in close proximity to highly mineralized areas. Arsenic, cadmium, and chromium concentrations are naturally elevated in the exposure and reference areas of Meliadine Lake (Azimuth 2021b).

Since 2014, sediment quality has been monitored following the AEMP design plan (i.e., collection of pre-construction data in 2016, and starting in 2018, collection of data every three years following the EEM requirements). In Meliadine Lake, samples are collected in five areas including a near-field area, mid-field area, and three reference areas (Figure 10.2-2).

Monitoring since 2014 primarily reflects existing conditions since construction and early operation of

Meliadine Mine. Further analysis of the pre-2014, 2015, 2016, and 2018 sediment data examined the relationship between metal concentrations and sediment particle size because there is a propensity for most metals to accumulate in finer sediments (Golder 2019c).

In the 2014 FEIS, it was stated that sediment quality in Meliadine Lake could be affected through release of treated effluent from the diffuser, erosion and sedimentation at the diffuser, and erosion and sedimentation on the shore of Meliadine Lake near mining infrastructure. Erosion and sediment control measures as well as best management practices will be implemented at the site of the diffuser, and along the shore of Meliadine Lake, where appropriate, to minimize mobilization of suspended solids, and associated adsorbed chemicals, in the water column. Loading of particulate matter from treated effluent through the diffuser will be controlled, as TSS in the end-of-pipe effluent is predicted to be no more than 15 mg/L. In addition, the use of a diffuser aids development of a mixing ratio in Meliadine Lake so that water quality guidelines are met at the edge of the mixing zone. Since water quality in Meliadine Lake at the edge of the mixing zone predicted to not exceed aquatic life or drinking water guidelines, and TSS in the effluent released from the Project will be managed to meet the regulations, it was predicted that sediment quality near the diffuser would not change from baseline concentrations.

Based on sediment data collected in 2018, arsenic, cadmium, and chromium were above the ISQG in the near-field and reference areas, and there was no indication that concentrations had increased in 2018 as compared to baseline/pre-construction (Azimuth 2021b). These monitoring results are consistent with the FEIS (Golder 2019c).

10.2.4.5 Fish Tissue Quality – Freshwater Environment

As part of the baseline studies to support the 2014 FEIS, tissue samples were collected from several species to provide information on the concentrations of metals in fish in freshwater environments within the LSA and RSA (Agnico Eagle 2014). These studies were conducted in 1997 and 1998, and occurred in the south basin of Meliadine Lake, Meliadine River, Lake B5, and a reference lake (Parallel Lake). Analyses of muscle, liver, and kidney tissues collected from Arctic char, lake trout, round whitefish, cisco and Arctic grayling indicated generally low levels of metal accumulation. Concentrations of aluminum, arsenic, lead, mercury, and zinc in lake trout tissues were higher in Meliadine Lake than in Parallel Lake, which was selected as a control basin for long-term monitoring. Mercury concentrations in lake trout tissues were strongly correlated with fish size. A small proportion (3 of 30) of lake trout muscle tissue samples from Meliadine Lake exceeded the Canadian Food Inspection Agency guideline of 0.5 mg/kg wet weight for human consumption (CFIA 2014). Round whitefish tissues indicated similar concentrations between Meliadine and Parallel lakes. In contrast to lake trout, mercury concentrations in round whitefish were weakly correlated with fish size and none of the muscle tissue samples exceeded the food consumption guidelines. Analytical results for cisco and Arctic grayling also documented low metal concentrations in the tissue samples collected from these species.

Fish tissue chemistry sampling was conducted in Meliadine Lake in the near-field area (east basin) in 2015 (Golder 2017) and in the reference areas in 2017 (Golder 2018d). Threespine Stickleback were sampled in both years, with a total of 194 carcass samples consisting of whole body fish with the internal organs removed (i.e., air bladder, gall bladder, gonads, intestine, kidney, liver, stomach, and spleen). Lake trout were only sampled in 2015, with 60 muscle, liver, and kidney samples collected for analysis.

Threespine Stickleback sampled from the near-field area were generally larger and exhibited lower metal concentrations in carcass tissue relative to fish sampled from the reference areas (Golder 2019c). Concentration of mercury in Threespine Stickleback were less than the food consumption guideline of 0.5 mg/kg wet weight; however, concentrations of mercury in Lake Trout exceeded the guideline in more than 50% of the samples. The CFIA mercury guideline was exceeded in Lake Trout in 56.7% of muscle, 65.0% of liver and 71.7% of kidney samples analyzed. The samples in exceedance corresponded to fish with lengths greater than 590 mm, 563 mm, and 546 mm, respectively. Mercury concentrations ranged from 0.14 to 2.35 mg/kg wet weight and varied predictably with fish length and tissue type.

Mercury concentrations in Lake Trout in 2015 were also higher than the national median (0.28 µg/g ww at a length of 541 mm as reported by Depew et al. 2013). As mercury bioaccumulates and biomagnifies, mercury concentrations are known to increase predictably with increasing fish size and trophic position. Therefore, it is not uncommon for Lake Trout, a large piscivorous fish, to exceed the CFIA guideline (Depew et al. 2013). As the 2015 Meliadine fish tissue chemistry data was collected prior to the construction of the mine and prior discharge to Meliadine Lake, mercury concentrations are considered baseline.

Concentrations of metals in Lake Trout tissues from Meliadine Lake were largely similar between 1998 and 2015 (Golder 2017). Given the sampling periods were separated by 17 years and collected from different parts of Meliadine Lake (i.e., the South Basin in 1998 and the East Basin in 2015), any differences in metal concentrations between the two sampling events likely reflect spatial and temporal variability in tissue chemistry in the region.

10.2.4.6 Surface Water and Sediment - Itivia Harbour

Based on baseline data (pre-2014), the area near the discharge location in Itivia Harbour plus the local study area is characterized as follows:

- Surface salinity in Hudson Bay ranges from 10 Practical Salinity Units (PSU) near the outlets of major rivers to 30 PSU in offshore locations of the bay (Anderson and Roff 1980; Prinsenberg 1986).
- In general, water salinity in Hudson Bay increases with distance from shore. Lower salinities in the inshore region as compared to the offshore region are due to dilution effects.

The existing conditions (post-2014) near the discharge area in Itivia Harbour in comparison to predictions (Section 8.2) are summarized as follows:

- Negligible changes to marine water quality were predicted in the previous assessments (Agnico Eagle 2018a, 2020a).

- Salinity was generally uniform throughout the water column and ranged between 30.7 and 30.9 PSU for all survey areas and depths. An exception was a surface (top 0 cm) measured at a single station (CTD-1, in Reference Area B) where salinity was slightly lower (30.5 PSU) (Golder 2019a).
- In surface water (at 1 m depth, ± SD) at Itivia Harbour, near the location of the proposed permanent engineered marine outflow, salinity was 29.32 ± 0.03 ppt and a pH was 8.08 ± 0.03; bottom water had similar salinity and pH values (Agnico Eagle 2020a).
- Total dissolved solids values were similar at all three sampling locations in Itivia Harbour (ranging from 34,200 to 34,300 mg/L). Approximately 78% of all analyzed metals (33 of 42) were below detection limits, and concentrations were lower than the CCME guidelines for the protection of marine aquatic life (Section 6.1.3 of Agnico Eagle 2020a).
- Dissolved oxygen concentrations were also vertically uniform at all survey locations and ranged from 6.5 to 8 mg/L (Golder 2019a).
- Concentrations of total suspended solids were low ranging from below the detection limit of 2 to 3.8 mg/L. Water quality results were screened against the CCME guidelines for the protection of marine aquatic life (CCME 1999a). None of the parameters exceeded CCME guidelines. (Golder 2019a).

Sediment quality data were collected to support the 2014 FEIS and to support the 2018 FEIS Addendum (Agnico Eagle 2014, 2018a). Sediment quality data are not routinely collected during operations because the previous assessments predicted negligible changes to water quality and thus there would be negligible to no changes to sediment quality due to mine related activities in Itivia Harbour. Based on baseline data (pre-2014), and existing conditions data (post-2014) the area near the discharge location in Itivia Harbour is characterized as follows:

- Cobble and gravel were the dominant substrates in the nearshore environment in Itivia Harbour.
- Metal concentrations in sediment were variable, ranging from below analytical detection limits to detectable but lower than the CCME interim sediment quality guidelines (ISQGs) for the protection of marine aquatic life. The exception was for chromium, which slightly exceeded the CCME ISQG of 52.3 mg/kg dry weight at all sample stations.

10.2.5 Pathway Analysis

Pathway analysis identifies and assesses the linkages between Mine components or activities, and the potential residual effects to human health, wildlife and aquatic life. The first part of the analysis is to produce a list of all potential effects pathways for the Mine. Each pathway is initially considered to have a linkage to potential effects on human health, wildlife and aquatic life. This step is followed by the development of environmental design features and mitigation that can be incorporated into the development description to remove a pathway or limit (mitigate) the effects to human health, wildlife and aquatic life. Environmental design features include Mine design elements, environmental best practices, management policies and procedures, and social programs. Environmental design features are developed through an iterative process between the Mine's engineering and environmental teams to avoid or mitigate effects.

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the Mine. This screening step is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on human health, wildlife and aquatic life. Pathways are determined to be primary, minor, or as having no linkage using scientific and traditional knowledge, logic, and experience with similar developments and environmental design features. Each potential pathway is assessed and described as follows:

- **No linkage** – pathway is non-existent or is removed as it was previously assessed and the proposed activities under Meliadine Extension represent a negligible change, or is removed by environmental design features and mitigation so that the proposed activities result in no detectable environmental change and residual effects to human health, wildlife and aquatic life relative to existing conditions or guideline values.
- **Minor** – pathway could result in a minor environmental change but would have a negligible residual effect to human health, wildlife and aquatic life relative to existing conditions or guideline values.
- **Primary** – pathway is likely to result in a measurable environmental change that could contribute to residual effects on human health, wildlife and aquatic life relative to existing conditions or guideline values.

Primary pathways require further effects analysis to determine the environmental significance from the Mine on human health, wildlife and aquatic life. Pathways determined to have no linkage to human health, wildlife and aquatic life, or those that are considered minor, are not predicted to result in environmentally significant effects on human health, wildlife and aquatic life. No linkage and minor pathways specific to the ecological health risk assessment are summarized in Appendix B Table B-11 but are not carried through the effects assessment for quantitative analysis.

Potential pathways previously identified for the 2014 FEIS and 2018 and 2020 FEIS addenda and their applicability to the Meliadine Extension as relevant to the ecological health risk assessment are presented in Table 10.2-2. Environmental design features and mitigation incorporated into the design of the Mine to remove a pathway or limit the effects to human health, wildlife and aquatic life are listed; design features and mitigation measures incorporated as part of the Meliadine Mine are similarly incorporated in the Meliadine Extension. The pathway is then determined to be primary, minor, or as having no linkage. The classification of pathways as primary, minor, or as having no linkage was determined by the disciplines that have assessed the pathway and provided predictions regarding changes to environmental quality. For example, pathways related to air emissions were assessed in the Air Quality section of the 2014 FEIS (Section 5.2) and those that were classified as primary were assessed further. Mitigation measures were incorporated into the predictive modelling for changes to air quality and surface water quality. The mitigation measures are described in detail in the relevant sections of this FEIS Addendum. No additional mitigation measures were considered in the HHERA.

Table 10.2-2: Potential Primary Pathways for Ecological Health Risk Assessment

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension -	Meliadine Extension Rationale
Ecological Health (Wildlife and Freshwater Aquatic Life)	Mine Site (operations)	Project activities will result in air emissions, which may cause changes in air concentrations and atmospheric deposition rates, and as a result, soil concentrations, which may affect the health of terrestrial life. NEW: The windfarm will result in reduced diesel fuel consumption and a commensurate reduction in emissions of CAC associated with diesel combustion, which is a positive effect.	Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards. Use of ultra-low sulfur diesel will stay in place. The use of low-emissions explosives such as emulsion will continue to be preferred. Speed limits and dust suppressant (water of calcium chloride) will continue to be used when required to reduce dust emissions. Sources of particulate emissions at the processing facility are controlled through the use of baghouses. Enclosures are used to reduce fugitive emissions at the processing facility. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. Installation of incinerator that complies with Nunavut Environmental Protection Act standards for dioxin and furans.	Primary	Primary	Section 5.2.5.2 of the 2014 FEIS The predictions indicate that predicted changes in air quality near the mine would be negligible to low for all indicators with the RSA, and would be negligible to high for indicators in the LSA (rated as moderate). The potential residual effects are limited to the operations case and thus all are considered reversible. Section 10.1.8.3.1.1.1 of the 2014 FEIS The predictions indicate that there will be no changes to chemical concentrations in soil as a result of air emissions and thus no predicted changes to food sources that might be used by higher-order animals (e.g., terrestrial vegetation serves as a food source for caribou or fox). As a result, there were no predicted Project-related impacts to traditional food quality as a result of bioaccumulation.	This pathway has been previously assessed and the Extension does not change the assessment	Table 5.2-25 of the 2014 FEIS There will be no adverse effects to air quality from the Meliadine Mine and associated infrastructure (i.e., the overall rating was Not Significant) Section 10.1.8.3.1.1.4 of the 2014 FEIS For wildlife there were no constituents of concern identified in soil or sediment. Adverse health effects to terrestrial life are not expected.	No change	No changes in mining rate are planned for the Meliadine Extension. The total tonnage of rock moved during the life of mine is smaller than what was predicted in the 2014 FEIS due to a refined mine plan. The windfarm will reduce NO_2 and SO_2 emissions. Predicted mine site emissions are under CAAQS guidance for 2020 and 2025. Mitigation and monitoring measures outlined in the 2014 FEIS will be carried forward through Meliadine Extension.
Ecological Health (Wildlife and Freshwater Aquatic Life)	AWAR (operations)	Project vehicles along the AWAR will result in air emissions, which may cause changes in air concentrations and as a result, soil concentrations which may affect the health of terrestrial life.	Best management practices to control fugitive particulate emissions from vehicles travelling along the AWAR will be followed.	Primary	Primary	Section 5.2.5.3 of the 2014 FEIS The predictions indicate that predicted changes in air quality along the AWAR would be negligible for all indicators with the RSA, and would be negligible for all indicators in the LSA except for PM10 (rated as moderate). Section 10.1.8.3.1.1.1 of the 2014 FEIS The predictions indicate that there will be no changes to chemical concentrations in soil as a result of air emissions and thus no predicted changes to food sources that might be used by higher-order animals (e.g. terrestrial vegetation serves as a food source for caribou or fox). As a result, there were no predicted Project-related impacts to traditional food quality as a result of bioaccumulation.	This pathway has been previously assessed and the Extension does not change the assessment	Table 5.2-30 of the 2014 FEIS There will be no adverse effects to air quality from the Meliadine Mine and associated infrastructure (i.e., the overall rating was Not Significant) Section 10.1.8.3.1.1.4 of the 2014 FEIS For wildlife there were no constituents of concern identified in soil or sediment. Adverse health effects to terrestrial life are not expected.	No change	No proposed changes to traffic and type of traffic along the AWAR as part of Meliadine Extension. Life of mine will be extended so duration of emissions will be longer. Existing robust mitigation measures will continue to be implemented. Monitoring will continue to be completed to ensure results are within 2014 FEIS predictions and regulatory guidelines.
Ecological Health (Wildlife and Freshwater Aquatic Life)	Mining activities and water management during construction, operations, and closure	Release of mine wastewater (including sewage) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations), which may affect the health of terrestrial and aquatic life.	Treated sewage will be piped to the tailings storage facility. Mine wastewater will be treated and tested before release to Meliadine Lake. If water quality does not meet discharge limits, it will be circulated and re-treated. Water quality will meet CCME aquatic life objectives, site-specific water quality objectives, or water licence limits at the edge of the mixing zone in Meliadine Lake. Underground water will be collected, contained, monitored, re-used in the underground, or collected, contained, monitored, or treated, if required, to meet discharge limits for release to Meliadine Lake. A site Water Management Plan has been developed and describes containment of contact water through the use of diversions, attenuation ponds, and treatment facilities during construction, operations, and closure. Other applicable design features and mitigation, as identified in the project closure plan.	Primary	Primary	Section 7.4.6.1 and 7.4.7 of the 2014 FEIS The predictions indicate that concentration levels gradually increase during the construction and operations phases of the mine and that these maximum concentrations do not exceed guidelines. During closure and post-closure, concentrations are predicted to gradually return to background concentrations. Changes were predicted to be low in magnitude, local in extent, and reversible. Section 10.1.8.3.1.1.4 of the 2014 FEIS For aquatic life, there were no constituents of potential concern identified in surface water and sediment of Meliadine Lake.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of	No change	This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. The Meliadine Extension will be within the footprint that has been previously assessed; the footprint of the Meliadine Extension is more compact than the 2014 FEIS footprint for water management infrastructure. The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension -	Meliadine Extension Rationale
								the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.		
Ecological Health (Wildlife and Freshwater Aquatic Life)	Mine infrastructure footprint (e.g., open pits, dikes, mine pits, waste rock, mine plant, site roads, camps) during construction, operations, closure, and post-closure	Project footprint, which will physically alter watershed areas and drainage patterns, rates, and quantities of diverted non-contact water to new watersheds, may change downstream flows, water levels, channel/bank stability in streams and may affect water and sediment quality, which may affect the health of terrestrial and aquatic life.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Access roads will be as narrow as possible, while maintaining safe construction and operation practices. Minimum haul road widths will follow that defined under the Mine Health and Safety Act. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed. Minimum setback distance of 31 m from the ordinary high water mark of waterbodies. Regular road inspections to check for ponding. Removal of snow at the culvert inlet prior to freshet. To reduce the potential for erosion in channels due to higher than normal water flows and levels, natural drainage courses will be surveyed to evaluate capacity and then modified if required. Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms. A site water management plan has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas. Monitoring during activities and use of adaptive management where necessary.	Primary (these five pathways are linked and were assessed together)	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS Water quality downstream of the mine may change due to diversion of water, dewatering, fugitive dust and aerial deposition. Contact water will not be released to the downstream small waterbodies. It was predicted there would be a negligible change in some water quality parameters from background. Changes were predicted to be low in magnitude, local in extent, and reversible (for larger waterbodies) to irreversible (for some small waterbodies). Section 10.1.8.3.1.1.4 of the 2014 FEIS Up to five constituents of potential concern (cadmium, copper, lead, mercury, and silver) were identified in three of the smaller waterbodies. Based on the results of the exposure assessment, toxicity assessment, and risk characterization, the potential residual effects were low.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.	No change	This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. The Meliadine Extension will be within the footprint that has been previously assessed; the footprint of the Meliadine Extension is more compact than the 2014 FEIS footprint for water management infrastructure. The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Ecological Health (Wildlife and Freshwater Aquatic Life)	Site Water Management: Dewatering of Project Footprint waterbodies to downstream receiving waterbodies (e.g., to lakes A7, A1, B6, B34, Meliadine Lake) during construction and operations	Dewatering of lakes may change flows, water levels, channel/bank stability, and water quality (e.g., suspended sediments, nutrients, metals) in receiving and downstream waterbodies, which may affect the health of terrestrial and aquatic life.	During dewatering activities, TSS will be monitored, and if necessary, treated before release downstream. Pumped water from the dewatered waterbodies will be directed through properly designed structures to the lake environment, and not to lake outlets, to prevent erosion in the receiving waterbodies and to attenuate flows. Shoreline areas susceptible to extensive erosion will be addressed by appropriate erosion protection measures to reduce erosion and associated re-suspension of fine sediment. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.							This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Pumped discharges for dewatering will be directed to a lake environment (not directly to outlets) or to a treatment facility and for discharge through the permanent diffusers. The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension -	Meliadine Extension Rationale
Ecological Health (Wildlife and Freshwater Aquatic Life)	Mine and supporting infrastructure during construction and operations	Fugitive dust sources and deposition of dust (including from blasting during mining) can change water and sediment quality, which may affect the health of terrestrial and aquatic life	Best management practices to control fugitive particulate emissions from haul roads and material handling. Use of water or dust suppressants to manage dust. Use of chemical suppressants will be in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of the Environment. Enforcing speed limits to suppress dust production. Design roads as narrow as possible while maintaining safe construction and operation practices. Crossings will be perpendicular to watercourse. The running surface of the road will be maintained thereby reducing the generation of dust. Enclosures and covers will be used in major ore handling areas and most crushing areas. For uncovered crushing areas, water or dust suppression will be used. Dust control systems will be used to limit dust emissions, for example, processing equipment with high efficiency bag houses will be used. Most personnel arriving at or leaving the site will be transported by bus, thereby reducing the amount of traffic (and dust). Operating procedures will be developed that reduce dust generation. For example, tailings deposition will be designed to limit dust generation.	Primary (these five pathways are linked and were assessed together)	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS Water quality downstream of the mine may change due to diversion of water, dewatering, fugitive dust and aerial deposition. Contact water will not be released to the downstream small waterbodies. It was predicted there would be a negligible change in some water quality parameters from background. Changes were predicted to be low in magnitude, local in extent, and reversible (for larger waterbodies) to irreversible (for some small waterbodies). Section 10.1.8.3.1.1.4 of the 2014 FEIS Up to five constituents of potential concern (cadmium, copper, lead, mercury, and silver) were identified in three of the smaller waterbodies. Based on the results of the exposure assessment, toxicity assessment, and risk characterization, the potential residual effects were low.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.	No change	This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Monitoring conducted in 2020 were within air quality standards and 2014 FEIS predictions. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Ecological Health (Wildlife and Freshwater Aquatic Life)	Mine and supporting infrastructure during construction and operations	Air emission of sulphur dioxide, nitrogen oxides, and particulates may change water and sediment quality, which may affect the health of terrestrial and aquatic life	Construction equipment and trucks will be equipped with industry-standard emission control systems. Compliance with regulatory emission requirements will be met. Processing equipment will use dust collectors to limit emissions of particulate matter. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. SO_2 emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than15 ppm of sulphur. Operating procedures will be developed that reduce dust generation. Generator efficiencies and equipment will be tuned for optimum fuel-energy efficiency.							This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. No increase in emissions is predicted for the Meliadine Extension due to the production rate staying the same. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Ecological Health (Wildlife and Freshwater Aquatic Life)	Pits (closure and post-closure)	Water quality in flooded pits may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality, which may affect the health of terrestrial and aquatic life	A Conceptual Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pits are designed to have stable slopes during mining and post-closure. The pits will be progressively reclaimed as excavation is completed. The pits will be flooded, with water from Meliadine Lake, over a 10 year period following completion of pit operations. Water quality in the pits will be monitoring continuously during the flooding process. All diversion dikes will be kept intact as a barrier between open pits and surrounding waterbodies until the pit water meets acceptable concentrations for release to the environment. Water will be treated if it is unacceptable for discharge.	Primary (these five pathways are linked and were assessed together)	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS Water quality downstream of the mine may change due to diversion of water, dewatering, fugitive dust and aerial deposition. Contact water will not be released to the downstream small waterbodies. It was predicted there would be a negligible change in some water quality parameters from background. Changes were predicted to be low in magnitude, local in extent, and reversible (for larger waterbodies) to irreversible (for some small waterbodies). Section 10.1.8.3.1.1.4 of the 2014 FEIS Up to five constituents of potential concern (cadmium, copper, lead, mercury, and silver) were identified in three of the smaller	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and	No change	This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Predictions suggest that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension -	Meliadine Extension Rationale
						waterbodies. Based on the results of the exposure assessment, toxicity assessment, and risk characterization, the potential residual effects were low.		beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.		
Ecological Health (Marine Aquatic Organisms)	Discharging treated groundwater effluent into marine environment	Accidental release of groundwater from an unknown location along the discharge pipe can have direct adverse effects on marine water quality and associated indirect effects on marine fish and other aquatic organisms. Change in water and sediment quality due to discharge of treated groundwater effluent from the Meliadine Mine can have adverse effects on marine aquatic life.	Operational activities will be engineered to use handling systems to minimize the risk of accidental spills into the marine environment. A Failure Modes Effects Analysis was completed to review all potential risks and develop mitigation for the discharge of saline water through the waterline (Golder 2020d). Visual inspections of equipment will be carried out regularly, and spills kits will be available Implementation of the Spill Contingency Plan and Risk Management and Emergency Response Plan. The Shipping Management Plan may also be implemented, as appropriate. Spills and leaks will be contained, cleaned-up and documented per applicable guidelines and regulations, spill kits will be restocked after use. Adherence to the Ocean Discharge Monitoring Plan. Implementation of a Risk Management and Emergency Response Plan specific to the potential release of treated groundwater. Operational activities will be engineered to use handling systems to minimize the risk of accidental spills into the marine environment. Discharge of effluent will meet regulatory requirements for both temperature and applicable water quality guidelines. If the treated groundwater effluent is not suitable for discharge, it will be stored at the Meliadine Mine and treated prior to discharge. Design, construct, and install a diffuser with the discharge pipe to aid in mixing. Monitoring program will be established, and adaptive management implemented if negative impacts are detected.	Primary Section 8.1.6 of the 2018 FEIS Addendum Section 8.1.3 of the 2020 FEIS Addendum	Primary	Table 15 of 2020 FEIS Addendum	This pathway has been previously assessed and the Extension does not change the assessment	Not Significant	No Change	No change to marine activities as part of the Meliadine Extension. The effects pathway statement has been updated from the previous assessments to include controlled discharge of treated effluent in additional to accidental discharge of treated effluent. This effect is considered previously assessed. Mitigation measures outlined in the 2020 FEIS Addendum will be carried forward through the Meliadine Extension. Primary pathways are the same as those identified in the 2020 FEIS Addendum (Section 8.1.2) and are not assessed further here.

10.2.6 Conceptual Site Model

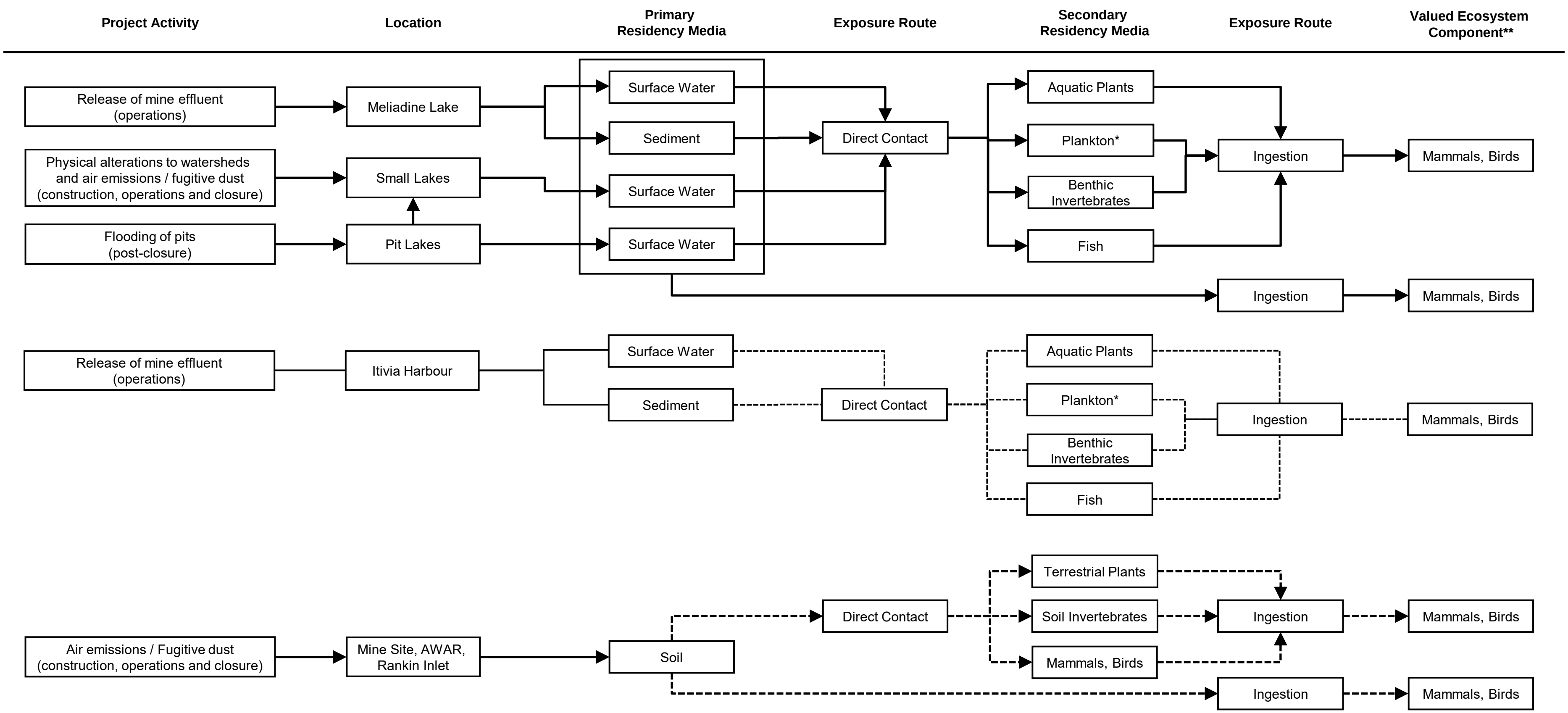
The CSMs for terrestrial health (Figure 10.2-7) and aquatic health (Figure 10.2-8) were based upon the primary pathways identified above (Table 10.2-2) and informed by the screening of air and water predictions. The exposure pathways between Mine activities, intermediate residency media (i.e., the aspects of the environment that that may experience a change in quality due to Mine activities/emissions), and receptors are shown to be either complete or incomplete. Where pathways are incomplete, quantitative assessment was not carried out given that environmental quality was not anticipated to change as a result of the Meliadine Extension. Complete pathways on the figure indicate that a change to environmental quality was predicted and an assessment of the potential effects to ecological health was carried out. A brief summary of the complete exposure pathways is provided below for ecological receptors:

- Ingestion of surface water by terrestrial wildlife
- Direct contact of surface water by aquatic organisms

The exposure pathway for food chain transfer was determined to be incomplete based on the results of the air and water screenings.

Conceptual Site Model for the Meliadine Extension – Terrestrial Health

FIGURE 10.2-7



NOTES

* Phytoplankton and zooplankton

** The valued ecosystem components have been simplified to mammals and birds. The species of mammals and birds selected as valued ecosystem components are described in Section 10.2.1.

Solid lines indicate pathways that were considered to be complete and quantitatively evaluated in the ecological health risk assessment.

Dashed lines indicate pathways that were considered to be incomplete (i.e., no COPCs were identified in site media).

Date: February 2022

Project: Meliadine Extension HHERA

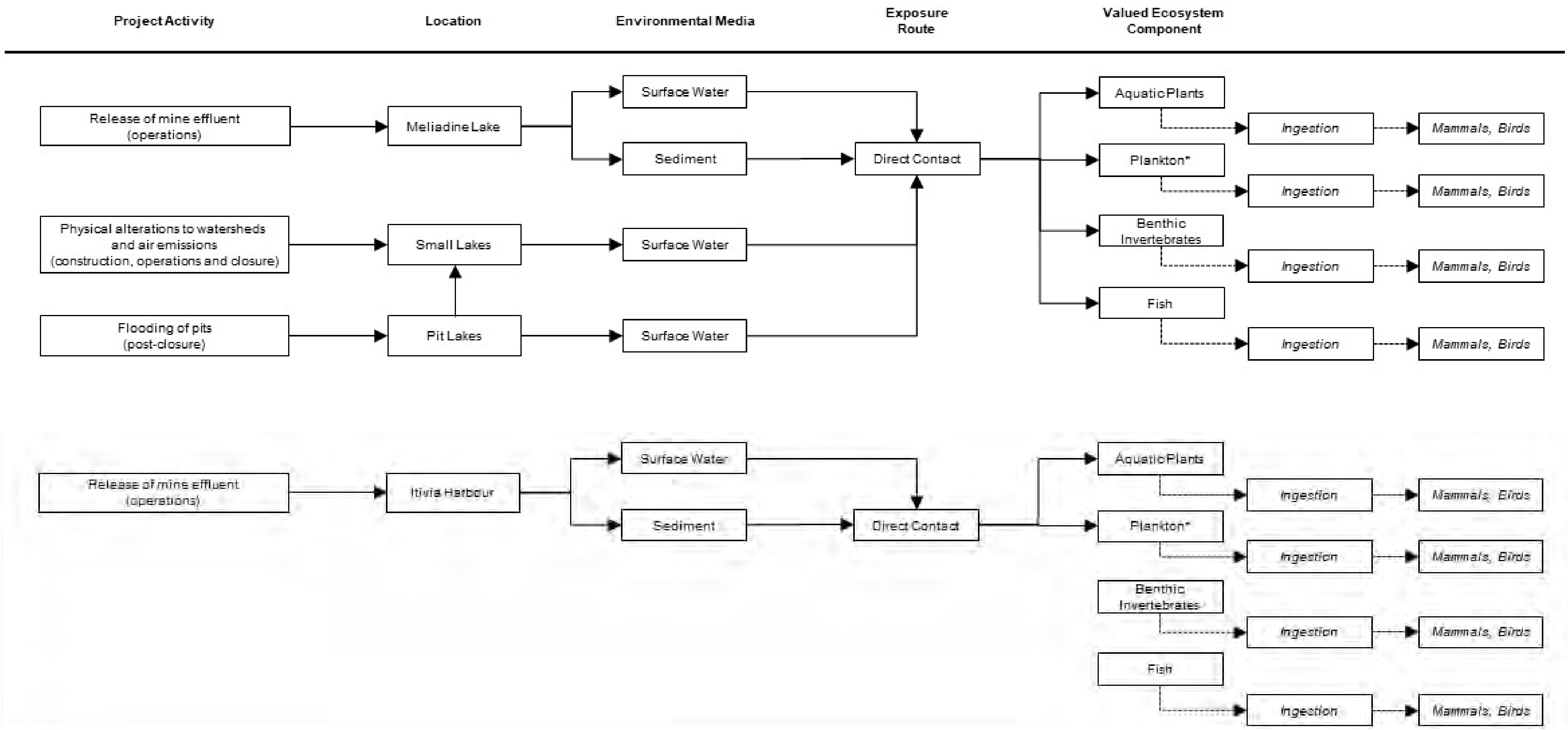
GOLDER MEMBER OF WSP

CAD: KCS

CKD:

Conceptual Site Model for the Meliadine Extension – Aquatic Life

FIGURE 10.2-8



NOTES

*Phytoplankton and zooplankton

Solid lines indicate pathways that were considered to be complete and quantitatively evaluated in the ecological health risk assessment.

Dashed lines indicate pathways that were considered to be incomplete (i.e., no COPCs were identified in site media).

Date: February 2022

Project: Meliadine Extension HHERA

GOLDER

CAD: KCS

CKD: SG

10.2.7 Assessment of Potential Meliadine Extension-related Effects

10.2.7.1 General Approach

This section provides the general approach used to evaluate the potential for adverse health effects to terrestrial and aquatic life associated with changes in environmental quality due to chemical releases from the Mine related to the Meliadine Extension.

As stated previously, risk assessment is the primary tool used to characterize potential adverse health effects, if any, to the environment from chemical releases. As described in Section 10.1.4, risk assessment includes four steps, namely problem formulation, exposure assessment, toxicity assessment, and risk characterization. Potential adverse health effects are characterized using a hazard quotient (HQ) approach. A target HQ of one was used in the assessment. An HQ of less than one indicates that adverse health effects to terrestrial and aquatic life are not expected. An HQ of greater than one indicates the potential for adverse health effects to terrestrial and aquatic life.

If any potential adverse health effects to the environment were determined based on the HQ approach, the health effects were further evaluated in terms of the assessment criteria suggested in the Guidelines for the Meliadine Mine (NIRB 2012) in the residual impact classification (Section 10.2.8), as follows:

- direction or nature of the effects;
- magnitude and complexity;
- geographic extent;
- frequency;
- duration;
- reversibility; and
- likelihood or probability of effects.

A determination of the significance for ecological health was then made (not significant or significant).

10.2.7.2 Project Environment

The ecological health risk assessment used predicted concentrations of chemicals in environmental media, as determined by other components, to determine the potential for adverse health effects to terrestrial and aquatic life associated with chemical releases from the Mine. The risk assessment relied upon the following predicted environmental data:

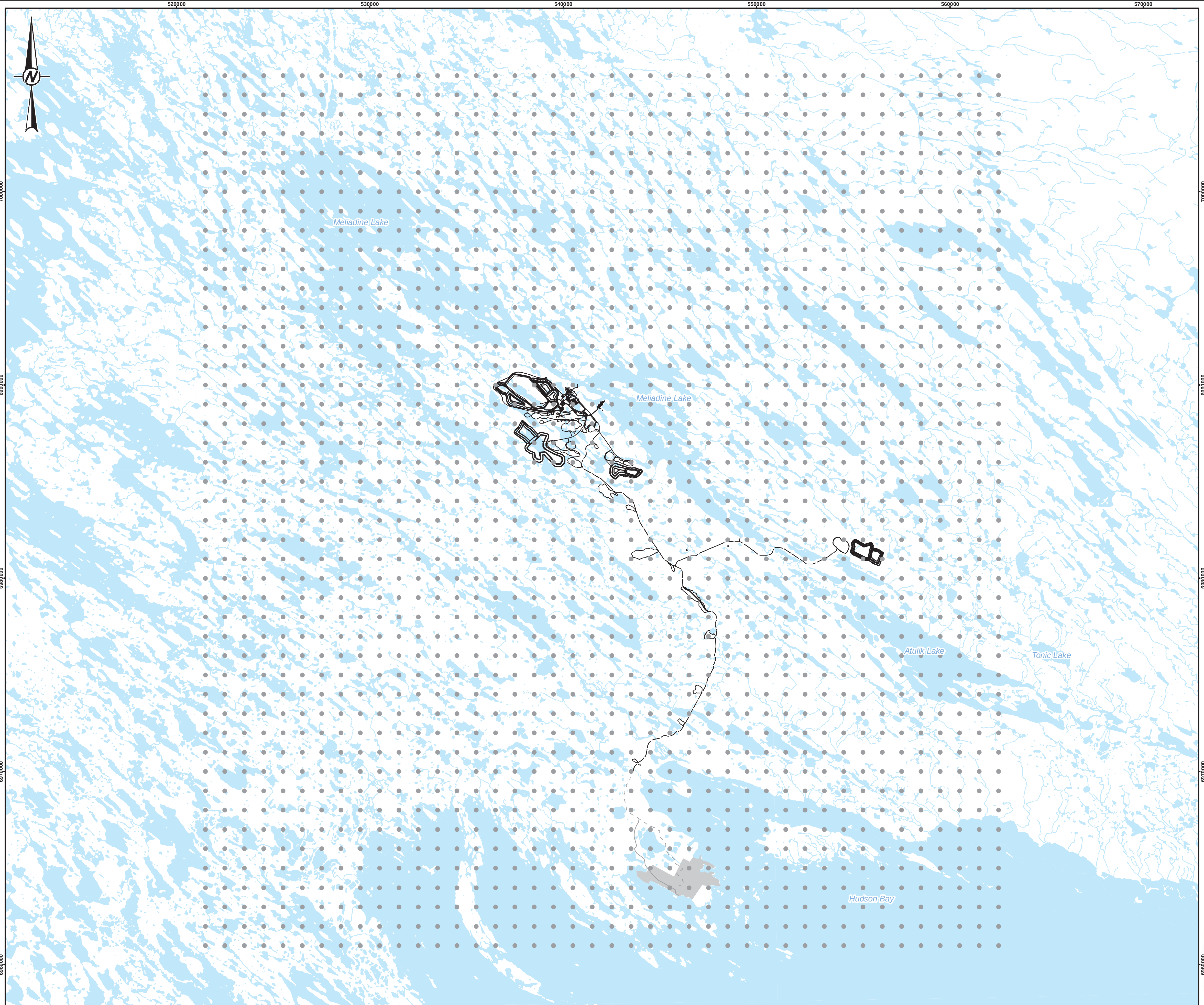
- **Predicted soil concentrations for the mine site, AWAR, and Rankin Inlet**. Soil concentrations were predicted in the ecological health risk assessment using the modelling methods developed by the USEPA (2005a) and relied upon modelled atmospheric deposition rates. For the Meliadine Extension, there were no changes to the predicted dry and wet deposition rates from the 2014 FEIS, thus the rates developed for the 2014 FEIS were used for this risk assessment. A detailed description of the atmospheric deposition modelling that yielded the predicted dry and wet deposition rates is provided in Section 5.2 (Air Quality) of the 2014 FEIS (Agnico Eagle 2014). In brief, given that emissions from the Project are likely to be greatest during the operations phase, the modelled deposition rates represent a bounding case from any phase of the Mine (i.e., construction, operations, closure, and post-closure). Deposition rates were modelled at a series of gridded receptors (i.e., for 1 km by 1 km grids on the entire modelling domain, which was 35 km by 35 km) (Figure 10.2-9).

