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# VOLUME 4.0 IMPACT ASSESSMENT METHODOLOGY

## Final Environmental Impact Statement (FEIS) – Meliadine Gold Project

REPORT

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# ᐅᓂᑉᑳᓗᒃᑖᒧᑦ ᓇᐃᓈᖅᓯᒪᔪᖅ

ᓯᑕᒪᖓᑦ ᐊᒃᑐᖅᑕᐅᓂᖓᓄᑦ ᖃᓄᐃᓕᐅᕈᑕᐅᓂᐊᖅᑐᓪᓗ ᐋᕿᒃᐊᑲᓐᓂᕈᙳᖅᑐᑦ ᑭᖑᓪᓕᖅᐹᓕᖅ ᐊᕙᑎᒧᑦ ᐊᒃᑐᖅᑕᐅᓂᖓᓄᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᑕᓯᕐᔪᐊᕐᒥ ᐅᔾᔪᖅᑕᕆᐊᙳᓂᐊᖅᑐᓄᑦ ᐅᓂᑉᑳᖅᓯᒪᔪᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᒥᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐊᒃᑐᐃᓇᐅᓂᐊᖅᑐᓂᒃ, ᖃᓄᑎᒋ ᐊᒃᑐᐃᓂᐊᕐᒪᖔᑖ ᐊᒻᒪ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᐊᕙᑎᒥᒃ ᐊᒃᑐᐃᓇᔭᕐᓂᖓ ᖃᓄᑎᒋᐅᓂᐊᕐᒪᖔᑦ ᐱᓕᕆᐊᙳᓂᐊᖅᑐᑯᑦ ᐃᓅᓯᕐᒧᑦ ᐊᕙᑎᒧᓪᓗ ᐊᒃᑐᐊᓗᐊᕐᓂᖏᑦ.

ᐊᑐᖅᑕᐅᓂᐊᖅᑐᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐱᓕᕆᐊᙳᓂᐊᖅᑐᑦ ᐊᒃᑐᐃᓇᔭᕐᓂᖓᓂᒃ ᐃᓅᓯᕐᒥᒃ ᓄᓇᒥᒃ ᓂᕐᔪᑎᓂᓪᓗ ᐊᕕᒃᑐᖅᓯᒪᔪᑦ ᐅᑯᐊ ᒪᓕᒃᓗᒋᑦ:

- ᐅᔨᕆᔭᐅᔪᑦ ᓄᓇᐅᑉ ᐃᓗᓕᖏᑦ ᐊᒻᒪ ᐅᔨᕆᔭᐅᔪᑦ ᐃᓅᓯᕐᒥᒃ ᓄᓇᒥᓪᓗ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᑦ;
- ᐊᑉᕐᑯᑎᒃᑯᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᖏ;
- ᐊᕙᑎᑉᑕ ᓯᓚᕐᔪᐊᕐᑲᕐᓂᖓᑕᓗ ᑭᓪᓕᓕᑉᕕᖏᑦ;
- ᐊᒃᑐᖅᑕᐅᓂᖏᓐᓄᑦ ᖃᐅᔨᓴᕐᓂᖅ;
- ᐊᒥᐊᑯᖏᑦᑕ ᐊᒃᑐᖅᑕᐅᓂᖏᓐᓄᑦ ᐊᕕᒃᑐᖅᑕᐅᓂᖏ ᐅᔨᕐᓇᕐᓂᖏᓗ;
- ᖃᓄᐃᓂᖏᑦ ᓇᓗᓇᖅᓯᓯᒪᔪᑦ; ᐊᒻᒪ
- ᖃᐅᔨᓴᖅᑕᐅᓂᖏ ᐋᕿᒃᐊᖅᑕᐅᓂᖏᓪᓗ.

ᓇᓗᓇᐃᖅᓯᒪᔪᖅ ᖃᓄᐃᓕᐅᕈᑕᐅᓂᐊᖅᑐᑦ ᕐᑯᓪᓖᓂ ᒪᓕᒃᑕᐅᔪᖅ ᑲᔪᓯᑎᑕᐅᑉᓗᓂᓗ ᖃᐅᔨᓴᕐᓂᓗᒃᑖᓄᑦ ᐃᓕᓯᒪᑉᓗᓂᓗ ᑭᖑᓪᓕᖅᐹᓕᐊᖅ ᓇᓗᓇᐃᔭᖅᓯᒪᔪᑦ ᐊᕙᑎᑉᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐅᓂᑉᑲᒥᑦ (ᐊᕕᒃᑐᖅᓯᒪᓂᖓ 5ᒥᑦ 10ᒧᑦ). ᐅᔨᕐᓇᓗᐊᖅᑐᑦ ᐃᒃᐱᖕᓇᕐᔭᖅᑐᑦ ᑎᑎᕋᖅᓯᒪᕗᑦ ᐊᑖᓐᓂ.

ᐱᓕᕆᐊᙳᓂᐊᖅᑐᒥᒃ ᖃᐅᔨᓴᕐᓂᕐᑲᖅᑎᓪᓗᒋᑦ, ᓄᓇᕗᒻᒥ ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏ ᓇᓗᓇᐃᖅᓯᓚᐅᖅᐳᑦ ᑎᑎᕋᖅᓯᒪᔪᓂᒃ ᐆᒪᔪᓂᒃ ᐃᓅᓯᕐᒧᓪᓗ ᐃᓕᖓᔪᓂᒃ ᐃᓱᒪᒋᔭᐅᓯᒪᔪᑦ ᐃᑉᓕᕐᓇᖅᑐᑦ ᐃᓅᓯᖅᑲᑎᒋᐊᕐᓇᖅᑐᑦ ᐊᒻᒪ ᐊᕙᑎᑉᑎᖓᓂᒃ ᐅᔨᕆᔭᐅᔭᕆᐊᓖᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᒃᓴᑦ ᐊᒃᑐᖅᑕᐅᓇᔭᕐᓂᖏᑦ ᐱᓕᕆᐊᙳᓂᐊᖅᑐᑯᑦ. ᐃᑉᓕᓇᔭᐅᔪᑦ ᐱᕈᖅᑐᕋᓗᖕᓄᑦ ᐃᓅᓯᖅᑲᑎᒋᐊᕐᓇᖅᑐᒧᓪᓗ ᐊᕕᒃᑐᖅᓯᒪᓂᖓ ᑐᑭᖅᑲᓕᖅᑎᑕᐅᓯᒪᕗᑦ ᓄᓇᒥᐅᓂᒃ, ᐱᕈᖅᑐᓂᒃ, ᐃᓕᕐᑯᓯᕐᒥᒃ, ᐃᓅᓯᖅᑲᑎᒋᐊᕐᓂᕐᒥᒃ ᐊᒻᒪ ᓄᓇᓖᑦ ᐱᕚᓪᓕᕈᑎᒃᓴᖏᓐᓂᒃ ᐊᕙᑎᓕᕆᓂᒃᑯᑦ ᒪᓕᒐᖅᑎᒍᑦ, ᑲᑎᒪᔨᐅᕙᒃᑐᑎᒍᑦ, ᑐᓴᖅᑕᐅᔪᓐᓇᖅᑐᒃᑯᑦ ᐅᕙᓘᓐᓃᑦ ᐃᓚᓐᓂᐊᖅᓯᒪᑎᐊᖅᑐᑎᒍᑦ ᐃᓚᑕᕆᔭᐅᓯᒪᑉᓗᑎᒃ ᐋᑐᑎᖅᑲᑎᐊᖅᑐᑦ ᐃᓅᖅᑲᑎᒌᖕᓄᑦ.

ᖃᐅᔨᓴᖅᑕᐅᓂᖏᑦ ᐊᑐᖅᑕᐅᕙᒃᑐᑦ ᐃᓚᑕᖅᓯᓂᕐᒥᒃ ᑕᑯᔪᓐᓇᖅᓯᓗᒋᑦᓗ ᐃᓚᒌᖕᓂᖏᑦ ᐱᓕᕆᐊᙳᔪᑉ ᐃᓗᓕᖏᑦ ᐱᓕᕆᐊᖏᑦᓗ ᐊᒃᑐᐃᔪᖕᓇᖅᑐᑦ (ᐃᒃᐱᖕᓇᕐᓂᖏᑦ ᐊᒃᑐᐃᔪᖕᓇᕐᓂᖓᑕ) ᐱᕈᖅᑐᕋᓗᖕᓂᒃ ᐃᓅᓯᖅᑲᑎᒋᐊᕐᓂᕐᒥᓪᓗ. ᐊᑉᕐᑯᑎᒋᔭᐅᓂᐊᖅᑐᑦ ᐃᓱᒪᓕᐅᕐᑲᒃᑕᕐᑐᑦ ᓯᕗᓪᓕᐅᑎᑕᐅᑉᓗᑎᒃ, ᐅᔨᕐᓇᓗᐊᖏᓂᖅᓴᐅᑉᓗᑎᒃ, ᐃᓚᓕᐅᑎᓯᒪᖏᒍᑎᓪᓗ ᖃᐅᔨᓴᕐᓂᕐᓄᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖅᑲᖏᓐᓄᓪᓗ, ᑎᑎᕋᐅᔭᖁᐊᓯᒪᔪᓄᑦ, ᐊᓯᖏᓐᓄᓪᓗ ᑕᐃᒪᓐᓇ ᐱᕙᓪᓕᐊᓯᒪᔪᓄᑦ ᐊᕙᑎᑉᑎᖓᓄᓪᓗ ᐃᓱᒪᓕᐅᕈᑎᓄᑦ. ᐊᕕᒃᑐᖅᓯᒪᓂᖓ ᐊᑐᒐᐅᓯᓐᓇᕆᐊᓖᑦ ᖃᐅᔨᓴᖅᑕᐅᓯᒪᕗᑦ ᐅᓂᑉᑳᑲᓐᓂᖅᓯᒪᑉᓗᑎᒃ ᐅᑯᐊ ᒪᓕᒃᓗᒋᑦ:

- ᐊᓯᖏᓐᓄᑦ ᐊᑕᖏᑐᑦ – ᐊᑐᐊᒐᐅᓂᐊᖅᑐᖅ ᐊᓯᕙᖅᑕᐅᔪᖅ ᐊᕙᑎᓕᕆᓂᕐᒥᒃ ᐃᓱᒪᓕᐅᕐᓂᕐᒥᒃ (ᐊᒃᑐᐃᓇᔭᕐᓂᖏᑦ) ᐱᓕᕆᐊᙳᓂᐊᖅᑐᑉ ᐊᒃᑐᐃᓂᖓ ᐊᓯᐊᙳᖅᓯᒪᖏᓪᓗᓂ ᐃᓅᓯᕐᒧᑦ ᐊᕙᑎᑉᑎᖓᓄᓪᓗ ᖃᐅᔨᓴᖅᑕᐅᔭᕈᓐᓇᖓᑦ ᒪᓕᒐᓕᐅᖅᓯᒪᔪᑎᒍᑦ;

- ᐊᖏᓗᐊᖏᑦᑐᖅ – ᐊᑉᕿ ᐊᑐᕐᑕᐅᔪᓐᓇᖅᑐᖅ ᐊᓯᐊᕓᖅᑎᑦᓯᔪᓐᓇᖅᑐᖅ ᐅᔾᔨᕐᓇᓗᐊᖏᑦᑐᒥᒃ ᐊᕙᑎᒥᒃ, ᑭᓯᐊᓂ ᐱᑕᖅᑲᕈᓐᓇᐃᖅᑎᑦᓯᓇᔾᔩᓐᖓ ᐅᔨᕆᔭᐅᔭᕆᐊᓕᒃ ᐅᔨᕐᓇᖅᑐᓂᒃ ᐊᕙᑎᒥᒃ ᐃᓅᓯᕐᒥᓗ ᐊᓯᐊᕓᖅᑎᑦᓯᔪᓐᓇᕐᓂᖓ ᐆᒃᑑᑦᑕᐅᓗᑎᒃ ᑐᖓᕕᖏᑦ ᐊᑑᑎᓕᓇᔭᖅᑕᖏᓪᓗ,
- ᐊᑑᑎᖃᓗᐊᕐᓂᖅᓴᖅ – ᐊᑐᐊᒐᖅ ᖃᓄᐃᓕᑎᑦᓯᔪᓐᓇᖅᑐᖅ ᐊᕙᑎᑉᑎᖓᓂᒃ ᐅᔨᕐᓇᖅᓯᑎᑦᓯᔪᓐᓇᖅᓱᓂᓗ ᐊᒥᐊᑯᑐᐊᕓᖅᑎᑦᓯᓗᓂ ᐃᓅᓯᕐᒥᒃ ᐊᕙᑉᑎᑉᑎᖓᓂᓪᓗ ᐊᓯᐊᕓᖅᑎᑦᓯᔪᓐᓇᕐᓂᖏᑎᒍᑦ; ᐅᕙᓘᓃᑦ

ᐃᓚᖅᑲᖏᑦᑐᑦ ᐊᓱᖏᓐᓂᒃ ᐃᓱᒪᓇᓗᐊᖏᓇᓱᕆᔭᐅᔫᓪᓘᓐᓃᑦ ᐊᕙᑎᑉᑎᖓᓂᒃ ᐊᓱᕓᖅᑎᑦᓯᓗᐊᕋᔭᖏᒻᒪᑕ ᐃᓱᒪᕆᔭᐅᔫᑦ ᖃᐅᔨᓴᖅᑕᐅᑲᓐᓂᖅᐸᖏᓛᑎᒡᓗ. ᑕᐃᒪᓐᓇᑦᑐᑕᐅᖅ, ᐃᓱᒪᓇᓗᐊᖏᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᓱᖅᐳᑦ ᐊᒃᑐᐃᓂᐊᕐᓂᖏᓐᓂᒃ ᐊᕙᑎᑉᑎᖓᓂᒃ ᐱᓕᕆᐊᕓᓂᐊᖅᑐᖁᑦ ᐅᖁᐊ ᐃᓱᒪᒋᐸᓗᒋᑦ ᐊᑑᑎᖃᖅᑐᑦ ᐊᕙᑎᑉᑎᖓᓂᒃ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᓐᓂᒃ ᐊᒻᒪ ᐃᓅᓯᕐᒥᒃ ᐱᕚᓪᓕᕐᓂᕐᒥᓪᓗ. ᐅᔨᕐᓇᓗᐊᖅᑐᑦ ᐊᑐᖅᑕᐅᕙᒃᑐᑦ ᑕᐃᔭᐅᓯᖅᑐᑦ “ᖃᐅᔨᓴᖅᑕᐅᓃᑦ ᐃᓯᓚᒍᑎᖏᑦ” ᒥᐊᓂᖓᔭᐅᔭᖓᐊᖅᑲᖅᐳᓪᓗ ᐃᓄᖕᓄᒃ ᐊᑐᖅᑕᐅᓯᕐᓂᖏᓐᓄᑦ ᓯᕗᓂᕐᒥ.

ᐱᕕᒃᓴᖅᑲᖅᑐᑦ ᐅᐸᓗᒥᓗ ᐊᑐᖅᑕᐅᔪᑦ ᑐᑭᓯᐅᖅᓯᒪᔪᑦ ᐅᔨᕐᓇᖅᑐᑯᑦ ᐃᓅᓯᐸᑎᖏᓐᓂᒃ ᐊᕙᑎᑉᑎᖓᓂᓪᓗ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᑦ ᓯᕗᓂᖓᓂ ᖃᐅᔨᓴᕐᓂᐅᑉ ᑲᓄᐃᓕᑎᑦᓯᓇᔾᔭᓐᖓᓚᐱᕕᒃᓴᖅᑲᖅᑐᑦ ᐅᐸᓗᒥᓗ ᐊᑐᖅᐅᔫᑦ ᐃᓚᓕᐅᑎᓯᒪᕗᑦ ᓇᓗᓇᐃᖅᓯᒪᔪᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᐸᓗᑎᒃ ᐱᕕᒃᓴᖅᑲᖅᑲᔭᖅᑐᑦ ᐅᐸᓗᒥᓗ ᐊᑐᖅᑕᐅᓇᔭᖅᑐᑦ ᖃᐅᔨᓴᕈᑎᖏᑦᑎᒍᑦ ᖃᓄᐃᓕᑎᑦᓯᓇᔭᕐᓂᖏᑦ, ᑐᑭᖃᓕᖅᑎᑦᓯᑲᓂᖅᓗᑎᒡᓗ ᑭᒡᓕᓕᕕᒃᓴᖏᓐᓂᒃ.