- **Predicted effluent and edge of mixing zone concentrations for Meliadine Lake**. A detailed description of the water quality modelling and predictions is provided in Appendix H-07 (mine site model) and Appendix H-09 (Meliadine Lake 3D model) and discussed in Section 7.4.3.1. In brief, treated effluent will be released to Meliadine Lake, which may cause a change in surface water quality of Meliadine Lake. Discharge to Meliadine Lake will occur via the existing diffuser outfall. At the end of operations, discharge of treated water to Meliadine Lake will stop. As the point source discharge is removed, water quality concentrations that increased in operations will decrease in closure and return to pre-mining conditions. The assessment includes an evaluation for the potential of acute lethality at the end of pipe (effluent chemistry) as well as potential for effects on drinking water quality and the potential for chronic toxicity to aquatic life at the edge of the mixing zone.
- **Predicted surface water concentrations for small waterbodies and pit lakes**. A detailed description of the water quality modelling and predictions for the small waterbodies and pit lakes is provided in Appendix H-07 (mine site model). Predictions of water quality have been made assuming fully mixed conditions. The prediction nodes used for this assessment are outlined in Table 10.2-3. Figure 10.2-10 illustrates the location of the waterbodies and pit lakes, and the flow path among them, at post-closure. Depending on the location of the waterbody (i.e., within or outside of the Mine area), and the mining phase (operations, closure, and post-closure), the predicted changes to water quality were evaluated for the potential to affect terrestrial life, aquatic life, or human health. The following assumptions were made:
    - Waterbodies outside of the controlled mine footprint (e.g., Lake B2) would be considered aquatic habitat and would be accessible to terrestrial life (small and large mammals, and waterfowl) throughout the mine life. These waterbodies may be used for traditional activities after mine life and were compared to human health guidelines at post-closure.
    - Contact water ponds inside the controlled mine footprint (e.g., Contact Pond B4) would not be considered aquatic habitat during operations but would be accessible to terrestrial life throughout the mine life. After mine life, these ponds will be reclaimed and flooded and, once water quality meets criteria, they will be reconnected to the pit lakes and the downstream environment; they may also be used for traditional activities and were compared to human health guidelines at post-closure.
    - After mining, the pits will be flooded to create Pit Lakes. Thus at post-closure, the pit lakes may be accessible to aquatic and terrestrial wildlife, and people may directly or indirectly use them.

- **Predicted effluent and edge of mixing zone concentrations for Itivia Harbour**. A detailed description of the water quality modelling and predictions for saline discharge to Itivia Harbour is provided in Appendix H-10 (Tetra Tech 2021b). The assessment includes an evaluation for the potential of acute lethality at the end of pipe (effluent chemistry) as well as the potential for chronic toxicity to marine aquatic life at the edge of the mixing zone.

The main stressor that could change sediment quality is from release of treated effluent from the diffuser, erosion and sedimentation at the diffuser, and erosion and sedimentation on the shore of Meliadine Lake near mining infrastructure. Erosion and sediment control measures as well as best management practices will be implemented at the site of the diffuser, and along the shore of Meliadine Lake, where appropriate, to minimize mobilization of suspended solids, and associated adsorbed chemicals, in the water column. In addition, TSS in the effluent will be in compliance with the MDMER.

Based on these design features, and modelling predictions for the Meliadine Extension, water quality at the edge of the mixing zone is not predicted to exceed aquatic life, terrestrial life, and human health guidelines. As such, sediment quality is not predicted to change from pre-mining conditions. This is consistent with the 2014 FEIS. These predictions will be validated through the AEMP and EEM monitoring programs.



LEGEND

- ECOLOGICAL RECEPTOR LOCATION
- MUNICIPAL BOUNDARY
- PROPOSED PROJECT INFRASTRUCTURE
- ALL-WEATHER ACCESS ROAD (AWAR)
- ROAD - NEW
- ROAD - EXISTING
- WATERCOURSE
- WATERBODY

0 4,000 8,000

1:200,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED AND NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 15

CLIENT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED

PROJECT

MELIADINE GOLD PROJECT
NUNAVUT

TITLE

ECOLOGICAL RECEPTOR LOCATIONS FROM THE 2014 FEIS FOR ASSESSING PREDICTED SOIL CONCENTRATIONS

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-22
DESIGNED	KCS
PREPARED	CDB
REVIEWED	KCS
APPROVED	MZ

PROJECT NO.	CONTROL	REV.	FIGURE
21490211	4000	0	10.2-9

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

Table 10.2-3: Water Quality Prediction Nodes by Waterbody and Mine Phase

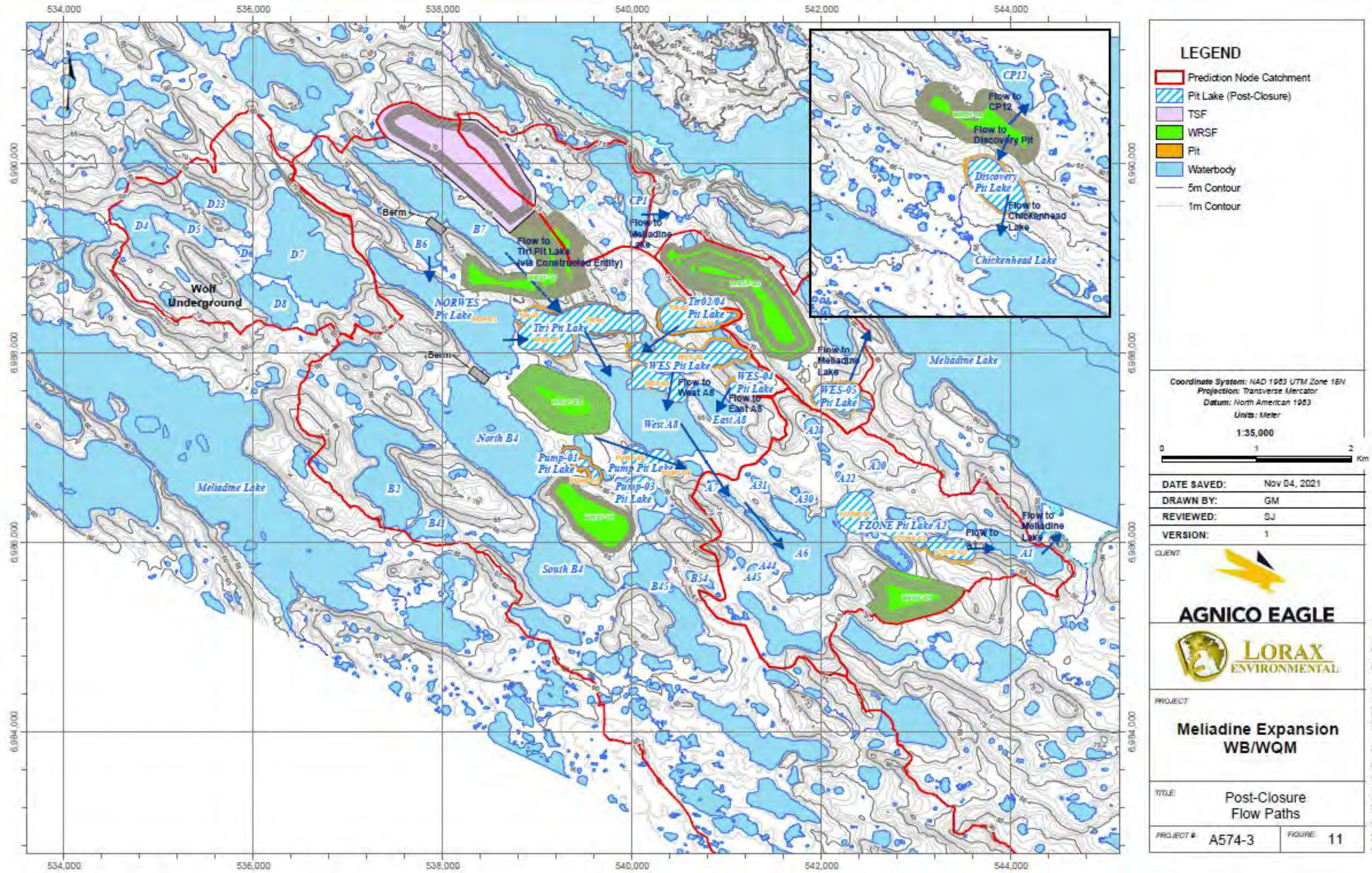
Location	Water Quality Prediction Node	Description	Operations (2024-2043)	Active Closure (2044-2050)	Post-Closure (2051-2119)
Inside the controlled mine footprint (contact ponds)	CP1	Operations and closure: Contact water pond Post-closure: Flooded and runoff to Meliadine Lake	TH[a]	TH[a]	AH, TH, HH
	A8 West	Operations and closure: Receive runoff from the disturbed area Post-closure: Flooded and a connection with WES Pit Lake	TH[a]	TH[a]	AH, TH, HH
	Saline Pond B7	Operations and closure: Saline water pond Post-closure: Flooded and runoff to Tiri Pit Lake To be listed in Schedule 2 in the MDMER; thus was not considered aquatic habitat for the HHERA	TH[a]	TH[a]	TH, HH
	Contact Pond B4	Operations and closure: Contact water pond Post-closure: Flooded and runoff to Lake B2 To be listed in Schedule 2 in the MDMER; thus was not considered aquatic habitat for the HHERA	TH[a]	TH[a]	TH, HH
Inside the controlled mine footprint (Pits)	TIR02	Closure: Active filling of pits	-	TH[b]	-
	TIR04	Closure: Active filling of pits	-	TH[b]	-
	NORWES Pit Lake	Post-closure: Pit lake in former B5 and WESNOR Pit	-	-	AH, TH, HH
	TIRI Pit Lake	Post-closure: Pit lake in former TIR01, TIR03, and WES01 pits	-	-	AH, TH, HH
	Pump Pit Lake	Post-closure: Pit lake in former PUMP01, PUMP02, PUMP03, and PUMP04 pits	-	-	AH, TH, HH
	F-Zone Pit Lake	Post-closure: Pit lake in former FZO01, FZO02, and FZO03 pits	-	-	AH, TH, HH
	Discovery	Closure: Active filling of pit Post-closure: Pit lake in former Discovery Pit	-	TH	AH, TH, HH
Outside the controlled mine footprint	B45	Operations and closure: Receive natural runoff from watershed Post-closure: Receive natural runoff from watershed and runoff from WRSF6 (Appendix H-07, Figure B.11)	AH, TH	AH, TH	AH, TH, HH
	B2	Operations and closure: Receive natural runoff from watershed Post-closure: Receive natural runoff from watershed and runoff from Contact Pond B4 (Appendix H-07, Figure B.11)	AH, TH	AH, TH	AH, TH, HH
	A1	Operations and closure: Receive natural runoff from watershed Post-closure: Receive natural runoff from watershed and runoff from F Zone Pit Lake (Appendix H-07, Figure A.11)	AH, TH	AH, TH	AH, TH, HH
	CH6	Operations and closure: Receive natural runoff from watershed Post-closure: Receive flow from Discovery Pit Lake	AH, TH	AH, TH	AH, TH, HH

Note: Water quality predictions were evaluated for the potential to cause residual effects to terrestrial health (TH), aquatic health (AH), and human health (HH; assessed in Section 10.3).

a) Assumed to be accessible by small terrestrial mammals and waterfowl during this Mine phase.

b) Assumed to be accessible by waterfowl during this Mine phase.

Figure 10.2-10: Meliadine Extension – Small Waterbodies and Pit Lakes Flow Paths at Post-closure (Year 2043)



10.2.7.3 Chemicals of Potential Concern

Chemicals may be released from the Meliadine Extension via airborne emissions, dust generation, and subsequent atmospheric deposition to soil and surface water, as well as via discharges to the aquatic environment. Airborne emissions include acid gases, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and metals. Particulate deposition to soil includes PAHs and metals. Particulate deposition to surface water includes metals only because there is currently no standard method that can be used to accurately model particulate deposition of PAHs to surface water. Acid gases and VOCs remain airborne due to their high vapour pressures, preventing any local deposition onto soils and surface water. If they do deposit, they tend not to persist in soil and water, rapidly biodegrading and volatilizing to the atmosphere. Therefore, acid gases and VOCs were not assessed further in the ecological health risk assessment but rather the assessment focused on those chemicals that may potentially deposit, including metals and PAHs. Discharges to the aquatic environment include major ions and metals only.

The following sections provide the detailed screening approaches used for the identification of COPCs in soil, surface water and sediment (freshwater and marine).

SOIL

The predicted concentrations of chemicals in soil as a result of the Mine were calculated as the sum of the incremental soil concentrations (ISCs) and the baseline concentrations. Incremental soil concentrations were calculated using the modelling methods developed by the USEPA (2005a). Specifically, the following equations were used to calculate the ISCs of inorganic and organic chemicals.

$$ISC_{Inorganic\ Chemicals} = \frac{100 \times (Dyd + Dyw) \times tD}{Z_S \times BD}$$

Where:

ISC = Incremental Soil Concentration (mg/kg dry weight)
100 = Units Conversion Factor (mg-m^2/kg-cm^2)
Dyd = Dry Deposition Rate (g/m^2/yr)
Dyw = Wet Deposition Rate (g/m^2/yr)
tD = Deposition Time (yr)
Zs = Soil Mixing Depth (cm)
BD = Soil Bulk Density (g/cm^3)

$$ISC_{Organic\ Chemicals} = \frac{100 \times (Dyd + Dyw) \times [1 - exp(-ks \times tD)]}{Z_s \times BD \times ks}$$

Where:

ISC = Incremental Soil Concentration (mg/kg dry weight)
100 = Units Conversion Factor ($mg\text{-}m^2/kg\text{-}cm^2$)
Dyd = Dry Deposition Rate ($g/m^2/yr$)
Dyw = Wet Deposition Rate ($g/m^2/yr$)
tD = Deposition Time (yr)
Z_s = Soil Mixing Depth (cm)
BD = Soil Bulk Density (g/cm^3)
ks = Soil Loss Constant (yr^{-1})

Calculation of the ISCs relied upon modelled atmospheric deposition rates. For the Meliadine Extension, there were no changes to the predicted dry and wet deposition rates from the 2014 FEIS, thus the rates developed for the 2014 FEIS were used for this risk assessment. A detailed description of the atmospheric deposition modelling that yielded the predicted dry and wet deposition rates is provided in Section 5.2 (Air Quality) of the 2014 FEIS (Agnico Eagle 2014). In brief, dry and wet deposition rates were modelled for 6 different scenarios. The descriptions for each of the scenarios are provided below:

- Scenario 1: Include emissions from the Tiriganiaq Pit, haul roads 1 and 3, material handling 18 and 20, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 2: Include emissions from the F Zone Pit, haul roads 6 and 7, material handling 12 and 13, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 3: Include emissions from the Pump Pit, haul roads 8 and 9, material handling 16 and 17, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 4: Include emissions from the Discovery Pit, haul roads 10 and 11, material handling 14 and 15, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 5: Include emissions from the Wesmeg pit, haul roads 12 and 13, material handling 21 and 22, underground emissions (vent raises 1 to 3), and the incinerator; and
- Scenario 6: Include emissions from underground emissions (vent raises 1 to 3) and the incinerator.

None of these scenarios provided an inclusive worst-case scenario for the Meliadine Extension, so all six scenarios were used for this assessment.

Given that the emissions from the Mine are likely to be greatest during the operations phase, the modelled deposition rates represent a bounding case from any phase of the Mine (i.e., construction, operations, closure, or post-closure). Deposition onto soil was assumed to occur throughout the operation phase of the Mine; deposition rate (tD) in equations (1) and (2) was 24 years, which is the revised length of the operation phase of the Mine when the Meliadine Extension is considered. Deposition during the closure and post-closure phases were assumed to be negligible (Agnico Eagle 2014).

All other assumptions with regards to ISCs from the 2014 FEIS were unchanged for this risk assessment. All chemicals deposited onto soil were assumed to mix within the top 2 cm of soil. Soil was assumed to have a bulk density of 1.5 g/cm^3. The soil loss constant (for calculation of the ISCs for PAHs) represents the loss constant due to all processes, including soil erosion, surface runoff, leaching, volatilization, and biotic and abiotic degradation. The processes of soil erosion, surface runoff, and leaching can transfer chemicals both onto and off the Mine area; thus, loss constants for these processes were set at zero. Only non-volatile chemicals were assumed to deposit to soil; as such, the loss constant due to volatilization was also set to zero. Loss constants for biotic and abiotic degradation have been measured in field studies, and the loss constants recommended by the USEPA (2005a) were applied in this calculation. The soil loss constants for degradation for each of the modelled PAHs are shown in Appendix H-12-A, Table H-12-A-1. Because all other loss constants have been set to zero, the soil loss constant is equal to the degradation loss constant.

An ISC was calculated at the location of the maximum dry/wet deposition rate of all modelled locations for each of the 6 different scenarios (Appendix H-12-A, Tables H-12-A-2a to H-12-A-2f). The calculated ISCs were added to the maximum measured baseline soil concentrations (all measured baseline soil concentrations can be found in the 2014 FEIS in Volume 6, Section 6.4, Soil and Terrain) to obtain the predicted soil concentrations for each chemical (Appendix H-12-A, Tables H-12-A-2a to H-12-A-2f). There are no measured baseline soil concentrations for gold and yttrium; however, deposition rates were obtained for these metals because there will be emissions of these metals during operations. The predicted soil concentrations of these metals were calculated as the sums of the typical average soil concentrations (0.005 mg/kg for gold and 23 mg/kg for yttrium) and the ISCs. Likewise, there are no measured baseline soil concentrations for PAHs; however, deposition rates were obtained for these chemicals because there will be emissions of PAHs during operations. A typical laboratory detection limit for PAHs is 0.05 mg/kg. Therefore, half of the laboratory detection limit (0.025 mg/kg) was used to represent baseline concentrations for PAHs, and was added to the ISCs to calculate the prediction soil concentrations of PAHs.

Chemicals of potential concern in soil were identified using a 2-tiered screening approach. In the first tier of screening, the predicted concentrations in soil were compared to soil quality guidelines. Concentrations were compared to the CCME Canadian Soil Quality Guidelines (SQG_Es) for the Protection of Environmental Health (CCME 1999a). If an SQG_E was not available for a chemical, the USEPA Ecological Soil Screening Levels (Eco-SSLs) for the protection of wildlife were used, if available (USEPA 2021a) (Appendix H-12-A, Tables H-12-A-3a to H-12-A-3f). Comparison to guidelines was considered to represent a conservative evaluation of the potential for the predicted concentrations to elicit adverse effects. Therefore, chemicals with predicted concentrations that were below guidelines were considered to pose no risk to environmental health and were not identified as COPCs. If the predicted concentration was greater than the guideline, the chemical was carried forward to the next tier of the screening process. Likewise, chemicals that lacked guidelines were carried forward to the next tier of the screening process.

A second tier screening was conducted by comparing the predicted concentrations in soil to the maximum measured baseline concentrations plus 10%. The second tier screening included only those chemicals that were above guidelines, or for which guidelines were not available, as determined through the first tier of screening. Comparison to maximum measured baseline concentrations plus 10% was considered to represent a conservative evaluation of whether a measurable Project-related impact on soil quality will occur. Given spatial and temporal variability, field sampling variability, variability in laboratory methods, and the conservatism applied in the deposition modelling, any predicted increase of less than 10% above baseline concentrations was considered unlikely to reflect a considerable change in soil quality as a result of the Mine. If the predicted concentration was greater than the maximum measured baseline concentration plus 10%, the chemical was identified as a COPC and carried forward in the risk assessment.

Predicted concentrations of arsenic, copper, nickel and selenium were greater than soil quality guidelines. Baseline concentrations of these metals were also greater than CCME guidelines. Predicted concentrations were less than maximum measured baseline concentrations plus 10% for all 6 scenarios (Appendix H-12-A, Tables H-12-A-3a to H-12-A-3f). There are no guidelines for aluminum, bismuth, calcium, gold, iron, lithium, magnesium, molybdenum, potassium, sodium, strontium, tin, titanium, yttrium, and thiophene; however, predicted concentrations were less than maximum measured baseline concentrations plus 10%. As a result, no COPCs were identified in soil for further evaluation in the risk assessment.

Given that no Mine-related changes to chemical concentrations were predicted for soil, there were no predicted Mine-related changes to food items that higher-order animals may rely upon as a food source (e.g., terrestrial vegetation serves as a food source for caribou or fox). As a result, there were no predicted Mine-related impacts to traditional food quality as a result of bioaccumulation.

SURFACE WATER – MELIADINE LAKE

The evaluation of surface water quality in Meliadine Lake included an assessment of the end of pipe (effluent) concentrations to determine if the effluent has the potential to be acutely lethal to aquatic life, and an assessment of the edge of mixing zone concentrations to determine if there are potential adverse effects (chronic) to wildlife drinking water and aquatic life living in the lake.

End of Pipe (Effluent)

Predicted end-of-pipe effluent concentrations were compared to federal regulatory limits (e.g., MDMER; Government of Canada 2021) and acute water quality guidelines (CCME, BC ENV and US EPA) to determine if the effluent has the potential to be above regulatory limits or acutely lethal. The screening values were selected from the following hierarchy of sources, in preferential order:

- MDMER limits (Government of Canada 2021) Schedule 4, Table 2, maximum authorized monthly mean concentrations;
- CCME (1999a) acute Canadian Water Quality Guidelines (CWQGs) for freshwater aquatic life;
- BC ENV (2021) Freshwater acute guidelines for the protection of aquatic life; and
- US EPA (2021b) National Recommended Water Quality Criteria for aquatic life, criterion maximum concentrations for freshwater.

Comparison to federal regulatory limits and acute water quality guidelines was considered to represent a conservative evaluation of the potential for the predicted concentrations to be acutely lethal. Acute lethality is defined in the MDMER as an effluent at 100% concentration that causes more than 50% mortality to rainbow trout in a 96-hour exposure or to *Daphnia magna* in a 48-hour exposure. Chemicals with predicted concentrations that were below MDMER limits or acute water quality guidelines were considered to not be acutely lethal.

There are no MDMER limits or acute water quality guidelines for the protection of aquatic life for calcium, sodium, potassium, and magnesium. Calcium, sodium, potassium, and magnesium are essential nutrients and are not expected to result in adverse health effects to aquatic life. Furthermore, major ions such as these can effectively reduce metal toxicity in aquatic biota. As such, these parameters were not evaluated further. Other chemicals that lacked acute guidelines were not further assessed as the focus of the screening was to confirm whether the effluent is acutely lethal. Acute lethality testing is conducted on effluent as part of ongoing monitoring at the Mine site and discharge of acutely lethal effluent is prohibited by the currently approved water licence. All chemicals were evaluated at the edge of mixing zone for potential adverse effects to wildlife and aquatic life.

Predicted end-of-pipe concentrations were below MDMER limits for all parameters with available limits. Predicted concentrations were below guidelines for all parameters with available acute guidelines, with the exception of aluminum and iron (Table H-12-B-1). The acute guideline for aluminum is based on dissolved concentrations. While the concentration of total aluminum is above the guideline, the predicted dissolved concentration of aluminum of 13.6 µg/L is below the guideline. Therefore, predicted aluminum concentrations were not considered to have the potential to cause acute lethality.

BC ENV has short-term acute guidelines for dissolved iron (350 µg/L) and total iron (1,000 µg/L). The dissolved iron guideline is based on a 96-hour median lethal concentration (LC_{50}) of 3,500 µg/L generated with testing conducted by BC ENV with a safety factor of 10. Maximum predicted dissolved iron concentration in effluent is 398 µg/L, which slightly exceeds the guideline, but is well below the lowest LC_{50}. In addition, the BC ENV testing yielded dissolved iron LC_{50}s of greater than 53,600 µg/L for rainbow trout and greater than 50,100 µg/L for *Daphnia magna* (Phippen et al. 2008). The total iron guideline of 1,000 mg/L is defined as a safe upper limit to protect fish species, and is equivalent to the US EPA chronic water quality criterion. As an acute screening value, this value may be overprotective. It is unlikely that the predicted iron concentrations in effluent have the potential to cause acute lethality.

Edge of Mixing Zone

Predicted maximum surface water concentrations in Meliadine Lake (edge of mixing zone) for the operations phase (2024-2043) were compared to chronic water quality screening values for the protection of wildlife and aquatic life.

For wildlife, the screening values were selected from the following hierarchy of sources, in preferential order:

- CCME CWQGs for the Protection of Livestock (CCME 1999a).
- Toxicological benchmarks for wildlife from Sample et al. (1996), as described below.

- Guidelines protective of wildlife available from other regulatory agencies (e.g., British Columbia Ministry of Environment [BC ENV] and USEPA).
- In the absence of guidelines/benchmarks for wildlife, aquatic life guidelines were used. This was considered a conservative approach as guidelines for protection of aquatic life are typically much lower than the guidelines for livestock watering.

Sample et al. (1996) derived benchmarks for water ingestion for several wildlife species and contaminants. The toxicological benchmarks for each species were derived using TRVs (no observed adverse effects levels [NOAELs] and LOAELs) from the toxicity tests that were subsequently scaled to the body weight of each wildlife species to derive species-specific TRVs. However, scaling TRVs to body weight to derive species-specific TRVs (i.e., allometric dose scaling) is no longer considered to be appropriate (MECP 2011). As such, the toxicological benchmarks derived by Sample et al. (1996) were re-calculated by multiplying the LOAELs (NOAELs were used where LOAELs were not available) from the toxicity tests (as provided in Sample et al. [1996]) by the body weight of each receptor and dividing the water ingestion rate for the wildlife species, as per the equation below:

$$Toxicological\ Benchmark = \frac{LOAEL_{test\ species} \times Body\ Weight_{wildlife\ species}}{Water\ Intake_{wildlife\ species}}$$

The TRVs, body weights and water intakes provided by Sample et al. (1996) were used to re-calculate the benchmarks and are summarized in Table H-B-2-2b. Where TRVs were not available from Sample et al. (1996), TRVs were taken from Los Alamos National Laboratory (LANL; 2017). The resulting toxicological benchmarks are also provided in Table H-B-2-2b. The most stringent of the benchmarks calculated for each wildlife species was used in the screening for each COPC. Use of the re-calculated Sample et al. (1996) benchmarks was considered appropriate because Sample et al. (1996) is cited by ECCC as a source in the derivation of wildlife TRVs for use at Federal Contaminated Sites Action Plan (FCSAP) sites (Environment Canada 2021).

For aquatic life, the screening values were based on the same sources used in the development of the AEMP benchmarks for the Protection of Aquatic Life (as of 2020; Table 2-2 in Azimuth 2021). These AEMP benchmarks are based on site-specific water quality objectives (SSWQOs), CCME water quality guidelines for the protection of aquatic life, Federal Environmental Quality Guidelines (FEQGs) published by ECCC, British Columbia Ministry of Environment and Climate Change (BC ENV), and other aquatic life guidelines from other jurisdictions. The AEMP benchmarks were adjusted to use the predicted minimum hardness in Meliadine Lake. There were no AEMP benchmarks for total cyanide and beryllium, therefore water quality guidelines from BC ENV (2021) were used.

The detailed chemical screening table for Meliadine Lake for wildlife is provided in Appendix H-12-B, Table H-12-B-2. There are no guidelines for the protection of wildlife for sodium, ammonia, potassium, iron, and magnesium. The predicted concentrations of total ammonia and iron were less than CCME CWQGs for the protection of aquatic life. While these guidelines are intended to be protective of aquatic life, it is considered that they are also protective of wildlife. This is because the CCME guidelines are developed in consideration of the end water use, and protection of aquatic life is generally considered the most sensitive end use. The guidelines for protection of aquatic life are typically much lower than the guidelines for livestock watering. Magnesium, potassium, and sodium are essential nutrients and are not expected to result in adverse health effects unless large quantities are ingested. Predicted concentrations of all other chemicals were less than guidelines for baseline concentrations. As a result, no COPCs were identified in surface water in Meliadine Lake for further evaluation for wildlife in the environmental risk assessment.

The detailed chemical screening table for Meliadine Lake for aquatic life is provided in Appendix H-12-B, Table H-12-B-3. There are no AEMP benchmarks or water quality guidelines for the protection of aquatic life for calcium, sodium, potassium, and magnesium. Calcium, sodium, potassium, and magnesium are essential nutrients and are not expected to result in adverse health effects to aquatic life. Furthermore, major ions such as these can effectively reduce metal toxicity in aquatic biota. As such, these parameters were not identified as COPCs.

Predicted concentrations of all chemicals were less than guidelines. As a result, no COPCs were identified in surface water in Meliadine Lake for further evaluation for aquatic life in the environmental risk assessment. Given that no Meliadine Extension-related changes to chemical concentrations were predicted for water for aquatic life, there were no predicted Meliadine Extension -related impacts to fish tissue quality as a result of bioaccumulation.

SURFACE WATER - SMALL WATERBODIES AND PIT LAKES

Chemicals of potential concern in surface water in the small waterbodies on the peninsula and the pit lakes were identified using a screening approach similar to that described for Meliadine Lake (edge of mixing zone).

The detailed chemical screening tables for wildlife are provided in Appendix H-12-B, Tables H-12-B-4a to H-12-B-4h (small waterbodies) and Tables H-12-B-5a to H-12-B-5g (pit lakes). For chemicals with guidelines, predicted concentrations were below guidelines for all small waterbodies and pit lakes, except Lake CP1, Saline Pond B7, Contact Pond B4, and Lake TIR04 pit lake. In Lake CP1, predicted concentrations of chloride (operations), ammonia (operations and active closure) and arsenic (operations) were greater than the guidelines. In Saline Pond B7, predicted concentrations of TDS (operations and active closure), chloride (operations and active closure), sulphate (operations), ammonia (operations and active closure) and arsenic (operations, active closure and post-closure) were greater than the guidelines. In Contact Pond B4, predicted concentrations of TDS (operations) and chloride (operations) were greater than guidelines. In TIR04 pit lake, predicted concentrations of chloride (active closure) were greater than guidelines. As such, these chemicals were identified as COPCs and carried forward for evaluations for wildlife in the environmental risk assessment.

There are no guidelines for the protection of wildlife for sodium, potassium, magnesium, ammonia, and iron. The predicted concentrations of total ammonia and iron in the small water bodies and the pit lakes were less than CCME CWQGs for the protection of aquatic life. While these guidelines are intended to be protective of aquatic life, it is considered that they are also protective of wildlife for the reasons described above for Meliadine Lake. Magnesium, potassium, and sodium are essential nutrients and are not expected to result in adverse health effects unless large quantities are ingested.

The potential for aquatic-feeding wildlife to be exposed to concentrations of COPCs through ingestion of dietary items was considered. However, given the COPCs with potential to bioaccumulate in fish (e.g., arsenic) were identified in project phases for lakes that are not fish-bearing due to Mine activities, this was considered to be an incomplete pathway.

The detailed chemical screening tables for aquatic life are provided in Appendix H-12-B, Tables H-12-B-6a to H-12-B-6f (small waterbodies) and Tables H-12-B-7a to H-12-B-7e. For chemicals with guidelines, predicted concentrations were below guidelines for all small waterbodies and pit lakes, except lakes A8 West, and TIRI pit lake. In Lake A8 West and TIRI Pit Lake, predicted concentrations of cobalt (post-closure) were greater than the guidelines. In Pump Pit Lake, predicted concentrations of cobalt and copper (post-closure) were greater than the guidelines. As such, these chemicals were identified as COPCs and carried forward for evaluations for aquatic life in the environmental risk assessment. In addition, cobalt and copper have potential to bioaccumulate in aquatic life, therefore these were also carried forward for potential risks to fish-eating wildlife.

There are no guidelines for the protection of aquatic for calcium, sodium, potassium, and magnesium. These parameters are essential nutrients and are not expected to result in adverse health effects to aquatic life. Furthermore, major ions such as these can effectively reduce metal toxicity in aquatic biota through competitive interactions at uptake sites. As such, these parameters were not identified as COPCs.

SURFACE WATER - ITIVIA HARBOUR

End of Pipe (Effluent)

Predicted waterline end-of-pipe effluent concentrations discharged to Itivia Harbour were compared to MDMER limits and acute marine water quality guidelines (CCME, BC ENV and US EPA) to determine if the effluent has the potential to be above regulatory limits or acutely lethal. As a second screening step, predicted concentrations were compared to predicted existing conditions in Itivia Harbour. The screening values were selected from the following hierarchy of sources, in preferential order:

- MDMER limits (Government of Canada 2021) Schedule 4, Table 2, maximum authorized monthly mean concentrations;
- CCME (1999a) acute CWQGs for marine aquatic life;
- BC ENV (2021) Marine acute guidelines for the protection of aquatic life; and
- USEPA (2021b) National Recommended Water Quality Criteria for aquatic life, criterion maximum concentrations for salt water.

Comparison to federal regulatory limits and acute water quality guidelines was considered to represent a conservative evaluation of the potential for the predicted concentrations to be acutely lethal. If the predicted concentration was greater than the MDMER limit or acute guideline, the chemical was compared to predicted existing conditions. If the predicted concentration was greater than the MDMER limit or water quality guideline and existing conditions, the chemical was evaluated further. Chemicals that lacked acute guidelines were not assessed as the focus of the screening was to confirm whether the effluent is acutely lethal. Acute lethality testing is conducted on effluent as part of ongoing monitoring at the Mine site. All chemicals were evaluated at the edge of mixing zone for potential adverse effects to wildlife and aquatic life.

The detailed chemical screening table for waterline end of pipe effluent discharge to Itivia Harbour (for aquatic life is provided in Appendix H-12-B, Table H-12-B-8. Predicted waterline end-of-pipe concentrations were below MDMER limits for all parameters with available limits. Predicted concentrations were below guidelines for all parameters with available acute guidelines. As such, the effluent was not considered to have the potential to cause acute lethality.

Edge of Mixing Zone

Predicted maximum surface water concentrations in Itivia Harbour (edge of mixing zone) for the operations phase (2024-2043) were compared to chronic marine water quality screening values for the protection aquatic life. As a second screening step, predicted concentrations were compared to predicted existing conditions in Itivia Harbour.

The screening values were selected from the following hierarchy of sources, in preferential order:

- CCME CWQGs for the Protection of Aquatic Life, marine long term (CCME 1999a);
- BC ENV (2021) Marine chronic guidelines for the protection of aquatic life; and
- US EPA (2021b) National Recommended Water Quality Criteria for aquatic life, criterion continuous concentrations for saltwater.

The detailed chemical screening table for Itivia Harbour (edge of mixing zone) for aquatic life is provided in Appendix H-12-B, Table H-12-B-9. Predicted edge of mixing zone concentrations were below guidelines for all parameters with available chronic marine guidelines, except for boron, cadmium, cobalt and mercury. However, predicted concentrations at the edge of mixing zone were below existing conditions for these parameters and therefore boron, cadmium cobalt and mercury were not retained as COPCs. Several parameters do not have marine guidelines, however predicted concentrations were below or within 10% of existing conditions, therefore these parameters were not retained as COPCs for Itivia Harbour.

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN

As discussed previously, three conditions must be present for there to be a potential for adverse health effects to terrestrial and aquatic health: chemicals must be present at harmful levels, receptors must be present, and there must be a way for receptors to come into contact with the chemicals released by the Project.

For wildlife, there were no COPCs identified in soil. There were some COPCs for wildlife identified during operations, active closure or post-closure in surface waters of lakes CP1, Saline Pond B7, Contact Pond B4 and Lake TIR04 pit lake, as summarized in Table 10.2-4.

For wildlife and aquatic life, there were no COPCs identified in surface water of Meliadine Lake. As such, the environmental risk assessment did not proceed beyond the chemical screening stage for aquatic life in Meliadine Lake. This indicates that adverse health effects to wildlife or aquatic life in Meliadine Lake as a result of the Meliadine Extension are not expected.

There were some COPCs for aquatic life identified in surface waters of lakes A8 West, TIRI Pit Lake, and Pump Pit Lake, as summarized in Table 10.2-5.

There were no COPCs identified in surface water of Itivia Harbour. As such, the environmental risk assessment did not proceed beyond the chemical screening stage for aquatic life in Itivia Harbour. This indicates that adverse health effects to aquatic life in Itivia Harbour as a result of the Meliadine Extension are not expected.

Table 10.2-4: Summary of Chemicals of Potential Concern Evaluated for Terrestrial Health

Lake	Project Phase	TDS	Chloride	Sulphate	Total Ammonia	Arsenic
Lake CP1	Operations	×	✓	×	✓	✓
	Active closure	×	×	×	✓	×
	Post-closure	×	×	×	×	×
Saline Pond B7	Operations	✓	✓	✓	✓	✓
	Active closure	✓	✓	×	✓	✓
	Post-closure	×	×	×	×	✓
Contact Pond B4	Operations	✓	✓	×	×	×
	Active closure	×	×	×	×	×
	Post-closure	×	×	×	×	×
TIR04 Pit Lake	Active closure	×	✓	×	×	×

✓ = chemical exceeds the wildlife screening value and, therefore, was retained for assessment.

× = chemical does not exceed the wildlife screening value and was not retained for assessment.

Table 10.2-5: Summary of Chemicals of Potential Concern Evaluated for Aquatic Health

Lake	Project Phase	Cobalt	Copper
A8 West	Post-closure	✓	×
TIRI Pit Lake	Post-closure	✓	×
Pump Pit Lake	Post-closure	✓	✓

✓ = chemical exceeds the aquatic life screening value and, therefore, was retained for assessment.

× = chemical does not exceed the aquatic life screening value and, therefore, was not retained for assessment.

10.2.7.4 Exposure Assessment

The exposure assessment provides an estimate of the degree of exposure of receptors to COPCs via the identified exposure pathways. For wildlife (e.g., mammals and birds), the exposure is expressed as the total dose (mg/kg-d) from ingestion of water. This permits the evaluation of exposure relative to TRVs that are expressed this way. Given that no COPCs were identified in soil, exposure via incidental ingestion of soil and ingestion of food items that may accumulate COPCs from soil was not evaluated. In addition, exposure by wildlife via consumption of fish that may accumulate COPCs was not evaluated considering that fish will not be present in Saline Pond B7 and Contact Pond B4 during any phase of the Project or in TIR04 Pit Lake during active closure. While fish may be present in Lake CP1 during post-closure, no surface water COPCs screened on during this phase of the Project. Therefore, ingestion of water was the only exposure pathway evaluated for wildlife.

For aquatic life, exposure is expressed as the concentrations of the COPCs in surface water. Again, this permits the evaluation of exposure relative to toxicity benchmarks that are expressed in this way.

WILDLIFE

Arsenic, TDS, chloride, sulphate, and total ammonia were retained as COPCs for wildlife ingestion of surface water during one or more phases of the Project from at least one of the small waterbodies (Lake CP1, Saline Pond B7, and Contact Pond B4) or TIR04 Pit Lake. TDS, chloride, sulphate and total ammonia cannot be quantitatively evaluated for ingestion of surface water by wildlife due to lack of available TRVs, therefore these COPCs were qualitatively evaluated in the risk characterization (Section 10.2.7.6). As such, exposure doses for wildlife were only calculated for arsenic.

Exposure doses of wildlife receptors were calculated based on predicted COPC concentrations in surface water in Lake CP1 during operations and Saline Pond B7 during operations, active closure and post-closure phases of the Meliadine Extension. Exposures were calculated considering an upper-bound estimate (i.e., predicted maximum concentrations in surface water) for the applicable phase of the Project (Table 10.2-6).

The doses from ingestion of surface water were calculated for each wildlife receptor using the following equation:

$$D_{water} = \frac{IR_{water} \times C_{water}}{BW}$$

Where:
D_{water} = estimated dose from ingestion of water (mg/kg-d)
IR_{water} = water ingestion rate (L/d)
C_{water} = COPC concentration in surface water (mg/L)
BW = receptor's body weight

The water ingestion rates and body weights used in the calculation of dose for each wildlife receptor are provided in Table 10.2-6. Values were taken from Environment Canada (2012) where available, or other sources if not available. Other sources included US EPA (1993), or online databases (i.e., Cornell Lab of Ornithology and Animal Diversity Web). Exposure doses for ingestion of surface water by wildlife are provided in Table 10.2-7.

Table 10.2-6: Receptor Characteristics for Mammals and Birds

Receptor	Body Weight (kg)[a]	Source	Water Ingestion Rate (L/day)[b]	Source
Caribou	187	Shefferly 2000 (average)	11	US EPA 1993
Arctic fox	5.2	Middlebrook 2007 (average)	0.44	US EPA 1993
Brown lemming	0.088	Barker 2003 (average)	0.011	US EPA 1993
Short-eared owl	0.35	Wiggins et al. 2020 (average of males and females)	0.029	US EPA 1993
American tree sparrow	0.018	Naugler et al. 2020	0.0040	US EPA 1993
Red-breasted merganser	1.1	Craik et al. 2020 (average of males and females)	0.062	US EPA 1993
Lesser scaup	0.71	Environment Canada 2012 (average)	0.047	US EPA 1993
Least sandpiper	0.025	Nebel and Cooper 2020 (average)	0.0049	US EPA 1993
Canada goose	5.7	Mowbray et al. 2020 (average)	0.19	US EPA 1993
Tundra swan	6.8	Limpert 2020 (average of males and females)	0.21	US EPA 1993

a) Environment Canada 2012 was used as preferred source for receptor parameter values; however, in the absence of values other sources were used.

b) US EPA (1993) allometric equations for birds for water ingestion: IRwater (L/day) = 0.059 x BW (kg)0.67 and for mammals: IRwater (L/day) = 0.099 x BW (kg)0.90, where BW = body weight is in kilograms.

Table 10.2-7: Exposure Doses for Surface Water for Arsenic – Wildlife

Receptor	Exposure Dose (mg/kg-d)			
	Lake CP1	Saline Pond B7		
	Operations	Operations	Active Closure	Post-Closure
Caribou	0.0018	0.0076	0.0028	0.0026
Arctic fox	0.0026	0.011	0.0041	0.0038
Brown lemming	0.0039	0.016	0.0061	0.0057
Short-eared owl	0.0026	0.011	0.0040	0.0037
American tree sparrow	0.0068	0.029	0.011	0.0099
Red-breasted merganser	0.0018	0.0075	0.0028	0.0026
Lesser scaup	0.0020	0.0086	0.0032	0.0030
Least sandpiper	0.0061	0.026	0.0097	0.0090
Canada goose	0.0010	0.0043	0.0016	0.0015
Tundra swan	0.00096	0.0041	0.0015	0.0014

AQUATIC LIFE

Exposures of aquatic receptors to COPCs were assessed based on predicted COPC concentrations in surface water in the small waterbodies (Lake A8 West) and the pit lakes (TIRI Pit Lake and Pump Pit Lake). For Lake A8 West and the pit lakes, exposures were calculated considering both an upper-bound estimate (i.e., predicted maximum concentrations in surface water) and a central tendency estimate (i.e., predicted median concentrations in surface water) for the post-closure phase of the Project (Table 10.2-8).

Table 10.2-8: Exposure Concentrations for Surface Water during Post-Closure – Aquatic Life

COPC	Units	A8 West		TIRI Pit Lake		Pump Pit Lake	
		Predicted Median	Predicted Maximum	Predicted Median	Predicted Maximum	Predicted Median	Predicted Maximum
Cobalt	µg/L	0.65	0.92	1.0	1.4	0.64	0.92
Copper	µg/L	NA	NA	NA	NA	1.7	2.1

COPC = chemical of potential concern; µg/L = micrograms per litre.
NA = not applicable: this parameter was not identified as a COPC in this lake.

10.2.7.5 Toxicity Assessment

The toxicity assessment provides the basis for evaluating what is an acceptable exposure and what level of exposure may adversely affect terrestrial or aquatic health. This involves the identification of the potentially toxic effects of the COPCs and determination of the concentrations that terrestrial and aquatic receptors can be exposed to without experiencing adverse effects. This value is called the toxicity benchmark. For wildlife, this is expressed as an acceptable daily dose and is also referred to as a toxicity reference value (TRV). For aquatic life, this is expressed as an acceptable concentration of the COPC in the media to which the receptor is exposed (i.e., surface water). These values are used as thresholds for comparison with exposure doses (for wildlife) or exposure concentrations (for aquatic life) during risk characterization. There is negligible risk of adverse health effects if a receptor is exposed to a concentration below the toxicity benchmark for a COPC.

WILDLIFE

The literature-based TRVs derived from toxicity studies for effects on survival, growth and reproduction. These types of TRVs are protective of species at an individual level and are most appropriate for species at risk because impairment of individuals could imperil populations. Use of these TRVs for common species is considered to be a conservative approach.

The default wildlife TRVs for mammals and birds published by the Federal Contaminated Sites Action Plan (FCSAP; Environment Canada 2021) were used in the ERA (Table 10.2-9).

Table 10.2-9: Toxicity Reference Values for Mammals and Birds

Receptor Group	TRV (mg/kg-d)	Principal Study	Reference	Details of Toxicity Study
Birds	4.4	CEAQ 2012	Environment Canada (2021)	The TRV is based on the second lowest EC_{20} of eight different studies reporting reproduction, growth and mortality endpoints for mallard ducks, chickens, and quails. The toxicity study underlying this EC_{20} observed reduced growth rates in chickens exposed to arsenic via ingestion for 16 days. Uncertainty factors were applied to the EC_{20}s to account for short exposure durations (factor of 2) and mortality endpoints (factor of 5).
Mammals	1.04	US EPA 2005	Environment Canada (2021)	The TRV is based on the highest bound NOAEL below the lowest bound LOAEL from a dataset of 55 toxicological studies for relevant biological endpoints (survival, growth, and reproduction). The highest bound NOAEL corresponds to a study on the effects of growth in beagle dogs exposed to 0, 1, 2 and 4 mg sodium arsenite/kg-d. No uncertainty factors were applied.

TRV = toxicity reference value; EC_{20} = effect concentration on 20% of test organisms; NOAEL = no observed adverse effects level; LOAEL = lowest observed adverse effects level; mg/kg-d = milligram per kilogram body weight per day.

AQUATIC LIFE

Cobalt and copper were identified as COPCs in Lake A8 West, TIRI Pit Lake and Pump Pit Lake during the post-closure phase of the Project. In general, the screening values were used as the toxicity benchmarks for the COPCs identified in these lakes, unless more recent toxicity benchmarks have been derived, as presented in Table 10.2-10 and discussed in the sections below.

Table 10.2-10: Toxicity Benchmarks for Aquatic Life – Pump Pit Lake

COPC	Waterbody	Toxicity Benchmark (µg/L)	Description
Cobalt	Lake A8 West	0.78	Federal Environmental Quality Guideline adjusted for site-specific hardness (ECCC 2017). The minimum predicted hardness concentrations at Lake A8 West (33.1 mg/L as $CaCO_3$), TIRI Pit Lake (26.4 mg/L as $CaCO_3$) and Pump Pit Lake (43.2 mg/L as $CaCO_3$) were lower than the minimum valid hardness for the equation, therefore the default hardness of 52 mg/L as $CaCO_3$ was used to calculate the FEQG of 0.78 µg/L for cobalt.
	TIRI Pit Lake		
	Pump Pit Lake		
Copper	Pump Pit Lake	0.38	BLM-based benchmark (ECCC 2021a).

$CaCO_3$ = calcium carbonate; BLM = biotic ligand model.

Cobalt

Cobalt was identified as a COPC based on predicted exceedances of the hardness-based federal environmental quality guideline in Lake A8 West, TIRI Pit Lake and Pump Pit Lake during the post-closure phase of the Project. The maximum predicted concentrations in Lake A8 West, TIRI Pit Lake and Pump Pit Lake were 0.92 µg/L, 1.4, µg/L and 0.92 µg/L, respectively.

ECCC (2017) recently compiled, reviewed, and ranked chronic toxicity data for cobalt to generate a species sensitivity distribution (SSD) that was corrected for hardness. A total of seven chronic studies representing 13 species were included (three fish taxa, six invertebrate taxa, and four algae/aquatic plant taxa). The

SSD incorporated EC_{10} and IC_{10} data for reproduction, growth and survival endpoints. Effect concentrations normalized to a hardness of 100 mg/L as $CaCO_3$ ranged from 2.2 to 2049 µg/L. The smallest normalized effect concentration was the geomean of 2.2 µg/L, calculated from the 28-day IC_{10} for growth from two studies using *Hyalella azteca* (Norwood et al. 2007; Heijerick et al. 2007, as cited by ECCC 2017). In comparison, the largest normalized effect was an 81-d EC_{20} of 2355 µg/L for biomass in rainbow trout, *Onchorhynchus mykiss*, when exposed to cobalt starting at the newly fertilized egg stage (Parametrix 2010, as cited by ECCC 2017).

Following the CCME (2007) protocol, ECCC (2017) derived a hardness-dependent federal environmental quality guideline (FEQG) that was set equal to the HC_5. Because hardness was a significant exposure and toxicity modifying factor (ETMF), the FEQG is expressed as an equation for which the site-specific hardness is incorporated to calculate a site-specific FEQG. The hardness-based equation is applicable to the range for which the slope was developed (52 to 396 mg/L as $CaCO_3$). The equation is:

$$Federal\ environmental\ quality\ guideline\ (\mu g/L\ cobalt) = e^{(0.414\times(\ln(hardness))-1.887)}$$

Accordingly, the minimum and maximum FEQG for total cobalt at water hardness levels of 52 mg/L and 396 mg/L are 0.78 µg/L and 1.80 µg/L, respectively.

The minimum predicted hardness concentrations at Lake A8 West (33.1 mg/L as $CaCO_3$), TIRI Pit Lake (26.4 mg/L as $CaCO_3$) and Pump Pit Lake (43.2 mg/L as $CaCO_3$) were lower than the minimum valid hardness for the equation, therefore the default hardness of 52 mg/L as $CaCO_3$ was used to calculate the FEQG of 0.78 µg/L for cobalt. This value was used as the toxicity benchmark for cobalt for Lake A8 West, TIRI Pit Lake and Pump Pit Lake (Table 10.2-10).

Copper

Cobalt was identified as a COPC based on predicted exceedances of the hardness-based CCME guideline of 2 µg/L in Pump Pit Lake during the post-closure phase of the Project. The maximum predicted concentrations in Pump Pit Lake was 2.1 µg/L.

The CCME guideline for copper is based on water hardness, as provided below:

Copper guideline = 2 µg/L at water hardness of 0 to 60 mg/L as $CaCO_3$ (soft)
= 2 µg/L at water hardness of 60 to 120 mg/L as $CaCO_3$ (medium)
= 4 µg/L at water hardness of 120 to 180 mg/L as $CaCO_3$ (hard)
= 6 µg/L at water hardness greater than 180 mg/L as $CaCO_3$ (very hard)

The guideline for soft water (0 to 60 mg/L as $CaCO_3$) is based on the guideline recommended by Demayo and Taylor (1981; as cited by the Canadian Council of Resource and Environment Ministers [CCREM] 1987) of 2 µg/L. The guidelines for medium, hard, and very hard water where derived using the regression equation of chronic copper toxicity versus hardness developed by the USEPA (1985), as follows:

$$\text{Copper concentration} = 0.2 \times e^{(0.8545[\ln(hardness)] - 1.465)}\ \mu g/L$$

The equation for chronic toxicity derived by the USEPA was derived from a final acute value and an acute-to-chronic ratio (ACR). The lowest hardness within each hardness category was used to calculate the copper guideline for that hardness category. In the development of the guideline for copper, the CCREM (1987) considered the effects of hardness on chronic copper toxicity to be inconclusive and the result from the equation was multiplied by an application factor of 0.2 to derive the guideline.

Since the development of the CCME guideline in 1987, there have been a number of advances in the understanding of copper toxicity and the factors that influence toxicity in surface waters. While hardness, and specifically calcium and magnesium ions, plays an important role in mitigating the toxicity of copper to aquatic organisms, other water quality parameters also influence toxicity (e.g., dissolved organic carbon [DOC]). The biotic ligand model (BLM)-based approach to deriving water quality criteria was developed as an improvement on the hardness-based approach because it considers the effects of a broad range of water quality parameters on copper bioavailability and toxicity (i.e., pH, organic matter, alkalinity, ion concentrations). Several BLMs are available for use including the US EPA Windward Environmental BLM (Windward 2019), the European Union Bio-met bioavailability tool (Bio-met 2019), the British Columbia BLM (BC ENV 2019), and most recently the ECCC BLM tool used in the derivation of the FEQG for copper (ECCC 2021b).

The BLM predicts copper toxicity by simulating the accumulation of copper at the "biotic ligand", which represents the site of toxic action in aquatic life. The model assumes that accumulation of copper at the biotic ligand at or above a critical threshold concentration leads to toxicity. Complexing anions (such as DOC and chloride) bind copper, thereby decreasing accumulation at the biotic ligand and copper toxicity. Similarly, competing cations (such as calcium, potassium, magnesium and sodium) compete with copper for binding sites at the biotic ligand, decreasing copper accumulation at the biotic ligand and copper toxicity. Because water hardness is primarily a function of calcium and magnesium ions in the water, the protective effect of water hardness on copper toxicity is addressed in the BLM through the competitive interaction between copper and the hardness cations (i.e., calcium and magnesium) at the biotic ligand. The amount of copper in the water required to reach the critical threshold concentration at the biotic ligand will vary depending on water quality. In this way, the BLM can be used to predict the concentration of copper in water that would result in toxicity to aquatic life. BLM copper toxicity predictions have been shown to agree well with measured values in published studies (US EPA 2007).

ECCC recently released a FEQG for copper (ECCC 2021a). FEQGs are preferably developed using the CCME (2007) protocol which allows for the use of BLM for water quality guidelines. The minimum chronic dataset requirements were satisfied for the derivation of a Type A long-term water quality guideline for freshwater environments for copper (ECCC 2021a). The BLM-based FEQG for copper is for dissolved concentrations of copper. The ECCC BLM considers the chronic toxicity database (EC_{10}s) for fish, invertebrates and plants. The BLM is used to normalize the toxicity database to site-specific chemical conditions, considering the effects of water quality on bioavailability. The normalized chronic toxicity database becomes the basis for developing an SSD that characterizes the range in sensitivity of aquatic organisms. The 5th percentile of the SSD (HC_5) is estimated using a range of distribution models (e.g., lognormal, log-logistic, log-Gumbel and log generalized extreme value [GEV]).

The ECCC BLM requires input data for multiple water chemistry parameters (i.e., temperature, pH, DOC, alkalinity, calcium, magnesium, sodium, potassium, sulphate, chloride). A simplified model is available that requires temperature, pH, DOC, and hardness, and uses ion ratios (i.e., Ca:Mg, Ca:Na, Ca:K, SO4:Cl) and pCO_2 to estimate the other parameters (ECCC 2021b). These ion ratios are median values from compiled water quality monitoring data from across Canada. An option is also available for the median North American ion ratios which are based on Canadian dataset and the United States Geological Survey's National Water Quality Assessment dataset. The atmospheric pCO_2 and pH are used to estimate alkalinity. The default value of 3.2 was determined to best represent the relationship between pH and alkalinity in natural waters (ECCC 2021b).

The BLM Windows Interface (Version 1.20) was used to develop the toxicity benchmark for copper for Pump Pit Lake (ECCC 2021b). Not all required water quality input parameters were predicted for Pump Pit Lake, therefore, the BLM was run with the Simplified Chemistry option using the predicted hardness data for Pump Pit Lake for the post-closure phase of the Project (43.3 to 137.1 mg/L as $CaCO_3$). The ion ratios for the Southern Arctic were used. For input parameters without predictions, the same assumptions as used in the derivation of the AEMP benchmarks were used (e.g., pH of 7.5, temperature of 15°C, DOC of 0.5 mg/L).

The BLM-derived chronic criteria for copper ranged from 0.38 µg/L to 0.47 µg/L for the post-closure period for Pump Pit Lake, and the fifth percentile of 0.38 µg/L was used as the toxicity benchmark in the assessment (Table 10.2-10). It is noted that the benchmark is based on dissolved copper but predicted concentrations in Pump Pit Lake are for total copper. Applying benchmarks based on dissolved copper to predicted total copper concentrations is a conservative approach because toxicity is typically associated with the dissolved fraction, and the dissolved fraction typically makes up only a fraction of the total concentration.

10.2.7.6 Risk Characterization

Risk characterization determines the potential for adverse health effects to occur. This is assessed by comparing the estimated exposures (from the exposure assessment) with those exposures that are determined to be acceptable (from the toxicity assessment). The characterization of risks includes consideration of the uncertainty and conservatism in the risk assessment.

Potential adverse health effects to wildlife and aquatic life were characterized using an HQ approach (CCME 2020). For wildlife, the estimated exposures to COPCs (dose from ingestion of surface water) were compared to literature-based TRVs for effects on survival, growth and reproduction to determine HQs. For aquatic life, the HQ is the ratio of the concentration of the COPC in the environmental media (i.e., surface water) to the toxicity benchmark. A target HQ of one was used in the assessment for wildlife and aquatic life, which is consistent with current risk assessment guidance. An HQ of less than one indicates that adverse health effects to wildlife and aquatic life are not expected. An HQ of greater than one indicates the potential for adverse health effects to wildlife or aquatic life. Chemicals of potential concern with HQs greater than one were considered further in the residual impact classification (Section 10.2.8).

Potential adverse effects to wildlife for arsenic were evaluated by comparing estimated exposure doses from ingestion of surface water to TRVs. The HQs are provided in Table 10.2-11. The HQs for Lake CP1 during operations and Saline Pond B7 during operations, active closure and post-closure were less than one for all receptors, indicating that adverse effects on the health of wildlife from arsenic surface water are not expected.

Table 10.2-11: Hazard Quotients for Surface Water for Arsenic – Wildlife

Receptor	Hazard Quotient			
	Lake CP1	Saline Pond B7		
	Operations	Operations	Active Closure	Post-Closure
Caribou	0.0017	0.0073	0.0027	0.0025
Arctic fox	0.0025	0.010	0.0039	0.0036
Brown lemming	0.0037	0.016	0.0059	0.0054
Short-eared owl	0.00058	0.0025	0.00092	0.00085
American tree sparrow	0.0015	0.0065	0.0024	0.0023
Red-breasted merganser	0.00040	0.0017	0.00063	0.00059
Lesser scaup	0.00046	0.0019	0.00073	0.00067
Least sandpiper	0.0014	0.0059	0.0022	0.0020
Canada goose	0.00023	0.00098	0.00036	0.00034
Tundra swan	0.00022	0.0009	0.00034	0.00032

Potential adverse effects of cobalt and copper to aquatic life were evaluated by comparing predicted maximum and median surface water concentrations to toxicity benchmarks. The HQs are provided in Table 10.2-12.

Table 10.2-12: Hazard Quotients for Surface Water during Post-closure – Aquatic Life

COPC	Units	Upper-Bound Estimate[a]			Central-Tendency Estimate[b]		
		Lake A8 West	TIRI Pit Lake	Pump Pit Lake	Lake A8 West	TIRI Pit Lake	Pump Pit Lake
Cobalt	µg/L	**1.2**	**1.7**	**1.2**	0.83	**1.3**	0.82
Copper	µg/L	NA	NA	**5.5**	NA	NA	**4.4**

COPC = chemical of potential concern.

NA = not applicable: this parameter was not identified as a COPC in this lake.

Shaded + bold = hazard quotient >1.

a)– based on the maximum predicted surface water concentration.

b) based on the median predicted surface water concentration.

When HQs were calculated using predicted maximum concentrations, the HQs for cobalt in Lake A8 West, TIRI Pit Lake and Pump Pit Lake were greater than the target HQ of one. When using predicted median concentrations, the HQ for cobalt in TIRI Pit Lake was greater than the target HQ of one. Therefore, cobalt in Lake A8 West, TIRI Pit Lake and Pump Pit Lake was considered further in the residual impacts analysis in Section 10.2.8.

When HQs were calculated using predicted maximum concentrations and median concentrations, the HQs for copper in Pump Pit Lake were greater than the target HQ of one. Therefore, copper in Pump Pit Lake was considered further in the residual impacts analysis in Section 10.2.8.

COPCs not retained for Quantitative Assessment for Wildlife

TDS

TDS concentrations were compared to the CCME long-term water quality guidelines for the protection of agricultural uses – livestock water (CCME 1999a), which are conservatively also considered protective of wildlife consuming water. TDS exceeded the CCME WQG protective of livestock water (3,000 mg/L) at Saline Pond B7 during the operations and active closure phases and in Contact Pond B4 during the operations phase of the Project. Maximum TDS concentrations in Lake B7 were 51,517 mg/L and 3,290 mg/L during operations and active closure phases, respectively, and then decreased to 733 mg/L in post-closure. TDS concentrations in Contact Pond B4 were 3,023 mg/L during operations and then decreased to 418 mg/L and 102 mg/L in active closure and post-closure, respectively.

Predicted TDS concentrations in Saline Pond B7 exceeded the CCME WQG protective of livestock water during operations from August 2025 to December 2043, and for five months (January to May 2044) into the active closure phase. However, Saline Pond B7 will be used a saline water pond during operations and will be flooded and allowed to runoff to TIRI Pit Lake during active closure. The high salinity of the water would affect the palatability of the water making it a less preferential source of drinking water by wildlife. The close proximity to the operating mine site would also be a deterrent to wildlife in the area. In addition, the open-water season in the region is short (early to mid-June to end of October) and the lake would be inaccessible to wildlife during winter. For these reasons, the likelihood of wildlife exposure to TDS in Saline Pond B7 is low and the potential risks to wildlife exposed to TDS in water from Saline Pond B7 during operations and active closure is considered low.

Predicted TDS concentrations in Contact Pond B4 exceeded the CCME WQG protective of livestock water during only one month of operations (August 2025) and were below the guideline in all other months of operations and the other phases of the Meliadine Extension. Given the low magnitude and frequency of the exceedance, the potential for adverse health effects for wildlife is expected to be negligible and risks to wildlife exposed to TDS in water from Contact Pond B4 is considered negligible.

Chloride

Chloride concentrations were compared to the BC ENV water quality guidelines for the protection of wildlife (BC ENV 2021). Chloride exceeded the BC ENV water quality guideline protective of wildlife (600 mg/L) at Lake CP1 during the operations, Saline Pond B7 during operations and active closure, Contact Pond B4 during operations and TIR04 Pit Lake during active closure.

With the exception of Saline Pond B7 during operations, the exceedances for predicted chloride concentrations were considered to have low magnitude and frequency as discussed below:

- Maximum chloride concentrations in Lake CP1 were 916 mg/L during the operations phase, then decreased to 181 mg/L and 19 mg/L, respectively, for active closure and post-closure. Predicted chloride concentrations in Lake CP1 exceeded the BC ENV water quality during only two months of operations (September and October 2024) and were below the guideline in all other months of operations and the other phases of the Project;
- Maximum chloride concentrations in Saline Pond B7 were 30,136 mg/L and 1,649 mg/L during operations and active closure phases, respectively, and then decreased to 61 mg/L in post-closure. Predicted chloride concentrations in Saline Pond B7 exceeded the BC ENV water quality during only five months of active closure (January to May 2044). The lake would be frozen during this period (i.e., frozen period is typically November to mid-June) and would be inaccessible to wildlife as a source of drinking water. Predicted chloride concentrations were below the guideline in all other months of active closure and the other phases of the Project (with the exception of operations, as discussed below);
- Maximum chloride concentrations in Contact Pond B4 were 1,738 mg/L during operations and then decreased to 178 mg/L and 23 mg/L in active closure and post-closure, respectively. Predicted chloride concentrations in Contact Pond B4 exceeded the BC ENV water quality during ten months of operations (August 2025 to May 2026). The lake would be frozen for seven months of this period (i.e., frozen period is typically November to mid-June) and would be inaccessible to wildlife as a source of drinking water. Predicted chloride concentrations were below the guideline in all other months of operations and the other phases of the Project; and
- The maximum chloride concentration in TIR04 Pit Lake was 770 mg/L during the active closure phase. Predicted chloride concentrations in TIR Pit Lake exceeded the BC ENV water quality during only five months of active closure (January to May 2044). The lake would be frozen during this period and would be inaccessible to wildlife as a source of drinking water. Predicted chloride concentrations were below the guideline in all other months of active closure and the other phases of the Project.

Given the low magnitude and frequencies of the exceedances, the potential for adverse health effects for wildlife is expected to be negligible and risks to wildlife exposed to chloride in water from Lake CP1 (operations), Saline Pond B7 (active closure), Contact Pond B4 (operations), and TIR04 Pit Lake (active closure) are considered negligible.

Predicted chloride concentrations in Saline Pond B7 exceeded the CCME WQG protective of livestock water each month from August 2025 to the end of the operations phase of the Project. As discussed above for TDS, Saline Pond B7 will be used as a saline water pond during operations. Given that chloride affects the palatability of the water, the close proximity of the mine would deter wildlife and the short open-water season would limit access, the likelihood of wildlife exposure to chloride in Saline Pond B7 is low and potential risks to wildlife exposed to chloride in water from Saline Pond B7 during operations is considered low.

Sulphate

Sulphate concentrations were compared to the CCME water quality guidelines for the protection of agricultural uses – livestock water (CCME 1999a), which are conservatively also considered protective of wildlife consuming water. Sulphate exceeded the CCME WQG for livestock water (1,000 mg/L) in Saline Pond B7 during the operations phase of the Project (2,947 mg/L). Concentrations decreased during active closure (350 mg/L) and post-closure (432 mg/L) in Saline Pond B7.

Predicted sulphate concentrations in Saline Pond B7 exceeded the CCME WQG protective of livestock from August 2025 to October 2043 in the operations phase, with a few exceptions in June 2040, June and July 2041, June to September 2042 and June 2043. As discussed above for TDS, Saline Pond B7 will be used as a saline water pond during operations. Given that other parameters in the water (e.g., TDS and chloride) affect the palatability of the water, the close proximity of the mine would deter wildlife and the short open-water season would limit access, the likelihood of wildlife exposure to sulphate in Saline Pond B7 is low. Therefore, potential risks to wildlife exposed to sulphate in Saline Pond B7 during operations are considered low.

Total Ammonia

Total ammonia concentrations were compared to the CCME long-term water quality guideline for the protection of aquatic life for freshwater. Total ammonia exceeded the CCME WQG protective of aquatic life (7 mg/L-N) at Lake CP1 and Saline Pond B7 during the operations and active closure phases. Total ammonia concentrations in Lake CP1 were 37 mg/L-N and 15 mg/L-N during operations and active closure phases, respectively, and then decreased to 1.0 mg/L-N in post-closure. Total ammonia concentrations in Saline Pond B7 were 53 mg/L-N and 13 mg/L-N during operations and active closure phases, respectively, and then decreased to 0.4 mg/L-N in post-closure.

A screening criterion for total ammonia is not available for the protection of wildlife consuming water. Ammonia is a by product of metabolism of nitrogen-containing compounds like proteins and nucleic acids in wildlife receptors. As such, wildlife receptors have evolved mechanisms for removing ammonia from the body, such as by converting to urea (which is excreted in urine) in mammals or to uric acid in birds. Therefore, because ammonia is regulated in wildlife, the potential for adverse health effects for aquatic wildlife is expected to be negligible and risks to these receptors from exposure to total ammonia in water is considered negligible.

10.2.8 Residual Impact Classification

Residual impact classification effects criteria and definitions are provided in Section 4.5.2 of the Application. They are consistent with the criteria and definitions used in the 2014 FEIS. Similarly, the specific assessment criteria used for evaluating residual impacts to aquatic life health risks (Table 10.2-13), and determining significance are consistent with those used for the 2014 FEIS. To determine the significance of an effect, various levels are associated with each criterion. Considering all criteria, the significance of the impact on the health of aquatic life is determined to be either significant or not significant.

Table 10.2-13: Effects Criteria and Levels for Assigning Significance to Aquatic Life Residual Impacts

Effects Criteria	Effects Level Definition		
Direction (of health effect)	**Positive** Effect is beneficial to health of aquatic life or does not result in a change to the health of aquatic life		**Negative** Effect is potentially harmful to the health of aquatic life
Magnitude (of health effect)	**Low** 1 < HQ ≤ 10	**Moderate** 10 < HQ ≤ 100	**High** HQ > 100
Geographic Extent (of condition causing health effect)	**On-Site** Effect is within the Project footprint	**Local** Effect extends into the LSA	**Regional** Effect extends into the RSA
Duration (of conditions causing health effect)	**Short-term** Conditions causing effect are of short duration (2-3 years)	**Medium-term** Conditions causing effect are evident during the operations phase (24 years)	**Long-term** Conditions causing effect extend beyond any one phase (>24 years)
Frequency (of condition causing health effect)	**Isolated** Conditions causing the effect occur infrequently (i.e., less than 5% of the year)	**Periodic** Conditions causing the effect occur at regular, although infrequent intervals (i.e., between 5 and 20% of the year)	**Continuous** Conditions causing the effect occur at regular and frequent intervals (i.e., more than 20% of the year)
Degree of Reversibility (of health effect)	**Readily Reversible** Effect is readily (i.e., immediately) reversible	**Reversible** Effect is reversible with time	**Irreversible** Effect is not reversible (i.e., permanent)
Likelihood (of health effects occurring)	**Unlikely** Effect is unlikely to occur	**Possible** Effect is possible, although not certain	**Likely** Effect is certain to occur

HQ = hazard quotient.

The following residual impacts were identified in the ecological health risk assessment:

- Surface Water Quality Assessment: Potential chronic health risks for aquatic life due to cobalt (Lake A8 West, TIRI Pit Lake and Pump Pit Lake) and copper (Pump Pit Lake) in surface water.

The overall significance of the residual impacts is shown in Table 10.2-14. The assessment of residual impacts is detailed in Tables 10.2-15 and 10.2-16. Residual impacts were not identified for soil quality.

Table 10.2-14: Residual Impact Classification for Ecological Health

Effect Pathways	COPC	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance
Direct contact with surface water by Aquatic Life	Cobalt	Negative	Low	Local	Long-term	Continuous	Reversible	Unlikely	Not significant
	Copper	Negative	Low	Local	Long-term	Continuous	Reversible	Unlikely	Not significant

Table 10.2-15: Significance of Residual Impacts for Aquatic Life for Cobalt for Lake A8 West, TIRI Pit Lake and Pump Pit Lake

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	Cobalt in surface water may cause adverse effects on aquatic life including a reduction in reproduction, growth and survival endpoints. The toxic mode of action is not well understood, but cobalt is known to inhibit various enzymes which may cause a reduction in tissue respiration and metabolism (ECCC 2017).
Magnitude	Low	The estimated HQs for cobalt were 1.2 in Lake A8 West, 1.7 in TIRI Pit Lake and 1.2 in Pump Pit Lake considering the upper-bound estimate water concentrations. Using the central-tendency estimate water concentrations resulted in estimated in an estimated HQ greater than the target HQ of 1 for TIRI Pit Lake; estimated HQs were acceptable using the central-tendency estimate for Lake A8 West and Pump Pit Lake.
Geographic Extent	Local	The water modelling provided predicted water concentrations of the COPCs at waterbodies within the LSA. For cobalt, there were exceedances of the water quality guidelines at Lake A8 West, TIRI Pit Lake and Pump Pit Lake; as such, the geographic extent for cobalt is classified as local (i.e., effect extends into the LSA).
Duration	Long-Term	Given that predicted concentrations of cobalt exceed water quality guidelines during the post-closure phase of the Project, the duration was considered long-term.
Frequency	Continuous	The predicted concentrations exceeded the toxicity benchmark, for more than 20% of the year during the post-closure phase of the Project. Therefore, the frequency of exceedances is considered to be continuous.
Reversibility	Reversible	The impact may result in effects on individual organisms but it is unlikely to result in population-level effects.
Likelihood	Unlikely	The lowest no effect concentration used to generate the species sensitivity distribution in the development of the FEQG (ECCC 2017) was greater than the FEQG by a factor of 2.2. Given the maximum predicted concentrations at Lake A8 West, TIRI Pit Lake and Pump Pit Lake are less than 2.2 times the calculated FEQG, the predicted cobalt concentrations are unlikely to result in adverse effects to aquatic life. In addition, given that the assessment relies on predictive water quality modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to cobalt will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Water Quality Modelling	The water balance and site water quality model considered the proposed mine plan at the time of the assessment. Primary factors that can affect confidence in the modelling results include the availability and accuracy of the baseline data, level of understanding of the existing conditions and range of natural and seasonal variation, accuracy and certainty in the source terms, accuracy and certainty in the models and modelling software, and certainty associated with effectiveness of proposed mitigations. Uncertainty was managed by incorporating conservative estimates, conducting model calibrations to existing operational data, collecting supplemental geochemical, data running sensitivity analyses, and verifying assumptions to minimize underestimating predicted concentrations.
	In the Selected Toxicity Benchmarks	The selected toxicity benchmark for cobalt of 0.78 µg/L was calculated using the hardness-based equation for the FEQG derived by ECCC (2017). The FEQG was developed using an SSD approach consistent with CCME (2007) and incorporated EC_{10} and IC_{10} data (no effect concentrations) for reproduction, growth and survival endpoints for plants, invertebrates and fish. The FEQG was set at a concentration below the lowest effect concentration. Therefore, the selection of this toxicity benchmark is conservative and may overestimate toxicity due to chronic exposure to cobalt.
Residual Impact Significance	Not Significant	With respect to aquatic health effects, the overall impacts are not considered to be significant to populations in Lake A8 West, TIRI Pit Lake and Pump Pit Lake because the conditions causing the residual effect are of low magnitude, the health effect is considered to be reversible for populations, and the overall potential for the aquatic health effect to occur is considered to be unlikely.

EC_{10}/IC_{10} = effect concentration/inhibition concentration for 10% of test organisms.

Table 10.2-16: Significance of Residual Impacts for Aquatic Life for Copper for Pump Pit Lake

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	Copper in surface water may cause adverse effects on aquatic life (i.e., fish, invertebrates, aquatic plants, amphibians) including a reduction in reproduction, growth and survival endpoints. In fish, elevated copper concentrations may have detrimental effects including physiological, ion regulatory, behavioural and chemosensory impairments (ECCC 2021a). In plants, copper may cause reduced growth, photosynthesis, respiration and nitrogen fixation (ECCC 2021a).
Magnitude	Low	The estimated HQs for Pump Pit Lake for copper were 5.5 and 4.4 considering the upper-bound and central-tendency estimate water concentrations, respectively.
Geographic Extent	Local	The water modelling provided predicted water concentrations of the COPCs at waterbodies within the LSA. For copper, there were exceedances of the water quality guidelines at Pump Pit Lake; as such, the geographic extent for cobalt is classified as local (i.e., effect extends into the LSA).
Duration	Long-Term	Given that predicted concentrations of copper exceed water quality guidelines during the post-closure phase of the Project, the duration was considered long-term.
Frequency	Continuous	Given the predicted concentrations exceed the toxicity benchmark consistently through the post-closure phase of the Project (e.g., >20% of the year), the frequency of exceedances is considered to be continuous.
Reversibility	Reversible	The impact may result in effects on individual organisms, but it is unlikely to result in population-level effects.
Likelihood	Unlikely	Predicted copper concentrations in Pump Pit Lake during post-closure exceeded the BLM-based toxicity threshold representing concentrations below which no effects on aquatic life would be expected. Therefore, additional assessment was undertaken to describe the likelihood of potential effects from copper exposure on the health of fish and aquatic life. Using the average hardness in Pump Pit Lake from three representative time periods of the post-closure phase (early [2051-2053], mid [2084-2086] and end [2117-2119]) and a multiple linear regression model (Brix et al. 2021), low effects thresholds were derived (Appendix H-12-C). Low effects thresholds were 1.8 µg/L for early post-closure, 2.1 µg/L for mid post-closure, and 2.2 µg/L for end of post-closure. Predicted copper concentrations during early post-closure (0.99-1.1 µg/L), mid post-closure (1.7 µg/L) and end of post-closure (2.0-2.1 µg/L) are lower than their respective low effect threshold. Therefore, population or community level effects are unlikely. Given that the assessment relies on predictive water quality modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to copper will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Water Quality Modelling	The water balance and site water quality model considered the proposed mine plan at the time of the assessment. Primary factors that can affect confidence in the modelling results include the availability and accuracy of the baseline data, level of understanding of the existing conditions and range of natural and seasonal variation, accuracy and certainty in the source terms, accuracy and certainty in the models and modelling software, and certainty associated with effectiveness of proposed mitigations. Uncertainty was managed by incorporating conservative estimates, conducting model calibrations to existing operational data, collecting supplemental geochemical data, running sensitivity analyses, and verifying assumptions to minimize underestimating predicted concentrations.
	In the Selected Toxicity Benchmarks	The selected toxicity benchmark for copper of 0.38 µg/L was derived using the BLM developed in the recent derivation of the FEQG (ECCC 2021a) and is based on predicted water quality parameters in Pump Pit Lake during the post-closure phase of the Project. The BLM considered EC_{10} toxicity data using plants, invertebrates and fish. Water quality is unknown for several input parameters used in the BLM (e.g., pH, temperature, DOC and alkalinity), therefore conservative assumptions were made. Therefore, the selection of this toxicity benchmark is conservative and may overestimate toxicity due to chronic exposure to copper.

Effects Criteria	Criteria Classification	Rationale
Residual Impact Significance	Not Significant	With respect to aquatic health effects, the overall impacts are not considered to be significant to populations in Pump Pit Lake because the conditions causing the residual effect are of low magnitude, the health effect is considered to be reversible for populations, and the overall potential for the aquatic health effect to occur is considered to be unlikely.

EC_{10} = effect concentration for 10% of test organisms.

10.2.9 Cumulative Effects Assessment

Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, cultural, and economic components of the environment through time and across space. Some changes may be human-related, such as increasing industrial development, and some changes may be associated with natural phenomenon, such as extreme rainfall events, and periodic harsh and mild winters. It is the goal of the cumulative effects assessment to estimate the contribution of these types of effects, in addition to project effects, to the relative change in the VECs or VSECs.

With respect to natural phenomena, these do not have a direct influence on terrestrial or aquatic health and as such were not considered further. However, human-induced influences, including past, present, and RFFDs, could potentially have a cumulative effect on terrestrial and aquatic health should they result in significant changes to environmental quality (e.g., water quality). The past, present, and foreseeable future industrial developments are described in Appendix B-1. The potential cumulative effects of these developments and their influence on environmental quality are discussed in the relevant sections of the FEIS Addendum as listed below:

- Terrestrial Environment, specifically the following components:
  - Soil and terrain (Section 6.4.6)
  - Vegetation (Section 6.5.6)
- Freshwater Environment, specifically the following components:
  - Surface water and sediment quality (Section 7.4.5)
  - Fish and fish habitat (Section 7.5.5)
- Marine Environment, specifically the following components:
  - Surface water and sediment quality (Section 8.2.5)
  - Biological environment (Section 8.2.5).

As indicated in these sections, quantitative predictions of changes to environmental quality due to other developments were not carried out for surface water and sediment quality. Qualitative assessments, were, therefore carried out for all relevant sub-disciplines.

As indicated in these other sections, cumulative effects to surface water and sediment quality are expected to be negligible. Therefore, the subsequent effects to terrestrial and aquatic health are also expected to be negligible.

10.2.10 Uncertainty

Consistent with the uncertainty identified for the 2014 FEIS, the key uncertainties that apply to the Meliadine Extension and the ecological risk assessment are described in Table 10.2-17. A detailed discussion of uncertainty related to the assessment of human health is available in Section 10.3.19.

Table 10.2-17: Uncertainties in the Ecological Risk Assessment

Source of Uncertainty	Overestimate/ Underestimate/ Neutral?
Model Predictions	
The concentrations of COPCs in water considered in the HHERA were the maximum monthly predictions over 24 years of modelled data during the operations phase (2024 to 2043) of the Project for Meliadine Lake, and over 7 years and 69 years of data for the active closure and post-closure phases of the Project (2051-2119) for the small waterbodies and pit lakes. It was conservatively assumed that the ecological receptors would be exposed to the maximum concentration throughout each phase of the Project.	Overestimate
ERA Assumptions	
The toxicity reference values used in the ERA for wildlife were selected from reputable sources including ECCC. The TRVs used in this RA are generally based on the most sensitive endpoints, with the application of safety factors to protect sensitive subpopulations. The uncertainty associated with TRVs is highly dependent on the number of studies available, and whether the key study was based on species similar to those observed on-site (low uncertainty) or dissimilar (high uncertainty) in the case of the wildlife and aquatic effects assessments. When few studies are available, several types of safety factors must be applied to account for this uncertainty (e.g., factors for inter- and intraspecies sensitivity).	Neutral-overestimate
Water quality is unknown for several input parameters used in the copper BLM (e.g., pH, temperature, DOC and alkalinity), therefore conservative assumptions were made.	Neutral-Overestimate
Individual survival, growth, reproduction, development and population changes were used as endpoints for aquatic life but these do not necessarily translate to population-level effects which are considered ecologically relevant.	Overestimate
The potential for additive effects between COPCs was not considered for aquatic life.	Neutral-Underestimate
Acclimation and adaptation were not considered for aquatic life although natural populations chronically exposed to metals often exhibit increased tolerance to exposure relative to unexposed or naïve populations such as those used in laboratory studies upon which the toxicity benchmarks are based.	Overestimate
Other uncertainties are described in Tables 10.2-16 and 10.2-17.	Overestimate

10.2.11 Monitoring and Follow-up

As described in Section 10.1.8, Agnico Eagle has prepared and follows numerous monitoring plans in compliance with the terms and conditions identified in Project Certificate No.006 and Water Licence 2AM-MEL1631. In addition, Agnico Eagle has updated management and monitoring plans to support the NIRB review process for the Meliadine Extension FEIS Addendum. The purpose of monitoring is to support management of the site, to manage risk, compare monitoring data to predictions, identify if there are issues, and implement additional mitigation (if required).

Monitoring and follow-up as described by other disciplines in the FEIS are applicable. These include continued monitoring of water quality (e.g., metals and major ions) under the AEMP. No additional monitoring or follow-up measures were identified in the HHERA.

The toxicity benchmarks used in the assessment for some parameters (copper) were derived using the BLM and predicted water quality in the Mine area. The need for these benchmarks will be verified and updated as necessary based on continued monitoring of water quality over the life of the Meliadine Extension.

10.3 Human Health

10.3.1 Valued Components

The identification of VCs and factors considered in their selection have not changed for the FEIS Addendum and are summarized in Table 10.3-1 as well as the Section 10.2.2 of the 2014 FEIS.

Table 10.3-1: Human Health Risk Assessment Valued Components

	Valued Component		Rationale for Selection
Health and Safety	Workers	Inuit	Inuit may be employed at the mine and reside in the Mine Camp or Exploration Camp.
		Non-Inuit	Non-Inuit may be employed at the mine and reside in the Mine Camp or Exploration Camp.
	Public	Inuit	Inuit are known to reside in Rankin Inlet and have several hunter/trapper cabins and camps on Meliadine Lake near the mine site area and around the AWAR.
		Non-Inuit	Non-Inuit are known to reside in Rankin Inlet and may use the area around the mine site and AWAR for recreational purposes.

10.3.2 Spatial and Temporal Boundaries

The spatial and temporal boundaries for the human health risk assessment were considered to be the same as those defined for the aspects of the environment that can directly affect human health, including air quality and noise (Section 5.1; Section 5.1.2; Figure 5.1-1), water quality (Section 7.4; Figure 7.1-4) fish quality (Section 7.5; Figure 7.1-5), and marine water quality (Section 8.2; Section 8.1-1; Figure 8.1-2).

The LSA for human health generally encompassed the disturbed mine footprint, the water bodies identified within the LSA for surface water quality, and the cabin locations identified within the LSA for air quality and noise. Additionally, the section of the AWAR that is incorporated into the LSA for surface water quality, air quality, and noise was included in the LSA for human health. However, the human health risk assessment has been carried out considering the Project components rather than the LSA (i.e., the mine site, the AWAR, and Rankin Inlet).

The RSA applicable for surface water quality, air quality, and noise are defined in the relevant sections of the FEIS addendum. As indicated above, the human health risk assessment has been carried out considering the project components rather than the RSA (i.e., the mine site, the AWAR, and Rankin Inlet).

The approach used to determine the temporal boundaries of effects from natural and human-related disturbances on VECs and VSECs is similar to the approach used to define spatial boundaries. In this assessment, temporal boundaries are linked to two concepts:

- the development phases of the project (i.e., construction, operation, maintenance, temporary closure [care and maintenance], final closure [decommissioning and reclamation]), and post-closure; and
- the predicted duration of effects from the project on a VEC or VSEC, which may extend beyond final closure (i.e., post-closure).