ᖃᓄᐃᓕᑎᑦᓯᓇᔭᕐᓂᖏᓐᓂᒃ ᖃᐅᔨᓴᕐᓂᖅ ᑐᑭᓰᓐᓇᖅᑎᑦᑎᖃᑦᑕᕐᑐᖅ ᐱᓕᕆᐊᕓᓂᐊᖅᑐᒥᒃ ᑐᑭᖃᑎᐊᖅᑐᒥᒃ ᐊᒃᑐᐃᓇᔭᕐᓂᖓ (ᐊᑐᑦᑕᐅᔩᓐᓇᕐᐊᕐᓂᖅᐸᑦ) ᐃᓅᓯᕐᒧᑦ ᐊᕙᑎᑉᑎᖕᓄᓪᓗ ᐊᒃᑐᐃᓇᔭᕐᓂᖏ. ᐊᓱᖏᓐᓂᒃ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᑦ ᐊᑕᐅᓯᐅᖏᑐᒥᒃ ᖃᐅᔨᓴᕐᓂᖅ ᐃᓚᐅᑎᓯᓱᖅᑐᖅ ᐃᓅᓯᐅᑉ ᐊᑐᖅᑕᖏᓐᓂᒃ ᓂᕈᑐᓂᕐᒥᓪᓗ ᐊᑐᑲᓂᕈᖅᓇᖅᑐᓂᓪᓗ ᐃᓅᓯᕐᒥᒃ ᐊᕙᑎᑉᑎᖓᓂᓪᓗ ᐊᒃᑐᐃᔪᖅᓇᕐᒪᖔᑖ, ᓇᓗᓇᖏᑦᑐᒥᒡᓗ ᐊᕙᑎᑉᑎᖓᓂᒃ ᐊᒃᑐᐃᓂᐊᕐᓂᖓ, ᑕᐃᑉᓯᒪᓂ, ᐅᐸᓗᒥᓗ ᓯᕗᓂᕐᒥᓪᓗ ᐱᕙᓪᓕᐊᓂᐊᖅᑐᓂᒃ. ᖃᐅᔨᓴᖅᑕᐅᓃᑦ ᐃᓱᒍᑎᖏᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᒃ ᐊᓯᐊᕓᖅᐸᓕᐊᔪᓂᒃ ᓇᓗᓇᕈᖅᓇᐃᖅᑎᑦᓯᓂᕐᒥᒃ ᐃᓅᓯᕐᒥᒃ ᐊᕙᑎᑉᑎᖓᓂᓪᓗ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᓕᕋᖓᑕ ᐊᑕᐅᓯᐅᑉ ᐊᓱᖏᑦᑕᓗ ᐊᒃᑐᐃᔪᑎᒋᔭᖏᓐᓂᒃ. ᐊᓱᖏᓐᓂᒃ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᑦᑕ ᓇᓗᓇᐃᒃᑯᑕᖏᑦ ᑎᑎᖅᓯᒪᔪᑦ ᓈᓴᐅᑎᑎᒍᑦ ᖃᑉᓯᐅᓂᖏᑎᒍᓪᓗ ᑎᑎᖅᓯᒪᔪᑦ, ᓄᓇᐅᑉᓗ ᓇᓚᐊᖑᓂᖓᓂᒃ, ᖃᓄᕐᓗ ᐊᒃᑐᐃᓯᒪᖅᑳᖅᓴᔭᕐᓂᖓᓂᒃ ᐊᑉᕿᑎᒋᓂᐊᖅᑕᖏᑎᒍᑦ ᓇᓗᓇᐃᖅᓯᒪᕗᑦ. ᐊᒃᑐᐃᓇᔭᕐᓂᖏ ᑕᐅᑐᒃᑯᒋᑦ, ᐊᑉᕿᑎᒋᓂᐊᖅᑕᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᓂᖏᓐᓄᑦ ᐃᓚᐅᖃᑕᐅᔪᑦ ᑐᑭᓕᐅᖅᓯᒪᕗᑦ ᐊᕕᒃᑐᖅᓯᒪᐸᓗᑎᒃ (ᐃᒃᐱᖕᓇᓗᐊᖏᑐᖅ, ᐊᕕᒃᑐᖅᓯᒪᔪᑦ ᓄᓇᐃᑦ ᐊᒃᑐᖅᑕᐅᓇᔭᕐᓂᖏᑦ, ᐅᑭᐅᓂᒃ ᖃᐃᓂᐊᖅᑐᓂᒃ ᐃᒃᐱᖕᓇᕐᓂᓇᓇᔭᖅᑕᖏᑦ, ᓇᓕᐊᖕᓂᒃ ᐱᔩᒥᓇᕐᓂᖅᓴᐅᓇᔭᕐᓂᖏᑦ).ᖃᐅᔨᓴᕐᓂᑯᑦ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᓐᓂᑦ ᐊᕕᒃᑐᖅᓯᒪᓂᖏᓪᓗ ᐊᑐᖅᑕᐅᒃᑕᖅᐳᖅ ᖃᐅᔨᓴᖅᑕᐅᑎᓪᓗᒋᑦ ᐃᒃᐱᖕᓇᕐᓂᖏᑦ ᐱᓕᕆᐊᒃᑯᑦ ᐃᓅᓯᕐᒥᒃ ᐊᕙᑎᑉᑎᖓᓂᓪᓗ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᓐᓄᑦ.

ᖃᐅᔨᓴᕐᓂᑯᑦ ᐊᕕᒃᑐᖅᓯᒪᔮᒃᑯᑦ, ᓇᓗᓇᐃᖅᓯᒪᔪᑦ ᐅᔨᕐᓇᓗᐊᖅᑐᑦ ᑎᑎᖅᓯᒪᕗᑦ ᖃᓄᕐᓗ ᖃᐅᔨᒪᓇᓗᐊᖏᑦᑐᑦ ᐱᓕᕆᐊᕆᔭᐅᓂᐊᕐᒪᖔᑦ ᐅᒃᐱᕈᓱᑦᑎᕐᓂᖅ ᐱᕈᖅᐸᓕᐊᑲᓂᕐᕿᐸᓗᒍ ᐊᒃᑐᐃᓇᔭᕐᓂᖏᓐᓂᒃ ᐃᓅᓯᕐᒥᒃ ᐊᕙᑎᑉᑎᖓᓂᓪᓗ ᓂᕆᐅᖕᓂᖏᑦ ᐊᖏᓗᐊᑯᖏᓪᓗᒋᑦ. ᑭᖑᓪᓕᕐᒥᒃ, ᖃᐅᔨᓴᕐᓂᖅ ᐊᐅᓚᓂᖏᓐᓄᑦ ᖃᐅᔨᒋᐊᖅᑕᕐᓂᕐᓗ ᐃᖏᒦᖅᑐᓂᒃ ᓇᓗᓇᐃᖅᓯᒪᕗᑦ. ᖃᐅᔨᓴᑕᐅᓂᖏᑦ ᖃᐅᔨᒋᐊᑲᓐᓂᕐᓂᖏᓪᓗ ᐱᓕᕆᐊᖑᔪᑦ ᐊᑐᖅᑕᐅᒃᑕᕐᑐᑦ ᐱᓕᕆᐊᖑᓂᐊᖅᑐᑉ ᐊᒃᑐᐃᓇᔭᕐᓂᖓ ᐃᒪᕐᒥᐅᑕᖁᖅᓂᒃ ᐃᓅᓯᕐᒥᓗ, ᖃᐅᔨᓴᕈᑕᐅᓗᑎᓗ ᖃᓄᖅ ᐊᒃᑐᐃᓗᐊᖅᑎᒋᓂᖏᑦ ᒥᑭᓂᖅᓴᐅᑎᓐᓂᓗᒋᑦ ᐃᒃᐱᖕᓇᖃᔭᕐᒪᖔᑦ ᓂᕆᐅᖕᓇᖏᑦᑐᑎᒍᑦ ᓯᕗᓂᕐᒥ. ᐱᓕᕆᐊᕓᓂᐊᖅᑐᑦ ᐊᑐᖅᑕᐅᒃᑕᕐᒥᔪᑦ ᐊᒃᑐᐃᑕᐃᓕᓂᐅᔪᑦ ᖃᓄᖅ ᐊᔪᖏᑎᐊᕐᒪᖔᑦ. ᓇᓗᓇᐃᖅᓯᓇᔭᕐᒥᔪᑦᑕᐅᖅ ᓇᓂ ᖃᖓᓗ ᒥᐊᓂᖅᓯᔨᒍᑦ ᐋᕿᒋᐊᕈᑕᐅᔪᑦ ᐊᑐᖅᑕᐅᓇᔭᕐᒪᖔᑦ ᐊᒃᑐᐃᑕᐃᓕᔪᑎᑦ ᐊᔪᕋᔭᕐᓂᖅᐸᑕ ᓂᕆᐅᓇᖏᑦᑐᓪᓗ ᓴᕿᓐᓇᔭᕐᓂᖅᐸᑕ.

# EXECUTIVE SUMMARY

Volume 4 Impact Assessment and Methodology of the Final Environmental Impact Statement (FEIS) for the Meliadine Gold Project (the Project) describes the approach that was used for analyzing potential effects, and classifying and determining the environmental significance of impacts from the Project on the biophysical and socio-economical environments.

The approaches and methods for assessing potential effects from the Project on the biophysical and socio-economic environments are broken down into the following key elements:

- Valued Ecosystem Components (VECs) and Valued Socio-Economic Components (VSECs);
- Pathway Analysis;
- Spatial and Temporal Boundaries;
- Effects Analysis;
- Residual Impact Classification and Significance;
- Uncertainty; and
- Monitoring and Follow-up.

The detailed approach outlined above is followed and carried through for all assessments included in the Final Environmental Impact Statement (Volumes 5 to 10). A summary of the key elements are provided below.

During Project scoping, the Nunavut Impact Review Board identified a list of biophysical and socio-economical components that were to be given full consideration as VECs and VSECs for the assessment of the significance of potential effects from the Project. Valued ecosystem and socio-economic components represent physical, biological, cultural, social, and economic properties of the environment that are either legally, politically, publically, or professionally recognized as important by society. The Inuit Qaujimajatuqangit (IQ) collected on the Project included knowledge on the existing condition, concerns on the various Project impacts, and recommendations for the Project.

Pathway analyses are used to identify and assess the linkages between Project components or activities and potential residual effects (i.e., effects after mitigation) to valued ecosystem or socio-economic components. 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 removed by environmental design features (i.e., effect mitigation) so that the Project results in no detectable (measurable) environmental change and residual effects to a VEC or VSEC when compared to baseline or guideline values;
- minor – pathway could result in a minor environmental change, but would have a negligible residual effect on a VEC or VSEC when compared to baseline or guideline values; or
- primary – pathway is likely to result in a measurable environmental change that could contribute to residual effects on a VEC or VSEC when compared to baseline or guideline values.