Thus, the temporal boundary for a VEC or VSEC is defined as the amount of time between the start and end of a relevant project activity or stressors (which are related to development phases), plus the duration required for the effect to be reversed. The temporal boundaries must be determined separately for construction, operation, maintenance, temporary closure, final closure, and post-closure periods, including planned exploration to be undertaken as part of the Mine (NIRB 2012).

For human health, there may be potential impacts to human health in all phases of the Mine extending into the post-closure phase. For example, while dust may be generated during the construction and operation phases of the Mine, the chemicals in dustfall that have deposited onto surface soil and altered soil quality may impact human health into the post-closure phase if those compounds are persistent in the environment (i.e., they do not appreciably degrade or volatilize). A conservative approach has been taken in the human health risk assessment to make sure that the potential for health effects extending beyond the life of the mine are addressed.

10.3.3 Incorporation of Inuit Qaujimajatuqangit, Traditional Knowledge and Consultation

Since the 2014 FEIS, additional IQ, TK, and comments/concerns related to the HHERA were provided by community members and incorporated into the Meliadine Extension assessment, which takes into account the review of the following sources:

- FEIS Addendum Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet 2020 (Agnico Eagle 2018a)
- Water License Amendment Consultation and Engagement Report, December 2020 (Agnico Eagle 2020)
- Waterline Consultations Report 2020 - Preliminary phase of consultation with Rankin Inlet key stakeholders for the Meliadine waterline project from January – March and July 2020 (Agnico Eagle 2020c).
- Waterline Consultations Report 2020- Consultation Plan for the Meliadine Waterline project Existing Environment and Baseline Information, August 2020 (Agnico Eagle 2020d)
- Community and public engagement for the Meliadine Extension (Section 3 of this Application)

Information gathered during engagement meetings has been considered and incorporated in this Application where relevant, including the effects assessment and mitigation measures. The following IQ, TK, comments and concerns have been expressed by community members related to effects of the Meliadine Extension on human health:

- Dust from the road can affect vegetation and activities, such as berry picking.

- Through public consultation and the Traditional Use Study (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014), it is known that surface water in the Meliadine Mine area could be used as a drinking water source by the Inuit.
- Concentration of total and dissolved parameters in water (e.g., total dissolved solids, total suspended solids, nutrients, total metals, dissolved metals, etc.) strongly influence the quality of water for aquatic organisms, wildlife, and the use of water as a drinking water source for Inuit or for recreational purposes.
- Through public consultation and the Traditional Use Study (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014), Meliadine Lake has been identified as an important drinking water source and source of water for making tea by local residents.
- Domestic fishing is still an important part of the Inuit way of life, accounting for as much as 20% of the diet of the residents of Rankin Inlet and Chesterfield Inlet. Most of the waterbodies in the general Meliadine area, including Meliadine Lake, are fished for Lake Trout and Arctic Char, and cabins in the study area are used as a base during fishing and hunting trips (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014).
- It is noted that the local communities identified fish resources in Meliadine Lake are important to them, but removal of fish and drainage of smaller waterbodies are of little concern (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014).
- In addition to local communities expressing the importance to them of Meliadine Lake and fish resources within the lake, they also raised concern over discharge of contaminated water into Meliadine Lake and the effect of this on fish populations (2014 FEIS Volume 9, Section 9.3; Agnico Eagle 2014).
- Inuit concerns were taken into consideration while developing pathways, including concerns related to lower water levels and the quality of water for drinking.
- Existing Inuit traditional societal value and principle of, respect for the land, no disruption of wildlife habitat, and no wastage of food harvested from the land or waters.
- The Meliadine area and river system is a significant area and historically important for many Inuit in the Kivalliq Region, and still is considered as a special place for annual fish and caribou harvest for supplementing Inuit households with healthy traditional foods.
- Arctic Char are an important food species for the residents of Rankin Inlet – residents have cabins on the north shore of Itivia Harbour and harvest Arctic Char, Sculpin, and Cod in the Itivia Harbour area (Nunami Stantec 2012; Appendix B). Itivia Harbour is heavily used by residents in the summer for launching boats (it is the only place accessible during low tide), and in the winter for snowmobile travel in and out of the community (Nunami Stantec 2012; Appendix B).
- Women did and still do most of the fishing in the communities. Community members used to walk from Rankin Inlet to the area near Diana River to fish on the surrounding lakes. All fish at Meliadine go upstream to Peter Lake, and then go downstream to the ocean via Diana River.
- Seasons are changing, and the streams are getting lower having an impact on fish. Some years are dry, and the water is low. Some years, the water is high when there is more rain. Fish have different sizes depending on the size of rocks in the streams and their location; they change

accordingly. When the water becomes dirty, fish move somewhere else. The community fish using fishing nets, and they have observed different species of fish they have not seen before.

- During the May and September fish runs, cabins are still used by the people of Rankin Inlet to serve as a base for fishing, particularly on weekends.
- Fishing for both Arctic Char and Arctic Grayling continues to be important to the people in the region. There are remnants of stone fishing weirs near the mouth of the Meliadine River, and stone drying racks scattered throughout the river valley (Agnico Eagle 2014).
- Areas near Rankin Inlet where people may harvest shellfish includes a local beach area (approximately 2 km northwest of the discharge area) and Aukpik Island (approximately 4 km southeast of the discharge area) (Agnico Eagle 2021b) (Figure 10.2-1).
    - The permanent diffuser evaluated through the 2020 FEIS Addendum (Agnico Eagle 2020a) will be in a water depth of 20 to 24 metres (depending on tidal fluctuation).
    - The area of predicted water quality change is limited to 100 metres from the discharge point.
    - There is a physical barrier between the location of the diffuser, the area of predicted change in water quality, and the areas where people may harvest shellfish.
- Impact of noise on wildlife, including caribous and birds.
- Impact of noise on humans around the site.

The concerns as they pertain to the Meliadine Extension have been incorporated into Section 5 (Atmospheric Environment – air quality and noise), Section 7 (Freshwater Environment), and Section 8 (Marine Environment) of the Application.

Further description about traditional use of the land for harvesting of country foods is provided below.

Harvesting areas

As part of the Meliadine Extension engagement activities, IQ and TK collected as part of the 2014 FEIS and subsequent events listed above, Agnico Eagle validated with community members and elders the following harvesting areas for wildlife, fish, and vegetation:

- We heard from the community that Inuit caribou hunting is an important activity. People from Rankin Inlet hunt caribou in the Meliadine area and elsewhere. They also hunt along the coast by boat (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).
- We heard from community consultation that the lower Meliadine was an important caribou hunting area. We learned that the herds migrated along the coast. Sometimes, large herds migrate through the area and many people hunt when caribou are present (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).
- We heard from the community that Meliadine Lake is a good fishing spot in the late winter and springtime. Many people follow the winter road toward the Meliadine Camp and then follow

snowmobile trails to the southeast end of the lake. There are many ice fishing holes made in Meliadine Lake in the spring (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).

- We learned from the community that Lingonberry grows almost everywhere on the tundra around Rankin Inlet. It has red berries that ripen in August, and are food to humans and wildlife. The berries are eaten by geese, ptarmigan, gulls, sik siks, foxes, and bears. The berries are eaten in the fall and in the spring, after spending the winter under the snow (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).
- We learned from community consultation that people tend to pick berries in Iqalugaarjuup Nunanga Territorial Park, near Second Landing Lake, and along the Diana River Trail. Sometimes, people cross the river to pick berries, mostly while hunting caribou or geese (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).
- We heard from community consultation that Meliadine Lake is an important area (Elder's Group Meeting, March 2021).

Additionally, we heard throughout engagement activities listed above related to the Meliadine Mine the following:

- Residents of Rankin Inlet tend to pick berries in Iqalugaarjuup Nunanga Territorial Park, near Second Landing Lake, and along the Dianna River Trail. Berries are also harvested from Km 12 to Km 27 of the AWAR.
- There are many Char at Josephine River Falls. Also, there are a lot of fish at Landing Lake. Women did, and still do, most of the fishing in the communities. Community members used to walk from Rankin Inlet to the area near Diana River to fish on the surrounding lakes. It would take all day. All fish at Meliadine go upstream to Peter Lake, and then go downstream to the ocean via Diana River.

Harvesting Practices and Seasonal Pattern

As part of the Meliadine Extension engagement activities, IQ and TK collected as part of the 2014 FEIS and subsequent events listed above, Agnico Eagle validated with community members and elders the following harvesting seasons for wildlife, fish, and vegetation:

- We heard from the community that thousands of snow geese, Canada geese, and white-fronted geese stop in the lower Meliadine lakes to rest and feed during both spring and fall migrations. People hunted there in the past and continue to do so now. Many still use the old taluit as blinds (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).
- We learned from the community that Lingonberry grows almost everywhere on the tundra around Rankin Inlet. It has red berries that ripen in August, and are food to humans and wildlife.

> The berries are eaten by geese, ptarmigan, gulls, sik siks, foxes, and bears. The berries are eaten in the fall and in the spring, after spending the winter under the snow (Results of Inuit Qaujimajatuqangit interviews and focus groups held in Rankin Inlet, Chesterfield Inlet and Whale Cove for the FEIS 2015).

Additionally, we heard throughout engagement activities listed above related to the Meliadine Mine the following:

- Harvesting activities are practiced year-round.
- Berry picking was and still is an important fall and spring activity throughout the Meliadine valley, wherever there are low slopes with heath tundra, and in hummocky areas at the edges of wetlands. During the spring, when there is light all day long, people would walk from Rankin to the area near Diana River to pick berries. Areas along the road were regularly used for berry picking. While people pick berries throughout the Meliadine valley, people are less likely to cross the Meliadine River when coming from Rankin Inlet to pick berries, especially if they are carrying young children on their ATVs. Mid-August and beginning of September is when cloudberries are harvested in the Rankin Inlet area up to Meliadine Lake.
- Fishing is practiced year-round. We heard from the community that Meliadine Lake is a good fishing spot in the late winter and springtime. Many people follow the winter road toward the Meliadine Camp and then follow snowmobile trails to the southeast end of the lake. There are many ice fishing holes made in Meliadine Lake in the spring. Additionally, we heard that summertime is generally a good season for fishing lake trout and spending time on the lake.
- We heard that caribou is hunted from Rankin Inlet by ATV in the winter, and by boat and ATV in the summer. In winter they are not limited by trails but can travel wherever they want to find caribou. In the summer they are somewhat limited to the ATV trails, but readily leave them to get closer to animals if the terrain is not too rocky to permit the passage of their vehicles.

Country food

We heard as part of the Meliadine Extension engagement activities that the daily diet still consists of various traditional foods. We heard from participants that especially caribou and fish meat regularly supplement their weekly diet. Arctic char is stocked up during the summer and ice freeze up with gill net in the ocean or lakes. Fish is stored in catches for personal consumption and to feed dog teams. Caribou meat is consumed fried, dried and raw. The meat is also grounded to cook meals. A wide variety of berries are harvested and are either consumed fresh or used to make jam and shared among relatives. Participant indicated that they share all their catches with anyone that needs traditional food. Traditional food sources are preferred over store bought and processed food for health and cost reasons.

Based on this information, the list of VECs listed in the ecological health risk assessment (Section 10.2.1) was reviewed and confirmed to include relevant receptors to support the assessment of effects to human health through ingestion of country foods.

10.3.4 Existing Environment

For the human health risk assessment, the baseline and existing conditions information collected as part of the 2014 FEIS, the 2018 and 2020 FEIS Addenda, and the ongoing monitoring at the Mine that is used to support the assessment is summarized below:

- Atmospheric environment, specifically the following components:
  - Air quality (Section 5.2.3)
  - Noise (Section 5.5.3)
- Terrestrial Environment, specifically the following components:
  - Soil and terrain (Section 6.4.3)
  - Vegetation (Section 6.5.3)
- Freshwater Environment, specifically the following components:
  - Surface water and sediment quality (Section 7.4.2)
  - Fish and fish habitat (Section 7.5.2)
- Marine Environment, specifically the following components:
  - Surface water and sediment quality (Section 8.2.2)
  - Biological environment (Section 8.2.2)
- Socio-economic environment, specifically the following components:
  - Population demographics (Section 9.2)
  - Traditional knowledge and traditional land use (Section 9.12).

The baseline data used in the human health risk assessment to characterize baseline and existing environmental quality and the existing way of life by people living in the area that may be affected by Mine activities are described below with respect to each of the components of the Meliadine Mine (i.e., mine site area, AWAR, and the community of Rankin Inlet).

The following baseline and existing conditions data are available for the mine site area, AWAR, and Rankin Inlet to support the human health risk assessment:

- Air quality (concentrations of indicator compounds including total suspended particulate [TSP], particles nominally smaller than 10 micrometres (µm) in diameter [PM_{10}], particles nominally smaller than 2.5 µm in diameter [$PM_{2.5}$], dust, nitrogen dioxide [NO_2], and sulphur dioxide [SO_2]);
- Noise (noise levels measured at the Mine camp complex and at Rankin Inlet);
- Soil (chemical concentrations measured in soil samples collected from the Mine site area and along the AWAR);
- Vegetation (chemical concentrations in vegetation samples collected from the Mine site area and along the AWAR);
- Water quality (chemical concentrations in water samples collected from waterbodies in the Mine site area and stream crossings along the AWAR);
- Sediment quality (chemical concentrations in sediment samples collected from water bodies in the Mine site area);

- Mammals and birds (traditional knowledge studies and observations of species in the Mine site area);
- Fish (observations in water bodies in the Mine site area); and
- Traditional land use (traditional knowledge studies and observations in the Mine site area, AWAR, and Rankin Inlet).

The information presented in other sections of the Application related to these aspects of the environment were reviewed to understand existing environmental conditions, human activities in the area including traditional use, and existing wildlife and aquatic communities.

10.3.4.1 Air Quality

Baseline air quality presented in the 2014 FEIS was obtained using Environment and Climate Change Canada National Air Pollution Surveillance Network. The air quality was representative of undisturbed natural area. Readings were very low and well below the given air quality standards.

Air quality monitoring is ongoing at the Meliadine Mine. Constituents monitored include NO_2, SO_2, TSP, PM_{10}, $PM_{2.5}$, and dust. Calculated annual average concentrations of NO_2 and SO_2 were well below the Government of Nunavut Ambient Air Quality Standards (NAAQS) and the 2014 FEIS maximum predicted values. 2020 was the fourth full year of monitoring for gaseous compounds.

Dustfall results are mostly within Alberta Environment's Ambient Air Quality Guidelines for recreational and industrial areas (Air Quality Monitoring Report in Agnico Eagle 2021c). In 2020, one of 40 onsite samples exceeded the recreational guideline, and no sample exceeded the industrial guideline. Historically, an increase in measured dustfall rates has occurred since mid-2017 when the construction period began, as anticipated. Despite increasing site activity, levels of dustfall at site perimeter monitoring stations are generally well within Alberta recreational guidelines, with exceedances occurring in a maximum of 4% of total dustfall samples in any given year since that time. Along the AWAR, annual average rates of dustfall have only exceeded the Alberta recreational guideline at the 25-m distance as expected in the 2014 FEIS.

Dust suppressant in the form of calcium chloride has been applied along the AWAR and road watering has been conducted around the site in previous years. Results of dustfall monitoring indicate that these best management practices are being effectively implemented to minimize emissions.

Suspended particulates (TSP, $PM_{2.5}$, and PM_{10}) monitoring results to date have been below maximum concentrations predicted in the 2014 FEIS and regulatory guidelines. Concentration of metals of concern in TSP (cadmium and iron) were less than 2014 FEIS-selected health-based screening values and 2014 FEIS maximum model predictions in all samples.

Incinerator stack testing has been ongoing since Project Certificate issuance in 2015 and all results to date have been below GN standards for mercury, and dioxins and furans.

10.3.4.2 Noise

Baseline information collected prior to development of the Meliadine Mine, are described in the 2014 FEIS (Agnico Eagle 2014). Baseline noise levels were representative of undisturbed environment as human activity in the study areas was minimal (35 A-weighted decibels [dBA]). Some measurements were also collected closer to Rankin Inlet where noise levels were measured in the 45-52 decibel (dBA) range.

A total of 20 locations were identified within the SSA and LSA as being at risk of receiving noise emissions. Modeling exercises and monitoring strategies for the existing environment are based upon limiting the impact on those 20 noise receptors. Monitoring data from Meliadine's noise monitoring plan collected since 2016 shows sounds levels at selected stations within the predictions and site noise criterion.

10.3.4.3 Soil and Vegetation

Summaries of metals concentrations in soil and vegetation for baseline and existing conditions are provided in Section 10.2.4.1 (soil) and Section 10.2.4.2 (vegetation).

10.3.4.4 Water and Sediment Quality

Summaries of water and sediment quality in Meliadine Lake and the small waterbodies adjacent to Mine activities and in Itivia Harbour for baseline and existing conditions are provided in Sections 10.2.4.3 and 10.2.4.4 (freshwater environment) and Section 10.2.4.6 (marine environment).

10.3.4.5 Terrestrial and Aquatic Life

The selection of VECs related to terrestrial wildlife (birds and mammals) and aquatic life (fish and other aquatic organisms) were based on IQ, TK, and observations of species in the Mine site. A summary of the selected VECs and the rationale for their selection are provided in Table 10.2-1.

10.3.4.6 Traditional Land Use

A summary of traditional land use in the Mine site area is provided in Section 10.3.3.

10.3.5 Pathway Analysis

A pathway analysis to identify and assess linkages between activities included in the Application and human health risk assessment was completed for the Meliadine Extension. Environmental design features and mitigation incorporated into the design of the Mine to remove a pathway or limit the effects to human health, wildlife and aquatic life are listed; design features and mitigation measures incorporated as part of the Meliadine Project are similarly incorporated in the Meliadine Extension. The pathway is then determined to be primary, minor, or as having no linkage. The classification of pathways as primary, minor, or as having no linkage was determined by the disciplines that have assessed the pathway and provided predictions regarding changes to environmental quality. For example, pathways related to air emissions were assessed in the Air Quality section of the 2014 FEIS (Section 5.2) and those that were classified as primary were assessed further. Mitigation measures were incorporated into the predictive modelling for changes to air quality and surface water quality. The mitigation measures are described in detail in the relevant sections of this Application. No additional mitigation measures were considered in the HHERA.

Primary pathways require further effects analysis to determine the environmental significance from the Mine on human health, wildlife and aquatic life. Pathways determined to have no linkage to human health, wildlife and aquatic life, or those that are considered minor, are not predicted to result in environmentally significant effects on human health, wildlife and aquatic life. No linkage and minor pathways specific to the human health risk assessment are summarized in Appendix B Table B-12 but are not carried through the effects assessment for quantitative analysis. Potential pathways identified for the human health risk assessment are presented in Table 10.3-2.

Table 10.3-2: Potential Primary Pathways for Human Health Risk Assessment

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Human Health and Safety	Mine Site (operations)	Project activities will result in air emissions, which may cause changes in air concentrations, which may directly affect human health. Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions, which may directly affect human health. Changes in atmospheric deposition rates may also result in alterations to soil concentrations, which may affect human food and water sources including country foods. NEW: The windfarm will result in reduced diesel fuel consumption and a commensurate reduction in emissions of CAC associated with diesel combustion, which is a positive effect.	Exhaust emissions from non-road vehicles will be managed through purchasing equipment that meet Tier 3 emission standards. Use of ultra-low sulfur diesel will stay in place. The use of low-emissions explosives such as emulsion will continue to be preferred. Speed limits and dust suppressant (water of calcium chloride) will continue to be used when required to reduce dust emissions. Sources of particulate emissions at the processing facility are controlled through the use of baghouses. Enclosures are used to reduce fugitive emissions at the processing facility. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. Installation of incinerator that complies with Nunavut Environmental Protection Act standards for dioxin and furans.	Primary	Primary	Section 5.2.5.2 of the 2014 FEIS The predictions indicate that predicted changes in air quality near the mine would be negligible to low for all indicators with the RSA, and would be negligible to high for indicators in the LSA (rated as moderate). The potential residual effects are limited to the operations case and thus all are considered reversible. Section 10.2.7 of the 2014 FEIS Predicted changes to air quality were evaluated at various receptor locations based upon Traditional Activity and Knowledge (Volume 9, Section 9.3 of the 2014 FEIS). Residual impacts were not identified for soil quality, water quality, sediment quality, and country foods quality (including fish quality). Residual impacts were identified for potential health risks to workers and recreational users; however based on the magnitude, duration, extent, and reversibility, the impacts were determined to be Not Significant.	This pathway has been previously assessed and the Extension does not change the assessment	Table 5.2-25 of the 2014 FEIS There will be no adverse effects to air quality from the Meliadine Mine and associated infrastructure (i.e., the overall rating was Not Significant) Table 10.2-25 of the 2014 FEIS Based on the magnitude, duration, extent, and reversibility, residual impacts to human health impacts were determined to be Not Significant.	No change	No changes in mining rate are planned for the Meliadine Extension. The total tonnage of rock moved during the life of mine is smaller than what was predicted in the 2014 FEIS due to a refined mine plan. The windfarm will reduce NO2 and SO2 emissions. Predicted mine site emissions are under CAAQS guidance for 2020 and 2025. Mitigation and monitoring measures outlined in the 2014 FEIS will be carried forward through Meliadine Extension.
Human Health and Safety	AWAR (operations)	Project vehicles along the AWAR will result in air emissions, which may cause changes in air concentrations, which may directly affect human health. Changes in atmospheric deposition rates may result in alterations to soil concentrations, which may affect human food and water sources including country foods.	Best management practices to control fugitive particulate emissions from vehicles travelling along the AWAR will be followed.	Primary	Primary	Section 5.2.5.3 of the 2014 FEIS The predictions indicate that predicted changes in air quality along the AWAR would be negligible for all indicators with the RSA, and would be negligible for all indicators in the LSA except for PM10 (rated as moderate). Section 10.2.7 of the 2014 FEIS Predicted changes to air quality were evaluated at various receptor locations based upon Traditional Activity and Knowledge (Volume 9, Section 9.3 of the 2014 FEIS). Residual impacts were not identified for soil quality, water quality, sediment quality, and country foods quality (including fish quality). Residual impacts were identified for potential health risks to workers and recreational users; however based on the magnitude, duration, extent, and reversibility, the impacts were determined to be Not Significant.	This pathway has been previously assessed and the Extension does not change the assessment	Table 5.2-30 of the 2014 FEIS There will be no adverse effects to air quality from the Meliadine Mine and associated infrastructure (i.e., the overall rating was Not Significant) Table 10.2-25 of the 2014 FEIS Based on the magnitude, duration, extent, and reversibility, residual impacts to human health were determined to be Not Significant.	No change	No proposed changes to traffic and type of traffic along the AWAR as part of Meliadine Extension. Life of mine will be extended so duration of emissions will be longer. Existing robust mitigation measures will continue to be implemented. Monitoring will continue to be completed to ensure results are within 2014 FEIS predictions and regulatory guidelines.
Human Health and Safety	General construction and operation of mine and supporting infrastructure	Sensory disturbance (i.e., noise) can directly affect human health. Sensory disturbance (i.e., noise) can indirectly affect	Where feasible, Agnico Eagle will continue to procure equipment designed to minimize noise emissions, install silencers on inlets and exhausts of noisy equipment. Windfarm operation noise will be monitored. Turbines were sited to be away from existing cabins	Primary	Primary	Section 5.5.5.2 of 2014 FEIS The predictions indicated that there would be an increase in noise near the mine and road footprint, but that noise levels would decrease with distance. The predicted magnitude of noise would be negligible to moderate within	This pathway has been previously assessed and the Extension does not change the assessment	Section 5.5.7 of the 2014 FEIS Based on the magnitude of the predicted noise levels, residual impacts to noise from the mine activities was determined to be Not Significant	No change	Mitigation measures outlined in the 2014 FEIS and corresponding management plans will be carried forward through Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
		human health by affecting migration patterns of wildlife populations (e.g., caribou) and subsequently human food sources including country foods. NEW: Wind turbines will emit noise during operation. This noise will propagate into the surrounding environment, where it may have residual effects on NPORs and wildlife. NEW: Noise emissions from the landing and take-off of planes can increase ambient noise levels.	and Meliadine camp. The blades of wind turbines will be equipped with trailing edge serrations to reduce noise emissions. Where feasible, flight corridor restrictions could be applied over sensitive areas with known high concentration of wildlife. The planes should maintain a minimum elevation of 300 metres, except for landing and take-off, as Project Certificate No.006 currently requires for Agnico Eagle charters landing in Rankin Inlet's airport.			the LSA Section 10.2.6.3.7.2 of the 2014 FEIS Predicted noise levels were evaluated at the human health receptor locations. Potential residual impact was identified for one receptor. Section 6.6.4.2.1 of the 2014 FEIS Wildlife distribution can be negatively affected by sensory disturbance (indirect effect); Sensory disturbance from the Project is predicted to have low to high magnitude effects on wildlife populations in the RSA (Table 6.6-30).		Table 10.2-25 of the 2014 FEIS Based on the magnitude, duration, extent and reversibility, residual impacts to human health were determined to be Not Significant Section 6.6.11.2 of the 2014 FEIS Based on the magnitude, duration, extent, and reversibility, residual impacts to wildlife were determined to be Not Significant. It was concluded that there should not be a significant adverse impact on the continued opportunity for traditional and non-traditional use of wildlife in the region.		
Human Health and Safety	AWAR (operations)	Meliadine project vehicles along the AWAR will result in noise emissions, which may cause changes in noise levels.	Best management practices to control noise emissions from vehicles travelling along the AWAR as described in the NAMP.	Primary	Primary	Table 5.5-6 of 2014 FEIS Section 10.2.6.3.7.2 of the 2014 FEIS Predicted noise levels were evaluated at the human health receptor locations. Potential residual impact was identified for one receptor.	No change	Section 5.5.7 of the 2014 FEIS Based on the magnitude of the predicted noise levels, residual impacts to noise from the mine activities was determined to be Not Significant Table 10.2-25 of the 2014 FEIS Based on the magnitude, duration, extent and reversibility, residual impacts to human health were determined to be Not Significant	No change	Mitigation measures outlined in the 2014 FEIS and corresponding management plans will be carried forward through Meliadine Extension.
Human Health and Safety	Rankin Inlet	Activities associated with material receipt, storage and transfer to the Meliadine Mine will result in noise emissions, which may cause localized changes in noise levels.	Bypass road developed to keep traffic in and near Rankin Inlet isolated from residences. Best management practices to control noise emissions from access roads and lay down area as described in the NAMP. Noise controls will be designed inherent, which may include selection of quieter equipment, enclosures, silencers, etc. Equipment noise control systems will be maintained. Limited Meliadine Mine air traffic, which is negligible compared to the existing air traffic	Primary	Primary	Table 5.5-6 of 2014 FEIS Section 10.2.6.3.7.2 of the 2014 FEIS Predicted noise levels were evaluated at the human health receptor locations. Potential residual impact was identified for one receptor.	No change	Section 5.5.7 of the 2014 FEIS Based on the magnitude of the predicted noise levels, residual impacts to noise from the mine activities was determined to be Not Significant Table 10.2-25 of the 2014 FEIS Based on the magnitude, duration, extent and reversibility, residual impacts to human health were determined to be Not Significant	No change	Mitigation measures outlined in the 2014 FEIS and corresponding management plans will be carried forward through Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Human Health and Safety	Mining activities and water management during construction, operations, and closure	Release of mine wastewater (including sewage) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations), which may affect human food and water sources including country foods.	Treated sewage will be piped to the tailings storage facility. Mine wastewater will be treated and tested before release to Meliadine Lake. If water quality does not meet discharge limits, it will be circulated and re-treated. Water quality will meet CCME aquatic life objectives, site-specific water quality objectives, or water licence limits at the edge of the mixing zone in Meliadine Lake. Underground water will be collected, contained, monitored, re-used in the underground, or collected, contained, monitored, or treated, if required, to meet discharge limits for release to Meliadine Lake. A site Water Management Plan has been developed and describes containment of contact water through the use of diversions, attenuation ponds, and treatment facilities during construction, operations, and closure. Other applicable design features and mitigation, as identified in the project closure plan.	Primary	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS The predictions indicate that concentration levels gradually increase during the construction and operations phases of the mine and that these maximum concentrations do not exceed guidelines. During closure and post-closure, concentrations are predicted to gradually return to background concentrations. Changes were predicted to be low in magnitude, local in extent, and reversible. Section 10.2.5.2 of the 2014 FEIS As described further in Sections 10.2.6.3.4, 10.2.6.3.5, and 10.2.6.3.6, no constituents of potential concern were identified in surface water, sediment, or fish tissue in Meliadine Lake; therefore, these pathways were considered to be incomplete and were not retained for further assessment in the human health risk assessment.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.	No change	This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. The Meliadine Extension will be within the footprint that has been previously assessed; the footprint of the Meliadine Extension is more compact than the 2014 FEIS footprint for water management infrastructure. The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Human Health and Safety	Mine infrastructure footprint (e.g., open pits, dikes, mine pits, waste rock, mine plant, site roads, camps) during construction, operations, closure and post-closure	Project footprint, which will physically alter watershed areas and drainage patterns, rates and quantities of diverted non-contact water to new watersheds, may change downstream flows, water levels, channel/bank stability in streams and may affect water and sediment quality, which may affect human food and water sources including country foods.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Access roads will be as narrow as possible, while maintaining safe construction and operation practices. Minimum haul road widths will follow that defined under the Mine Health and Safety Act. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed. Minimum setback distance of 31 m from the ordinary high water mark of waterbodies. Regular road inspections to check for ponding. Removal of snow at the culvert inlet prior to freshet. To reduce the potential for erosion in channels due to higher than normal water flows and levels, natural drainage courses will be surveyed to evaluate capacity and then modified if required. Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms. A site water management plan has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas. Monitoring during activities and use of adaptive management where necessary.	Primary (these five pathways are linked and were assessed together)	Primary		This pathway has been previously assessed and the Extension does not change the assessment		No change	This pathway has been previously assessed. The Meliadine Extension does not change the results of the previous assessment. The Meliadine Extension will be within the footprint that has been previously assessed; the footprint of the Meliadine Extension is more compact than the 2014 FEIS footprint for water management infrastructure. The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Human Health and Safety	Site Water Management: Dewatering of Project Footprint Lakes to Downstream Receiving Lakes (e.g., to Lake A7, A1, B6, B34, Meliadine Lake) during construction and operations.	Dewatering of lakes may change flows, water levels, channel/bank stability, and water quality (e.g., suspended sediments, nutrients, metals) in receiving and downstream waterbodies, which may affect human food and water sources including country foods.	During dewatering activities, TSS will be monitored, and if necessary, treated before release downstream. Pumped water from the dewatered lakes will be directed through properly designed structures to the lake environment, and not to lake outlets, to prevent erosion in the receiving waterbodies and to attenuate flows. Shoreline areas susceptible to extensive erosion will be armoured to reduce erosion and associated re-suspension of fine sediment Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.	Primary (these five pathways are linked and were assessed together)	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS The predictions indicate that concentration levels gradually increase during the construction and operations phases of the mine and that these maximum concentrations do not exceed guidelines. During closure and post-closure, concentrations are predicted to gradually return to background concentrations. Changes were predicted to be low in magnitude, local in extent, and reversible. Section 10.2.5.2 of the 2014 FEIS As described further in Sections 10.2.6.3.4, 10.2.6.3.5, and 10.2.6.3.6, no constituents of potential concern were identified in surface water, sediment, or fish tissue in Meliadine Lake; therefore, these pathways were considered to be incomplete and were not retained for further assessment in the human health risk assessment.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.	No change	This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Pumped discharges for dewatering will be directed to a lake environment (not directly to outlets) or to a treatment facility and for discharge through the permanent diffusers. The sub-watersheds to be affected by the Extension are the same as those in the 2014 FEIS. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Human Health and Safety	Mine and supporting infrastructure during construction and operations	Fugitive dust sources and deposition of dust (including from blasting during mining) can change water and sediment quality, which may affect human food and water sources including country foods.	Best management practices to control fugitive particulate emissions from haul roads and material handling. Use of water or dust suppressants to manage dust. Use of chemical suppressants will be in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of the Environment. Enforcing speed limits to suppress dust production. Design roads as narrow as possible while maintaining safe construction and operation practices. Crossings will be perpendicular to watercourse. The running surface of the road will be maintained thereby reducing the generation of dust. Enclosures and covers will be used in major ore handling areas and most crushing areas. For uncovered crushing areas, water or dust suppression will be used. Dust control systems will be used to limit dust emissions, for example, processing equipment with high efficiency bag houses will be used. Most personnel arriving at or leaving the site will be transported by bus, thereby reducing the amount of traffic (and dust). Operating procedures will be developed that reduce dust generation. For example, tailings deposition will be designed to limit dust generation.							This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Monitoring conducted in 2020 were within air quality standards and 2014 FEIS predictions. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

Valued Component	Project Phase/Activity	Effect Pathways	Environmental Design Features and Mitigation	Pathway Assessment - 2014 FEIS	Pathway Assessment - Meliadine Extension	Residual Impacts - 2014 FEIS	Residual Impacts – Meliadine Extension	Assessed Significance – 2014 FEIS	Assessed Significance – Meliadine Extension	Meliadine Extension Rationale
Human Health and Safety	Mine and supporting infrastructure during construction and operations	Air emission of sulphur dioxide, nitrogen oxides and particulates may change water and sediment quality, which may affect human food and water sources including country foods.	Construction equipment and trucks will be equipped with industry-standard emission control systems. Compliance with regulatory emission requirements will be met. Processing equipment will use dust collectors to limit emissions of particulate matter. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. SO_2 emissions from non-road vehicles and stationary equipment will be reduced through the use of diesel fuel with less than 15 ppm of sulphur. Operating procedures will be developed that reduce dust generation. Generator efficiencies and equipment will be tuned for optimum fuel-energy efficiency.	Primary (these five pathways are linked and were assessed together)	Primary	Section 7.4.6.2 and 7.4.7 of the 2014 FEIS The predictions indicate that concentration levels gradually increase during the construction and operations phases of the mine and that these maximum concentrations do not exceed guidelines. During closure and post-closure, concentrations are predicted to gradually return to background concentrations. Changes were predicted to be low in magnitude, local in extent, and reversible. Section 10.2.5.2 of the 2014 FEIS As described further in Sections 10.2.6.3.4, 10.2.6.3.5, and 10.2.6.3.6, no constituents of potential concern were identified in surface water, sediment, or fish tissue in Meliadine Lake; therefore, these pathways were considered to be incomplete and were not retained for further assessment in the human health risk assessment.	This pathway has been previously assessed and the Extension does not change the assessment	Section 7.4.9 of the 2014 FEIS The significance of changes to water and sediment quality was assessed through evaluating how predicted changes in water and sediment quality could affect receptors including aquatic life and traditional and non-traditional uses of water. All pathways that impact water and sediment quality were used in the significance assessment. The Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of fish in the local study area and beyond (Section 7.5 of the 2014 FEIS), on the health of aquatic life (Section 10.1 of the 2014 FEIS), or on human health (Section 10.2 of the 2014 FEIS). Therefore, the Project will not have a significant adverse impact on water and sediment quality.	No change	This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. No increase in emissions is predicted for the Meliadine Extension due to the production rate staying the same. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.
Human Health and Safety	Pits (closure and post-closure)	Water quality in flooded pits may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality, which may affect human food and water sources including country foods.	A Conceptual Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pits are designed to have stable slopes during mining and post-closure. The pits will be progressively reclaimed as excavation is completed. The pits will be flooded, with water from Meliadine Lake, over a 10 year period following completion of pit operations. Water quality in the pits will be monitoring continuously during the flooding process. All diversion dikes will be kept intact as a barrier between open pits and surrounding waterbodies until the pit water meets acceptable concentrations for release to the environment. Water will be treated if it is unacceptable for discharge.							This pathway and effects have been previously assessed. The Meliadine Extension does not change the results of the previous assessment. Predictions indicate that water quality in the pits will be below guidelines, suitable for aquatic life, and suitable for reconnection to downstream waterbodies and watercourses. Mitigation measures and environmental design features outline in the 2014 FEIS and supporting management and monitoring plans will be carried through the Meliadine Extension.

10.3.6 Conceptual Site Model

A CSM (Figure 10.3-1) was developed for human health based upon the primary pathways identified above (Table 10.3-2) and informed by the screening of air, water, and noise predictions. The exposure pathways between Mine activities, intermediate residency media (i.e., the aspects of the environment that that may experience a change in quality due to Mine activities/emissions), and receptors are shown to be either complete or incomplete. Where pathways are incomplete, quantitative assessment was not carried out given that environmental quality was not anticipated to change as a result of the Meliadine Extension. Complete pathways on the figure indicate that a change to environmental quality was predicted and an assessment of the potential effects to human health was carried out. A brief summary of the complete exposure pathways is provided below for Inuit and non-Inuit members of the public:

- inhalation of air;
- ingestion of surface water; and
- sensory disturbance due to noise.

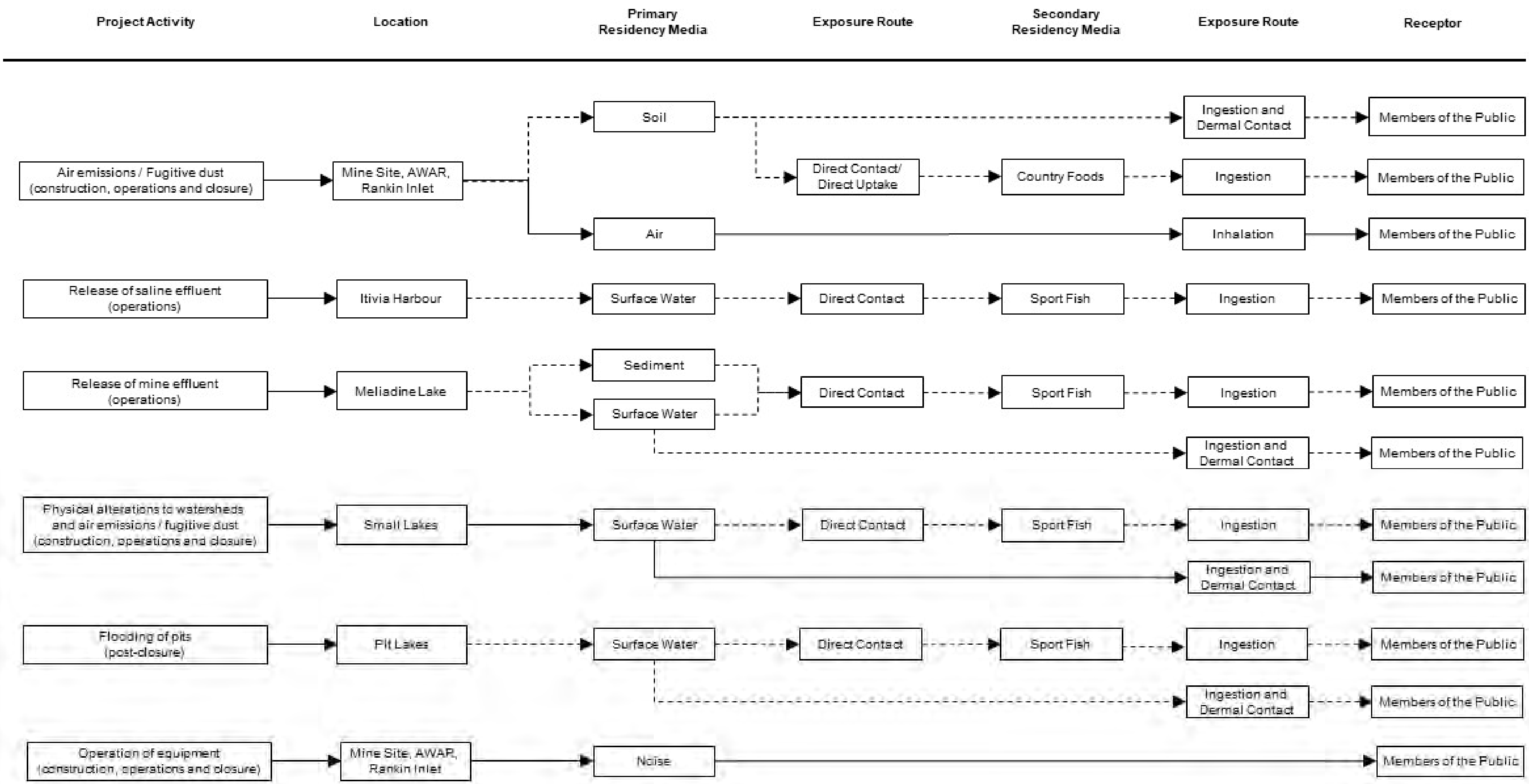
Health effects due to inhalation of ambient air were assessed at several receptor locations representing commonly used traditional areas (as determined through the collection of traditional knowledge; i.e., hunter/trapper cabins and the territorial park) and as well as at Rankin Inlet. It was assumed that the Main Camp and Exploration Camp are within the Mine disturbed footprint and would be managed under an occupational health and safety program for both air quality and noise. As such, the Main Camp and Exploration Camp were not assessed further in the human health risk assessment.

Given that no Mine-related changes to chemical concentrations were predicted for water in Meliadine Lake for wildlife (i.e., all predicted concentrations will be below water quality guidelines), there were no predicted Mine-related impacts to traditional food quality as a result of bioaccumulation.

It is noted that lake water would not be used by the camps during operations and at closure as a drinking water source unless it was treated prior to consumption. The assessment carried out in the HHERA considers that Meliadine Lake water could be consumed without prior treatment by members of the public throughout the life of the Mine, and considers that untreated water from the small waterbodies and pit lakes could be used by members of the public in the post-closure phase.

Conceptual Site Model for the Meliadine Extension – Human Health

FIGURE 10.3-1



NOTES

Solid lines indicate pathways that were considered to be complete and quantitatively evaluated in the human health risk assessment.

Dashed lines indicate pathways that were considered to be incomplete (i.e., no COPCs were identified in site media).

Date: February 2022	CAD: KCS
Project: Meliadine Extension HHERA	CKD: SG

GOLDER MEMBER OF WSP

10.3.7 Assessment of Potential Meliadine Extension-related Effects

10.3.7.1 General Approach

This section provides the general approach used to evaluate the potential for adverse effects on human health associated with changes in environmental quality due to chemical releases from the Mine related to the Meliadine Extension.

As stated previously, risk assessment is the primary tool used to characterize potential adverse health effects, if any, to the environment from chemical releases. As described in Section 10.1.4, risk assessment includes four steps, namely problem formulation, exposure assessment, toxicity assessment, and risk characterization. Potential adverse health effects are characterized using a hazard quotient (HQ) approach for non-carcinogenic chemicals and an incremental lifetime cancer risk (ILCR) approach for carcinogenic chemicals.

If any potential adverse effects to human health were determined based on the HQ approach, the health effects were further evaluated in terms of the assessment criteria suggested in the Guidelines for the Meliadine Mine (NIRB 2012) in the residual impact classification (Section 10.3.8), as follows:

- direction or nature of the effects;
- magnitude and complexity;
- geographic extent;
- frequency;
- duration;
- reversibility; and
- likelihood or probability of effects.

A determination of the significance for human health was then made (not significant or significant).

10.3.7.2 Project Environment

The effects analysis for human health was carried out considering the potential changes in chemical concentrations in air, soil, water, sediment, fish, country foods (plants and animals consumed by humans), and noise for a bounding case. The bounding case is defined as the phase of the Mine that either was considered to result in the highest potential change in environmental quality by the subcomponent (e.g., air quality, noise) or that resulted in the highest predictions out of all of the phases that were modeled (e.g., water quality). The following Mine phases were considered when identifying the bounding scenario:

- Construction;
- Operation;
- Closure; and
- Post-closure.

For air quality (and by extension soil quality and country food quality through particulate deposition) and noise, the operations phase represents the bounding case. The predicted changes in environmental media for the operation phase of the Mine are considered to represent the maximum emissions during the life of the Mine. The predicted concentrations in environmental media for the bounding scenario were applied in the human health risk assessment to ensure that potential risks to human receptors were not underestimated. The Air Quality section of the 2014 FEIS (Section 5.2, Agnico Eagle 2014) describes the rationale for carrying out the modeling for the operation phase for air quality.

The human health risk assessment relied upon the following predicted environmental data:

- **Predicted concentrations of nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) in air**: Although no increase in emissions due to the Meliadine Extension is predicted due to the production rate staying the same as that predicted in the 2014 FEIS, NO_2 and SO_2 were re-assessed because of the change in guidance from the Canadian Ambient Air Quality Standards (CAAQS) for these two constituents, which have lower thresholds starting in 2020 and 2025. Air quality modelling methods and results are presented in Appendix H-01. A conservative scenario was developed based on the busiest year during operations (i.e., 2030) in terms of total emissions. This was evaluated by the total tonnage being moved over the year. Scenarios for Meliadine Extension's alternatives, such as the windfarm and airstrip, are also assessed in terms of their impact on ambient air quality. The windfarm will reduce NO_2 and SO_2 emissions. Briefly, three scenarios were modelled based on the percentage of power being provided by the wind farm (0%, 50%, 100%), with more wind power resulting in few site generators running continuously. Discrete sensitive receptors were used to model the air quality at 25 specific locations (Figure 10.3-2). The receptor locations were updated for the Meliadine Extension based on current information on cabin locations, obtained through recent engagement activities.
- **Predicted concentrations of indicator compounds (i.e., TSP, PM_{10}, $PM_{2.5}$, dust), metals, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOC) in air**: No change in emissions due to the Meliadine Extension is predicted compared to the 2014 FEIS. Thus, it was assumed that there are no changes in predicted concentrations and the 2014 FEIS predictions were used in this assessment. Briefly, six scenarios were modelled, which included different sets of pits and haul roads, with each scenario including underground emissions and the incinerator. The difference between the 2014 FEIS and this assessment occur in updates to the air quality screening criteria, and interpretation of particulate matter as a non-threshold toxicant. The 26 receptor locations modelled in the 2014 FEIS and included in this assessment are provided in Figure 10.3-2.
- **Predicted soil concentrations for the mine site, AWAR, and Rankin Inlet**. Soil concentrations were predicted as described in Section 10.2.7.3.1 using modelled atmospheric deposition rates. For the Meliadine Extension, there were no changes to the predicted dry and wet deposition rates from the 2014 FEIS, thus the rates developed for the 2014 FEIS were used for this risk assessment. A detailed description of the atmospheric deposition modelling that yielded the predicted dry and wet deposition rates is provided in Section 5.2 (Air Quality) of the 2014 FEIS (Agnico Eagle 2014). In brief, given that emissions from the Mine are likely to be greatest during the operations phase, the modelled deposition rates represent a bounding case from any phase of the Mine (i.e.,

construction, operations, closure, and post-closure). Deposition rates were modelled at a series of gridded receptors (i.e., for 1 km by 1 km grids on the entire modelling domain, which was 35 km by 35 km).

- **Predicted noise levels for the mine site, AWAR, and Rankin Inlet**. Although no change in level of activity is planned due to the Meliadine Extension, the refined mine plan presented in the Meliadine Extension can have different locations of noise sources. Operation of an on-site airstrip and on-site windfarm was assessed as potential sources of noise. Increase in noise levels at different noise points of reception (NPOR) were predicted. In total, 20 NPOR were assessed as points of interest of the community around the mine site and AWAR, such as cabins used for hunting and fishing activities, and in Rankin Inlet. The receptor locations are provided in Figure 10.3-2.
- **Predicted edge of mixing zone concentrations for Meliadine Lake throughout the Mine life**. A detailed description of the water quality modelling and predictions is provided in Appendix H-07 (mine site model) and Appendix H-09 (Meliadine Lake 3D model) and discussed in Section 7.4.3.1. In brief, treated effluent will be released to Meliadine Lake, which may cause a change in surface water quality of Meliadine Lake. Discharge to Meliadine Lake will occur via the existing diffuser outfall. At the end of operations, discharge of treated water to Meliadine Lake will stop. As the point source discharge is removed, water quality concentrations that increased in operations will decrease in closure and return to pre-mining conditions. It was assumed the surface water from Meliadine Lake could be used for drinking water throughout the Mine life.
- **Predicted surface water concentrations for small waterbodies and pit lakes in post-closure**. A detailed description of the water quality modelling and predictions for the small waterbodies and pit lakes is provided in Appendix H-07 (mine site model). Predictions of water quality have been made assuming fully mixed conditions. The prediction nodes used for this assessment are outlined in Table 10.2-3 and Figure 10.2-10 illustrates the location of the waterbodies and pit lakes, and the flow path among them, at post-closure. It was assumed that surface water from the small waterbodies and pit lakes near the Mine could be used for drinking water during after mine closure was complete (i.e., post-closure). The following small waterbodies and pit lakes were assessed for this exposure pathway:
    - Small waterbodies that were contact ponds during operations: CP1, Saline Pond B7, Contact Pond B4, Lake A8 West
    - Small waterbodies that were outside the controlled mine footprint and receiving natural runoff from the watershed during operations: Lake B2, Lake A1, Lake CH6
    - Pit lakes: NORWES Pit Lake, TIRI Pit Lake, Pump Pit Lake, F-Zone Pit Lake, Discovery Lake

The results of the IQ and TK (Section 10.3.3) was considered when selecting the types of country foods human receptors would be most likely to consume from the Mine area and when interpreting the residual impacts of the effects analysis, as applicable. While there may be some variability in the intensity and frequency of exposure by Inuit and non-Inuit, the approach taken in the human health risk assessment has assessed the likely worst-case exposures as quantified through the use of governmental guidance documents and site-specific traditional knowledge. There were no cases of either discrepancies or gaps between popular science and traditional knowledge.

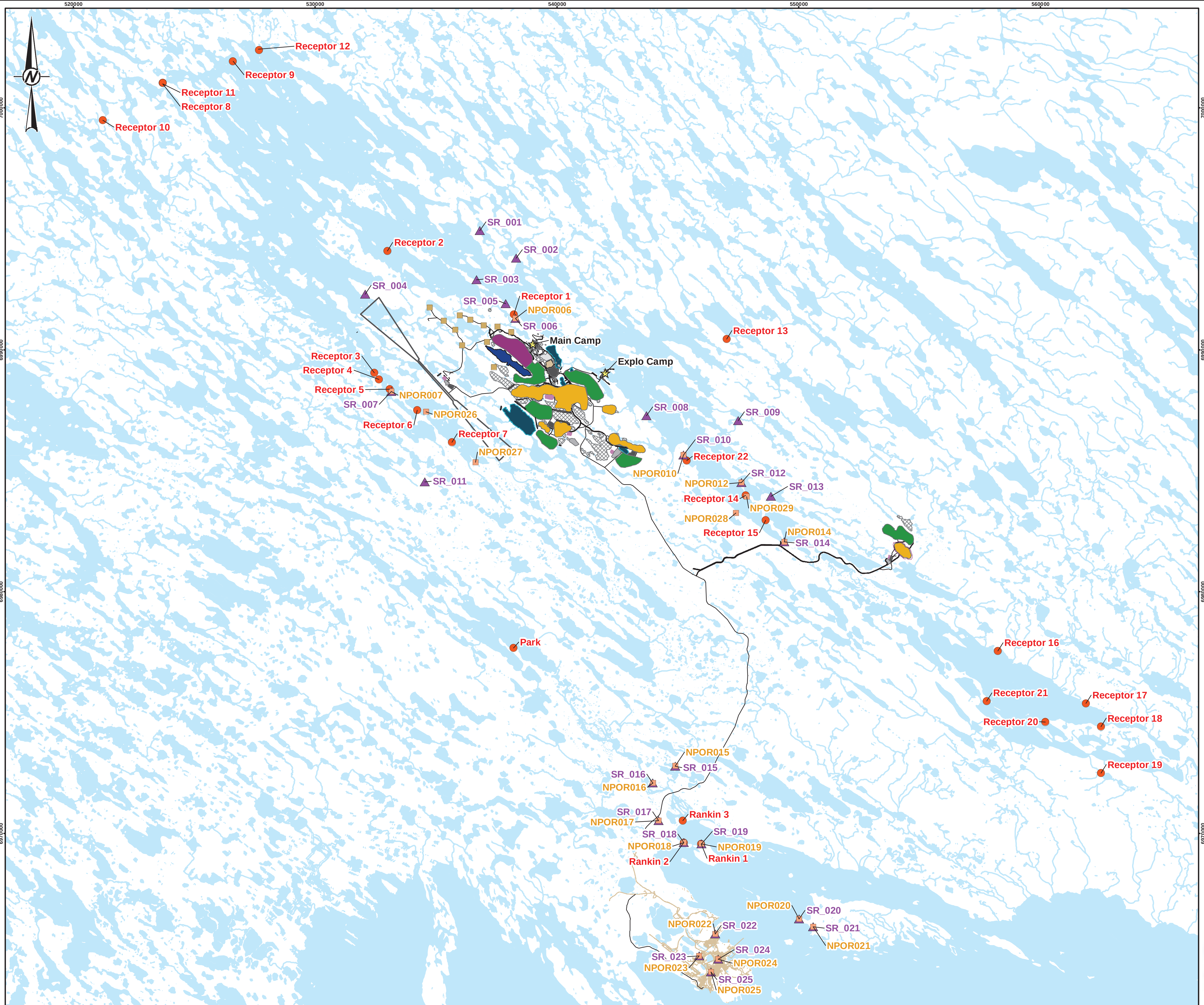
Indirect and cumulative effects have not been quantitatively predicted by any of the subcomponents for which data were relied upon in the human health risk assessment. However, qualitative assessment of indirect and cumulative effects has been incorporated throughout the effects analysis, where possible and applicable.

10.3.7.3 Chemicals of Potential Concern

In general, to determine whether a chemical has the potential to affect human health (i.e., the chemical is identified as a COPC in the human health risk assessment), the predicted concentrations for its bounding case were compared to relevant health-based screening guidelines and to baseline concentrations plus 10% (the Baseline Case) for air quality and soil quality. Comparison of predicted water quality to baseline conditions would not have reduced the number of COPCs at the screening step, and thus baseline comparisons were not used for the surface water assessment. If a chemical only exceeds baseline concentrations and not its respective health-based guideline, it is not considered to be present at levels that could affect human health. If a chemical exceeds its health-based guideline but is present in the environment at levels within 10% of baseline concentrations, then it is not considered to be significantly different from baseline and no health effect is predicted to occur as a result of the Mine. When the chemical is predicted to be present at levels greater than baseline and greater than a health-based guideline, the incremental change in environmental concentrations as a result of the Mine may potentially affect human health. Therefore, the chemical is retained for further assessment in the human health risk assessment.

The addition of 10% to baseline concentrations is standard practice in environmental assessments to represent variability in environmental background conditions. Comparison to a threshold of 10% above baseline concentrations accounts for variability in spatial and temporal concentrations, field sampling, laboratory methods, and the conservatism incorporated in the predictive models. Therefore, a predicted increase in concentration of less than 10% above baseline concentrations is considered to represent a negligible change in environmental quality as this change is within typical background levels.

It should be noted that baseline conditions were not quantified for all environmental media, all chemicals, and all locations. Where alternative COPC screening approaches were taken, these are described further on a case-by-case basis.



LEGEND

- ON-SITE WIND TURBINES
- 2021 NOISE RECEPTOR LOCATIONS
- 2014 HHERA RECEPTOR LOCATIONS
- 2021 AIR QUALITY RECEPTOR LOCATIONS
- CAMP LOCATIONS
- WASTE ROCK STORAGE FACILITY
- TAILINGS STORAGE FACILITY
- OPEN PITS COMPLETED
- MINING AREA
- BERM
- LAY DOWN AREA
- OP2
- OP2-EXT
- ORE PAD
- SALT ROCK PILE
- CONTACT WATER POND
- SALINE POOL
- WATERBODY
- DEWATERED
- WATERCOURSE
- ROAD
- RANKIN INLET
- BUILDING
- AIR STRIP

0 4,000 8,000

1:160,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM AGNICO EAGLE MINES LIMITED AND NATURAL RESOURCES CANADA.

DATUM: NAD 83 PROJECTION: UTM ZONE 15

CLIENT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED

PROJECT

MELIADINE GOLD PROJECT

NUNAVUT

TITLE

RECEPTOR LOCATIONS FOR THE HUMAN HEALTH RISK ASSESSMENT – MELIADINE EXPANSION

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-02-22
DESIGNED	KCS
PREPARED	LB
REVIEWED	KCS
APPROVED	MZ

PROJECT NO.	CONTROL	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

10.3.7.4 Air Quality

2021 Predictions for NO_2 and SO_2

Air quality predictions were carried out considering three modelling scenarios for one year of the operation phase. The following modelling scenarios were considered and modelled:

- Scenario 1 – assumes that no power is provided by the wind farm; four site generators are running continuously.
- Scenario 2 – assumes that 50% of power is provided by the wind farm; two site generators are running continuously.
- Scenario 3 – assumes that 75% of power is provided by the wind farm; one site generator is running continuously.

The air quality modelling study focused on the year with the maximum total amount of material (overburden, tailings, waste rock, salt rock, and ore combined) moved, and therefore the highest anticipated total air emission rates during the projected LOM plan (as of August 2021). Full details of the modelling methodology are provided in Appendix H-01.

Concentrations of NO_2 and SO_2 in air were predicted at several receptor locations for 1-hour and annual averaging periods. The receptor locations were based on the NPOR assessed for noise, and including some of the same locations as assessed for human health receptors in the 2014 FEIS. Differences between the 2014 FEIS receptor locations and the current air/noise assessment are related to updated information about the location of cabins around the Mine site. The receptor locations used in the 2021 air quality modeling included (see Figure 10.3-2):

- 17 hunter/trapper cabins around the mine site or AWAR (SR_001 to SR_014, SR_017 to SR_019);
- 2 locations at the territorial park (SR_015 and SR_016);
- 2 hunter/trapper cabins close to Rankin Inlet (SR_020 and SR_021); and
- 4 locations in Rankin Inlet (SR_022 to SR_025).

2014 Predictions for Remaining Indicator Compounds

Air quality predictions were carried out considering 6 modeling scenarios for the operation phase. Each of these scenarios is described in detail in the Air Quality section of the 2014 FEIS (FEIS Volume 5, Section 5.2). The scenarios are described briefly below:

- Scenario 1: Include emissions from the Tiriganiaq Pit, haul roads 1 and 3, material handling 18 and 20, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 2: Include emissions from the F-Zone Pit, haul roads 6 and 7, material handling 12 and 13, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 3: Include emissions from the Pump Pit, haul roads 8 and 9, material handling 16 and 17, underground emissions (vent raises 1 to 3), and the incinerator;

- Scenario 4: Include emissions from the Discovery Pit, haul roads 10 and 11, material handling 14 and 15, underground emissions (vent raises 1 to 3), and the incinerator;
- Scenario 5: Include emissions from the Wesmeg Pit, haul roads 12 and 13, material handling 21 and 22, underground emissions (vent raises 1 to 3), and the incinerator; and
- Scenario 6: Include emissions from underground emissions (vent raises 1 to 3), and the incinerator.

As there is no change in emission rates between the 2014 FEIS and the Meliadine Extension, the 2014 FEIS predictions were used for the current assessment. The receptor locations were selected based upon the Traditional Activity and Knowledge section of the 2014 FEIS (FEIS Volume 9, Section 9.3) and input from AEM based upon their public consultation with members of the local communities. The receptor locations from the 2014 FEIS air quality modelling that were included in this assessment were (see Figure 10.3-2):

- 22 hunter/trapper cabins around the mine site (Receptor 1 to 22);
- 3 hunter/trapper cabins close to Rankin Inlet (Rankin 1 to 3); and
- 1 location at the territorial park (Park).

Air Quality Evaluation

To evaluate the potential Mine-related effects on air quality, the assessment evaluated the potential inhalation exposure to chemicals by workers and the public that are emitted to ambient air at the above noted receptor locations. Inhalation exposures following short-term (or acute) and long-term (or chronic) durations were evaluated. Also, the potential exposures to particulate matter (i.e., particulate matter less than 10 µm in diameter [PM_{10}], particulate matter less than 2.5 µm in diameter [$PM_{2.5}$], and diesel particulate matter (DPM) by workers and the public were evaluated. The highest predicted concentrations for each averaging period (i.e., 1-hour, 24-hour, and annual) were used in the assessment for each of the scenarios.

To evaluate acute inhalation exposures, predicted Mine emissions based on a 1-hour averaging period were used as representative concentrations to which human receptors would potentially be exposed on a short-term basis. Health effects associated with acute exposures to chemicals in ambient air typically include irritation and effects on respiratory function (i.e., non-cancer endpoints).

To evaluate chronic inhalation exposures, predicted Mine emissions based on a 24-hour and annual averaging periods were used as representative concentrations to which human receptors would be exposed on a daily and long-term basis. Health effects associated with long-term exposures to chemicals in ambient air include non-cancer and cancer endpoints, which are evaluated in this assessment on the basis of 24-hour and annual averaging periods, respectively.

The sections below describe the methods and results of the air quality risk assessments for the Mine.

ACUTE AIR QUALITY

Problem Formulation

Selection of 1-hour Air Thresholds

Predicted changes in ambient air concentrations as a result of the Mine were identified based upon the components and activities as described in the Air Quality section of the 2014 FEIS (FEIS Volume 5, Section 5.2). The following groups of chemicals were assessed:

- Indicator compounds (i.e., NO_2, SO_2, TSP, PM_{10}, $PM_{2.5}$, dust);
- Metals (e.g., arsenic, lead);
- PAHs; and
- VOCs.

Peak 1-hour concentrations for indicator compounds, metals, PAHs, and VOCs were compared to the most conservative of the available 1-hour (i.e., acute) health-based thresholds from the following agencies:

- Government of Nunavut Department of Environment (NDOE 2011);
- CCME (1999b, 2017);
- Ontario Ministry of the Environment, Conservation and Parks (MECP 2018);
- World Health Organization (WHO 2000; WHO 2005a,b);
- California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA 2019, 2022);
- ATSDR (2022); and
- Texas Commission on Environmental Quality (TCEQ 2022).

The most protective health-based threshold was selected out of NDOE, CCME, OMOE, WHO, OEHHA, and ATSDR. If no health-based standards were available, then a standard based upon another endpoint, such as odour, was used. Additionally, the TCEQ was used only when thresholds from other jurisdictions were not available, unless detailed supporting documentation was available from TCEQ.

Each of these agencies derived health-based air thresholds based upon a prescribed level of protection. Most often, these air thresholds are presented as air concentrations at and below which health effects are not expected to occur and may incorporate additional safety factors. Therefore, a predicted air concentration above their respective health-based threshold indicates a health effect is possible, but not certain. Further assessment is required to determine the likelihood of that health effect occurring.

The available jurisdictional health-based 1-hour thresholds were considered for use in the Acute Air Quality Risk Assessment (Table H-12-D-1 in Appendix H-12-D). A threshold was selected if it was the most protective (i.e., the lowest) out of all of the available thresholds and its supporting information was available for review.

Chemical Groupings

Many of the chemicals had sufficient toxicity information and screening standards available, which allowed them to be assessed as individual chemicals (specifically, metals and metallic combustion by-products, such as lead). However, other chemicals were assessed as groups because insufficient toxicity information was available for the individual chemicals. In these cases, the individual chemicals were grouped based upon their physical/chemical properties and mixture-specific toxicity data. These chemical groups were represented by a surrogate chemical for which toxicity information was available. This approach was applied to individual chemicals within PAHs and VOCs. The groupings for PAHs and VOCs are consistent with what was used in the 2014 FEIS and are provided in Appendix H-12-E.

The following chemicals were evaluated individually:

Indicator compounds

- Carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), $PM_{2.5}$, PM_{10}, and suspended particulate matter (SPM). Diesel particulate matter (DPM) was also assessed as an individual compound.

Metals

- Aluminum, antimony, arsenic, barium, beryllium, bismuth, cadmium, calcium, chromium, cobalt, copper, gold, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium, yttrium, and zinc.

Polycyclic Aromatic Hydrocarbons

- Acenaphthylene and benzo(k)fluoranthene.

Volatile Organic Compounds

- Acetaldehyde, acetone, benzene, ethylbenzene, ethylene, formaldehyde, and toluene.

Chemical concentrations (1-hour peak concentrations) were predicted for individual compounds or chemicals groups, as appropriate, among indicator compounds, metals, PAHs, and VOCs for all of the receptor locations and mining scenarios during the bounding operations phase.

<u>**Comparison of Predicted Peak Concentrations to 1-hour Air Thresholds**</u>

The predicted peak 1-hour concentrations of chemicals in air were compared to the most protective acute thresholds to determine whether further assessment was required (Table H-12-D-2 [NO_2 and SO_2], and Tables H-12-D-3a to H-12-D-3f [remaining indicator compounds], in Appendix H-12-D). The maximum peak 1-hour concentrations out of all receptor locations and mining scenarios were selected for identification of COPCs. If the predicted peak concentrations were greater than the selected 1-hour air thresholds, then the chemical was retained as a COPC and considered further in the Acute Air Quality Risk

Assessment. Chemicals that were retained as a COPC were assessed with respect to potential human health effects at all receptor locations under the modelled scenarios.

A baseline case was not considered in the comparison of predicted peak concentrations to acute thresholds because the Meliadine Mine Site is located in a pristine area of Nunavut, Canada. No other sources of anthropogenic emissions of these chemicals are present and, therefore, background air emissions were not collected as part of this environmental assessment.

NO_2 met the 1-hour air threshold at all locations and scenarios. However, NO_2 was retained as a COPC as Health Canada (2016a) considers NO_2 a non-threshold chemical, and thus predicted air concentrations of NO_2 were discussed further with respect to effects on human health (see Section 10.3.8).

It should be noted that exceedances of iron were identified; however, its selected acute threshold was based upon the toxicity of particulate matter and not the toxicity of the chemical itself. Therefore, iron was not retained further in the Acute Air Quality Assessment and was evaluated as particulate matter. There are no acute thresholds for PM_{10} and $PM_{2.5}$; these chemicals were assessed using 24-hour thresholds in the Chronic Air Quality Assessment.

Based upon the screening process outlined above, NO_2, DPM, acrolein, and aldehyde were retained as COPCs for the 1-hour averaging time. These COPCs were assessed further in the Risk Characterization section below. Note that aldehyde was evaluated as a group of chemicals.

Exposure Assessment

The predicted 1-hour peak concentrations for identified COPCs were applied as the exposure point concentrations to which receptors, at each receptor location identified above, are exposed.

Toxicity Assessment

As discussed above, acute air thresholds provided by several agencies were reviewed and the most appropriate thresholds were selected for use in this assessment. These thresholds were used for comparison with the predicted peak 1-hour concentrations of each COPC. For NO_2, the 2025 CAAQS was used as the acute air threshold for this comparison.

The same air thresholds were used to assess potential harmful effects due to chemicals for both Inuit and non-Inuit receptors; the derivation of air thresholds incorporates uncertainty factors that account for human variability in terms of sensitivity to chemicals.

Risk Characterization

For each of the COPCs identified above, a HQ was calculated for each receptor location as follows:

$$HQ = \frac{Predicted\ peak\ COPC\ concentration\ in\ air\ (\mu g/m^3)}{Acute\ threshold\ (\mu g/m^3)}$$

An example calculation for 1-hour NO_2 concentrations at SR_006 (i.e., a cabin located close to the disturbed mine footprint) under Scenario 1 is shown below:

$$HQ = \frac{69\ \mu g/m^3}{79\ \mu g/m^3}$$

$$HQ\ for\ NO_2\ acute\ exposure = 0.9$$

An HQ value greater than 1 indicates that predicted exposure is greater than the threshold. For parameters and locations where HQ values were greater than 1, further analysis was carried out to describe the potential residual impacts.

A summary of the acute 1-hour HQs is provided in Table 10.3-3 (for NO_2) and Table 10.3-4 (remaining COPCs). For a detailed comparison of air concentrations against acute air thresholds see Table H-12-D-4 (NO_2) and Tables H-12-D-5a to H-12-D-5f (other indicator compounds) in Appendix H-12-D. The HQs for NO_2 were less than 1 at all receptor locations for all three scenarios (Table 10.3-3). The HQs for the other COPCs were less than 1 at the Park and cabin receptor locations near Rankin Inlet under all mining scenarios (Table 10.3-3). For the cabin receptor locations near the Mine Site and the AWAR, the HQs for all COPCs were less than 1, with the exceptions of aldehyde under Scenarios 1 and 2 and DPM under Scenario 1.

Table 10.3-3: Hazard Quotients for Acute 1-hour Averaging Time for Nitrogen Dioxide

COPC	Mine Site and AWAR[a]	Park[b]	Near Rankin Inlet[c]	Rankin Inlet[d]
2021 Predictions – Scenario 1				
NO_2	0.3 to 0.9	0.4	0.2	0.2 to 0.3
2021 Predictions – Scenario 2				
NO_2	0.2 to 0.8	0.3	0.2	0.2
2021 Predictions – Scenario 3				
NO_2	0.2 to 0.8	0.3	0.1	0.2

All HQs were less than the target of 1.
(a) 17 hunter/trapper cabins around the mine site or AWAR (SR_001 to SR_014, SR_017 to SR_019)
(b) 2 locations at the territorial park (SR_015 and SR_016)
(c) 2 hunter/trapper cabins close to Rankin Inlet (SR_020 and SR_021)
(d) 4 locations in Rankin Inlet (SR_022 to SR_025)
COPC = chemical of potential concern; AWAR = all-weather access road; NO_2 = nitrogen dioxide.

Table 10.3-4: Hazard Quotients for Acute 1-hour Averaging Time for Remaining COPCs

COPC	Mine Site and AWAR (Receptors 1 to 22)	Park	Rankin Inlet (Receptors 1 to 3)
2014 Predictions – Scenario 1			
DPM	0.1 to 1	0.4	0.1 to 0.2
Acrolein	0.06 to 0.8	0.8	0.1
Aldehyde	0.1 to 1	0.4	0.2 to 0.3
2014 Predictions – Scenario 2			
DPM	**0.1 to 2**	0.3	0.2
Acrolein	0.06 to 1	0.2	0.1
Aldehyde	**0.1 to 2**	0.3	0.2
2014 Predictions – Scenario 3			
DPM	0.1 to 1	0.5	0.2
Acrolein	0.06 to 0.7	0.02	0.1
Aldehyde	0.1 to 1	0.5	0.3
2014 Predictions – Scenario 4			
DPM	0.1 to 1	0.3	0.1
Acrolein	0.07 to 0.8	0.2	0.1
Aldehyde	0.1 to 1	0.33	0.2
2014 Predictions – Scenario 5			
DPM	0.1 to 1	0.4	0.1 to 0.2
Acrolein	0.05 to 0.8	0.2	0.1
Aldehyde	0.1 to 1	0.4	0.2 to 0.3
2014 Predictions – Scenario 6			
DPM	0.08 to 1	0.3	0.1
Acrolein	0.04 to 0.7	0.2	0.1
Aldehyde	0.08 to 1	0.3	0.2

Bold and shaded cells indicate a HQ greater than the target of 1.
COPC = chemical of potential concern; AWAR = all-weather access road; DPM = diesel particulate matter.

As a result, the following receptors, locations, and COPCs were considered further in the residual impacts analysis in Section 10.3.8:

- Recreational users at two cabins (receptor location 1 and 22) – aldehyde (Scenario 2 only); and
- Recreational users at two cabins (receptor location 1 and 22) – DPM (Scenario 2 only).

Health Canada (2016a) considers NO_2 to be a non-threshold substance and a threshold concentration below which no adverse effects are expected is not likely to exist (i.e., any level of increased exposure may result in negative health effects). There is no prescribed method for assessing health risks of non-threshold constituents; therefore, NO_2 was assessed using the same approach as the other COPCs (i.e., following a HQ approach and residual effects characterization).

CHRONIC AIR QUALITY

Problem Formulation

Selection of Chronic Air Thresholds

The jurisdictional chronic thresholds based on 24-hour and annual averaging periods for indicator compounds, metals, PAHs, and VOCs were applied for chemical screening (see Tables H-12-D-6 and H-12-D-7, respectively, in Appendix H-12-D). The most protective of the available thresholds from the following agencies were applied:

- Government of Nunavut Department of Environment (NDOE 2011);
- CCME (1999b, 2017);
- Ontario Ministry of the Environment, Conservation and Parks (MECP 2018);
- World Health Organization (WHO 2000, 2005a,b);
- California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA 2019, 2022);
- ATSDR (2022); and
- Texas Commission on Environmental Quality (TCEQ 2022).

Mine-related emissions were evaluated on the basis of their ability to cause health effects following long-term exposures. Health effects considered following long-term exposures included carcinogenic and non-carcinogenic health outcomes. The non-carcinogenic and carcinogenic health endpoints were evaluated by comparing predicted concentrations against jurisdictional chronic thresholds based on 24-hour and annual averaging periods, respectively. For substances considered to elicit non-carcinogenic health effects, chronic thresholds are derived based on a target hazard quotient of 0.2; whereas substances considered to be cancer causing have regulatory thresholds that are derived based on an incremental lifetime cancer risk of 1-in-100 000, as prescribed by Health Canada.

The selection of a target hazard quotient of 0.2 for the chronic air assessment was considered to be appropriate for those chemicals that may persist in the environment and may be present in environmental media other than air (e.g., soil, water, sediment, and country foods). For chemicals that would be expected to only be present in air (e.g., indicator compounds and VOCs), the use of a threshold based upon a target hazard quotient of 1 is considered to be appropriate. Therefore, although acrolein and aldehyde initially screened into the assessment based upon screening thresholds derived using a target hazard quotient of 0.2, these chemicals are not considered to be COPCs using the unadjusted thresholds.

Comparison of Predicted Peak Concentrations to Chronic Thresholds

If the predicted concentrations for a chemical were greater than its respective chronic health-based thresholds, the chemical was identified as a COPC and retained for further evaluation.

For NO_2 and SO_2, the maximum predicted annual average concentrations from the 2021 predictions were compared to the chronic annual health-based thresholds (see Table H-12-D-8).

For the remaining indicator compounds, the maximum predicted concentrations for all substances, for all receptor locations, and all mining scenarios from the 2014 predictions were compared to the chronic (24-hr and annual) health-based thresholds (see Tables H-12-D-9a to H-12-D-9f and H-12-D-10a to H-12-D-10f in Appendix H-12-D). For chemicals where individual thresholds are not available, the groupings as identified in the Acute Air Quality Risk Assessment (Section 10.3.7.4.1, Appendix H-12-E) were used.

It should be noted that exceedances of iron were identified; however, its selected chronic threshold was based upon the toxicity of particulate matter and not the toxicity of the chemical itself. Therefore, iron was not retained further in the Chronic Air Quality Assessment and was evaluated as particulate matter.

Health Canada (2016a,b) considers NO_2, $PM_{2.5}$, and PM_{10} to be non-threshold substances and a threshold concentration below which no adverse effects are expected is not likely to exist (i.e., any level of increased exposure may result in negative health effects). There is no prescribed method for assessing health risks of non-threshold constituents; therefore, NO_2, $PM_{2.5}$, and PM_{10} were assessed using the same approach as the other COPCs (i.e., following a HQ approach and residual effects characterization).

The COPCs assessed in the Chronic Air Quality Risk Assessment are summarized in Table 10.3-5 and were evaluated further in the Risk Characterization section below.

Table 10.3-5: Summary of Identified Chemicals of Potential Concern for the Chronic Air Quality Risk Assessment

COPC	Cancer Endpoint	Non-Cancer Endpoint
Acrolein[a]	NA	✓
NO_2	NA	✓
DPM	✓	NA
PM_{10}	NA	✓
$PM_{2.5}$	NA	✓

COPC = chemical of potential concern; NA = not applicable; NO_2 = nitrogen dioxide; DPM = diesel particulate matter; PM = particulate matter; ✓ = applicable for the COC.
(a) Surrogate to represent group of chemicals with similar structure.

Toxicity Assessment

Toxicity assessment involves the classification of the harmful effects of substances and the estimation of the amounts of substances that can be received by an organism without adverse health effects. For each COPC identified above, an appropriate toxicity benchmark or TRV was determined based on reported mode of action (i.e., threshold vs. non-threshold mode of action). For threshold substances (i.e., generally not a carcinogen), adverse effects are expected to only occur above a certain dose rate. However, for non-threshold substances (i.e., most carcinogens), theoretically all doses can exert a toxic effect.

Contaminant Classification

Regulatory agencies, such as the OMOE, classify contaminants based on their mode(s) of action. For substances exhibiting a threshold for toxicity (i.e., non-carcinogens), an acceptable level of exposure at or below which no adverse effects are anticipated is established. Typically, this threshold level is represented by a reference concentration (RfC) for the inhalation pathway. For non-threshold-acting chemicals (i.e., carcinogens), any level of exposure may theoretically pose a potential risk, and a unit risk is used to predict risks from estimated exposures.

Classification systems have been developed based on the carcinogenic properties of chemicals, including those from Health Canada (2021b), USEPA (1986, 2005b), and the International Agency for Research on Cancer (IARC; 2021a) (Table 10.3-6). Based on these agencies, the carcinogenicity classification of the identified COPCs was determined. The US EPA moved from classifying substances by categories (US EPA 1986) to classifying using narrative statements (US EPA 2005b). The US EPA provides classifications for substances using either the 1986 guidelines or 2005 guidelines, depending on when the substance was last reviewed.

Table 10.3-6: Classification Systems for Carcinogenic Substances

Health Canada (2021b)	IARC (2021a)	USEPA (1986)	USEPA (2005b)
Group I – Carcinogenic to humans	Group 1 – Carcinogenic to humans	Group A – Carcinogenic to humans	Carcinogenic to humans
Group II – Probably carcinogenic to humans	Group 2A – Probably carcinogenic to humans	Group B – Probably carcinogenic to humans	Likely to be carcinogenic to humans
Group III – Possibly carcinogenic to humans	Group 2B – Possibly carcinogenic to humans	Group C – Possibly carcinogenic to humans	Suggestive evidence of carcinogenic potential
Group IV – Unlikely to be carcinogenic to humans	Group 3 – Not classifiable as to its carcinogenicity to humans	Group D – Not classifiable as to human carcinogenicity	Inadequate information to assess carcinogenic potential
Group V – Probably not carcinogenic to humans Group VA – Inadequate data for evaluation	Does not apply	Group E – Evidence of non-carcinogenicity for humans	Not likely to be carcinogenic to humans
Group VI – Unclassifiable with respect to its carcinogenicity to humans	Does not apply	Does not apply	Does not apply

IARC = International Agency for Research on Cancer; USEPA = United States Environmental Protection Agency.

The carcinogenic classifications of acrolein are conflicting (Table 10.3-7). Acrolein was not classified by Health Canada (2021b). US EPA updated their cancer assessment for acrolein in 2003, and determined that "the highly reactive nature of acrolein and studies supporting the lack of systemic distribution of acrolein suggest that acrolein is not likely to reach potential target sites at a sufficient concentration to initiate a carcinogenic process in mammalian species" (USEPA 2003). However, a more recent assessment by IARC (2021b) classified acrolein as "probably carcinogenic to humans", based on "based on sufficient evidence of cancer in experimental animals and strong mechanistic evidence". The evidence regarding cancer in humans was deemed to be inadequate because there are only a few, small studies that either poorly assessed exposure or could not distinguish the effects of acrolein from other inhalation toxicants (i.e., constituents in cigarette smoking). Given that maximum predicted annual average acrolein concentrations in air met the annual air threshold, acrolein was not assessed as a carcinogen. Instead, acrolein was assessed as a non-carcinogen using the 24-hour average predictions.

Table 10.3-7: Identification of COPCs Assessed as Carcinogens in the Chronic Air Quality Assessment

COPC	Carcinogenic Classification			Assessed as a Carcinogen?
	Health Canada (2021b)	USEPA (1986, 2005b, 2022a)	IARC (2021a,b)	
Acrolein	NC	Inadequate information to assess carcinogenic potential	Group 2A	No[a]
DPM	NC	Likely to be carcinogenic to humans	Group 1	Yes
PM_{10}	NC	NC	Group 1	No[a]

IARC = International Agency for Research on Cancer; NC = not classified; USEPA = United States Environmental Protection Agency.
(a) Acrolein and PM_{10} were not identified as COPCs in the chronic air quality assessment based on carcinogenic effects given that the predicted annual average concentrations met the annual air threshold. Therefore, these COPCs were evaluated with respect to non-carcinogenic effects based upon 24-hour predictions.

Based on the body of evidence, IARC has classified particulate matter as a carcinogen (IARC 2016). Given that maximum predicted annual average PM_{10} concentrations in air met the annual air threshold, PM_{10} was not assessed as a carcinogen. Instead, PM_{10} was assessed as a non-carcinogen using the 24-hour average predictions.

Dose-Response Assessment

For the chronic inhalation assessment, TRVs for non-carcinogenic substances are called Reference Concentrations (RfC), which are estimates of continuous inhalation exposure to a chemical by the human population (including sensitive subgroups) that is likely to be without an appreciable risk of harmful effects over a lifetime.

Available RfCs for the COPCs were compiled from the following agencies:

- Health Canada (2021b);
- USEPA's IRIS (USEPA 2022);
- ATSDR (2022);
- California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA 2022);
- Netherlands National Institute of Public Health and the Environment (RIVM 2001, 2009); and
- WHO (2022a,b).

The lowest available RfC for acrolein was from IRIS (Table 10.3-8). However, Health Canada (2017b) has instead adopted the OEHHA RfC of 0.35 µg/m^3. Both the USEPA and OEHHA studies were based upon 13-week studies in rats with an endpoint of respiratory epithelial lesions. However, the OEHHA value is based upon a more recent study than the USEPA's key study (i.e., 2008 versus 1978), and the OEHHA value adopts an uncertainty factor of 200 versus 1,000 from USEPA. Given that Health Canada has completed a review of the studies and recommends the OEHHA TRV, and Golder's review did not identify any gaps in the review, the OEHHA RfC was selected for use in the chronic inhalation assessment.

Table 10.3-8: Reference Concentrations for COPCs Evaluated in the Chronic Air Quality Risk Assessment – Non-Carcinogens

COPC	Health Canada (2021b)	USEPA (2022)	RIVM (2001, 2009)	WHO (2022a,b)	OEHHA (2022)	ATSDR (2022)	Toxicological Endpoints and Derivations
Acrolein	NC	0.02	NC	NC	**0.35**	NC	The IRIS RfC was based on a subchronic LOAEL of 0.09 mg/m^3 for nasal lesions in rats. The LOAEL was adjusted for exposure duration (6 hour/day, 5 days/week) and human equivalent concentration (0.14, regional gas dosimetry ratio). Rats were exposed to concentrations of 0, 0.4, 1.4, or 4.9 ppm acrolein for 13 weeks. An uncertainty factor of 1000 was applied. The OEHHA threshold was based on a NOAEL of 0.2 ppm for lesions in the respiratory epithelium in rats. The NOAEL was adjusted for duration (6 hour/day, 5 days/week) and a human equivalent concentration (0.85, dosimetric adjustment factor). Rats were exposed for 65 days to concentrations of 0.02 to 1.8 ppm acrolein. An uncertainty factor of 200 was applied.

Concentrations are in µg/m^3. Bolded and shaded RfC was used in the risk assessment.
COPC = chemical of potential concern; NC = not calculated; IRIS = Integrated Risk information System; RfC = reference concentration; LOAEL = lowest observable adverse effect level; ppm = parts per million; NOAEL = no observable adverse effect level.

Predicted concentrations of NO_2 and particulate matter were compared with available screening thresholds. As there are no RfC available for DPM, PM_{10}, and $PM_{2.5}$, the 24-hour and annual air criteria were adopted for use as TRVs for the chronic air assessment (Table 10.3-9). For NO_2, only predicted annual concentrations are available, which were compared to annual air criteria.