Pathways with no linkage or that are considered minor are not predicted to result in environmentally significant effects and are not analyzed further. Alternatively, primary pathways undergo further effects analysis to determine the potential environmental significance of the Project on the key properties of VECs and VSECs. Key properties are called “assessment endpoints”, and should be protected for their use by future human generations; they.

Spatial and temporal boundaries are defined for each VEC and VSEC prior to the effects analysis. Spatial and temporal boundaries link component-specific characteristics with the appropriate spatial and temporal scales for effects analyses, and gives broad definitions for the boundaries.

The effects analysis provides the general approach to analyzing potential Project-specific and cumulative (where applicable) effects for VECs and VSECs. Cumulative effects assessment includes other human activities that overlap with the spatial and temporal distribution of a VEC or VSEC, and has the potential to substantially affect the environment, including past, present, and reasonably foreseeable future development. Assessment endpoints are used to focus the analysis of changes to VECs or VSECs that are associated with one or more primary pathways. The residual effects summary presents a numerical and/or qualitative description of magnitude, geographic extent, duration, and frequency of residual effects from each pathway. From the summary of residual effects, each pathway that is linked to an assessment endpoint is classified using categorical scales for each impact criterion (e.g., low magnitude, regional geographic extent, long-term duration, high likelihood). Results from the effects analysis and residual impact classification are then used in the evaluation of the significance of impacts from the Project on VECs and VSECs.

For each effects analysis, key sources of uncertainty are presented, and how the uncertainty is addressed to increase the level of confidence that potential effects to the VEC and VSEC would not be worse than predicted is discussed. Finally, a monitoring and follow-up program is presented for each effects analysis. Monitoring and follow-up programs are used to measure the relevant effects of the Project on the biophysical and socio-economic environments, and to test the accuracy of impact predictions to reduce uncertainty and unexpected effects in the future. The programs are also used to determine the effectiveness of mitigation measures. They will also indicate where and when adaptive management strategies will be used if mitigation is not successful or if unexpected effects are identified.

# Abbreviation and Acronym List

| | |
|---|---|
| CESA | Caribou Effects Study Area |
| FEIS | Final Environmental Impact Statement |
| IQ | Inuit Qaujimajatuqangit (see note [1]) |
| NIRB | Nunavut Impact Review Board |
| NSA | Nunavut Settlement Area |
| Project | Meliadine Gold Project |
| RFFD | Reasonably Foreseeable Future Development |
| RSA | Regional Study Area |
| VEC | Valued Ecosystem Component |
| VSEC | Valued Socio-Economic Component |

*Note: [1] IQ symbol appearing in right hand margin denotes where IQ is referenced in the assessment.

# Table of Contents

**TABLES**



**APPENDICES**

# 4.0 IMPACT ASSESSMENT METHODOLOGY

## 4.1 Introduction

### 4.1.1 Context

This section describes the approach that was used for analyzing effects, and classifying and determining the environmental significance of impacts from the Meliadine Gold Project (Project) on the biophysical and socio-economic components in this Final Environmental Impact Statement (FEIS). The approach described below was applied to the analysis and assessment of the effects from the Project using information from the Project Description (FEIS Volume 2, Section 2.0) and existing (baseline) conditions. Information from traditional, non-traditional knowledge, and land use were used to help assess effects.

### 4.1.2 Purpose and Scope

The purpose of this section is to describe the methods and approach to analyzing and assessing impacts. Key elements of the assessment for the FEIS include the following:

- valued ecosystem components (VECs) and valued socio-economic components (VSECs);
- pathway analysis;
- spatial and temporal boundaries;
- Project-specific effects;
- cumulative effects;
- impact assessment methods;
- uncertainty; and
- monitoring and follow-up.

The assessment approach presented here is based on ecological, cultural, and socio-economic principles, and assessment best practice. Several elements of the approach can be consistently applied to all biophysical and socio-economic components. Alternately, certain elements of the assessment approach may have to be modified for some components.

For example, the definitions of VECs and VSECs can be applied to all environmental and socio-economic components (e.g., hydrogeology, air, soil, wildlife, cultural). There is general consistency in the approach for identifying pathways that link the Project to potential effects on valued components of the biophysical and socio-economic environment. Likewise, the approach to determining the spatial and temporal boundaries for the effects analysis and assessment is similar across biophysical and socio-economic components.

In contrast, the methods for analyzing effects, classifying residual impacts (e.g., direction [positive or negative response from VEC], magnitude, and duration), and predicting environmental significance can differ between biophysical and socio-economic components. For example, socio-economic effects of a specific project are difficult to isolate from the ongoing processes of interdependent social, cultural, and economic change. Evolving social trends, government policy and programming decisions, and individual choice all have effects that will be concurrent with potential Project effects. Biophysical components are influenced simultaneously and may be confounded by natural and human-related factors beyond the effects discussed herein. However, for many components, Project-specific effects can be quantified (e.g., incremental changes to ground and surface water supply, air quality, soil, and fish and wildlife habitat).

An effect to a biophysical component is typically negative or positive. However, as the socio-economic conditions of different communities, subpopulations, and individuals may vary, a socio-economic effect may have both positive and negative directions. Therefore, differences in the overall approach and methods between biophysical and socio-economic components are identified in this section, and additional details are provided in the Socio-Economic section of the FEIS.

### 4.1.3 Approach to Traditional Knowledge

IQ

The FEIS adopts the definition of traditional knowledge as described by NIRB's Guide to terminology and definitions as follows:

*[Traditional Knowledge is the] [c]umulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission* (NIRB 2007).

The guide further indicates that specific Inuit Traditional Knowledge is referred to as Inuit Qaujimajatuqangit (IQ), which represents the [g]*uiding principles of Inuit social values including: respecting others, relationships, and caring for people; development of skills through practice, effort and action; working together for a common cause; fostering good spirit by being open, welcoming, and inclusive; serving and providing for family and/or community; decision making through discussion and consensus; being innovative and resourceful; and respect and care for the land, animals and the environment* (NIRB 2007).

The IQ collected on the Project included knowledge on the existing condition, concerns on the various project impacts, and recommendations for the Project. Knowledge of the existing conditions is included in baseline reports or environmental setting portions of the FEIS. Concerns on the various project impacts are included as part of the effects assessments and recommendations are considered when developing mitigation and monitoring plans. In the effects assessment, IQ was used to identify VECs and VSECs by the value placed on VEC, to identify the Project impacts that may affect VECs or VSECs, and to assess significance on those VECs or VSECs (see Sections 4.2, 4.3 and 4.5.5).

The IQ used throughout the main volumes of the FEIS will be highlighted using the letters "IQ" in the margins. The amount of IQ in each chapter is not consistent because the disciplines are not consistently important to community members. Much of the IQ collected for the Project focused on wildlife and fish species, as well as land use. A synthesis of IQ data collected for the Project is provided in FEIS Volume 9, Section 9.3.

### 4.1.4 Content

The following sections present approaches and methods for assessing effects from the Project on the biophysical and socio-economic environments.

**Section 4.2**: Valued Components – provides definitions of VECs and VSECs and their endpoints for biophysical and socio-economic attributes of the environment, which determines the effects that are classified.

**Section 4.3**: Pathway Analysis – provides the definition of pathways, and approach and methods for verifying no linkage, minor, or primary pathways.

**Section 4.4**: Spatial and Temporal Boundaries – links component-specific characteristics with the appropriate spatial and temporal scales for effects analyses, and gives broad definitions for spatial and temporal boundaries.

**Section 4.5**: Effects Analysis – gives the general approach to analyzing Project-specific and cumulative effects for biophysical and socio-economic components.

**Section 4.6**: Residual Impact Classification – introduces and provides generic definitions for residual impact criteria and presents an overview of the approach and method used to classify impacts and predict environmental significance.

**Section 4.7**: Uncertainty – introduces the key sources of uncertainty and discusses how uncertainty is addressed to increase the level of confidence that effects are not worse than predicted.

**Section 4.8**: Monitoring and Follow-up – presents the concepts of adaptive management and different types of monitoring. This section also explains how monitoring and follow-up programs are used to measure the relevant effects of the Project on the eco-systemic and socio-economic environments in the Nunavut Settlement Area (NSA), and to test the accuracy of impact predictions to reduce uncertainty and unexpected effects in the future. It is also used to determine the effectiveness of mitigation and the use of adaptive management if mitigation is not successful or unexpected effects are identified.

## 4.2 Valued Ecosystem Components and Valued Socio-Economic Components

Valued ecosystem components and VSECs represent physical, biological, cultural, social, and economic properties of the environment that are either legally, politically, publically, or professionally recognized as important to a particular region, community, or by society as a whole. The inter-relationships between components of the biophysical and socio-economic environments provide the structure of a social-ecological system (Walker et al. 2004; Folke 2006). Examples of physical properties that can be considered VECs include groundwater, surface water, soil, air, or parks. Aquatic and terrestrial plant and animal populations represent biological properties that can be considered VECs. Traditional and non-traditional uses of water, plants, and animals, as well as other biophysical properties (e.g., ecological services, archaeological, or other resources) can be VSECs of the cultural, social, and economic environment. The FEIS integrates Project-related effects on VECs and VSECs for the people who likely are directly and indirectly influenced by the Project.

### 4.2.1 Identification of Valued Ecosystem Components

In nature, VECs can be found at the beginning, middle, or end of pathways, or analogously, at the bottom, middle, or top trophic level of food chains (Section 4.3). For example, benthic invertebrates are at the lower trophic level (towards the beginning of the pathway) in an aquatic ecosystem, while lake trout are the top predator in some aquatic systems (at the end of the pathway). In Arctic terrestrial ecosystems, changes to soil and vegetation represent initial pathways to birds, caribou, and muskox, which influence top trophic level predators, such as wolves and bears. Valued socio-economic components typically enter at the middle and top levels of pathways. For example, people hunt caribou that occur in the middle of the food chain, and fish for lake trout, which occur at the top of the food chain.

Valued ecosystem components and VSECS were selected based on scientific and traditional knowledge and professional experience regarding their role in the ecosystem and value placed on them by humans for traditional use and cultural connection (i.e., social factors), economics, recreation, tourism and aesthetics, where appropriate (Appendix 4.1-B). This section through Section 4.2.3 provides general methods for VEC and VSEC selection; detailed rationale is provided in FEIS Volumes 5 through 10 where appropriate. During Project scoping, the Nunavut Impact Review Board (NIRB) identified the following list of biophysical components that were to be given full consideration for selection of VECs for the assessment:

- air quality;
- climate and meteorology;
- noise and vibration;
- terrestrial environment, including;
  - terrestrial ecology;
  - landforms and soil;
  - permafrost and ground stability;
- geology and geochemistry;
- hydrology (including water quantity) and hydrogeology;
- groundwater and surface water quality;
- sediment quality;
- freshwater aquatic environment, including;
  - aquatic ecology;
  - aquatic biota (including representative fish as defined in the *Fisheries Act*, benthic invertebrates and other aquatic organisms);
  - habitat including fish habitat as defined in the *Fisheries Act*;
- vegetation;
- terrestrial wildlife and wildlife habitat, including;
  - representative terrestrial mammals (i.e., caribou, caribou habitat and behaviour, muskoxen, wolverine, grizzly bears, polar bears, brown bears, wolves, and less conspicuous species that may be maximally exposed to contaminants);
  - wildlife migration routes including crossings;
- birds and their habitat, including;

  - raptors;
  - migratory birds;
  - seabirds;
- marine environment, including;
  - marine ecology;
  - marine water and sediment quality;
  - marine biota including fish and Species at Risk;
  - marine habitat; and
- marine wildlife.

### 4.2.2 Identification of Valued Socio-Economic Components

The NIRB identified the following list of socio-economical components that were to be given full consideration for selection of VSECs for the assessment:

- economic development and opportunities;
- employment;
- education and training;
- contracting and business opportunities;
- population demographics;
- traditional activity and knowledge, including;
  - harvesting;
  - land use and mobility;
  - food security;
  - language;
  - cultural and commercial harvesting;
- non-traditional land use and resource use;
- cultural, archaeological and paleontological resources;
- individual and community wellness, including;
  - family and community cohesion;
  - potential indirect effects of the project on frequency and types of crime incidents;
- community infrastructure and public service, including housing; and
- health and safety, including worker and public safety.

### 4.2.3 Assessment Endpoints and Measurement Endpoints

General factors considered when selecting VECs included:

- biophysical components identified by NIRB during Project scoping and Agnico Eagle Mines Limited (AEM) community and stakeholder consultation, and as outlined in the Project Guidelines (NIRB 2012);
- whether potential VECs represent important ecosystem processes or socio-economic factors;
- whether potential VECs are territorially and federal listed species (COSEWIC 2012; *SARA* 2012, CESCC 2001), as well as internationally listed by the IUCN (www.IUCNredlist.org);
- whether there is value placed on the VECs or VSECs by IQ holders; IQ
- whether potential VECs are communities or species that reflect the interests of regulatory agencies, traditional use, and communities;
- whether potential VECs can be measured or described with measurement endpoints;
- whether potential VECs allow cumulative effects to be considered; and
- current experience with environmental assessments and effects monitoring programs in NU and the NT.

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 and reference 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 Project-related changes to physical and chemical properties of water. Measurement endpoints for predicting effects to air quality may include changes in concentrations of particulate matter (dust) and nitrogen oxides. Impacts to long-term social, cultural, and economic values are predicted through analysis of measurement endpoints, such as employment and income, education and training, and capacity for agricultural and recreational land use. 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 the Project on VECs and VSECs is then predicted by linking residual effects on measurement endpoints to the associated assessment endpoint (Section 0). For example, changes to habitat quantity and quality are used to assess the significance of impacts from the Project on the maintenance of the abundance, assemblages and distribution of wildlife populations (assessment endpoint). Use of maintenance of abundance and distribution as an assessment endpoint was presumed to be more intuitive in terms of long-term sustainable populations that are ecologically functional and provide continued opportunities for traditional and non-traditional use of wildlife for future human generations (see Volume 6, Section 6.6.11.1 for additional detail). Impacts to wildlife are then used to determine the significance of the Project on the continued opportunity for traditional and non-traditional use of wildlife (also an assessment endpoint, which incorporates sustainability). Valued components, assessment endpoints, and measurement endpoints used in this FEIS are presented in Table 4.2-1. Appendix 4.1-B provides a chart summarizing reasons of value for VECs and VSECs. Some of the VECs identified by NIRB, were not considered valued components for the Project because they are not likely to be impacted by the Project. Some of the VECs identified by NIRB measured baseline conditions for the assessment of other VECs/VSECs (i.e. ground stability, geochemistry) so were not considered VECs themselves. The FEIS VECs and VSECs were presented to the local communities for review and feedback during a series of open houses held for the Project in 2012 (SD 3-1 Public Engagement and Consultation Baseline, Section 7.2.3). The FEIS Volumes 5 through 10, provide additional rationale on VEC or VSEC selection.

**Table 4.2-1: Assessment and Measurement Endpoints Associated with Valued Components (VECs or VSECS)**

| Valued Component (VEC or VSEC) | Assessment Endpoints | Measurement Endpoints |
|---|---|---|
| Atmospheric environment<br>■ Air quality<br>■ Noise | ■ Compliance with applicable ambient air quality criteria<br>■ Compliance with applicable noise standards<br>■ Contribution of greenhouse gas to climate change | ■ Greenhouse Gas emissions<br>■ Total suspended particulates<br>■ Carbon, sulphur, and nitrogen oxides<br>■ Particulate matter (e.g., dust)<br>■ Equivalent noise level |
| 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<br>■ Groundwater quality |
| Hydrology | ■ 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<br>■ Surface topography, drainage boundaries, waterbodies, and water pathways |
| Surface water quality and Sediment quality | ■ 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) | ■ Physical analytes (e.g., pH, conductivity, turbidity)<br>■ Major ions and nutrients<br>■ Total and dissolved metals<br>■ Organic compounds |
| Freshwater Aquatic Ecology:<br>■ Fish habitat<br>■ Arctic char;<br>■ lake trout;<br>■ Arctic grayling; and<br>■ benthic invertebrates. | ■ Habitat Units (as part of No-Net Loss plan)<br>■ Abundance and distribution<br>■ Continued opportunity for traditional and non-traditional use of fish | ■ Habitat units<br>■ Habitat quantity and fragmentation<br>■ Habitat quality, lower trophic levels<br>■ Fish health, including survival and reproduction<br>■ Access to fish |
| Marine Environment:<br>■ water quality;<br>■ fish;<br>■ habitat; and | ■ Maintenance and population abundance and distribution of marine biota, fish and wildlife<br>■ Maintenance and population abundance and distribution of Species | ■ Habitat quantity<br>■ Habitat quality<br>■ Relative abundance and distribution of fish species |

**Table 4.2-1: Assessment and Measurement Endpoints Associated with Valued Components (VECs or VSECS) (continued)**

| Valued Component (VEC or VSEC) | Assessment Endpoints | Measurement Endpoints |
|---|---|---|
| ■ mammals<br>■ marine birds | at Risk<br>■ Continued opportunity for use of marine biota, fish and wildlife | ■ Survival and reproduction of marine wildlife<br>■ Availability of marine biota, fish, and wildlife<br>■ Access to marine biota, fish, and wildlife |
| Soil | ■ Assessed through other components (i.e., maintenance of plant populations) | ■ Soil quality<br>■ Soil quantity and distribution<br>■ Reclamation suitability |
| Vegetation:<br>■ plant populations and communities.<br>■ Listed rare plants<br>■ Traditional plant use | ■ Maintenance of population abundance and distribution of plant populations and communities<br>■ Continued opportunity for use of traditional plants<br>■ Maintenance of population abundance and distribution of plant species at risk | ■ Relative abundance and distribution of plant species<br>■ Presence of invasive species<br>■ Availability of plants for traditional use |
| Wildlife:<br>■ waterbirds;<br>■ upland birds; migratory birds;<br>■ raptors;<br>■ caribou, caribou habitat and behaviour; and<br>■ wolves. | ■ Maintenance of population abundance and distribution of the abundance and distribution of wildlife populations<br>■ Continued opportunity for traditional and non-traditional use of wildlife | ■ Habitat quantity and fragmentation<br>■ Habitat quality<br>■ Relative abundance and distribution of wildlife species<br>■ Survival and reproduction<br>■ Access to wildlife<br>■ Availability of wildlife |
| Species health:<br>■ 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<br>■ Exposure<br>■ Toxicity |
| Heritage Resources | ■ Protection of archaeological and paleontological resources | ■ Archaeological and sacred sites<br>■ Paleontological sites |
| Employment and Business Opportunities | ■ Maintenance of long-term economic properties | ■ Employment<br>■ Gross Domestic Product and economic growth<br>■ Inflation and Consumer Price Index<br>■ Trade balance<br>■ Investment<br>■ Employment by industry<br>■ Economic infrastructure<br>■ Government fiscal situation<br>■ Business opportunities and contracting<br>■ Economic development |