Table 10.3-9: Selected Toxicity Reference Values for NO2 and Particulate Matter Based on a 24-hour and Annual Averaging Period

COPC	Selected TRV (µg/m³)	Basis	Source
24-hour Averaging Period			
DPM	NA	No 24-hour thresholds were available.	NA
$PM_{2.5}$	27	CAAQS: Canadian ambient air quality standard for 2025. The metric is the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations. Supporting documentation was not available for the CCME CAAQS.	CCME (2017)
PM_{10}	45	WHO AQG: Lowered in 2021 from the 2005 guideline of 50 µg/m³ to 45 µg/m³ to take into account new evidence on effects on mortality at concentrations below 20 µg/m³.	WHO (2021)
Annual Averaging Period			
NO_2	22.5	CAAQS: Canadian ambient air quality standard for 2025. The metric is the 1-year average of all 1 hour concentrations. Supporting documentation was not available for the CCME CAAQS.	CCME (2017)
DPM	5 (non-carcinogenic)	Health Canada: Screening value based on a NOAEL of 0.46 mg/m³ for effects on the respiratory tract (inflammation, histopathological and/or functional changes) in rats (Health Canada 2016b). The NOAEL was adjusted to a human equivalent concentration of 0.12 mg/m³. An uncertainty factor of 25 was applied (100.4 for toxicodynamic differences in animal to human extrapolation and 10 for sensitive individuals in the human population).	Health Canada (2016c)
	0.0003 [µg/m³]$^{-1}$ (carcinogenic)	Cal OEHHA: Inhalation unit risk (IUR) of $3x10^{-4}$ per µg/m³ based on epidemiological data where occupationally-exposed individuals had elevated risks of developing lung cancer (OEHHA 2008).	OEHHA (2022)
$PM_{2.5}$	8.8	CAAQS: Canadian ambient air quality standard. The standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing pollutant missions; a value of 8.8 µg/m³ is proposed for the year 2020. The metric is the 3-year average of the annual average concentrations. Supporting documentation was not available for the CCME CAAQS.	CCME (2017)
PM_{10}	15	WHO AQO: Lowered in 2021 from the 2005 guideline of 20 µg/m³ to 15 µg/m³ to take into account new evidence on effects on mortality at concentrations below 20 µg/m³.	WHO (2021)

COPC = chemical of potential concern; TRV = toxicity reference value; µg/m³ = micrograms per cubic metre; NA = not available.

Exposure Assessment

For the Chronic Air Quality Assessment, the peak 24-hour and annual average concentrations were predicted for each COPC and receptor location under six different scenarios (2014 predictions). For NO_2, the peak annual average concentrations were predicted for each receptor location under three different scenarios (2021 predictions). These predicted concentrations are the exposure concentrations to which human receptors are exposed to. The exposure doses for each receptor and scenario are estimated using the equation below.

$$Exp_{inh} = \frac{C_{air} \times RAF_{inh} \times IR \times ET \times EF \times ED}{BW \times AT \times CF_1 \times CF_2}$$

Where:
Exp_{inh} = exposure dose due to inhalation of chemicals in air (mg/kg-d)
C_{air} = concentration of COPC in air (mg/m^3)
RAF_{inh} = inhalation relative absorption factor (unitless)
IR = inhalation rate (m^3/h; 16.6 m^3/d)
ET = exposure time (h/d)
EF = exposure frequency (d/yr; 30 d/yr for a recreational user)
ED = exposure duration (yr; 24 years of construction and operations)
BW = body weight (kg)
AT = averaging time (yr; for non-carcinogens, ED = AT, for carcinogens, life expectancy of 80 years)
CF_1 = unit correction factor (24 h/d)
CF_2 = unit correction factor (365 d/yr)

The recreational user was assumed to spend 30 days per year at a cabin location, and be exposed to predicted air concentrations for 24 years, which is the revised length of the operation phase of the Mine when the Meliadine Extension is considered.

The exposure doses based on a 24-hour averaging period for the COPCs (Tables H-12-D-11a to H-12-D-11f in Appendix H-12) were estimated for each receptor location. An example calculation for 24-hour acrolein concentrations at Receptor 1 (i.e., a cabin located close to the disturbed mine footprint) under Scenario 1 is shown below:

$$Dose\ for\ acrolein\ (non-carcinogen) = \frac{0.67\ \mu g/m^3 \times 1 \times 16.6\ m^3/d \times 24\ h/d \times 30\ d/yr \times 24\ yr}{70.7\ kg \times 24\ yr \times 24\ h/d \times 365\ d/yr}$$

$$Dose\ for\ acrolein\ (non-carcinogen) = 1.3 \times 10^{-2}\ \mu g/kg\ bw/day$$

For PM_{10} and $PM_{2.5}$, exposure doses were also calculated based on an annual averaging period; these results are provided in Tables H-12-D-12a to H-12-D-12f.

For DPM, the chronic exposure doses were calculated for the predicted annual average concentrations of DPM at each receptor locations (Tables H-12-D-13a to H-12-D-13f in Appendix H-12) using the equation above. Exposure was assumed to occur either during the first 24 years of life (i.e., from infant to early adult) or for 24 years as an adult.

An example calculation for annual DPM concentrations at Receptor 1 (i.e., a cabin located close to the disturbed mine footprint) under Scenario 1 is shown below:

$$Dose\ for\ DPM\ (carcinogen) = \frac{0.17\ \mu g/m^3 \times 1 \times 16.6\ m^3/d \times 24\ h/d \times 30\ d/yr \times 24\ yr}{70.7\ kg \times 80\ yr \times 24\ h/d \times 365\ d/yr}$$

$$Dose\ for\ DPM\ (carcinogen) = 9.8\ \times\ 10^{-4}\ \mu g/kg\,bw/day$$

Risk Characterization

Long-term health effects were evaluated by calculating HQs for non-carcinogens. A HQ is the ratio between the exposure likely to be incurred by the person and the amount of exposure that is considered to be safe. No health risk is predicted if the HQ is less than one.

When the HQ is greater than one, the scenario poses a potential concern and requires further scrutiny. However, HQ values greater than one do not necessarily indicate that adverse health effects will occur; a large margin of safety has been included in their estimation.

In the risk characterization step, HQs were calculated for non-carcinogenic COPCs as the ratio of the exposure dose and the TRV (with appropriate unit conversion), according to the following equation:

$$HQ\ = \frac{Exp_{inh}}{TRV}$$

An example calculation for 24-hour acrolein concentrations at Receptor 1 under Scenario 1 is shown below:

$$HQ\ for\ Acrolein = \frac{1.3\ \times\ 10^{-2}\ \mu g/kg\,bw/day}{8 \times 10^{-2}\,\mu g/kg\ \ bw/day}$$

$$HQ\ for\ Acrolein = 0.2$$

A summary of the HQs is provided in Table 10.3-10 (for NO_2) and Table 10.3-11 (remaining COPCs). For a detailed comparison of air concentrations against chronic air thresholds see Table H-12-D-14a to H-12-D-14c (NO_2) and Tables H-12-D-15a to H-12-D-15f (other indicator compounds) in Appendix H-12. All HQs are less than the target of 1 for all COPCs at all receptor locations under all scenarios (Tables 10.3-10 and 10.3-11). Based on these results, acrolein was not retained for further assessment. However, NO_2, $PM_{2.5}$, and PM_{10} were considered further in the residual impacts analysis. Health Canada (2016a,b) considers them non-threshold chemicals, and thus predicted air concentrations of NO_2, $PM_{2.5}$, and PM_{10} were discussed further with respect to effects on human health.

Table 10.3-10: Hazard Quotients for Chronic Annual Averaging Time for Nitrogen Dioxide in the Chronic Air Quality Assessment

COPC	Mine Site and AWAR[a]	Park[b]	Near Rankin Inlet[c]	Rankin Inlet[d]
2021 Predictions – Scenario 1				
NO_2	0.003 to 0.01	0.004 to 0.005	0.003	0.003
2021 Predictions – Scenario 2				
NO_2	0.002 to 0.008	0.003 to 0.004	0.002	0.002 to 0.003
2021 Predictions – Scenario 3				
NO_2	0.002 to 0.006	0.003	0.002	0.002

All HQs were less than the target of 1.
(a) 17 hunter/trapper cabins around the mine site or AWAR (SR_001 to SR_014, SR_017 to SR_019)
(b) 2 locations at the territorial park (SR_015 and SR_016)
(c) 2 hunter/trapper cabins close to Rankin Inlet (SR_020 and SR_021)
(d) 4 locations in Rankin Inlet (SR_022 to SR_025)
COPC = chemical of potential concern; AWAR = all-weather access road; NO_2 = nitrogen dioxide.

Table 10.3-11: Hazard Quotients for Other Non-Carcinogenic Chemicals of Potential Concern in the Chronic Air Quality Assessment

COPC	Recreational User		
	Cabins around the Mine Site[a]	Park	Cabins close to Rankin Inlet[b]
Scenario 1			
Acrolein	0.02 to 0.2	0.04	0.02
PM_{10}	0.003 to 0.04	0.007	0.004 to 0.005
$PM_{2.5}$	0.003 to 0.03	0.007	0.004
Scenario 2			
Acrolein	0.02 to 0.2	0.03	0.02 to 0.03
PM_{10}	0.004 to 0.1	0.009	0.007 to 0.008
$PM_{2.5}$	0.003 to 0.04	0.006	0.005
Scenario 3			
Acrolein	0.02 to 0.2	0.05	0.02
PM_{10}	0.004 to 0.08	0.01	0.005 to 0.006
$PM_{2.5}$	0.003 to 0.03	0.008	0.004 to 0.005
Scenario 4			
Acrolein	0.02 to 0.1	0.03	NC
PM_{10}	0.003 to 0.03	0.006	0.004
$PM_{2.5}$	0.003 to 0.03	0.006	0.003 to 0.004
Scenario 5			
Acrolein	0.02 to 0.2	0.04	0.02
PM_{10}	0.003 to 0.06	0.008	0.004 to 0.005
$PM_{2.5}$	0.003 to 0.03	0.007	0.004
Scenario 6			

COPC	Recreational User		
	Cabins around the Mine Site[a]	Park	Cabins close to Rankin Inlet[b]
Acrolein	0.03 to 0.1	0.03	NC
PM_{10}	0.001 to 0.02	0.004	0.002
$PM_{2.5}$	0.002 to 0.02	0.006	0.003

Based on a 24 hour averaging period. All hazard quotients were less than target of 1.
(a) Receptor locations 1 to 22.
(b) Receptor locations Rankin 1 to 3.
COPC = chemical of potential concern; NC = not calculated.

For PM_{10} and $PM_{2.5}$, HQs were also calculated based on an annual averaging period; these results are provided in Tables H-12-D-16a to H-12-D-16f. For the carcinogenic assessment, the estimated incremental lifetime cancer risks (ILCR) based on an annual averaging period were calculated for each receptor location; these results are provided in Tables H-12-D-17 to H-12-D-17f. The ILCRs were calculated for carcinogenic COPCs as the product of the exposure dose and the TRV according to the following equation:

$$ILCR = Exp_{inh} \times TRV$$

Where:
Exp_{inh} = exposure dose due to inhalation of chemicals in air (mg/kg-d)
TRV = toxicity reference value (inhalation unit risk adjusted for body weight and inhalation rate)

An example calculation for annual DPM concentrations at Receptor 1 under Scenario 1 is shown below:

$$ILCR\ for\ DPM\ (adult) = 9.8\ \times\ 10^{-4}\ \mu g/kg\ bw/day\ \times \left(\frac{0.0003\ (\mu g/m^3)^{-1} \times 70.7\ kg\ bw}{16.6\ m^3/day} \right)$$

$$ILCR\ for\ DPM\ (adult) = 1\ \times\ 10^{-6}$$

For carcinogens, an ILCR greater than 1 in 100 000 (or 0.00001 or 1 x 10^{-5}) indicates that predicted exposure is associated with cancer risk that is above the target risk considered to be acceptable by Health Canada. All ILCRs for DPM met the target ILCR of 1 in 100 000 for recreational users at all locations and for all mining scenarios (Table 10.3-12). Therefore, DPM was not retained for further assessment.

Table 10.3-12: Incremental Lifetime Cancer Risks for Diesel Particulate Matter

Scenario	COPC	Recreational User		
		Cabins	Park	Rankin
Scenario 1	DPM	0.0000003 to 0.000001	0.0000004	0.0000003 to 0.0000004
Scenario 2	DPM	0.0000002 to 0.000002	0.0000004	0.0000004
Scenario 3	DPM	0.0000003 to 0.000001	0.0000005	0.0000004
Scenario 4	DPM	0.0000002 to 0.000001	0.0000004	0.0000003
Scenario 5	DPM	0.0000003 to 0.000001	0.0000004	0.0000003
Scenario 6	DPM	0.0000003 to 0.0000008	0.0000003	0.0000002

No ILCRs greater than target of 1x10^{-5}.
COPC = chemical of potential concern; DPM = diesel particulate matter.

10.3.7.5 Soil Quality

Changes to soil quality as a result of the Mine was predicted using wet and dry particulate deposition rates for the non-volatile parameters (i.e., metals and PAHs) predicted to be present in emissions (Section 10.2.7.3). In brief, particulate deposition onto soil was modeled and the resulting change in soil quality as a result of particulate deposition was predicted. The resulting soil quality predictions were then compared to baseline soil quality and health-based soil quality screening guidelines.

There are no regulatory guidelines or risk-based concentrations that can be directly compared to deposition rates. Thus, an alternative chemical screening process was used. The predicted deposition rates were used to calculate the resulting concentrations of chemicals in soil, which in turn were compared to CCME and USEPA soil guidelines protective of human health.

The predicted soil concentrations as a result of air deposition during the operation phases of the Mine are provided in Appendix H-12-F, Tables H-12-F-1a to H-12-F-1f. The chemicals in soil would be retained as a COPC if the predicted soil concentration exceeded baseline conditions plus 10% and exceeded a soil screening guideline.

As shown in Appendix H-12-F, Tables H-12-F-1a to H-12-F-1f, background concentrations of several chemicals (i.e., gold, yttrium, and PAHs) are not available. As such, where health-based screening guideline values were available, if the incremental soil concentration was less than the typical method detection limit (i.e., 0.05 mg/kg for PAHs), then these compounds were not retained as COPCs. Where guideline values were not available (i.e., gold, yttrium, phenanthrene, thiophene, acenaphthylene, and benzo(ghi)perylene), further assessment was carried out.

- Dermitis is the most frequently reported toxic reaction with exposure to gold (Klaasen 2001; as cited in HSDS 2022). Gold dust is generally non-toxic when ingested orally due to its poor adsorption (Venugopal and Luckey 1978 in HSDB 2022). However, people with gold allergies may have an allergic reaction when ingesting gold-containing liquor (Guenthner et al. 1999 in HSDB 2022). Given the predicted incremental concentrations of gold were in the range of 0.0000001 to 0.00001 mg/kg, gold was not retained as a COPC.
- No short-term or long-term toxicity data in either humans or laboratory animals were found on the potential oral toxicity of yttrium. Given that the predicted incremental concentrations of yttrium were in the range of 0.00001 to 0.001 mg/kg, yttrium was not retained as a COPC.
- Acenaphthylene and benzo(ghi)perylene have been classified as carcinogens by Ontario MECP (2011). Toxicity data are not available for phenanthrene or thiophene. However, if it was considered that these compounds behave in the same way as the most toxic of the PAHs (i.e., benzo(a)pyrene), even the sum of the predicted concentrations for all compounds would be much lower than the EPA regional screening level (RSL) for benzo(a)pyrene. Therefore, these PAHs were not retained as COPCs in the HHRA.

Given that the predicted soil concentrations were less than baseline concentrations plus 10%, no COPCs were retained in soil for the human health risk assessment and no residual health impacts due to changes to soil quality were identified.

10.3.7.6 Country Foods Quality

Given that no COPCs were identified in soil (Section 10.2.7.3) because Mine-related changes to soil quality were considered to be negligible, concentrations of chemicals, including potentially bioaccumulative chemicals, were not anticipated to change in country foods (i.e., plants and animals consumed by humans). As a result, country foods were not assessed further with respect to potential health effects and no residual health impacts due to changes to country food quality were identified. Details related to the types of country foods, including the parts of country foods that are consumed and their consumption frequency, are identified in 2014 FEIS Volume 9, Section 9.3.

10.3.7.7 Surface Water Quality

Problem Formulation

Changes in surface water quality were predicted in Meliadine Lake during operations and closure, and in the small waterbodies and pit lakes during post-closure. To determine whether potential human exposure to surface water in these water bodies could affect human health, surface water quality predictions were compared to health-based guidelines. Guidelines for Canadian Drinking Water Quality are available from Health Canada (2020) and were used to screen the water quality predictions. Where guidelines for water quality parameters were unavailable from Health Canada, the USEPA RSLs for tap water were adopted for screening purposes (USEPA 2021c). The comparison of water quality predictions to the applicable health-based guidelines is provided in Appendix H-12-G, Table H-12-G-1 (Meliadine Lake), Tables H-12-G-2a to H-12-G-2h (small waterbodies), and Tables H-12-G-3a to H-12-G-3e (pit lakes). There were no exceedances of water quality parameters that have health-based guidelines in any of the water bodies, with the exception of Saline Pond B7 that had exceedances of TDS, arsenic, cobalt, manganese and thallium.

The guideline for TDS was developed in 1991 and is based upon an aesthetic objective of ≤500 mg/L. The TDS guideline is based on taste (aesthetic objective) and scaling in water pipes and appliances (operational guideline). Health Canada has not identified any health effects associated with TDS, and therefore no guideline value based on health effects was derived. This also means that no health effects have been associated with TDS for drinking, bathing, and cooking every day for a lifetime, and no health effects would be expected for swimming and other recreational uses. TDS is not expected to be associated with direct effects to human health, therefore, TDS was not retained as a COPC.

As shown in the tables, several water quality parameters did not have health-based screening guidelines. The potential health effects that may be associated with these water quality parameters are described further below.

- Essential Nutrients: There are several substances without health-based guidelines that are essential nutrients and are not expected to result in adverse health effects unless large quantities are ingested. These nutrients include calcium, magnesium, and potassium. Therefore, these substances were not retained as COPCs.

- Ammonia: Health Canada (2020) indicates that ammonia is not considered to be either an aesthetic or health concern at the concentrations typically found in water supplies. Levels in water supplies tend to be in the range of <0.001 to 0.65 mg/L (Health Canada 1987). In the small waterbodies, ammonia was predicted to be 0.075 to 1.0 mg/L as nitrogen (0.091 to 1.2 mg/L). Ammonia concentrations in the pit lakes were predicted to range between 0.020 to 0.064 mg/L as nitrogen (0.020 to 0.072 mg/L). No short-term or long-term toxicity data in humans are available, although some short-term toxicity data are available for laboratory animals. No effect or less serious low effect dose levels range from about 20 to 3000 mg/kg-d for rats (ATSDR 2004). These dose levels would be associated with a drinking water concentration that is orders of magnitude greater than the predicted pit lake ammonia concentrations. Even incorporating appropriate uncertainty factors, a person would have to consume more than one thousand litres of water per day to be potentially toxic. Therefore, ammonia was not considered further as a COPC.

In summary, no COPCs were identified for Meliadine Lake and for most of the small waterbodies and pit lakes with the exception of Saline Pond B7. In Saline Pond B7, maximum predicted concentrations of arsenic, cobalt, manganese, and thallium exceeded drinking water guidelines, and were carried forward for further assessment.

Toxicity Assessment

Toxicity reference values (termed reference doses or RfDs for non-carcinogenic substances and slope factors or SFs for carcinogenic substances) were obtained preferentially from Health Canada (2021b) and USEPA's Integrated Risk Information System (IRIS) (USEPA 2022a). The more current TRV was selected if a value was available from both agencies. Consideration was also given to study subjects (e.g., human versus animal study) and whether the critical endpoint was based on a no observed adverse effect level (NOAEL). When a suitable TRV was not available from USEPA or Health Canada, the following sources were also consulted:

- Agency of Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (ATSDR 2022)
- California Environmental Protection Agency (California Environmental Protection Agency 2020)
- Netherlands National Institute of Public Health and the Environment (RIVM 2001, 2009)
- US EPA provisional peer-reviewed toxicity reference values (USEPA 2022b)
- World Health Organization (WHO 2022a,b)

The TRVs provided in Table 10.3-13 and the rationale for their selection are provided below.

Table 10.3-13: Selected Toxicity Reference Values for COPCs Evaluated in the Water Quality Assessment for Human Health Risk Assessment

COPC	Selected TRV	Source
Arsenic	RfD: 0.0003 mg/kg-d SF: 1.8 (mg/kg-d)-1	USEPA (2022a) Health Canada (2021b)
Cobalt	0.0014 mg/kg-d	RIVM (2001)
Manganese	TDI: 0.025 mg/kg-d	Health Canada (2021b)
Thallium	None	USEPA (2012)

COPC = chemical of potential concern; mg/kg-d = milligram per kilogram body weight per day; (mg/kg-d)-1 = cancer incidence per milligram per kilogram body weight per day; RfD = oral reference dose; SF = oral slope factor; TRV = toxicity reference value.

Arsenic

- **RfD:** Health Canada does not derive a non-carcinogenic TRV for arsenic, so the U.S. EPA RfD was used instead. The US EPA RfD is based on a NOAEL of 0.009 mg/L for hyperpigmentation, keratosis, and possible vascular complications in people exposed to arsenic in water (Tseng 1977, Tseng et al. 1968 as cited in US EPA 1991a). The NOAEL was converted into daily dose of 0.008 mg/kg-d using the following assumptions: 1) a water intake rate of 4.5 L/day; 2) an estimated arsenic exposure concentration of 0.002 mg/day in sweet potatoes and rice to account for the arsenic content in food due to a lack of measured data; and 3) a body weight of 55 kg. An uncertainty factor of 3 was applied for lack of data to determine whether reproductive toxicity could be a critical effect and whether the NOAEL of the critical study sufficiently accounts for a range of sensitive individuals.
- **SF:** The Health Canada slope factor is based on epidemiological studies where humans were exposed to 10 to greater than 600 µg/L arsenic in drinking water for less than or equal to 60 years (Morales et al. 2000, Chen et al. 1985, Wu et al. 1989; as cited in Health Canada 2006). The unit risks associated with ingestion of 1 µg/L of arsenic in drinking water ranged from 3.06×10^{-6} to 3.85×10^{-5} (95% upper bound ranging from 6.49×10^{-6} to 4.64×10^{-5}). The most sensitive endpoint for both males and females was lung cancer. The overall unit risk associated with the ingestion of arsenic in drinking water was reported as a range, given that lifetime exposure to arsenic results in more than one cancer endpoint in different individuals. The above unit risk range has the liver cancer unit risk (3.06×10^{-6}) as its lower bound and the lung cancer unit risk (3.85×10^{-5}) as its upper bound. Based on these data, Health Canada (2006) derived an OSF of 1.8 $(mg/kg\text{-}d)^{-1}$.

Cobalt

Health Canada does not derive a TRV for cobalt. There is a provisional chronic oral RfD of 0.0003 mg/kg-d provided by US EPA provisional peer-reviewed TRV for cobalt, which is based on decreased radioactive iodine uptake in the thyroid (Roche and Layrisse 1956; as cited in US EPA 2008b). The provisional RfD was derived using the dose of 1 mg/kg-d as a LOAEL based on humans exposed for 2 weeks. An uncertainty factor of 3000 was applied to account for the following: a factor of 10 for the use of a LOAEL instead of NOAEL; 10 for extrapolation from subchronic to chronic; 10 for human variability; 10 for sensitive populations; and 3 for a lack of a multi-generation toxicity study. The temporal relationship between prolonged oral cobalt exposure and increased severity of thyroid effects in humans (or experimental animals) is not clear, and therefore there is a low confidence in the provisional chronic RfD. Instead, the TRV from RIVM (2001) was selected.

RIVM (2001) provides a TDI of 0.0014 mg/kg-d; this value was derived based upon the lowest LOAEL reported for humans of 0.04 mg/kg-d based on cardiomyopathy and systemic effects in other organs systems following a subchronic oral exposure (up to 8 months). An uncertainty factor of 30 was applied for the following: a factor of 3 for intra-human variation; and a factor of 10 for extrapolation to a NOAEL. It was noted in a sub-chronic study reviewed by ATSDR (2004) that anemic patients have been treated with higher dosages of cobalt (e.g., 0.6 to 1.0 mg/kg-d) without adverse effect. However, given the relatively high and frequent consumption of beer in the study that is the basis of the RIVM TDI, it was considered likely that those individuals may have suffered from pre-existing cardiovascular disease and poor diet, increasing their sensitivity to cobalt-induced toxicity. RIVM (2001) indicates that the incidence of cardiomyopathy observed in heavy beer drinkers may have been increased as the result of the concomitant consumption of alcohol.

There are deficiencies in both key studies that were the bases of the USEPA and RIVM chronic RfDs. In the case of RIVM's (2001) TRV, the cardiomyopathy observed in the human subject was likely affected by alcohol consumption and poor diet, which may have contributed to increased sensitivity to cobalt-induced cardiomyopathy. However, this increased sensitivity is expected to provide a more conservative estimate of toxicity and therefore a conservative (or protective) TRV. The two human studies that were the basis of the US EPA provisional peer-reviewed TRV were carried out in the 1950s and while iodine uptake was reduced, it is unclear whether this finding was clinically or statistically significant and whether there was a control group from which to serve as a point of comparison. There are considered to be more deficiencies associated with the provisional peer-reviewed toxicity reference value and as a result, the RIVM (2001) TDI of 0.0014 mg/kg-d was selected as the chronic oral RfD.

Manganese

The Health Canada RfD is based on a LOAEL of 25 mg/kg-d for neuro-developmental toxicity in neonatal and adult rats exposed to manganese through sucrose solution and/or via drinking water for 21 days following birth (Kern et al. 2010, Kern and Smith 2011, and Beaudin et al. 2013 as cited in Health Canada 2019). An uncertainty factor of 1000 was applied for the following: a factor of 10 for intraspecies variability; 10 for interspecies extrapolation; and 10 for the use of a LOAEL rather than a NOAEL.

Thallium

Thallium is not commonly assessed in human health risk assessments, and the available toxicity data are insufficient to derive a defensible TRV. The surface water screening criterion for thallium was based on the US EPA PPRTV of 0.00001 mg/kg-d for soluble thallium (US EPA 2012a). The US EPA indicated that the available studies on thallium toxicity in humans are of poor quality and not suitable for deriving a TRV or a provisional reference dose. The screening chronic provisional reference dose proposed by the US EPA (2012) is based on a high level of uncertainty. Uncertainty factors were based on extrapolation from animals to humans (10), human variability (10), lack of adequate developmental toxicity data (10) and extrapolation from sub chronic to chronic exposure (3), for a total uncertainty factor of 3,000. Thus thallium was excluded from further consideration.

Exposure Assessment

The exposure assessment was completed considering the amount of time members of the public could rely on surface water as a potable water source at Saline Pond B7 with identified COPCs (Table 10.3-14). Exposure doses were calculated for adults given this is the age group most likely to be on extended hunting trips in the area, during which they may rely on nearby lakes for their potable water. The maximum concentration of total metals in post-closure (2051 to 2119) was used as the surface water exposure concentration. The total metals fraction is applicable for human health as it is assumed people would not filter water prior to consumption.

Table 10.3-14: Exposure Assumptions for Water Quality – Human Health

Exposure Parameter	Potable Water Scenario	Rationale/Source
Water Concentration	Arsenic: 0.044759 mg/L Cobalt: 0.004121 mg/L Manganese: 0.284915 mg/L	Maximum in Post-Closure (2051 to 2119)
Water Consumption Rate	1.5 litres per day	Adult; Health Canada (2021a)
Body Weight	70.7 kg	Adult; Health Canada (2021a)
Exposure Frequency	14 days per year	Assume a two-week hunting trip each year
Exposure Duration	60 years	Long-term predictions were assumed to represent the remainder of the adult life stage (total adult life stage = 60 years, life expectancy = 80 years; Health Canada 2021a)

Considering the assumptions described above (Table 10.3-14), exposure doses were calculated for each COPC using the equation below; the results are provided in Table 10.3-15.

$$Dose = \frac{C_W \times IR_W \times RAF_{oral} \times D_1 \times D_2 \times D_3}{BW \times LE}$$

Where:

Dose = estimated dose from ingestion of COPC in surface water (mg/kg-d)

C_W = COPC concentration in surface water (mg/L)

IR_W = water ingestion rate (L/day)

RAF_{Oral} = relative absorption factor from the gastrointestinal tract (i.e., bioavailability via water ingestion) (unitless)

D_1 = days per week exposed / seven days

D_2 = weeks per year exposed / 52 weeks

D_3 = total years exposed to Site (for carcinogens only)

BW = body weight (kg)

LE = life expectancy (year) (for carcinogens only)

Example calculation for non-carcinogen:

$$Dose\ for\ arsenic\ (non-carcinogen) = \frac{0.044759\ mg/L \times\ 1.5\ L/d\ \times 1\ \times 7/7\ \times 2/52}{70.7\ kg}$$

$$Dose\ for\ arsenic\ (non-carcinogen) = 3.6\ \times\ 10^{-5}\ mg/kg\text{-}d$$

Example calculation for carcinogen:

$$Dose\ for\ arsenic\ (carcinogen) = \frac{0.044759\ mg/L \times\ 1.5\ L/day\ \times 1\ \times 7/7\ \times 2/52\ \times 60\ years}{70.7\ kg \times 80\ years}$$

$$Dose\ for\ arsenic\ (carcinogen) = 2.7\ \times\ 10^{-5}\ mg/kg\text{-}d$$

Table 10.3-15: Exposure Assessment for Water Quality

COPC	Type of Endpoint	Project Phase(s)	Exposure Dose (mg/kg-d)
Arsenic	Non-carcinogen	Post-Closure	3.6×10^{-5}
	Carcinogen	Post-Closure	2.7×10^{-5}
Cobalt	Non-carcinogen	Post-Closure	3.4×10^{-6}
Manganese	Non-carcinogen	Post-Closure	2.3×10^{-4}

COPC = chemical of potential concern; mg/kg-d = milligrams per kilogram body weight per day.

Risk Characterization

Using a target HQ of 0.2 for non-carcinogenic COPCs and target incremental lifetime cancer risk (ILCR) of 3 in 100,000 for arsenic, HQs and ILCRs were calculated for each location and COPC (Table 10.3-16). It is noted that an alternate target ILCR was used for the drinking water pathway to be consistent with the estimated cancer risk levels associated with arsenic exposure at the Canadian Guideline for Drinking Water Quality (CGDWQ; Health Canada 2006) for arsenic which ranges from 3 to 39 in 100,000 at the Maximum Average Concentration (MAC) of 10 µg/L and 8 to 97 in 100,000 at a concentration of 25 µg/L (consistent with the SSWQO). Therefore, it was considered reasonable to adopt a target ILCR that is consistent with the MAC to ensure that risks do not exceed those of the Canadian population.

Table 10.3-16: Risk Characterization for Water Quality – Human Health

COPC	Project Phase(s)	Estimated Risks
Non-cancer Endpoints – Hazard Quotients		
Arsenic	Post-Closure	0.12
Cobalt	Post-Closure	0.0024
Manganese	Post-Closure	0.0093
Cancer Endpoints – Incremental Lifetime Cancer Risks		
Arsenic	Post-Closure	**4.9×10^{-5}**

Shaded and bold text = HQ > 0.2 or ILCR > 3 in 100 000.

All calculated HQs were less than their target of 0.2, thus non-carcinogenic health risks are not expected for members of the public that may use Saline Pond B7 as a potable water supply. The calculated ILCR for arsenic was greater than the target of 3 in 100,000. Thus, arsenic in surface water at Saline Pond B7 was considered further in the residual impacts analysis in Section 10.3.8.

10.3.7.8 Fish Tissue Quality

Given that no COPCs were identified in surface water that contain fish (Section 10.2.7.3), concentrations of chemicals were not anticipated to change in fish tissue. Saline Pond B7 will be a listed lake under Schedule 2 of the MDMER, and thus is not considered aquatic habitat for this assessment (Table 10.2-3). As such, it is assumed that no fish will occur in this lake, even during post-closure. Based on these results, fish tissue quality was not assessed further with respect to potential health effects and no residual health impacts due to changes to fish tissue quality were identified.

10.3.7.9 Noise

The objective of the Noise Assessment is to evaluate noise levels potentially generated by the Meliadine Extension that may affect human health under long-term exposure duration (e.g., many years to lifetime). Specifically, the noise assessment will use the percent highly annoyed (%HA) developed by Health Canada (2017c) to assess potential effects to human health.

Noise Modelling

Noise generated at the Mine Site, along the AWAR, and at Rankin Inlet was assessed in the 2014 FEIS. Two new primary pathways for the Meliadine Extension are associated with operation of the windfarm and alternative airstrip that will increase noise levels during operations. For this FEIS Addendum, computer noise models were developed to predict noise levels from the Meliadine Extension at potentially affected environmental receptors. Details of these models are provided in Appendix H-02; a brief summary is provided below.

Most Meliadine Extension noise sources will be effectively continuous or steady state. Sources in this category include trucks, loaders, dozers, graders, diesel generators, wind turbines, fans/blowers, compressors, and crushers. These types of sources will emit noise into the environment continuously for 24 hours per day. In contrast, noise associated with the Meliadine Extension airstrip will be intermittent. The airstrip will emit noise into the environment when airplanes take off or land, but the airstrip will be effectively silent at other times. Because noise emissions and noise effects from the Meliadine Extension airstrip are qualitatively different than noise emissions and noise effects from other Meliadine Extension equipment and activities, separate computer models were developed to predict and analyze noise effects from these two groups of sources.

For consistency with the 2014 FEIS, computer models of continuous noise sources associated with the Meliadine Extension were developed using International Organization for Standardization (ISO) technical standard 9613-2 (ISO 1996). Inputs to the computer models consisted of source emissions in the form of octave band sound power levels and environmental conditions that are known to influence noise propagation (e.g., ground cover, temperature, humidity, wind conditions).

Noise source emissions for the Meliadine Extension and the environmental inputs to the computer models are discussed in detail in Appendix H-02. The environmental inputs were selected to be consistent with the 2014 FEIS. When calculating noise levels at receptors, the ISO 9613-2 algorithm used the environmental inputs to account for four noise attenuation mechanisms:

- geometric divergence;
- atmospheric absorption;
- ground absorption; and
- screening by barriers.

According to the ISO 9613-2 standard, the overall accuracy of the propagation algorithm used in the Meliadine Extension computer models is ±3 dBA for distances between source and receptor up to 1 km. The accuracy for propagation distances greater than 1 km is not stated in the standard.

A number of conservative assumptions were made to account for the level of uncertainty inherent in the noise level predictions. Most importantly, each receptor was assumed to be downwind from each source 100% of the time. Because downwind conditions tend to enhance noise propagation, this assumption is conservative and likely overestimates the noise levels from the Meliadine Extension. In addition, terrain features were the only acoustical screening elements considered in the noise model. Acoustical screening from anthropogenic features (e.g., buildings) and acoustical screening from vegetation were not considered in the computer model. This is a conservative approach to modelling noise from the Meliadine Extension.

Computer models of airstrip noise sources were based on an algorithm from European Civil Aviation Conference (ECAC) Document 29 (ECAC 2016). Inputs to the ECAC models consisted of aircraft types, which are used to establish noise emissions based on historical measurements and empirical formulae, runway orientation and length, and take off/landing frequencies within a representative six-month period.

When calculating noise levels at receptors, the ECAC algorithm accounts for noise attenuation due to geometric divergence, atmospheric absorption, and screening by barriers in a manner similar to the ISO 9613-2 algorithm. The ECAC does not quantify the accuracy or uncertainty associated with its modelling algorithm; however, it is likely the ECAC algorithm has an overall accuracy comparable to the ±3 dBA value specified for ISO 9613-2 since the ECAC and ISO 9613-2 algorithms use similar methods to account for propagation effects.

For the most part, noise modelling of the Meliadine Extension made use of the same receptors as the 2014 FEIS. However, Agnico Eagle confirmed that nine receptors included in the 2014 FEIS are no longer active (i.e., NPOR001 through NPOR005, NPOR008, NPOR009, NPOR011, and NPOR013) and therefore, these nine receptors were not included in the modelling. In addition, Agnico Eagle identified four new receptors that have been developed within the noise study area since the 2014 FEIS (i.e., NPOR026 through NPOR029); these four new receptors were included in the modelling. The locations of the noise receptors are provided in Figure 10.3-2.

The noise modelling focused on a temporal snapshot when noise emissions and the magnitude of potential noise effects are expected to be greatest. The combination of maximum open pit production plus intense underground production makes the year 2034 the most appropriate snapshot for computer modelling to assess potential noise effects from the Meliadine Extension.

Noise Assessment Methods

The assessment of human health impacts related to noise followed the current guidance of Health Canada (2017c). This guidance is typically used in assessing the potential effects of noise on communities as part of the environmental and social impact assessments of large projects undergoing environmental permitting. This guidance considers the following:

- characteristics of the noise level;
- construction noise impacts based on increased levels of annoyance in the population;
- operational noise impacts based on increased levels of annoyance in the population;
- impact on special land uses such as schools, hospitals, and seniors' residences; and
- sleep disturbance impacts.

The percentage of the population that become highly annoyed (%HA) is a measure of health impact that Health Canada advises be used to evaluate long-term operational noise (Health Canada 2017c). There is a well-established dose-response relationship between day-night sound level and community noise annoyance, as measured by %HA (Michaud et al. 2008). The %HA approach as a measure of potential noise impact has been accepted by two US federal agencies, which are the Federal Transit Administration (US FTA 1995) and the US Federal Railroad Administration (US FRA 1998). It is also used in US standards (ANSI 1996, as cited by Michaud et al. 2008) and International Organization for Standardization (ISO) standards (ISO 2003) as a measure of noise impact. The WHO identifies noise annoyance as one of the health effects for which guideline levels have been set (WHO 1999). Health Canada suggests that mitigation be proposed if the predicted change in %HA at a specific receptor is greater than 6.5% between project and baseline noise environments, or when the baseline-plus-project-related noise is in excess of an day-night sound level (Ldn of 75 dBA).

The Health Canada approach deals with increases in predicted noise levels over the existing conditions for the daytime (L_d) and nighttime (L_n) equivalent noise levels, as well as a whole day equivalent noise level descriptor (L_{eq24}). In addition, impulsive and tonal characteristics of source noise are accounted for because they can increase potential effects. The %HA was calculated for each receptor locations using the following equations from Health Canada (2017c):

$$\%HA = \frac{100}{1+e^{(10.4-0.132\times L_R dn)}}$$

Where:
$L_R dn$ = the 24-hour energy averaged noise level in which the contribution from the night-time noise level that is artificially increased by 10dBA, and calculated using this equation:

$$L_R dn = 10 \times \log_{10}\left(\left(\left[15 \times 10^{(0.1\times L_R d)}\right] + \left[9 \times 10^{\left(0.1\times(L_R n+10)\right)}\right]\right) \div 24\right)$$

Where:
$L_R d$ = daytime noise level
$L_R n$ = nighttime noise level

Noise predictions were carried out for 20 noise receptors located within approximately 5 km of the Meliadine Extension (Figure 10.3-2). These receptors included 16 hunter/trapper cabins located near the Mine Site, along the AWAR, near the Park, and close to Rankin Inlet. Four receptors located in Rankin Inlet were also included.

The noise modelling focused on nighttime noise levels, because the Mine operates 24 hours per day and regulatory noise limits are more restrictive during the nighttime period. To calculate %HA values using the Health Canada formula, daytime noise levels are required; for this assessment it was assumed daytime noise levels are equal to nighttime noise levels at all receptors. This is consistent with the approach taken for the 2014 HHERA noise assessment. For all receptors except those located in Rankin Inlet, a 10 dBA penalty was applied to the predicted noise levels as is required for receptors in rural environments (Health Canada 2017c).

For the assessment, %HA values were calculated for the pre-Meliadine case (i.e., noise levels as they existed before the Meliadine project), the “Approved Meliadine” case (i.e., cumulative noise levels from the 2014 FEIS), and the “Meliadine Extension” case (i.e., the full Meliadine Extension, including the on-site wind turbines and airstrip). The change in %HA was calculated for each combination of assessment cases:

- Pre-Meliadine vs. Approved Meliadine
- Pre-Meliadine vs. Meliadine Extension
- Approved Meliadine vs. Meliadine Extension

Noise Assessment Results

The predicted noise levels and %HA calculations for each receptor location are provided in Table H-12-H-1 in Appendix H-12. Predicted cumulative noise levels associated with the Meliadine Extension (in combination with other sources in the environment) range from 51.5 to 60.5 dBA (Table H-12-H-1), which is below the 75 dBA benchmark. These cumulative noise levels were obtained by summing predicted noise levels from the Meliadine Extension with representative pre-Meliadine noise levels. They represent average noise levels over a typical 24-hour period.

Predicted %HA values for each modelled noise receptor is presented in Table 10.3-17. Most hunter/trapper cabin locations had predicted %HA values of less than 6.5%, indicating that there is negligible potential for adverse health effects due to noise for people using these areas recreationally. One receptor, NPOR014, had a lower %HA for the Meliadine Extension compared to the Approved Project. NPOR014 is a cabin located immediately adjacent to the Discovery Pit access road. Noise levels at this receptor are dominated by ore haul trucks travelled back and forth between Discovery Pit and the processing plant. The predicted noise level at NROR014 is less for the Meliadine Extension than for the Approved Project modelled in the 2014 FEIS because of reduced truck volumes on the access road (i.e., fewer truck trips per day were modelled in the Meliadine Extension than in the 2014 FEIS). The Rankin Inlet locations also had predicted %HA values less than 6.5%.

Two receptors had predicted %HA above the benchmark of 6.5%: NPOR006 and NPOR017. NPOR006 is a cabin located close to the proposed wind turbines, and thus the increase in %HA is related to that noise source. NPOR017 is a cabin that is situated approximately 150 m from the AWAR. Both cabins are currently used for traditional hunting and trapping. These receptor locations with a %HA above 6.5% will be evaluated further in the residual impacts assessment.

Table 10.3-17: Predicted Percentage of Highly Annoyed Due to Predicted Noise Levels

Noise Receptor	Description	%HA			Change in %HA		
		Pre-Meliadine	Approved Meliadine	Meliadine Extension	Pre-Meliadine vs. Approved Meliadine	Pre-Meliadine vs. Meliadine Extension	Approved Meliadine vs. Meliadine Extension
NPOR006	Present Day Cabin	2.6	4.8	**7.4**	2.2	4.8	2.6
NPOR007	Present Day Cabin Tatty's	2.6	2.8	5.3	0.2	2.7	2.5
NPOR010	Present Day Cabin Peter's	2.6	3.7	5.3	1.1	2.7	1.6
NPOR012	Present Day Cabin Barney Tootoo's	2.6	2.9	3.0	0.3	0.4	0.1
NPOR014	Present Day Cabin	2.6	**8.8**	5.1	6.2	2.5	-3.7
NPOR015	Iqalugaarjuup Nunanga Territorial Park	2.6	2.8	2.8	0.2	0.2	0.0
NPOR016	Iqalugaarjuup Nunanga Territorial Park	2.6	3.2	3.2	0.6	0.6	0.0
NPOR017	Present Day Cabin Tommy's	2.6	**7.5**	**8.2**	4.9	5.6	0.7
NPOR018	Present Day Cabin Ugjuk's	2.6	2.8	2.8	0.2	0.2	0.0
NPOR019	Present Day Cabin Angutetuark's	2.6	2.7	2.7	0.1	0.1	0.0
NPOR020	Present Day Cabin Ollie's	2.6	2.7	2.7	0.1	0.1	0.0
NPOR021	Present Day Cabin Nattar's	2.6	2.7	2.7	0.1	0.1	0.0
NPOR022	Rankin Inlet Receptor	3.8	3.8	3.8	0.0	0.0	0.0
NPOR023	Rankin Inlet Receptor	2.6	2.7	2.7	0.1	0.1	0.0
NPOR024	Rankin Inlet Receptor	6.3	6.3	6.3	0.0	0.0	0.0
NPOR025	Rankin Inlet Receptor	3.0	3.3	3.4	0.3	0.4	0.1
NPOR026	New Receptor Not Included in 2014 FEIS	2.6	3.1	5.5	0.5	2.9	2.4
NPOR027	New Receptor Not Included in 2014 FEIS	2.6	3.9	3.9	1.3	1.3	0.0
NPOR028	New Receptor Not Included in 2014 FEIS	2.6	2.8	3.0	0.2	0.4	0.2
NPOR029	New Receptor Not Included in 2014 FEIS	2.6	2.8	3.1	0.2	0.5	0.3

Notes: "Pre-Meliadine" refers to %HA values calculated using baseline data. "Approved Meliadine" refers to the %HA values calculated for the 2014 FEIS. ""Meliadine Extension" refers to %HA values calculated for the complete Meliadine Extension, including the on-site wind turbines and airstrip. Shaded and bolded values are greater than 6.5%.

%HA = percent highly annoyed.

10.3.8 Residual Impact Classification

Residual impact classification effects criteria and definitions are provided in Section 4.5.2 of the Application. They are consistent with the criteria and definitions used in the 2014 FEIS. Similarly, the specific assessment criteria used for evaluating residual impacts to human health risks (Tables 10.3-18 and 10.3-19), and determining significance (Table 10.3-20) are consistent with those used for the 2014 FEIS.

Table 10.3-18: Effects Criteria and Levels for Assigning Significance to Human Health Residual Impacts

Effects Criteria	Effects Level Definition		
Direction (of health effect)	**Positive** Effect is beneficial to human health or does not result in a change to human health	**Negative** Effect is potentially harmful to human health	
Magnitude (of health effect)	Assignment of magnitude of effects is provided in Table 10.3-20		
Geographic Extent (of condition causing health effect)	**On-Site** Effect is within the Project footprint (e.g., on-site worker camp)	**Local** Effect extends in the LSA	**Regional** Effect extends into the RSA
Duration (of conditions causing health effect)	**Short-term** Conditions causing effect are of short duration (2-3 years)	**Medium-term** Conditions causing effect are evident during the operations phase (24 years)	**Long-term** Conditions causing effect extend beyond any one phase (>24 years)
Frequency (of condition causing health effect)	**Isolated** Conditions causing the effect occur infrequently (i.e., less than 5% of the year)	**Periodic** Conditions causing the effect occur at regular, although infrequent intervals (i.e., between 5 and 20% of the year)	**Continuous** Conditions causing the effect occur at regular and frequent intervals (i.e., more than 20% of the year)
Degree of Reversibility (of health effect)	**Readily Reversible** Effect is immediately reversible following cessation of exposure	**Reversible** Effect is reversible with time (i.e., there is a recovery)	**Irreversible** Effect is not reversible (i.e., permanent)
Likelihood (of health effects occurring)	**Unlikely** Effect is unlikely to occur	**Possible** Effect is possible, although not certain	**Likely** Effect is certain to occur

Table 10.3-19: Magnitude Residual Impact Classification Criteria for Human Health

Parameter	Magnitude			
	Negligible	Low	Moderate	High
Non-Carcinogenic Compounds	No change from baseline conditions, below applicable guidelines, or HQ ≤ 1	1[a] < HQ ≤ 10	10 < HQ ≤ 100	HQ > 100
Carcinogenic Compounds	No change from baseline conditions, below applicable guidelines, or ILCR ≤ 0.00001	0.00001 < ILCR ≤ 0.0001	0.0001 < ILCR ≤ 0.001	ILCR > 0.001
Noise Levels[b]	No change from baseline, i.e., %HA ≤ 6.5%	6.5% < %HA ≤ 7.5%	7.5% < %HA ≤ 8.5%	%HA > 8.5%

(a) For non-carcinogenic compounds that can exert effects on receptors via multiple pathways (e.g., non-volatile chemicals), an HQ of ≤ 0.2 represents a negligible magnitude level. A low magnitude for these parameters would be defined as 0.2 < HQ ≤ 10.

(b) For the 2014 HHERA, specific critical noise level (HCII) was included in the magnitude criteria for noise levels; this indicator was not applied in the current assessment due to a change in the Health Canada guidance for noise assessments.

HQ = Hazard Quotient; represents the target ratio of the predicted chemical exposure relative to its health-based benchmarks.

ILCR = Incremental Lifetime Cancer Risks represents additional or extra risk of developing cancer due to exposure to a chemical (from the Project) incurred over the lifetime of an individual.

%HA = Percent Highly Annoyed.

Table 10.3-20: Significance of Effect Decision Matrix for Human Health

Effects Criteria	Effect Level		
Magnitude: Low			
Geographic Extent	On-site	Local	Regional
Duration	Short-term	Medium-term	Long-term
Frequency	Isolated	Periodic	Continuous
Reversibility	Ready Reversible	Reversible	Irreversible
Likelihood	Unlikely	Possible	Likely
Magnitude: Moderate			
Geographic Extent	On-site	Local	Regional
Duration	Short-term	Medium-term	Long-term
Frequency	Isolated	Periodic	Continuous
Reversibility	Ready Reversible	Reversible	Irreversible
Likelihood	Unlikely	Possible	Likely
Magnitude: High			
Geographic Extent	On-site	Local	Regional
Duration	Short-term	Medium-term	Long-term
Frequency	Isolated	Periodic	Continuous
Reversibility	Ready Reversible	Reversible	Irreversible
Likelihood	Unlikely	Possible	Likely

Note that all directions of effect were classified as negative.

Shaded cells indicate combinations of classifications that are associated with a significant residual impact.

It should be noted that the direction of effect is considered to be negative for all COPCs, receptors, and locations, given that the TRVs used in the risk assessment are intended to identify the potential for adverse health effects at doses higher than the TRV. Therefore, where an estimated HQ is greater than its target HQ, this implies that an adverse health effect is possible.

Further to the conservatism and uncertainties associated with the air quality predictive modelling, the distribution of COPC concentrations predicted in the air modelling (i.e., peak or maximum, 98th percentile, 95th percentile, 75th percentile), the frequency of exceedances of the applicable air threshold, the receptor characteristics and exposure scenarios, and the TRVs is provided below to support the residual impact classification of the “magnitude” assessment criterion.

With respect to the duration assessment criterion, it should be noted that the predictive air quality modelling was carried out considering that the operations phase would result in the highest potential emissions out of all phases; that is, emissions from the other phases (construction, closure, post-closure) would be expected to be lower than that estimated for operations. However, given that emissions would also be expected during construction and to a lesser extent during closure, it is not possible to determine whether emissions during these phases could result in HQs greater than target levels, particularly for chemicals related to diesel truck exhaust (e.g., DPM). Given these uncertainties, the duration of the potential health effects associated with changes to air quality is considered to be long-term.

The following residual impacts were identified in the human health risk assessment:

- Acute Air Quality Assessment: Potential acute health risks for recreational users due to aldehyde and DPM;
- Surface Water Quality Assessment: Potential chronic health risks for recreational users due to arsenic in drinking water; and
- Noise Assessment: Noise impacts for recreational users at two hunter/trapper cabins.

In addition, NO_2, $PM_{2.5}$, and PM_{10} in air were also considered further in the residual impacts analysis. These are non-threshold substances and a threshold concentration below which no adverse effects are expected is not likely to exist (i.e., any level of increased exposure may result in negative health effects) (Health Canada 2016a,b). There is no prescribed method for assessing health risks of non-threshold constituents; therefore, NO_2, $PM_{2.5}$, and PM_{10} were assessed using the same approach as the other threshold COPCs (i.e., following a HQ approach and residual effects characterization).

The overall significance of the residual impacts is shown in Table 10.3-21. The assessment of residual impacts is detailed in Tables 10.3-22 to 10.3-28. Residual impacts were not identified for soil quality, water quality, sediment quality, and country foods quality (including fish quality).

Table 10.3-21: Residual Impact Classification for Human Health Risk Assessment

Residual Impact	COPC	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance
Acute health effects for recreational users due to inhalation of air contaminants	Aldehyde	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely	Not significant
	DPM	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely	Not significant
Acute and chronic health effects for recreational users due to inhalation of nitrogen dioxide	NO_2	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely	Not significant
Chronic health effects for recreational users due to inhalation of particulate matter	PM_{10}	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely	Not significant
	$PM_{2.5}$	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely	Not significant
Chronic health effects for recreational users due to drinking water quality	Arsenic	Negative	Low	Local	Long-term	Continuous	Irreversible	Unlikely	Not significant
Health effects due to noise for recreational users	Noise	Negative	Low to Moderate	Local	Long-term	Continuous	Readily Reversible	Possible	Not significant

COPC = chemical of potential concern; DPM = diesel particulate matter; NO_2 = nitrogen dioxide; PM = particulate matter.

Table 10.3-22: Significance of Residual Impacts for Aldehyde for Recreational Users (Acute)

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	The sensitivity of human volunteers to aliphatic aldehydes ranging from butanal to octanal indicated that mucous membrane irritation thresholds tended to decrease with increasing chain length (COMEAP 2000). Generally, aldehydes increase in potency from the less potent saturated aliphatic aldehydes to cyclic aldehydes to unsaturated aliphatic aldehydes, which are more potent, as measured by decreased breathing frequency in mice (COMEAP 2000).
Magnitude	Low	The estimated HQs were 2 (Receptors 1 and 22 for Scenario 2) for aldehyde considering the peak concentrations for the acute averaging time for recreational users at the hunter/trapper locations around the mine site; estimated HQs were acceptable for all other modelling scenarios and receptor locations. Statistics on the hourly air predictions were carried out, which included the 98th, 95th, and 75th percentiles of the concentration data. Only the peak concentrations resulted in estimated HQs greater than the target HQ of 1 for all scenarios; estimated HQs were acceptable using the 98th percentile, 95th percentile, and 75th percentile statistics.
Geographic Extent	Local	The air modelling provided predicted air concentrations of the COPCs at specific receptor locations within the air quality LSA. For aldehyde, there were exceedances of the acute threshold at two hunter/trapper cabins around the mine site; as such, the geographic extent for aldehyde is classified as local (i.e., effect extends into the LSA).
Duration	Long-Term	Given that emissions of aldehyde could occur outside the operations phase, it is possible that aldehyde emissions could exceed health-based guidelines and pose a potential health risk during the construction, active closure, or post-closure phases.
Frequency	Isolated	The number of exceedances was not reported for the hunter/trapper locations. However, based upon the statistics, only the peak predicted concentrations exceeded its acute threshold, while the 98th percentile and lower percentile statistics did not exceed the threshold. Therefore, the frequency of exceedances is considered to be isolated.
Reversibility	Reversible	Based upon the information provided for acute health effects above, the most likely health effects associated with aldehyde considering the peak exposure concentrations includes mucus membrane irritation. These symptoms are reversible; i.e., health effects are expected to improve once exposure to aldehyde is reduced or ceased.
Likelihood	Unlikely	Given that the assessment relies on predictive air modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to aldehyde will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Air Quality Modelling	The concentrations of COPCs in air considered in the risk assessment were the predicted peak 1-hour concentrations from the 5-year modelling dataset for each of the 6 scenarios considered for the operations phase. It was conservatively assumed that the Mine operated continuously at its maximum design capacity over the duration of the 5 years of modelling.
	In the Receptor Characteristics and Exposure Scenarios	The selected receptors were considered to be members of the public that may include the very young and elderly, who may have special sensitivities to mucus membrane irritants. These special sensitivities were accounted for in the conservative selection of the toxicity benchmark. As described below, the benchmark is based upon odour, which is a more sensitive endpoint than a health-based endpoint as indicated by TCEQ. No additional conservatism or uncertainty is associated with these assumptions.

Effects Criteria	Criteria Classification	Rationale
	In the Selected Acute Thresholds	The selected acute threshold for aldehyde of 10 µg/m^3 is an odour-based Ambient Air Quality Criteria for propanal set by MECP (2018). Health-based thresholds are available for other aldehyde compounds, although the thresholds set for these compounds are higher than that of propanal. Additionally, the available health-based thresholds were set by TCEQ, for which supporting information is not available. Therefore, the selection of this threshold is conservative and may overestimate toxicity due to acute exposure to aldehyde compounds.
Residual Impact Significance	Not Significant	With respect to acute health effects, the overall impacts are not considered to be significant to members of the public in the LSA because the conditions causing the residual effect are of low magnitude, are considered to occur infrequently, and the overall potential for the health effect to occur is considered to be unlikely.

HQ = hazard quotient; COPC = chemical of potential concern; LSA = local study area; TCEQ = Texas Commission on Environmental Quality.

Table 10.3-23: Significance of Residual Impacts for DPM for Recreational Users (Acute)

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	There is limited information related to health effects for diesel particulate matter due to acute (or short-term) exposures; most health effects are associated with chronic (or long-term) exposures. As summarized by USEPA (2002), acute exposures to DPM have been associated with eye, nose, and throat irritation, lung irritation and respiratory effects such as cough, and neurophysiological symptoms such as light-headedness and nausea. Short-term exposures may also exacerbate immunologic responses such as those associated with allergens and asthma.
Magnitude	Low	The estimated HQs for DPM were 2 (Receptors 1 and 22 for Scenario 2) considering the peak concentrations for the acute averaging time for recreational users at the hunter/trapper locations around the mine site; estimated HQs were acceptable for all other modelling scenarios and receptor locations. Statistics on the hourly air predictions were carried out, which included the 98th, 95th, and 75th percentiles of the concentration data. Only the peak concentrations resulted in estimated HQs that were greater than the target HQ of 1; all other statistics (i.e., 98th percentile, 95th percentile, and 75th percentile) resulted in acceptable HQs.
Geographic Extent	Local	The air modelling provided predicted air concentrations of the COPCs at specific receptor locations within the air quality LSA. For DPM, there were exceedances of the acute threshold at two hunter/trapper cabins around the mine site; as such, the geographic extent for DPM is classified as local (i.e., effect extends into the LSA).
Duration	Long-term	Given that emissions of DPM could occur outside the operations phase, it is possible that DPM emissions could exceed health-based guidelines and pose a potential health risk during the construction, active closure or post-closure phases.
Frequency	Isolated	The number of exceedances were not reported for the hunter/trapper locations. However, based upon the statistics, only the peak predicted concentrations exceeded its acute threshold, while the 98th percentile and lower percentile statistics did not exceed the threshold. Therefore, the frequency of exceedances is considered to be isolated.
Reversibility	Reversible	Based upon the information provided for acute health effects above, the most likely health effects associated with the COPCs considering the peak exposure concentrations include mucous membrane irritation and some mild neurological and gastrointestinal symptoms such as nausea. These symptoms are reversible; i.e., health effects are expected to improve once exposure to the COPC is reduced or ceased.
Likelihood	Unlikely	Given that the assessment relies on predictive air modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to DPM will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Air Quality Modelling	The concentrations of COPCs in air considered in the risk assessment were the predicted peak 1-hour concentrations from the 5-year modelling dataset for each of the 6 scenarios considered for the operations phase. It was conservatively assumed that the Mine operated continuously at its maximum design capacity over the duration of the 5 years of modelling.
	In the Receptor Characteristics and Exposure	The selected receptors were considered to be members of the public that may include the very young and elderly, who may have special sensitivities to mucus membrane irritants. The selected acute threshold is based on health, and sensitive subpopulations were accounted for in the derivation of the threshold.

Effects Criteria	Criteria Classification	Rationale
	Scenarios	
	In the Selected Acute Thresholds	The selected acute threshold for DPM is 10 µg/m³, based on respiratory effects in healthy subjects. The threshold is protective of the general population, including sensitive individuals, exposed to DPM for up to 2 hours. The threshold is not overly conservative; however, Health Canada (2016c) has indicated that epidemiological studies for large populations are preferable to controlled human studies for characterizing a dose-response relationship for short-term exposure to diesel particulate matter and health effects.
Residual Impact Significance	Not Significant	With respect to acute health effects, the overall impacts are not considered to be significant to members of the public in the LSA because the conditions causing the residual effect are of low magnitude, are considered to occur infrequently, and the overall potential for the health effect to occur is considered to be unlikely.

USEPA = United States Environmental Protection Agency; DPM = diesel particulate matter; HQ = hazard quotient; COPC = chemical of potential concern; LSA = local study area.

Table 10.3-24: Significance of Residual Impacts for NO_2 for Recreational Users (Acute and Chronic)

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	Acute: Short-term exposure to NO_2 is correlated with respiratory effects, cardiovascular effects, and increased mortality (Health Canada 2016a). Chronic: Long-term exposure to NO_2 is correlated with respiratory effects including adverse impacts on lung function and increased incidence of asthma and/or allergic responses (Health Canada 2016a). However, there is some uncertainty regarding the possible role of co-pollutants. Health Canada (2016a) has determined that NO_2 is a non-threshold chemical, meaning that there is no safe concentration (i.e., there is no threshold below which there are no known health effects).
Magnitude	Low	All predicted NO_2 concentrations in air met the 1-hr and annual 2025 CAAQS. Acute HQs ranged from 0.1 to 0.9. Chronic HQs ranged from 0.002 to 0.01. Although predicted concentrations met the screening criteria, Health Canada (2016a) states that there is no safe concentration. Given that the Mine is a source of NO_2 in the LSA, and air concentrations are therefore expected to increase relative to baseline conditions (as assessed in the 2014 FEIS), and maximum predicted concentrations are below the acute and chronic screening criteria, a rating of "low" magnitude was selected.
Geographic Extent	Local	The air modelling provided predicted air concentrations of the COPCs at specific receptor locations within the air quality LSA. Although there were no exceedances of the applicable air threshold for NO_2, the highest concentrations in air occurred at several receptor locations closest to the near the Mine as opposed to along the AWAR or near/in Rankin Inlet. NO_2 is a product of fuel combustion, and is emitted with exhaust from combustion engines, and products from blasting operations.
Duration	Long-term	Given that emissions of NO_2 could occur outside the operations phase, it is possible that emissions could pose a potential health risk during the construction, active closure or post-closure phases.
Frequency	Isolated	There were no exceedances of screening criteria based on 1-hr and annual averaging period predicted concentrations during the operation year with the higher air emissions rate.
Reversibility	Reversible	Any adverse health effects are expected to improve once exposure to the COPC is reduced or ceased.
Likelihood	Unlikely	Given that the assessment relies on predictive air modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to NO_2 will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Air Quality Modelling	The concentrations of COPCs in air considered in the risk assessment were the predicted peak 1-hour and annual concentrations from the 5-year modelling dataset for each of the 3 scenarios considered for the operations phase of the Project. Air predictions were made for the operation year with the highest potential emission rates, which provides conservative estimates of air concentrations that were assumed to apply throughout the operations phase.
	In the Receptor Characteristics and Exposure	The selected receptors were considered to be members of the public that may include the very young and elderly, who may have special sensitivities to respiratory effects of NO_2. The selected thresholds are based on health, although whether sensitive subpopulations were accounted for in the derivation of the thresholds could not be determined because no supporting documentation is available.

Effects Criteria	Criteria Classification	Rationale
	Scenarios	
	In the Selected Thresholds	The selected thresholds were the CAAQS for 2025: 79 µg/m^3 for the acute assessment, 22.5 µg/m^3 for the chronic assessment. Although supporting documentation is not available for the CAAQS, a risk assessment conducted by Health Canada (2016a) indicated that exposure to nitrogen dioxide is correlated with respiratory effects, cardiovascular effects, and increased mortality. Based on the assessment, Health Canada recommended development of new CAAQS for NO_2, citing strong evidence of association between NO_2 exposure and adverse health effects, evidence of adverse health effects occurring at levels below the NAAQO of 400 µg/m^3 (the applicable air quality criterion for Canada at the time of the study), and evidence that nitrogen dioxide is a non-threshold substance. The following uncertainties were identified in the assessment: confounding effects of exposure to co-pollutants, exposure characterized by central monitoring station data, appropriate dose-response curve, need for better characterization of cardiovascular effects, limited studies on emerging effects of nitrogen dioxide, varying sensitivities to exposure, and influences of genetics.
	In the Assessment Approach	There is limited risk assessment guidance for assessing non-threshold substances. Although predicted air concentrations are below CAAQS, Health Canada (2016a) states that there is no safe concentration. Air quality monitoring is ongoing at the Meliadine Mine. Constituents monitored include NOx, SO_2, TSP, PM_{10}, $PM_{2.5}$, and dust. Calculated annual average concentrations of NO_2 and SO_2, as measured since 2016, were well below the Government of Nunavut Ambient Air Quality Standards (NAAQS) and maximum predicted concentrations from the 2014 FEIS.
Residual Impact Significance	Not Significant	The overall impacts with respect to predicted NO_2 concentrations in air are not expected to be significant to members of the public in the LSA because there are no receptor locations with predicted exceedances of the CAAQS based on conservative modelling assumptions. NO_2 is monitored as part of the Air Quality Monitoring Plan, which will continue with the Meliadine Extension.

HQ = hazard quotient; COPC = chemical of potential concern; LSA = local study area; Canadian Ambient Air Quality Standard; NAAQO = National Ambient Air Quality Objective; FEIS = Final Environmental Impact Statement.

Table 10.3-25: Significance of Residual Impacts for PM_{10} for Recreational Users

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	Long-term exposure to PM_{10} and $PM_{2.5}$ is associated with increased mortality from all causes, cardiovascular disease, respiratory disease and lung cancer (Chen and Hoek 2020). Health Canada (2016b) has determined that PM_{10} is a non-threshold chemical, meaning that there is no safe concentration (i.e., there is no threshold below which there are no known health effects). However, Health Canada (2016b) considers there to be a higher risk with exposure to fine particulates ($PM_{2.5}$).
Magnitude	Low	All predicted PM_{10} concentrations in air met the 24-hour and annual WHO's (2021) most stringent target AQG of 45 µg/m^3 (24-hour) and 15 µg/m^3 (annual). HQs based on peak 24-hour average concentrations ranged from 0.001 to 0.1. HQs based peak annual average concentrations ranged from 0.00007 to 0.007. Although predicted concentrations met the screening criteria, Health Canada (2016b) states that there is no safe concentration. Given that the Mine is a source of PM_{10} in the LSA, and air concentrations are therefore expected to increase relative to baseline conditions (as assessed in the 2014 FEIS), and maximum predicted concentrations are below the screening criteria, a rating of "low" magnitude was selected.
Geographic Extent	Local	The air modelling provided predicted air concentrations of the COPCs at specific receptor locations within the air quality LSA. Although there were no exceedances of the applicable air threshold for $PM_{2.5}$, the highest concentrations in air occurred at several receptor locations closest to the near the Mine (e.g., Receptor 1 and 22) as opposed to along the AWAR or near/in Rankin Inlet.
Duration	Long-term	Given that emissions of PM_{10} could occur outside the operations phase, it is possible that emissions could pose a potential health risk during the construction, active closure or post-closure phases.
Frequency	Isolated	There were no exceedances of screening criteria based on 1-hr and annual averaging period predicted concentrations during the operation year with the higher air emissions rate.
Reversibility	Reversible	Any adverse health effects are expected to improve once exposure to the COPC is reduced or ceased.
Likelihood	Unlikely	Given that the assessment relies on predictive air modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to PM_{10} will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Air Quality Modelling	The concentrations of PM_{10} considered in the risk assessment were the predicted peak 24-hour and annual concentrations from the 5-year modelling dataset for each of the six scenarios considered for the operations phase of the Mine. It was conservatively assumed that the Mine operated continuously at its maximum design capacity over the duration of the 5 years of modelling.
	In the Receptor Characteristics and Exposure Scenarios	The selected receptors were considered to be members of the public that may include the very young and elderly, who may have special sensitivities to respiratory effects of $PM_{2.5}$. The selected thresholds are based on health and consider sensitive subpopulations.

Effects Criteria	Criteria Classification	Rationale
	In the Selected Thresholds	The selected thresholds were the most stringent of WHO's (2021) recently derived AQG: 45 µg/m^3 (24-hour) and 15 µg/m^3 (annual). The WHO AQGs are meant to be protective of human health, with the assumption that adverse health effects do not occur or are minimum below the AQG level. WHO defines the long-term air quality guideline level as "the lowest exposure level of an air pollutant above which the guideline development group is confident that there is an increase in adverse health effects" (WHO 2021).
	In the Assessment Approach	There is limited risk assessment guidance for assessing non-threshold substances. Although predicted air concentrations are below recently updated WHO (2021) AQG, Health Canada (2016c) states that there is no safe concentration for PM_{10}. Air quality monitoring is ongoing at the Meliadine Mine. Constituents monitored include NOx, SO_2, TSP, PM_{10}, $PM_{2.5}$, and dust. Calculated 24-hour average concentrations of PM_{10} and $PM_{2.5}$, as measured in 2020, were below the Government of Nunavut Ambient Air Quality Standards/BC Ambient Air Quality Objectives and maximum predicted concentrations from the 2014 FEIS.
Residual Impact Significance	Not Significant	The overall impacts with respect to predicted PM_{10} concentrations in air are not expected to be significant to members of the public in the LSA because there are no receptor locations with predicted exceedances of the WHO AQG based on conservative modelling assumptions. PM_{10} is monitored as part of the Air Quality Monitoring Plan, which will continue with the Meliadine Extension.

HQ = hazard quotient; COPC = chemical of potential concern; LSA = local study area; WHO = World Health Organization; AQG = air quality guideline; FEIS = Final Environmental Impact Statement.

Table 10.3-26: Significance of Residual Impacts for $PM_{2.5}$ for Recreational Users

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	Long-term exposure to PM_{10} and $PM_{2.5}$ is associated with increased mortality from all causes, cardiovascular disease, respiratory disease and lung cancer (Chen and Hoek 2020). Health Canada (2016b) has determined that $PM_{2.5}$ is a non-threshold chemical, meaning that there is no safe concentration (i.e., there is no threshold below which there are no known health effects). Finer particulates ($PM_{2.5}$) pose greater risk than larger particulates (>2.5 µm in size) because they can be inhaled deeper into the lungs, are chemically reactive, and have complex characteristics (Health Canada 2016b).
Magnitude	Low	All predicted $PM_{2.5}$ concentrations in air met the 24-hour and annual 2025 CAAQS (27 µg/m³ and 8.8 µg/m³, respectively). They also met WHO's (2021) most stringent target AQG of 15 µg/m³ (24-hour) and 5 µg/m³ (annual). HQs (calculated using 2025 CAAQS) based on peak 24-hour average concentrations ranged from 0.002 to 0.04. HQs based peak annual average concentrations ranged from 0.0001 to 0.01. Although predicted concentrations met the screening criteria, Health Canada (2016b) states that there is no safe concentration. Given that the Mine is a source of $PM_{2.5}$ in the LSA, and air concentrations are therefore expected to increase relative to baseline conditions (as assessed in the 2014 FEIS), and maximum predicted concentrations are below the acute and chronic screening criteria, a rating of "low" magnitude was selected.
Geographic Extent	Local	The air modelling provided predicted air concentrations of the COPCs at specific receptor locations within the air quality LSA. Although there were no exceedances of the applicable air threshold for $PM_{2.5}$, the highest concentrations in air occurred at several receptor locations closest to the near the Mine (e.g., Receptor 1 and 22) as opposed to along the AWAR or near/in Rankin Inlet.
Duration	Long-term	Given that emissions of $PM_{2.5}$ could occur outside the operations phase, it is possible that emissions could pose a potential health risk during the construction, active closure or post-closure phases.
Frequency	Isolated	There were no exceedances of screening criteria based on 1-hr and annual averaging period predicted concentrations during the operation year with the higher air emissions rate.
Reversibility	Reversible	Any adverse health effects are expected to improve once exposure to the COPC is reduced or ceased.
Likelihood	Unlikely	Given that the assessment relies on predictive air modelling and toxicity data, both of which are associated with uncertainty and conservatism, it is unlikely a health effect due to $PM_{2.5}$ will occur (see below).
Certainty	Conservatism and Uncertainty	
	In the Predictive Air Quality Modelling	The concentrations of $PM_{2.5}$ considered in the risk assessment were the predicted peak 24-hour and annual concentrations from the 5-year modelling dataset for each of the six scenarios considered for the operations phase of the Mine. It was conservatively assumed that the Mine operated continuously at its maximum design capacity over the duration of the 5 years of modelling.

Effects Criteria	Criteria Classification	Rationale
	In the Receptor Characteristics and Exposure Scenarios	The selected receptors were considered to be members of the public that may include the very young and elderly, who may have special sensitivities to respiratory effects of $PM_{2.5}$. The selected thresholds are based on health, although whether sensitive subpopulations were accounted for in the derivation of the thresholds could not be determined because no supporting documentation is available.
	In the Selected Thresholds	The selected thresholds were the CAAQS for 2025: 27 µg/m^3 (24-hour) and 8.8 µg/m^3 (annual). Supporting documentation is not available for the CAAQS.
	In the Assessment Approach	There is limited risk assessment guidance for assessing non-threshold substances. Although predicted air concentrations are below recently updated WHO (2021) AQG, Health Canada (2016c) states that there is no safe concentration for $PM_{2.5}$. Air quality monitoring is ongoing at the Meliadine Mine. Constituents monitored include NOx, SO_2, TSP, PM_{10}, $PM_{2.5}$, and dust. Calculated 24-hour average concentrations of PM_{10} and $PM_{2.5}$, as measured in 2020, were below the Government of Nunavut Ambient Air Quality Standards/BC Ambient Air Quality Objectives and maximum predicted concentrations from the 2014 FEIS.
Residual Impact Significance	Not Significant	The overall impacts with respect to predicted $PM_{2.5}$ concentrations in air are not expected to be significant to members of the public in the LSA because there are no receptor locations with predicted exceedances of the CAAQS based on conservative modelling assumptions. $PM_{2.5}$ is monitored as part of the Air Quality Monitoring Plan, which will continue with the Meliadine Extension.

HQ = hazard quotient; COPC = chemical of potential concern; LSA = local study area; CAAQS = Canadian Ambient Air Quality Standard; WHO = World Health Organization; AQG = air quality guideline; FEIS = Final Environmental Impact Statement.

Table 10.3-27: Significance of Residual Impacts for Arsenic for Recreational Users (Chronic)

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	Arsenic was evaluated for carcinogenic effects over a lifetime, which is considered to be a chronic exposure. Drinking water with high levels of arsenic can increase the risk of cancers of the internal organs including bladder, liver, and lungs (Health Canada 2006).
Magnitude	Low	The estimated ILCR of $5x10^{-5}$ for arsenic is greater than the target of $3x10^{-5}$, but less than $1x10^{-4}$.
Geographic Extent	Local	The potential effect for water consumption is limited to only one lake during post-closure: Saline Pond B7.
Duration	Long-term	The duration of the conditions causing the effect is classified as long-term, given that arsenic exceedances occur in Saline Pond B7 throughout Post-Closure.
Frequency	Continuous	The maximum predicted arsenic concentration in Saline Pond B7 during the Post-Closure phase (2051 to 2119) of 45 µg/L was used in the risk calculation. Using the median or average predicted concentration of 34 µg/L yielded an ILCR of $4x10^{-5}$, which is higher than the target ILCR of $3x10^{-5}$. Therefore, the frequency of exceedances is considered to be continuous.
Reversibility	Irreversible	The effect may result in an increase in cancer risk over the negligible cancer risk level adjusted for the arsenic MAC (i.e., $3x10^{-5}$).
Likelihood	Unlikely	Saline Pond B7 is unlikely to be used by members of the public as a drinking water source. Meliadine Lake, which is very close, or Meliadine River are currently used as sources of drinking water. There are no cabins located near Saline Pond B7.
Certainty	Conservatism and Uncertainty	
	In the Predictive Water Quality Modelling	The water balance and site water quality model considered the proposed mine plan at the time of the assessment. Primary factors that can affect confidence in the modelling results include the availability and accuracy of the baseline data, level of understanding of the existing conditions and range of natural and seasonal variation, accuracy and certainty in the source terms, accuracy and certainty in the models and modelling software, and certainty associated with effectiveness of proposed mitigations. Uncertainty was managed by incorporating conservative estimates, inputs, and assumptions to minimize underestimating predicted concentrations.
	In the Receptor Characteristics and Exposure Scenarios	Members of the public were assumed to utilize Saline Pond B7 as a potable drinking water source for two weeks a year during post-closure; however, this is unlikely as there are more attractive sources close by (e.g., Meliadine Lake, which has historically been used as a drinking water source). It is possible that Saline Pond B7 may be used as an emergency drinking water source (7 days or less per year); under this situation the estimated ILCR is less than the target ILCR of $3x10^{-5}$.
	In the Selected TRV	There is limited information on the mode of action for arsenic carcinogenicity. A non-linear model was used to estimate the slope factor for internal organ cancers, which may result in an overestimate of risks (Health Canada 2006). The Government of Canada's Priority Substances List Assessment Report on Arsenic (Government of Canada 1993) provides estimates of total daily exposure to inorganic arsenic from environmental sources ranging from 0.1 to 2.6 µg/kg/day, which includes exposure via drinking water. In areas near mining point sources, exposure may be up to 35 µg/kg/day. These exposures would correspond to ILCRs of $1.5x10^{-4}$ to $3.9x10^{-3}$ for the general population, and up to $5.9x10^{-2}$ in populations near mining point sources. The estimated ILCRs for this HHRA are at the low end to middle of the range of background exposure for the general Canadian population and are much lower than the background estimates near mining point sources. The Health Canada slope factor is therefore considered to be conservative.
Residual Impact Significance	Not Significant	With respect to adverse health effects linked to arsenic in surface water of Saline Pond B7, the overall impacts are not considered to be significant to members of the public because it is unlikely Saline Pond B7 will be used as a source of drinking water considering recreational use is unlikely (i.e., fish will not be present during post-closure) and Meliadine Lake provides a more favorable source of drinking water.

ILCR = incremental lifetime cancer risk; MAC = maximum acceptable concentration.

Table 10.3-28: Significance of Residual Impacts for Noise for Recreational Users

Effects Criteria	Criteria Classification	Rationale
Direction	Negative	There is a potential for annoyance due to elevated noise levels predicted as a result of the Meliadine Extension. The main contributor to the change in noise levels at Tommy's cabin (NPOR017) is truck traffic on the AWAR approximately 150 m away, and at another cabin (NPOR006) is the wind turbines nearby.
Magnitude	Low to Moderate	The magnitude of the health effect is classified as low for the cabin near the wind farm (NPOR006) and moderate for Tommy's cabin (NPOR017) near the AWAR.
Geographic Extent	Local	There are only two locations at which noise levels were retained in the residual impact analysis. Tommy's cabin (NPOR017) is located approximately 150 m from the AWAR close to Rankin Inlet, and the anticipated change in noise levels is due to traffic on the AWAR. The other cabin (NPOR006) is located closer to the Mine site near the wind farm. These locations are within the noise LSA and as such, the geographic extent of the impact is classified as local.
Duration	Long-Term	The duration of the conditions causing the effect is classified as long-term, given that traffic on the AWAR and the operation of the wind farm would be expected for the construction, operations, and closure phases of the Mine.
Frequency	Continuous	The frequency of the condition causing the effect is classified as continuous given that the average level of traffic was modelled as 2 trucks per hour for 24 hours per day during the operations phase. Therefore, while the noise is intermittent, it occurs several times each day. The wind turbines are expected to be in operation continuously during the life of the Mine.
Reversibility	Readily Reversible	The effect (i.e., annoyance) is readily reversible, given that once the level of traffic is reduced or the wind farm dismantled, the level of annoyance will also be reduced.
Likelihood	Possible	The likelihood of the effect occurring is possible, given that annoyance is a highly subjective effect and certain individuals may be more sensitive than others. Given that 6.5% is considered to be the minimum change in noise levels required to change community reaction, the level of 6.5% is intended to protect more sensitive individuals.
Certainty	Conservatism and Uncertainty in the Predictive Noise Modelling	For Tommy's cabin (NPOR017), the change in %HA from the Approved Project is relatively small (0.7% change); a larger change was predicted for the other cabin (NPOR006) due to proximity to the wind turbines (2.6%). Conservative assumptions were employed including assuming all receptor locations are downwind and only considering terrain features as acoustical barriers. These assumptions likely overestimated noise levels. Noise monitoring at the Mine site and along the AWAR are ongoing. Monitoring data collected since 2016 shows sounds levels at selected stations within the 2014 FEIS predictions and the noise monitoring criterion of 45 dBA ($L_{eq(24\ h)}$).
Residual Impact Significance	Not Significant	This change in noise level was considered to be a low to moderate magnitude of effect, depending on the location. Additionally the potential for the effect occurring is possible, and may occur continuously given that the change in noise levels is due to truck traffic, which amounts to 2 trucks per hour for 24 hours per day during the operations phase and the expected continuous operation of the wind turbines. Given that the percent highly annoyed measure is intended to be protective of the most sensitive individuals and the predicted percent highly annoyed measure only slightly exceeded the target, the potential residual effect is not considered to be significant.

AWAR = All-weather Access Road; %HA = percent highly annoyed; LSA = local study area; $L_{eq(24\ h)}$ = equivalent continuous sound level averaged over a 24-hour period.

10.3.9 Cumulative Effects Assessment

Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, cultural, and economic components of the environment through time and across space. Some changes may be human-related, such as increasing industrial development, and some changes may be associated with natural phenomenon, such as extreme rainfall events, and periodic harsh and mild winters. It is the goal of the cumulative effects assessment to estimate the contribution of these types of effects, in addition to project effects, to the relative change in the VECs or VSECs.

With respect to natural phenomena, these do not have a direct influence on human health and as such were not considered further. However, human-induced influences, including past, present, and foreseeable future industrial developments, could potentially have a cumulative effect on human health should they result in significant changes to environmental quality (e.g., air quality, water quality). The past, present, and foreseeable future industrial developments are described in Appendix B-1. The potential cumulative effects of these developments and their influence on environmental quality are discussed in the relevant sections of the FEIS Addendum as listed below:

- Atmospheric environment, specifically the following components:
  - Air quality (Section 5.2)
  - Noise (Section 5.5)
- Terrestrial Environment, specifically the following components:
  - Soil and terrain (Section 6.4)
  - Vegetation (Section 6.5.2)
- Freshwater Environment, specifically the following components:
  - Surface water and sediment quality (Section 7.4.2)
  - Fish and fish habitat (Section 7.5.2)
- Marine Environment, specifically the following components:
  - Surface water and sediment quality (Section 8.2.2)
  - Biological environment (Section 8.2.2)
- Socio-economic environment, specifically the following components:
  - Population demographics (Section 9.2)
  - Traditional knowledge and traditional land use (Section 9.12).

As indicated in these sections, quantitative predictions of changes to environmental quality due to other developments were not carried out for air quality, noise, and surface water and sediment quality. Qualitative assessments, were, therefore carried out for all relevant sub-disciplines.

As indicated in these other sections, cumulative effects to air quality, noise, and surface water and sediment quality are expected to be negligible. Therefore, the subsequent effects to human health are also expected to be negligible.

10.3.10 Uncertainty

Consistent with the uncertainty identified for the 2014 FEIS, the key uncertainties that apply to the Meliadine Extension and the human health risk assessment are described in Table 10.3-29. A detailed discussion of uncertainty related to the assessment of ecological health is available in Section 10.2.10.