**Table 4.2-1: Assessment and Measurement Endpoints Associated with Valued Components (VECs or VSECS) (continued)**

| Valued Component (VEC or VSEC) | Assessment Endpoints | Measurement Endpoints |
|---|---|---|
| | | ■ Income<br>■ Traditional economic activities |
| ■ Population demographics<br>■ Education and training<br>■ Individual, family and community wellbeing<br>■ Community infrastructure and Public Services<br>■ Worker and Public Health and Safety<br>■ Governance and Leadership | ■ Maintenance of long-term social systems | ■ Demographic Changes<br>■ Migration<br>■ Education achievement and capacities<br>■ Family and community cohesion and function<br>■ Crime incidents<br>■ Physical and mental health<br>■ Addiction<br>■ Safety<br>■ Security<br>■ Community infrastructure<br>■ Public Service<br>■ Performance and capacity of governments |
| Traditional activity and knowledge | ■ Maintenance of traditional activity and knowledge | ■ Traditional and Commercial Harvesting<br>■ Land Use and Mobility<br>■ Food Security<br>■ Language |
| Non-traditional land use and resource use | ■ Maintenance of land use opportunities | ■ Hunting<br>■ Fishing<br>■ Tourism<br>■ Recreation<br>■ Parks and protected Areas<br>■ Wilderness character |
| Human Health<br>■ Workers<br>■ Public (Inuit and non-Inuit) | ■ Protection of air quality and noise with respect to human health<br>■ Continued opportunity for use of surface water, fish and country foods for traditional and non-traditional use | ■ Air quality<br>■ Soil quality<br>■ Country food quality<br>■ Water quality<br>■ Sediment Quality<br>■ Fish Quality<br>■ Noise |
| Cultural Impacts | ■ Maintenance of cultural resources | ■ Changes to the Cultural, Archaeological and Paleontological Record |

## 4.3 Pathway Analysis

Pathway analysis identifies and assesses the linkages between Project components or activities, and the corresponding potential residual effects to VECs or VSECs (e.g., water quantity, soil, wildlife, and socio-economics) and is the first step in impact prediction. Potential pathways through which the Project could affect VECs or VSECs were identified from a number of sources including the following:

- a review of the Project Description and scoping of potential effects by the environmental and engineering teams for the Project;
- scientific knowledge, existing information, and experience with other northern mines including the Agnico Eagle Meadowbank Gold Mine;
- engagement with the communities, Inuit organizations, and government;
- traditional knowledge (IQ); and IQ
- consideration of potential effects identified for this Project.

First, a matrix table of all Project activities or components was completed for each of the environmental and socio-economic components (Appendix 4.1-A). Within this matrix, all potential interactions between project activities from construction through closure and environmental components were identified. From these interactions, a list was made of all potential effects pathways for the Project. Each pathway was initially considered to have a linkage to potential effects on VECs or VSECs. Summary tables of the potential Project effects pathways identified for each valued component are provided in the detailed pathway analysis sections in FEIS Volumes 5 through 10.

Pathway analysis is a screening step that is used to verify the existence of linkages from the initial list of potential effects pathways for the Project. This screening step is largely a qualitative assessment, and is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on VECs or VSECs. This is in alignment with the statement in the "Guidelines for the Preparation of an Environmental Impact Statement for Agnico Eagle Mines Limited's Meliadine Project" (Guidelines) that state "In this assessment, more emphasis should be placed on significant impacts to VECs and VSECs, extending across all project phases if applicable." (NIRB 2012).

Pathway analysis was followed by the development of environmental design features (i.e., mitigations) that were incorporated into the Project Description to remove a pathway or limit (mitigate) the effects to VECs or VSECs. Environmental design features include Project design elements, environmental best practices, management policies and procedures, and social programs. Environmental design features were developed through an iterative process between the Project's engineering and environmental teams to avoid or mitigate effects.

Knowledge of the environmental design features was then applied to each of the pathways to determine the expected amount of Project-related changes to the environment and the associated residual effects (i.e., effects after mitigation) on VECs or VSECs. Changes to the environment can alter physical measurement endpoints (e.g., water and soil chemistry, and amount of habitat) and biological measurement endpoints such as distribution and abundance (Table 4.2-1). For an effect to occur there has to be a source (Project component or activity) that results in a measurable environmental change (pathway) and a correspondent effect on a VEC or VSEC.

Project activity → change in environment → effect on VEC or VSEC

Pathways were determined to be primary, minor, or as having no linkage using scientific knowledge and IQ (i.e., traditional knowledge), logic, and experience with similar developments and environmental design features. Each potential pathway was assessed and described as follows: IQ

- no linkage – pathway is removed by environmental design features so that the Project results in no detectable (measurable) environmental change and residual effects to a VEC or VSEC relative to baseline or guideline values;
- minor – pathway could result in a minor environmental change, but would have a negligible residual effect on a VEC or VSEC relative to baseline or guideline values; or
- primary – pathway is likely to result in a measurable environmental change that could contribute to residual effects on a VEC or VSEC relative to baseline or guideline values.

Primary pathways require further effects analysis and impact classification to determine the environmental or socio-economic significance from the Project on the VECs or VSECs. Pathways with no linkage to a VEC or VSEC, or that are considered minor, were not analyzed further or classified in the FEIS because environmental design features have removed the pathway (no linkage), or residual effects to the VEC or VSEC were determined to be negligible through a simple qualitative evaluation of the pathway (minor). Pathways determined to have no linkage to a VEC or VSEC, or those that were considered minor, were not predicted to result in environmentally significant effects on VECs or VSECs. Rationale is provided throughout the FEIS for each minor and no linkage pathway identified.

All primary pathways are assessed in the FEIS. However, primary pathways for one VEC or VSEC may end up being a minor pathway or having no linkage to other VECs or VSECs. For example, local changes to surface water levels may be a primary pathway for effects on aquatic vegetation, but may be considered a minor pathway for effects on the population size and distribution of a wildlife species with a larger home range.

## 4.4 Spatial and Temporal Boundaries

### 4.4.1 Spatial Scales and Boundaries

Individuals, populations, and communities function within the environment at different spatial (and temporal) scales. In addition, the response of physical, chemical, and biological processes to changes in the environment can occur across a number of spatial scales at the same time (Holling 1992; Levin 1992). As a result, the scale of the investigation will determine the range of patterns and processes that can be observed and predicted with certainty (Wiens 1989; Harris et al. 1996).

Effects from the Project on the biophysical environment are typically stronger at the local scale, and larger scale effects are more likely to result from other ecological factors and human activities. For example, effects from the Project on environmental components with limited movement (e.g., soil and vegetation) will likely be limited to local changes from metal mining, processing, and Project infrastructure. Some indirect changes to vegetation from dust deposition and air emissions may occur, but the effect should be limited to the local scale of the Project. Similarly, for species with small home ranges, any effects from the Project on a local population likely will not be transferred to other populations in the region.

For VECs with more extensive distributions, such as fish that can move within a watershed and wildlife species with large home ranges or are migratory, effects from the Project have a higher likelihood of combining with effects from other human developments and activities. Watersheds may be influenced by multiple users, who generate cumulative effects to these resources. Similarly, larger animals (e.g., caribou) that are influenced by the Project will likely encounter other human activities and developments in their daily and seasonal ranges. Consequently, effects from the Project could combine with influences from other developments in the individual's home range. In addition, the home ranges of several individuals may be affected, which results in cumulative effects to the population.

The purpose of the examples above is to emphasize the different levels of organization in natural systems, and the corresponding need to analyze and predict Project effects to VECs and VSECs at the appropriate spatial scales. For the FEIS, the spatial scope must be able to capture the scale-dependent processes and activities that influence the geographic distribution and movement patterns specific to each VEC or VSEC, taking into account the maximum area potentially affected by the Project. Since the responses of physical, biological, cultural, and economic properties to natural and human-induced disturbance will be unique and occur across different scales, studies should use a range of spatial (and temporal) scales (Wiens 1989; Levin 1992). Accordingly, the FEIS has adopted a multi-scale approach for describing baseline conditions (existing environment) and predicting effects from the Project on VECs and VSECs.

For the FEIS, the spatial boundaries of the local study areas were designed to measure baseline environmental conditions and then predict direct effects from the Project footprint and activities, including the Project facilities, buildings and infrastructure, roads, and proposed shipping routes in the NSA (Volume 2, Section 2.6 outlines the physical extent of the Project), on the VECs or VSECs and associated measurement endpoints (e.g., changes to ground and surface water quality, physical disturbance to vegetation, and soil admixing). Local study areas were also defined to assess small-scale indirect effects from Project activities on VECs, such as changes to soil and vegetation from dust and fuel emissions.

The boundaries for regional study areas (RSA) were designed to quantify baseline conditions at a scale that was large enough to assess the maximum predicted geographic extent (i.e., maximum zone of influence) of direct and indirect effects from the Project on VECs or VSECs and measurement endpoints. The RSAs are defined as the areas for which there is potential for direct, indirect, and/or cumulative biophysical and socio-economic Project-related effects. Project-related effects at the regional scale include potential changes to downstream surface and groundwater quantity and quality, vegetation communities, wildlife habitat quality, wildlife, and people that use these ecosystem services. The RSAs can include lands, communities, and portions of Nunavut or other regions of Canada that may be relevant to the assessment of the wide-spread effects of the Project. It also includes the traditional and contemporary land and resource use, including protected areas and other harvesting activities that could potentially be affected by the Project. Cumulative effects are typically assessed at a regional spatial scale and, where relevant, may consider influences that extend beyond the RSA or are even transboundary (i.e., beyond Nunavut) (e.g., marine shipping).

Details of the spatial boundaries defined for the assessment of each valued component are provided in FEIS Volumes 5 through 10.

### 4.4.2 Temporal Boundaries

Spatial and temporal boundaries are tightly correlated because processes that operate on large spatial scales typically occur at slower rates and have longer time lags than processes that operate on smaller spatial scales (Wiens 1989; Chapin et al. 2004; Folke et al. 2004). An example of a large spatial scale process that can occur at a slow rate is the movement of a river or stream channel, or climate change. Alternately, rapid changes in plant transpiration rates and bird community diversity may occur at smaller spatial scales. The establishment of temporal boundaries has 2 aspects (Whitney and Maclaren 1985):

- the time horizon that will be used in predicting change; and
- the temporal variability and periodicity that characterize the predicted impacts.

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 the FEIS, temporal boundaries are linked to 2 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 (including traditional and non-traditional use as listed in Table 4.2-1), which may extend beyond final closure (i.e., into 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. As noted in the Guidelines, 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 Project (NIRB 2012).

After removal of the stressor, reversibility is the likelihood and time required for a VEC/VSEC or system to return to a state that is similar to the state of systems of the same type, area, and time that are not affected by the Project. Reversibility does not imply returning to environmental conditions that existed prior to development of the Project. Ecological and socio-economic systems continually evolve through time (Chapin et al. 2004; Folke 2006). Subsequently, the physical, biological, social, and economic properties of the social-ecological system at closure (approximately 15 years from now) will likely be different than the current observed patterns, independent of Project effects. Return or recovery to pre-Project conditions may not be possible or even desirable. Ecological systems are complex, non-equilibrium systems, and the assumption that ecosystems can be managed to preserve or return to the same pre-stressed state is likely false (Landis and McLaughlin 2000; Sandberg and Landis 2001). The state of ecological and socio-economic systems at Project closure may be equally functional with the desired structure, but likely will not be the same as before development.

For those effects that are reversible, the FEIS evaluated the duration or time required to reverse the effect on the VEC/VSEC or system. Some effects may be reversible soon after removal of the stressor, such as effects to air quality from equipment operation. Other effects may require a longer duration before changes are reversed. Examples of potential irreversible effects include damage to archaeological sites and change in topography due to ground subsidence.

## 4.5 Effects Analysis

### 4.5.1 Project-Specific Effects

In the FEIS, the effects analysis considers all pathways that likely result in measurable environmental changes and residual effects to VECs or VSECs (i.e., after implementing environmental design features). Thus, the analysis was based on residual Project-specific (incremental) effects that are verified to be primary in the pathway analysis (Section 4.3). Residual changes to VECs or VSECs were analyzed using measurement endpoints and are expressed as effects statements in the FEIS (e.g., Effects to Hydrology, Effects to Wildlife Population Size and Distribution). Effects statements may have more than one primary pathway that link a Project activity with a change in a VEC or VSEC. For example, a pathway for an effect to hydrology is the alteration of local flows and drainage areas from the Project footprint. Incremental effects from the Project to wildlife population size and distribution may include changes in habitat quantity and quality, and movement.

Effects to social, economic, and cultural properties include positive and negative changes to employment, training, education, family income, traditional land use, family and community cohesion, and long-term social, cultural, and economic sustainability. Some of these measurement endpoints can be analyzed quantitatively (e.g., number of jobs created, estimated income levels). Other endpoints, such as community cohesion and traditional land use, are more difficult to quantify, and involve information from public engagement, literature, examples from similar projects under similar conditions, existing information, and experienced opinion. The effects analysis considered the interactions among the unique and common attributes, challenges, and opportunities related to social, cultural, and economic measurement endpoints. A key aspect of the effects analysis was to predict the influence from the Project on the development and sustainability of socio-economic conditions in the region.

Residual effects to traditional and non-traditional land use practices (e.g., hunting, fishing, plant and berry gathering) were assessed through the analysis of VECs that are directly associated with these assessment endpoints. For example, analysis of Project-specific effects to soil quality were used to determine the associated influence on the land to sustain vegetation used by wildlife or for traditional uses, such as berry picking. Analysis of changes to waterfowl abundance and distribution were used to assess the effect of the Project on the continued opportunity for harvesting ducks and geese. Therefore, effects to assessment endpoints for traditional and non-traditional land use were analyzed and assessed within discipline sections that contain the applicable biophysical VECs or socio-economic VSECs.

A detailed description of the methods and assumptions associated with the methods used to analyze residual effects from the Project on VECs and VSECs are provided in each discipline section of Volumes 5 through 10 (e.g., hydrology, atmospheric environment, terrain and soils, wildlife, employment, and business opportunities). Where possible and appropriate, the analyses was quantitative and included data from field studies, modelling results, scientific literature, government publications, effects monitoring reports, and personal communications. Available IQ and community information was incorporated into the analysis and results. Due to the amount and type of data available, some analyses were qualitative and included professional judgement or experienced opinion. Detailed methods for the effects analyses are presented in a detailed and transparent manner in FEIS Volumes 5 through 10, including supporting documentation. All studies used are cited and referenced in the reference section of each volume. The choice of methods and interpretation of results use current theories, knowledge, including IQ, and standards.

Following the effects analysis, a summary of residual effects is provided for each discipline. Results from the effects analyses were used to describe the direction, magnitude (intensity), duration, and geographic (spatial) extent of the predicted residual changes to VECs or VSECs (Section 4.5.4). These in turn are used in the determination of significance (Section 4.5.5), with cumulative and transboundary effects included, where appropriate. Where possible and appropriate, expected changes are expressed quantitatively. For example, the magnitude of the effect may be expressed in absolute or percentage values above baseline (existing) conditions, reference conditions or a guideline value. Duration (which is linked to reversibility) of the change was estimated relative to Project phases, and the geographic extent of effects were expressed in area (hectare) or distance (metre [m], kilometre [km]) from the Project, where applicable. In addition, the likelihood, and frequency of effects were also described, where applicable.

Expressions such as “short-term” duration or “moderate” magnitude were not used in the summary of residual effects. These expressions were reserved for the classification of impacts, where definitions of these expressions are provided.

### 4.5.2 Approach to Cumulative Effects

#### *4.5.2.1 Definition and Application*

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.

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 Project and one or more additional developments/activities overlap (or interact) with the temporal or spatial distribution of the VEC or VSEC. For some VECs, Project-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 Project and other developments and human activities.

In this FEIS, cumulative effects are identified, analyzed, and assessed within the Project-specific assessments for those VECs, where it is applicable. Similar to Project-specific effects, the analysis of cumulative effects involved pathway analysis (Section 4.3) and effects analyses (Section 4.5.1), and the classification and determination of significance of residual impacts as outlined in Section 4.5.4 and 4.5.5.

#### *4.5.2.2 Assessment Cases*

For VECs and VSECs that require cumulative effects analysis, the concept of assessment cases was applied to the associated spatial boundary (effects study area) to estimate the incremental and cumulative effects from the Project (Table 4.5-1). The approach incorporates the temporal boundary for analyzing the effects from previous, existing, and reasonably foreseeable developments before, during, and after the anticipated life of the Project.

**Table 4.5-1: Contents of Each Assessment Case**

| Baseline Case | Project Case | Future Case |
|---|---|---|
| Range of conditions from existing and approved developments prior to the Project. | Baseline Case plus the Project. | Application Case plus reasonably foreseeable developments. |

The baseline case represents a range of conditions over time within the effects study area prior to application of the Project, and not a single point in time. Observations collected during baseline studies represent part of the range of variation in the ecological and social systems produced by historical and current environmental selection pressures (both human and natural). In this FEIS, baseline conditions represent the cumulative effects from previous and existing land uses and natural processes that have shaped the biophysical, cultural, and socio-economic components during the period of human settlement (e.g., past 100 to 200 years). Analyzing the temporal changes to the landscape is fundamental to predicting the cumulative effects from development on VECs that move over large areas, such as caribou and traditional land users.