Table 10.3-29: Uncertainties in the Human Health Risk Assessment

Source of Uncertainty	Overestimate/ Underestimate/ Neutral?
Model Predictions	
The concentrations of NO_2 and SO_2 in air considered in the HHRA were the predicted maximum concentrations from one year of the operation phase that was considered to have the highest anticipated total air emission rates during the projected LOM plan (as of August 2021). It was conservatively assumed that the human receptors would be exposed to the maximum emissions throughout each phase of the Project.	Overestimate
Not all of 2021 receptor locations modelled for NO_2, SO_2, and noise are the same as the 2014 HHERA receptor locations. However, the 2021 receptor locations are generally located closer to the Mine site and are considered to have higher exposure than the receptor locations previously assessed in the 2014 HHERA. In addition, receptor locations that are the same between the 2014 HHERA and the 2021 air/noise receptor locations include receptor locations that had the highest residual impacts (e.g., Receptors 1 and 22 in the 2014 HHERA).	Neutral
Air predictions for remaining indicator compounds considered in the HHRA were not remodeled because changes in emission rates due to the Meliadine Extension are not expected.	Neutral
The concentrations of COPCs in water considered in the HHERA were the maximum monthly predictions over 24 years of modelled data during the operations phase (2024 to 2043) of the Project for Meliadine Lake, and over 69 years of data for the post-closure phase of the Project (2051-2119) for the small waterbodies and pit lakes. It was conservatively assumed that the human receptors would be exposed to the maximum concentration throughout each phase of the Project.	Overestimate
HHRA Assumptions	
The HHRA evaluated Saline Pond B7 as a potential drinking water source for human receptors during extended hunting trips (e.g., 14 days per year). However, it is unlikely that human receptors would be using Saline Pond B7 as a source of drinking water considering recreational use is unlikely (i.e., fish will not be present during post-closure) and Meliadine Lake provides a more favorable source of drinking water.	Overestimate
The noise assessment included a number of conservative assumptions to account for the level of uncertainty inherent in the noise level predictions. Most importantly, each receptor was assumed to be downwind from each source 100% of the time. Because downwind conditions tend to enhance noise propagation, this assumption is conservative and likely overestimates the noise levels from the Meliadine Extension. In addition, terrain features were the only acoustical screening elements considered in the noise model. Acoustical screening from anthropogenic features (e.g., buildings) and acoustical screening from vegetation were not considered in the computer model. This is a conservative approach to modelling noise from the Meliadine Extension.	Overestimate
The toxicity reference values used in the HHRA for human health were selected from reputable sources including Health Canada and the U.S. EPA. The TRVs used in this RA are generally based on the most sensitive endpoints, with the application of safety factors to protect sensitive subpopulations. The uncertainty associated with TRVs is highly dependent on the number of studies available, and whether the key study was based on humans (low uncertainty) or small mammals (high uncertainty). When few studies are available, several types of safety factors must be applied to account for this uncertainty (e.g., factors for inter- and intraspecies sensitivity).	Neutral-overestimate
Other uncertainties are described in Table 10.3-22 to 10.3-29.	Overestimate

10.3.11 Monitoring and Follow-up

As described in Section 10.1.8, Agnico Eagle has prepared and follows numerous monitoring plans in compliance with the terms and conditions identified in Project Certificate No.006 and Water Licence 2AM-MEL1631. In addition, Agnico Eagle has updated management and monitoring plans to support the NIRB review process for the Meliadine Extension FEIS Addendum. The purpose of monitoring is to support management of the site, to manage risk, compare monitoring data to predictions, identify if there are issues, and implement additional mitigation (if required).

Monitoring and follow-up as described by other disciplines in the Application are applicable. These include continued monitoring of air quality criteria air contaminants (e.g., NO_2, $PM_{2.5}$, PM_{10}) under the Air Quality Monitoring Plan, of water quality (e.g., arsenic) under the Aquatic Effects Monitoring Plan, and noise under the Noise Abatement and Monitoring Plan. No additional monitoring or follow-up measures were identified in the HHERA.

10.4 Summary of the HHERA for the Meliadine Extension

10.4.1 Ecological Health Risk Assessment

The residual impacts related to ecological health were the same as the 2014 HHERA except as noted below:

- Potential chronic health risks for aquatic life to cobalt (Lake A8 West, TIRI Pit Lake and Pump Pit Lake) and copper (Pump Pit Lake) were identified in the Surface Water Quality Assessment as described in Section 10.2.7.6.
    - The 2014 HHERA identified residual effects for the health of aquatic life for copper in Lake CH and Tiriganiaq Pit Lake; however, these were expected to be not significant.
    - The overall objectives of the water management strategy have not changed since the 2014 FEIS (i.e., surface contact water will be intercepted and diverted to contact water attenuation ponds and treated before discharge). However, changes to the water management and infrastructure on site required a refinement of the site water balance model (Appendix H-07). This model provided updates to predicted quantity and quality of water to be managed on site, but also updates to quantity and quality of water to be discharged to Meliadine Lake.
    - With respect to adverse health effects on aquatic linked to cobalt in surface water of Lake A8 West, TIRI Pit Lake and Pump Pit Lake, and to copper in surface water of Pump Pit Lake, the overall impacts are not considered to be significant to aquatic life because the conditions causing the residual effect are of low magnitude, the health effect is considered to be reversible for populations, and the overall potential for the aquatic health effect to occur is considered to be unlikely.

In conclusion, the potential risks to ecological health were similar to those assessed in the 2014 FEIS, and are determined to be acceptable.

10.4.2 Human Health Risk Assessment

The residual impacts related to human health were the same as the 2014 HHERA except as noted below:

- As in the 2014 HHERA, potential acute health risks for recreational users due to aldehyde and DPM were identified in the Acute Air Quality Assessment as described in Section 10.3.7.4.
    - With respect to acute health effects, the overall impacts are not considered to be significant to members of the public in the LSA because the conditions causing the residual effect are of low magnitude, are considered to occur infrequently, and the overall potential for the health effect to occur is considered to be unlikely.
- The 2014 HHERA identified residual impacts for mine workers exposed to chemicals in air at the Exploration Camp. The current assessment assumed the Exploration Camp is within the Mine disturbed footprint and would be managed under an occupational health and safety program for both air quality and noise. As such, the Exploration Camp was not assessed in the current assessment.
- Since the 2014 HHERA, Health Canada has issued guidance that NO_2, PM_{10}, and $PM_{2.5}$ are to be assessed as non-threshold chemicals. Therefore, these criteria air contaminants were assessed using the same approach as the other threshold COPCs (i.e., following a HQ approach and residual effects characterization).
    - HQs are less than 1 for all receptor locations and mining scenarios as shown in Section 10.3.7.4.
    - The overall impacts with respect to predicted NO_2, PM_{10}, and $PM_{2.5}$ concentrations in air are not expected to be significant to members of the public in the LSA because there are no receptor locations with predicted exceedances of the CAAQS (for NO_2 and $PM_{2.5}$) or other stringent air quality guidelines (i.e., WHO AQG for PM_{10}) based on conservative modelling assumptions. These chemicals are monitored as part of the Air Quality Monitoring Plan, which will continue with the Meliadine Extension.
- Potential chronic health risks for recreational users due to arsenic in drinking water in Saline Pond B7 were identified in the Surface Water Quality Assessment as described in Section 10.3.7.7.
    - No residual effects due to changes in water quality were identified in the 2014 HHERA.
    - The overall objectives of the water management strategy have not changed since the 2014 FEIS (i.e., surface contact water will be intercepted and diverted to contact water attenuation ponds and treated before discharge). However, changes to the water management and infrastructure on site required a refinement of the site water balance model (Appendix H-07). This model provided updates to predicted quantity and quality of water to be managed on site, but also updates to quantity and quality of water to be discharged to Meliadine Lake.
    - With respect to adverse health effects linked to arsenic in surface water of Saline Pond B7, the overall impacts are not considered to be significant to members of the public because it is unlikely that human receptors would not be using Saline Pond B7 as a source of drinking water considering recreational use is unlikely (i.e., fish will not be present

during post-closure) and Meliadine Lake provides a more favorable source of drinking water.

- Noise impacts for recreational users at two hunter/trapper cabins were identified in the Noise Assessment as described in Section 10.3.7.9.
  - The 2014 HHERA identified the potential for annoyance due to elevated noise levels at one cabin (Tommy's cabin). The main contributor to the change in noise levels at Tommy's cabin is truck traffic on the AWAR approximately 150 m away.
  - The current assessment also identified the potential for annoyance due to elevated noise levels at a cabin located near the proposed windfarm. The operation of the windfarm is a new pathway for the Meliadine Extension.
  - Given that the percent highly annoyed measure is intended to be protective of the most sensitive individuals and the predicted percent highly annoyed measure only slightly exceeded the target, the potential residual effect is not considered to be significant.

In conclusion, the potential risks to human health were similar to those assessed in the 2014 FEIS, and are determined to be acceptable.

11 ACCIDENTS AND MALFUNCTIONS

11.1 Introduction

Agnico Eagle is committed to protecting the health and safety of all its workers, community members, and the environment, and to adhering to all legislated safety standards. There is an understanding that accidents can occur, but with proper prevention and mitigation measures, emergency response planning, training, and preparation will substantially reduce the risk, frequency, and severity of such incidents.

The types of major accidents and malfunctions that may occur, specifically tied to Meliadine Extension activities, include the windfarm and aircraft incidents. Other potential accidents or malfunctions (i.e., vehicle accidents, spills, fires, on-site pipe malfunctions, waterline failure) have already been assessed and Management Plans are approved to ensure appropriate mitigation measures are in place. It is not anticipated that the risks of accidents or malfunctions (e.g., vehicle accidents, spills) would increase or change as a result of Meliadine Extension activities.

The Roads Management Plan is in place to address vehicle accidents along the AWAR. Consultations on the AWAR with the community of Rankin Inlet, Inuit Elders, HTO, and KivIA are ongoing from as early as 2004 (refer to the Roads Management Plan for further details) where feedback has guided mitigation measures to prevent potential accidents or malfunctions, such as signage for snowmobiles for safe crossings. Additional safety measures include, but are not limited to, holding public information sessions in Rankin Inlet for AWAR users on a regular basis (minimum of twice per year), placing an emergency spill response sea can at Km 7 and Km 18 along the AWAR which has the necessary spill response supplies to address any spills that could occur along the road in an emergency situation.

Should a spill occur from on-site water management infrastructure (e.g., pipe), these would continue to report to a pit, pond, or area where water would be recovered and redirected to contact ponds. Any potential impacts would be within the Meliadine Mine footprint and applicable mitigation measures would apply.

For the waterline specifically, as part of the 2020 FEIS Addendum (Agnico Eagle 2020a), Agnico Eagle made commitments to address concerns raised about potential malfunctions of the waterline. Issues raised during engagement opportunities for the waterline (Agnico Eagle 2020d, Public Registry ID 331287) included health and safety whereby Agnico Eagle committed to implement an emergency response number, place markers along the waterline, and install a leak detection system to monitor the waterline for leaks. As a result of the waterline NIRB review process, Agnico Eagle made additional commitments to mitigate potential accidents or malfunctions of the waterline, such as:

- testing the waterline prior to each discharge season;
- applying mitigation to prevent saline water from entering the waterbody at the three bridge crossings; and

- integrating the operation and maintenance component of the waterline system into an existing management plan which will include a decision framework, similar to the one included in the Road Management Plan, to assist in management of operation of the waterline during caribou migration.

An Airstrip Use Management Plan (Appendix D-03) and Windfarm Management Plan (Appendix D-36) have been developed to support these new activities so that appropriate management and monitoring objectives are implemented. Details of potential accidents and malfunctions are provided below.

11.2 Windfarm

11.2.1 Ice Fall and Ice Throw

Ice can accumulate on the rotor blades of a wind turbine when the ambient temperature and relative humidity are at certain levels. When icing conditions exist, wind turbines are no more prone to ice accretion than other large outdoor structures and, as with other structures, the ice will eventually either melt, sublimate, or fall to the ground.

When the turbine is operational, and the blades are rotating, two additional factors affect the rate of ice accretion. The relative velocity of the rotor blades tends to increase the rate of accretion, whereas the flexing of the blades tends to decrease the rate of accretion. Ice that detaches from the rotating blades may be thrown from the blades and will land within the plane of the wind turbine rotor or downwind of the turbine. The distance range of falling ice depends on the blade position, the height of the tower and the wind speed and direction. Studies have shown that the maximum ice throw would be 1.5 times the total height (1.5 x 149.5m = 225m) but it rarely goes that far.

The turbines will be equipped with an ice detection system which is based on a specially developed power curve analysis method. During operation, the ice detection system compares the operation data such as wind, power, and blade angle with the recorded long-term mean values. If changes in the aerodynamic properties of the rotor blade due to ice accumulation are detected, the turbine will be brought to a halt and will remain shut-down until the imbalance has been corrected. This would significantly reduce the potential for ice throw.

As the proposed wind turbine locations are located approximately 25 km north of Rankin Inlet and 430 m from the closest cabin, ice throw is not expected to present a hazard to the general public.

Along the access roads located within the ice throw area, signs will be posted to notify road users of the potential for ice throw. Traffic along these access roads may be shut-down when the ice detection system shows imbalance and until the turbine are brought to a halt or imbalance has been corrected. Operation and maintenance personnel will be briefed on the potential for ice fall and ice throw, and operational procedures will be developed to minimize the risk. The safety risk due to ice fall and ice throw is expected to be minimal.

11.2.2 Aeronautical Obstruction

The wind turbines will reach a maximum height which may present a hazard to low-flying aircraft. Transport Canada and NAV Canada will be consulted with respect to the proposed windfarm's potential impacts on air navigation.

As per Transport Canada's *Standard 621 for obstruction marking and lighting*, the wind turbines will be indicated to pilots by installing CL-864 lights on specified turbines, such as the windfarm indicators (i.e., turbine on the perimeter of the windfarm) and the dominant turbine (i.e., highest height above mean sea level).

The risk of the wind turbines impacting low-flying aircraft is expected to be minimal.

11.2.3 Equipment Failure

Like any piece of complex operating equipment, there is possibility for component failures (e.g., generator, rotor blade, bearing, collapse). Equipment failure presents a safety risk to the operation and maintenance personnel. The causes of the equipment failure for the windfarm include but are not limited to foreign object damage including ice throw, poor design, power regulator failure, and improper installation, operation, and/or maintenance. To mitigate the potential for equipment failure, the wind turbines will be installed according to the manufacturer specifications, will meet national and international standards for windfarms (CSA 2008; IEC 2005), and will be equipped with ice detection system and lightning protection system. Operation and maintenance procedures will be developed and personnel will be properly trained to perform inspections of the equipment.

11.2.4 Fire

The use of flammable materials and failure or malfunction of electrical/electronic equipment may result in fire. Fire presents a risk to human safety while the use of chemicals for fire suppression may present a risk to terrestrial valued components. During construction and operational phases of the windfarm, the Windfarm Management Plan will be implemented to reduce the risk of fire. The wind turbines will also be equipped with lightning protection system. These mitigation measures are expected to minimize the risk of fire. In the unlikely event of a fire, Agnico Eagle's Risk Management and Emergency Response Plan will be implemented.

11.3 Aircraft Incidents

Should the option to build the on-site airstrip advance, aircraft failure presents a safety risk to the public and worker personnel, as well as potential impacts to the environment. The causes of the aircraft incidents include, but are not limited to, improper maintenance, poor weather conditions, and operation and/or maintenance failure. While these incidents could occur, the likelihood of a major accident is considered highly unlikely (refer to the Risk Management and Emergency Response Plan; Appendix D-29) given preventative measures.

Federal aviation requirements that include extensive safety and preventative maintenance programs to ensure the safe operation of aircraft would be followed. Agnico Eagle has been operating the Meadowbank Complex airstrip since 2010 and has well-established emergency response plans that would be applied at Meliadine. In addition, a well-maintained airstrip with acceptable markings, lighting, electronic beacons, and weather reporting services defined in consultation with air carriers would be in place.

12 MITIGATION, MANAGEMENT, AND MONITORING PLANS

12.1 Introduction

This Application constitutes additional information as it relates to Meliadine Extension; however, Agnico Eagle feels that the new activities associated with Meliadine Extension can be managed under the robust existing management plans and that Project Certificate No.006 does not require T&C reconsiderations. Therefore, Agnico Eagle has updated its mitigation, monitoring, and management plans (i.e., operational plans) already in place for the Meliadine Mine in support of Meliadine Extension.

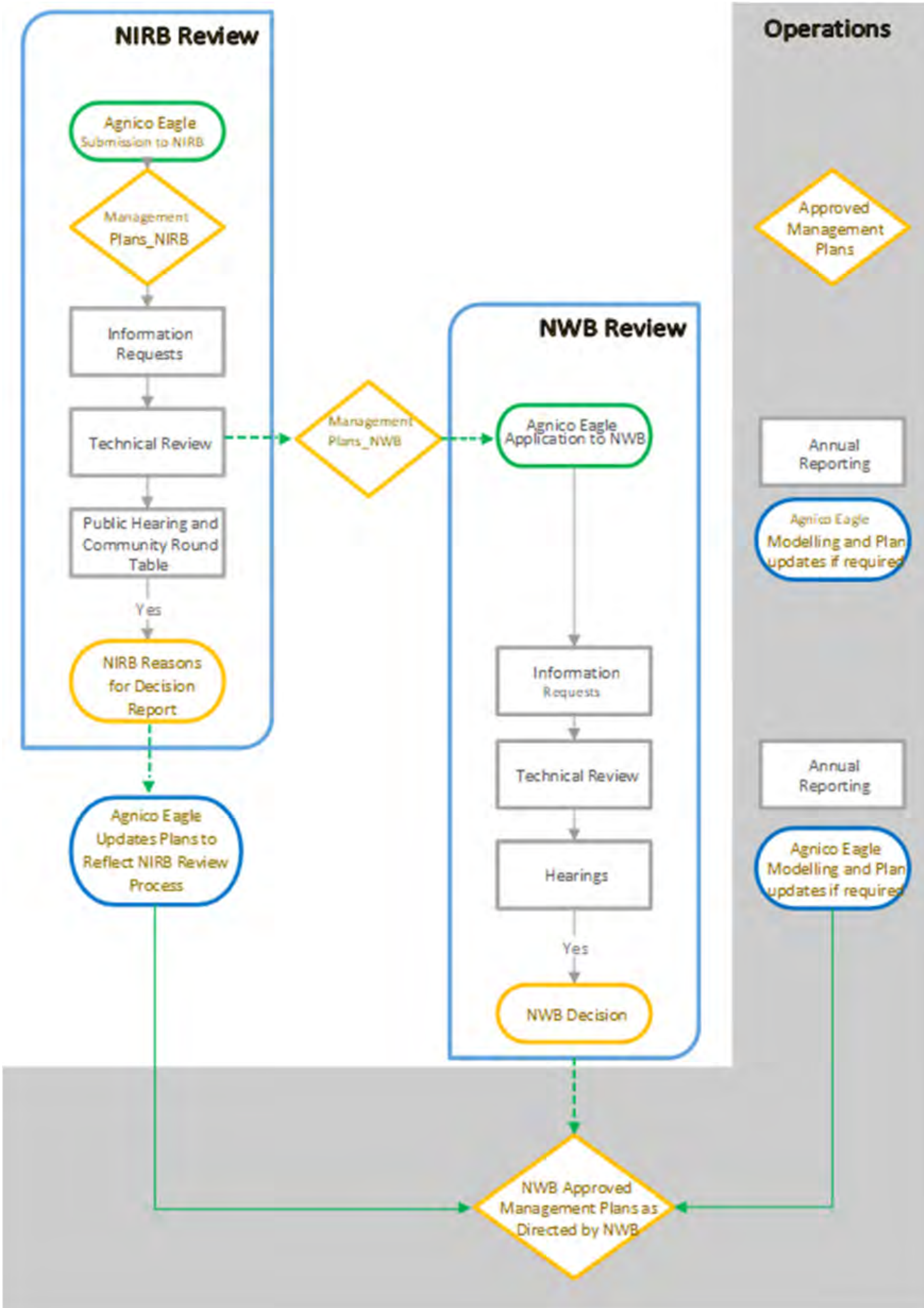
Agnico Eagle has indicated the plans submitted in support of the NIRB review includes "_NIRB" (both in the file name and version history). These plans are living documents which will evolve as the Meliadine Mine advances and are updated to reflect changes in operation, technology, direction or requests made by the NIRB and/or NWB, and subsequent approvals for the project.

The review of Management Plans is an iterative process throughout the environmental assessment phase and permitting stage for a project. Figure 12.1-1 provides an overview of the key touch points for review of the Management Plans, including the following:

1) **Management Plans submission to NIRB:** _NIRB updates have been included in this submission to support this Application;
2) **Management Plans to NWB:** To be provided in response to NWB Information Requests and NIRB review comments/ recommendations. Management Plans will integrate where possible, additional works and updated modelling results completed by Agnico Eagle, responses, commitments and directions resulting from the NIRB process; and
3) **Final Approved Management Plans:** To be provided following NWB issuance of Type A Water Licence, where required. Management Plans will integrate where possible, additional works completed by Agnico Eagle, responses, commitments, and directions resulting from the NWB process.

Once approved, Agnico Eagle will implement the Management Plans as directed by the NIRB and NWB in accordance with the Type A Water Licence.

Figure 12.1-1: Technical Review and Management Plans



12.2 Management Plans Submitted to NIRB

Agnico Eagle has updated management and monitoring plans to support the NIRB review process for this Application based on the following criteria:

- Management Plans that are referenced and revised due to Meliadine Extension.
- Management Plans that are referenced in Project Certificate No.006 (i.e., plans that were submitted by Agnico Eagle to NIRB to comply with Project Certificate No.006).

Agnico Eagle has defined five categories of Management Plans formatted for review of Meliadine Extension as follows:

1) **Level 0 Not Updated:** Management Plans are superseded since submission of the 2014 FEIS (Agnico Eagle 2014) or no updates (these are submitted for ease of regulatory review).
2) **Level 1 Updated Management Plan:** Where mitigation and monitoring practices are approved (as required) and already in place for the Meliadine Mine. These approved Management Plans are submitted for ease of regulatory review. Level 1 includes updates such as updates to the layout or terminology to include Meliadine Extension.
3) **Level 2 Updated Management Plan:** Where mitigation and monitoring practices are approved (as required) and already in place for the Meliadine Mine. These approved Management Plans are submitted for ease of regulatory review. Level 2 includes updates such as new sampling stations or new infrastructure, but mitigation and monitoring strategies do not change as a result of Meliadine Extension activities.
4) **Level 3 Updated Management Plan:** Where mitigation and monitoring practices are approved (as required) and already in place for the Meliadine Mine. Level 3 includes updates where new residual effects were identified as part of the Meliadine Extension and new mitigation or monitoring measures are required within the plan, when a change in mitigation and monitoring strategy is being proposed, or a revamp to facilitate implementation by the operation and/or enforcement by the inspector.
5) **Level 4 New Management Plan:** Wherein a plan was not previously in place and a new plan was developed to account for Meliadine Extension activities.

For complete list of plans and additional information, refer to Table 12.2-1.

Table 12.2-1: List of Monitoring, Mitigation, and Monitoring Plans for Meliadine Extension

Management Plan Title for Meliadine Extension Application NIRB Submission	Current Plan		Category for this Application	Application Appendix Reference	Note
	Project Certificate No.006	Type A Water Licence 2AM-MEL1631			
Adaptive Management Plan-v2_NIRB		February 2021, v1	Level 2	D-01	
Air Quality Monitoring Plan-v4_NIRB	June 2020; v3		Level 1	D-02	
Airstrip Use Management Plan-v1_NIRB			Level 4	D-03	Developed to support the option/alternative of an on-site airstrip
Ammonia Management Plan-v4_NIRB		March 2021, v3	Level 1	D-04	
Aquatic Effects Monitoring Plan-v2_NIRB		June 2016, v1	Level 1	D-05	
ARD-ML Testing Plan-v1_NIRB			Level 4	D-06	Developed to support Meliadine Extension
Blast Monitoring Plan-v4_NIRB		March 2021, v3	Level 1	D-07	
Borrow Pits and Quarries Management Plan-v7_NIRB		March 2018, v6	Level 1	D-08	
Bulk Fuel Storage Facility: Environmental Performance Monitoring Plan-v2_NIRB		August 2019, v1	Level 1	D-09	
Business Development Plan	April 2014, v3		Level 0	n/a	Superseded by IIBA
Community Involvement Plan	April 2014, v3		Level 0	n/a	Superseded by IIBA
Cultural and Heritage Resources Protection Plan-v2_NIRB	April 2012, v1		Level 1	D-10	
Dust Management Plan-v7_NIRB		June 2020, v6	Level 1	D-11	
Environmental Management Protection Plan-v10_NIRB		March 2019, v9	Level 3	D-12	
Explosives Management Plan-v8_NIRB	March 2021, v7		Level 1	D-13	
Greenhouse Gas Reduction Plan-v2_NIRB	January 2019, v1		Level 1	D-14	
Hazardous Materials Management Plan-v6_NIRB		March 2018, v5	Level 1	D-15	
Human Resources Plan	April 2014, v3		Level 0	n/a	Superseded by IIBA
Incineration and Composter Waste Management Plan-v7_NIRB		February 2019, v6	Level 2	D-16	
Itivia Bulk Fuel Storage Facility Management Plan-v2_NIRB		August 20190, v1	Level 1	D-17	
Conceptual Closure and Reclamation Plan		2020	Level 2	D-18	
Landfarm Management Plan-v4_NIRB		February 2019, v3	Level 3	D-19	
Landfill and Waste Management Plan-v8_NIRB		March 2019, v7	Level 1	D-20	
Mine Waste Management Plan-v9_NIRB		August 2021, v8	Level 3	D-21	
Noise Abatement and Monitoring Plan-v4_NIRB	March 2020, v3		Level 2	D-22	

Management Plan Title for Meliadine Extension Application NIRB Submission	Current Plan		Category for this Application	Application Appendix Reference	Note
	Project Certificate No.006	Type A Water Licence 2AM-MEL1631			
Occupational Health and Safety Plan	April 2014, v3		Level 0	D-23	Provided for NIRB reference.
Ocean Discharge Monitoring Plan-v5_NIRB	October 2021, v4	n/a	Level 2	D-24	
OPEP/OPPP-v5	June 2021, v5	n/a	Level 0	D-25	Provided for NIRB reference.
Conceptual Fish Offsetting Plan_NIRB		April 2014, v0	Level 3	D-26	
Ore Storage Management Plan-v4_NIRB		March 2021, v3	Level 1	D-27	
Quality Assurance / Quality Control-v4_NIRB		March 2019, v3	Level 1	D-28	
Risk Management and Emergency Response Plan includes Accident and Malfunctions-v5_NIRB		April 2015, v4	Level 1	D-29	
Roads Management Plan-v9_NIRB		December 2019, v8	Level 3	D-30	
Shipping Management Plan-v9_NIRB	March 2019, v8		Level 1	D-31	
Socio-Economic Management Plan	April 2014, v1		Level 0	n/a	Superseded by IIBA
Socio-Economic Monitoring Program	May 2019, v3		Level 0	D-32	Provided for NIRB reference.
Spill Contingency Plan-v12_NIRB		December 2019, v10	Level 1	D-33	
Terrestrial Environment Management and Monitoring Plan-v4_NIRB	June 2020, v3		Level 1	D-34	
Wildlife Protection and Response Plan-v9_NIRB	January 2019, v8		Level 1		Is an appendix to Terrestrial Environment Management and Monitoring Plan
Water Management Plan-v12_NIRB		August 2021, v11	Level 3	D-35	
Groundwater Management Plan-v8_NIRB		August 2021, v7	Level 3		Is an appendix to Water Management Plan
Freshet Action Plan-v7_NIRB		March 2020, v6	Level 3		Is an appendix to Water Management Plan
Sediment and Erosion Management Plan-v4_NIRB		March 2021, v3	Level 1		Is an appendix to Water Management Plan
Water Quality and Flow Monitoring Plan-v3_NIRB		March 2020, v2	Level 2		Is an appendix to Water Management Plan
Water Quality Management and Optimization Plan		August 2021, v4b	Level 0	n/a	Plan was submitted to NWB to address Water Licence Amendment Part F, Item 9
Windfarm Management Plan-v1_NIRB			Level 4	D-36	Developed to support windfarm as part of Meliadine Extension

13 CONCLUSIONS

This Application provides an evaluation of the potential incremental biophysical and socio-economic effects of the Meliadine Extension. It provides descriptions of Meliadine Extension design features and mitigations that will be implemented to remove or minimize potential adverse effects to VCs in the Meliadine Mine area. Existing management and monitoring plans were modified where required to assess the validity of the Meliadine Extension impact predictions made.

Agnico Eagle is committed to protect the environment, as well as public and worker health and safety by conducting operations in an environmentally sound manner while pursuing continuous improvement of its environmental performance.

Sustainable development of the Meliadine Extension will continue to contribute to the economic development of Nunavut. Agnico Eagle will continue to lend support to the vision and contribute to the goals of Inuit Beneficiaries of Nunavut, and for a more self-reliant Nunavut for all Nunavummiut with the extended mine life of Meliadine Extension.

Overall, the Meliadine Extension represents a negligible change from the 2014 FEIS and approved Meliadine Mine activities. Significant lasting impacts are not anticipated, aside from socio-economic benefits (e.g., training, jobs, business partnerships, tax revenue), as well as through the reduction of greenhouse gases. Cumulative effects are considered not significant for all wildlife (including caribou), birds, and marine components.

13.1 Summary of Residual Impacts for Meliadine Extension

As detailed in Section 4 of this Application, the approach and methods for assessing potential effects from the Meliadine Extension on the biophysical and socio-economic environments include pathway analyses, effects analysis, and residual impact classification and significance, which is consistent with the approaches used for the 2014 FEIS, the 2018 FEIS Addendum, and 2020 FEIS Addendum.

As a result of the Meliadine Extension, new primary pathways were identified for activities related to the windfarm and airstrip for only three VECs (i.e., air quality, noise, and terrestrial birds). For the remainder of the VECs/VSECs, no new primary pathways were identified; however, results of the effects assessment were updated for Meliadine Extension.

Overall, the Meliadine Extension activities represent a negligible change from the approved 2014 FEIS and the 2018 and 2020 FEIS Addenda assessment activities (Agnico Eagle 2014, 2018a, 2020a).

13.1.1 Significant Residual Impacts

Potential significant residual impacts were identified in the 2014 FEIS solely within the socio-economic environment. As a result of Meliadine Extension, no new projected significant residual impacts are anticipated, except for one under socio-economics (public and worker health and safety) which was deemed to be a positive impact in this Application.

It is important to note for the socio-economic environment, a determination of “significant” results in an overall positive change. The significant residual impacts for Meliadine Extension are summarized in Table 13.1-1 but the reader is reminded that significance for socio-economic components in this table are not a negative impact.

13.1.2 Non-Significant Residual Impacts

The impacts that remain following mitigation for the assessment endpoint of a VEC are not anticipated to be different than those previously assessed. As a result, there is no change in the residual impact classification from the 2014 FEIS and the 2018 and 2020 FEIS Addenda (Agnico Eagle 2014, 2018a, 2020a) representing a negligible change for all VEC/VSECs:

- atmospheric environment (air and noise)
- terrestrial environment (soil and terrain, vegetation, wildlife and wildlife habitat, birds and bird habitat)
- freshwater environment (groundwater, hydrology, surface water quality, fisheries)
- marine environment and wildlife
- traditional activity and knowledge
- socio-economics (see notes in Section 13.1.1)
- cultural, archaeological, and paleontological resources
- human and ecological health

Tables 13.1-2 summarizes the new non-significant residual impacts as a result of Meliadine Extension.

Most of the newly identified non-significant residual impacts are tied to human health risks whereby since the 2014 HHERA, Health Canada has issued guidance that NO_2, PM_{10}, and $PM_{2.5}$ are to be assessed as non-threshold chemicals. Therefore, these criteria air contaminants were assessed using the same approach as the other threshold COPCs (i.e., following a HQ approach and residual effects characterization). In conclusion, the potential risks to ecological and human health were similar to those assessed in the 2014 FEIS, and are determined to be acceptable.

Table 13.1-1: Summary of the Potential Significant Residual Impacts of the Meliadine Extension

VSEC	Effect Pathways	Assessed Significance		Meliadine Extension Rationale
		2014 FEIS	Meliadine Extension	
Economic Development and Opportunities	Employment	Significant (Positive)	No change	Additional employment opportunities from 2014 FEIS (increase of 205 positions) and extended life of mine until 2043.
	Gross Domestic Product and Economic Growth	Significant (Positive)	No change	The longer life of mine will continue to contribute to the GDP and Economic growth of Nunavut and the Kivalliq.
	Business Development and Contracting: Meliadine Extension would increase demand for goods and services, which should lead to growth in several sectors. Expenditure would add to the economic activity in Nunavut, including investment	Significant (Positive)	No change	The longer life of mine will extend business and contracting opportunities and associated expenditures will continue to add to the economic activity in Nunavut.
	Government Fiscal Situation: Meliadine Extension would increase public revenue	Significant (Positive)	No change	The longer life of mine will continue to positively contribute to public revenue.
	Income: Meliadine Extension would directly and indirectly contribute to disposable income of employees and other local people	Significant (Positive)	No change	The Meliadine Extension will continue to contribute to disposable income of employees and other local people by adding 205 positions compared to the 2014 FEIS and extending the life of mine until 2043.
Education and Training	Improvement in education achievement, dropout rates, school attendance	Significant (Positive)	No change	Consistent with the 2014 FEIS, Meliadine Extension is anticipated to contribute positively to the regional graduation rate by providing additional employment opportunities for an extended period of time (until 2043).
	Improvement in available training in existing education system	Significant (Positive)	No change	Consistent with the 2014 FEIS, the Meliadine Extension will continue to have positive effects on the existing education system by maintaining contributions and building capacity in the regional and local study area.
	Improvement on education and skill levels of local workforce	Significant (Positive)	No change	The Meliadine Extension will continue the workforce training in place at Meliadine. Continuing existing programs is expected to provide benefits consistent with the 2014 FEIS. Additionally, on the job training and education are expected to provide opportunities for Nunavummiut employees to advance to more skilled level position and build capacities.

VSEC	Effect Pathways	Assessed Significance		Meliadine Extension Rationale
		2014 FEIS	Meliadine Extension	
Employment	Nutrition: Meliadine Extension employment may increase time and resources available for harvesting nutritious country foods	Significant (Positive)	No change	Meliadine Extension is expected to continue to have an effect on nutrition by increasing employment up to 905 employees throughout a longer period of time (closure in 2043).
	Safety: Meliadine Extension health and safety training may improve health and safety at mine site and outside of the workplace	Significant (Positive)	No change	By creating additional employment opportunities and extending the duration of employment beyond the period assessed in the 2014 FEIS, Meliadine Extension-related training, education and on-site services will reach a larger number of workers, for a longer period of time, further enhancing this beneficial effect on community health and safety.
Community Infrastructure and Public Services	Local and Regional transportation: The construction of the AWAR may increase access to areas outside of Rankin Inlet by local residents. Meliadine Extension-related traffic may increase traffic on local roads.	Significant (Positive)	No change	Change in the direction to only positive for the Meliadine Extension. Predictions from the 2014 FEIS believed that we would see project induced in-migration to Rankin Inlet and out-migration from other Kivalliq communities to Rankin Inlet. Although, based on available and current data, there is no indication of mining-induced in-migration. Traffic on local roads not expected due to completion of by-pass road. Continued positive effects from usage of the AWAR.
Governance and Leadership	Fiscal performance of government	Significant (Positive)	No change	The Meliadine Extension will continue to add substantially to the income of government, for a longer period of time until 2043.
	Operational, regulatory and monitoring capacity of government	Significant (Positive)	No change	The Meliadine Extension will continue to put pressure on public services to review permitting application and complete compliance monitoring. However, the Meliadine Extension would also have long-term beneficial effects on capacities of government institutions in Nunavut and the Kivalliq region.
Public and Worker Health and Safety	Good Health and Safety Performance for the Project: Health and Safety training may result in increased health and safety capacity for Project Activities	Not significant	Significant (Positive)	Aligned with the 2014 FEIS assumptions, the Meliadine Extension is expected to have an overall positive effect on health and safety performance for the Meliadine Extension by continued provision of training and on-site health services.
Traditional Activity and Knowledge	Land Use and Mobility	Significant	No change	The Meliadine Extension will continue to enhance access to the LSA and local areas. The Meliadine Extension noise level effect on traditional activities will be enhanced (low to negligeable) due to the addition of a windfarm and the airstrip alternative. Visual disturbance will be enhanced by the addition of an on-site windfarm.

Table 13.1-2: Summary of the Potential Non-Significant Residual Impacts of the Meliadine Extension

VEC	New Effects Pathway	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood
Noise	Wind turbines will emit noise during operation. This noise will propagate into the surrounding environment, where it may have residual effects on NPORs and wildlife. Noise emissions from the landing and take-off of planes can increase ambient noise levels.	Negative	Low	Local	Medium-term	Moderate	Reversible	Likely
Waterbirds, upland birds, raptors	Collision with wind turbines causing injury or mortality to individual birds, which can affect population size (upland birds and waterbirds)	Negative	Negligible	Beyond regional	Medium-term to unknown	Periodic	Reversible to irreversible	Highly likely
	Collision with wind turbines causing injury or mortality to individual birds, which can affect population size (raptors)	Negative	Negligible to low	Beyond regional	Medium-term to unknown	Periodic	Reversible to irreversible	Highly likely
Ecological Health	Potential chronic health risks for aquatic life at closure for cobalt (Lake A8 West, TIRI Pit Lake and Pump Pit Lake) and copper (Pump Pit Lake) were identified in the surface water quality assessment	Negative	Low	Local	Long-term	Continuous	Reversible	Unlikely
Human Health	Acute health effects for recreational users due to inhalation of air contaminants (Aldehyde and DPM)	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely
	Acute and chronic health effects for recreational users due to inhalation of nitrogen dioxide (NO_2)	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely
	Chronic health effects for recreational users due to inhalation of particulate matter (PM_{10} and $PM_{2.5}$)	Negative	Low	Local	Long-term	Isolated	Reversible	Unlikely
	Chronic health effects for recreational users due to drinking water quality	Negative	Low	Local	Long-term	Continuous	Irreversible	Unlikely
	Health effects due to noise for recreational users	Negative	Low to Moderate	Local	Long-term	Continuous	Readily Reversible	Possible

13.2 Summary of Cumulative Effects for Meliadine Extension

Cumulative effects represent the sum of all natural and human-induced influences on the physical, biological, socio-cultural, and economic components of the environment through time and across space. Some changes may be human-related, such as increasing industrial development, and some changes may be associated with natural phenomenon, such as extreme rainfall events, and periodic harsh and mild winters. The cumulative effects assessment is used to estimate the contribution of these types of effects, in addition to Meliadine Extension effects, on VECs. Not all VECs complete a cumulative effects assessment as the potential effects are localized.

Cumulative effects identified, analyzed, and assessed in consideration of the proposed activities of Meliadine Extension, relative to the 2014 FEIS, are provided below. Further details can be found within Sections 5 to 10 of this Application, where applicable.

13.2.1 Significant Cumulative Effects

As a result of Meliadine Extension, significant cumulative effects are not anticipated.

13.2.2 Non-Significant Cumulative Effects

Tables 13.2-1 summarizes the non-significant cumulative effects as a result of the Meliadine Extension.

Table 13.2-1: Summary of the Potential Non-Significant Cumulative Effects

VEC	Conclusion
Terrestrial Wildlife and Wildlife Habitat	Cumulative effects from primary effect pathways are not expected to decrease resilience and increase the risk to wildlife population maintenance and opportunities for traditional use. Consequently, cumulative effects from each primary effect pathway are considered not significant for all wildlife VECs. These conclusions are consistent with the 2014 FEIS.
Birds and Bird Habitat	Cumulative effects from primary effect pathways are not expected to decrease resilience and increase the risk to bird population maintenance and opportunities for traditional use. Consequently, cumulative effects from each primary effect pathway are considered not significant for all bird VCs. These conclusions are consistent with the 2014.
Marine Wildlife	No instances were identified where the potential for cumulative effects changed as a result of the Meliadine Extension. The changes identified were a result of revisions to the suite of RFFDs. Thus, cumulative effects from the RFFD may occur if most or all of the future projects proceed simultaneously. However, the likelihood of this occurring is low.
Socio-economics	The 2014 FEIS and Meliadine Extension are expected to extend the prioritization of Kivalliq employment candidates and businesses, and the commitments regarding procurement identified in the IIBA. As a result, potential for overlapping employment demand from developments in other regions is considered limited to none.

13.3 Transboundary Effects

A geographic extent was a criterion used in the assessment of potential residual impacts from the Meliadine Extension on VCs. Geographic extent refers to the spatial extent of potential direct or indirect impact, and was generally categorized into four scales; local, regional, beyond regional, and transboundary. Transboundary is defined as effects from the Meliadine Extension that extend outside of the Nunavut Territory. In the case of the socio-economic assessment, Nunavut was used to define regional extent, and as such any beyond regional residual impacts to socio-economic VCs are also transboundary.

Caribou are likely to be affected by transboundary effects from human disturbances across their annual range. However, the contribution of the Meliadine Extension when considered with transboundary developments and activities is expected to be negligible. The incremental direct and indirect effects are both <1% at the scale of the Qamanirjuaq herd post-calving range (refer to Sections 6.6.5.1, 6.6.5.2), which are considered negligible residual effects (Section 6.6.6). The contribution of direct and indirect effects from the Meliadine Extension will be even smaller at a larger annual range scale, are unlikely to be measurable ecologically and be within the resilience limits of caribou.

As in the 2014 FEIS, it is recognized that for select socio-economic parameters, there is some potential for transboundary effects related to the Meliadine Extension. These include potential economic benefits elsewhere in Canada in the form of employment, business and contracting opportunities (and associated provincial and federal tax revenue) not filled by Nunavummiut. Transboundary cumulative effects include cumulative economic benefits from resource development projects in Nunavut.

Marine shipping associated with the Meliadine Extension also has the potential for transboundary effects. Potential transboundary effects to marine water quality, fish and fish habitat, mammals and/or birds include accidental spills, underwater and in-air noise, and vessel strikes. The potential residual impacts of these effects were determined to be not significant.

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