Baseline conditions also represent the historical and current environmental selection pressures that have shaped the observed patterns in VECs or VSECs. Environmental selection pressures include both natural (e.g., weather, changes on gene frequencies, predation, and competition) and human-related factors (e.g., mineral development and sport hunting/fishing). Depending on which selection pressures are currently driving changes to the VEC and system, baseline conditions typically fluctuate within a range of variation through time and space. The fluctuations are generated by variation in natural factors (natural variation) and variation associated with human influences. Relative to ecological time and space, baseline conditions are in a constant state of change due to the pushing and pulling of environmental selection pressures. Thus, baseline conditions can be thought of as normally distributed probability values within a defined spatial scale, and the location of the value (e.g., upper or lower end, or middle of the distribution) is dependent on which environmental factors are currently playing a key role in the state of the VEC or VSEC and system at a particular moment in time.

The temporal boundary of the application case begins with the anticipated first year of construction of the Project, and continues until the predicted effects are reversed (Section 4.4.2). For some VECs and VSECs, the effects may be determined to be irreversible within the temporal boundary of the assessment. The Future Case includes the predicted duration of residual effects from the Project, and other previous, existing, and reasonably foreseeable developments. Thus, the minimum temporal boundary for the Application and Future cases is the expected operational lifespan of the Project, which like the Baseline Case, includes a range of conditions over time. For several VECs and VSECs, the temporal extent of some effects likely will be greater than the operation phase of the Project because the effects will not be reversible until post-closure. The difference between the Application and Future cases is that the Application Case considers the incremental effect from the Project in isolation of potential future land use activities.

Analyses of the effects for the Baseline and Application cases are largely quantitative. Alternately, effects analyses for the Future Case may be more qualitative due to the large degree and number of uncertainties. For example, there are uncertainties associated with the timing, rate, type, and location of developments in the study areas for each VEC or VSEC. There are also uncertainties in the direction, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of Project effects.

#### *4.5.2.3 Previous and Existing Developments*

Cumulative effects assessment should include all other human activities that substantially affect the environment, including past, present, and reasonably foreseeable future development. Therefore, to encompass the largest area used in the biophysical environmental assessment, the caribou effects study area (CESA) was used as the spatial boundary to define the developments to be included in the cumulative effects assessment. Additional details are provided in FEIS Volumes 6, 7, 8, and 9 for specific VECS and VSECs.

Previous and existing developments in the CESA include roads, communities (including airports), hunting or fishing camps, inactive mines, mineral exploration camps, contaminated sites, fuel storage areas, quarries, and campgrounds. Assessing the incremental and cumulative impacts of the Project requires an understanding of the nature and extent of development and human activity within the area of interest. To estimate this, a database containing the type and location of previous, existing, and reasonably foreseeable projects was compiled. The following sources were checked for information on activity in the CESA:

- NIRB: permitted and licensed activities within the Nunavut;
- Aboriginal Affairs and Northern Development Canada: permitted and licensed activities within Northwest Territories and Nunavut;
- Natural Resources Canada: GIS file of community locations from Natural Resources Canada's GeoGratis website;
- Treasury Board of Canada: Federal Contaminated Sites Inventory;
- Nunavut Parks: locations of existing and proposed protected areas;
- location of hunting camps from operator websites;
- Nunavut Planning Commission;
- websites of companies holding land use permits; and
- knowledge of the area and Project status.

The developments included in the database are current to 31 December 2011. It is recognized that development is not stagnant and while the number of small developments varies over time, the difference in small development has not changed substantially between December 2011 and December 2013 so as to change results in any way that would impact the effects assessment. Therefore the CESA database was not updated for smaller developments that may have come into existence or have ceased since December 2011. However the database was reviewed for previous and existing large developments (i.e., mines) and none were identified.

A summary of previous and existing developments within the CESA is provided in Table 4.5-2.

**Table 4.5-2: Previous and Existing Developments within the Caribou Effects Study Area**

| Type of Development | Active | Inactive | Grand Total |
|---|---|---|---|
| Camp | 7 | 7 | 14 |
| Community | 4 | | 4 |
| Contaminated Site | | 58 | 58 |
| Fuel Storage | | 3 | 3 |
| Mine | | 1 | 1 |
| Mineral Exploration | 12 | 15 | 27 |
| Miscellaneous | 2 | 3 | 5 |
| Quarrying | 1 | 1 | 2 |
| Road | | 2 | 2 |
| Territorial Campground | 2 | | 2 |
| **Grand Total** | **28** | **90** | **118** |

Data were divided into 3 shapefiles for points, lines, and polygons. The use or type of existing development was derived from land use permit classifications. In the case of multiple land use permits issued for the same development, these were merged into a single feature in the database, using the most relevant descriptions.

- The accuracy of the location of the developments is variable; in some cases it is precise, in other cases the exact site of the activities were not recorded, or the activities were dispersed in nature (such as exploration camps with drilling programs).
- Any developments within municipal boundaries were not included, as the community is assumed to be the greatest source of disturbance (with the exception of the historic nickel mine located within the boundaries of Rankin Inlet).
- Historic winter road or winter hauling routes were not included in the database, as these have a short duration of activity, and cause little or no disturbance to the landscape.
- All contaminated sites were included; however, the priority of these should be considered. Low priority contaminated sites are often too small to be of relevance at larger spatial boundaries, such as RSA or CESA level. In cases where a priority was not assigned, the site was not included in the map.
- Priority was placed on identifying developments closest to the proposed Project. Some developments immediately outside the caribou effects study area were included if they had potential to have indirect effects on the study area (such as from roads or aircraft).
- Developments for which the land use permit was issued more than five years ago were considered to be inactive. Similarly, contaminated sites were considered to be inactive. This does not account for the duration or seasonality of activity of each permit holder, nor extensions granted to the land use permit.

#### 4.5.2.4 Reasonably Foreseeable Developments

Reasonably foreseeable future development (RFFD) is defined by NIRB as *Projects or activities that are currently under regulatory review or that will be submitted for regulatory review in the near future, as determined by the existence of a proposed project description, letter of intent, or any regulatory application filed with an authorizing agency* (NIRB 2007).

The Guidelines for the Project provide further direction for the inclusion of the RFFD (NIRB 2012), including the following:

- Section 2.1, NIRB Impact Review Principles: An understanding of past and potential future environmental, economic, and social trends in the region potentially affected by the proposed, and how the Project will influence these trends is required - The inclusion of a time perspective on all phases of the Project, from the early planning stages through operations and closure including post closure and maintenance phases where appropriate.
- Section 5.3 Regional Context: The Proponent shall describe in general terms the regional biophysical and socio-economic environments of the Kivalliq Region and Nunavut as a whole, including: ecological land classifications, ecological processes and relationships, the location of other base and precious metal finds and other existing and potential developments, and current and future land use plans.
- Section 7.11 Cumulative Effects Assessment: A longer temporal scale...will enable the Proponent to consider all activities from past developments into the present time and the reasonably foreseeable future for a more accurate analysis of variability and significant long-term effects.

While the NIRB definition limits RFFD to projects for which a regulatory application has been filed, Agnico Eagle Mines Limited has included reasonably foreseeable developments based on the following criteria:

- have been proposed and scoped to a reasonable level of detail;
- are currently undergoing regulatory review; and
- have the potential to change the Project or the impact predictions.

The Wolf deposit, located north-west of the Tiriganiaq deposit, is currently known, but still requires some exploration work to be better defined and included in the mine plan. Currently, the Wolf deposit does not have sufficient proven reserves to be economically mined and so was not included as a development, or as part of the Project. An environmental impact assessment (including a cumulative effects analysis) for the Wolf deposit will be completed in the future if the deposit becomes economically feasible to be developed.

Thus, the following proposed projects have been selected as a suite of major developments that may occur in the CESA in the foreseeable future:

- The Manitoba to Nunavut Road – This major project has received ongoing support from the Governments of Nunavut and Manitoba. Although no permit applications have yet been filed, a preferred alignment has been selected, and the project would change the face of development in the Kivalliq region.

- The Churchill Diamonds Project – This project is currently in the exploration phase and applications have not been made to advance to mining, but it was included as a likely project to be induced by the Manitoba to Nunavut Road, and was identified in the Manitoba to Nunavut Road route selection study as such. Although formally outside of the CESA, this project was conservatively included as a future development because it would have impacts to the socio-economics of the region, and may have impacts related to sensory disturbance on the Qamanirjuaq caribou herd.
- The Ferguson Lake Project – This project is currently in the exploration phase and applications have not been made to advance to mining, but a scoping study has investigated the possibility of advancing to mining. This project was included as a likely project to be induced by the Manitoba to Nunavut Road, and was identified in the Manitoba to Nunavut Road route selection study as such.
- The Kiggavik Uranium Project – This project is currently undergoing review with NIRB to become a uranium mine. Although formally outside of the CESA, this project was conservatively included as a future development because it would have impacts to the socio-economics of the region, and may have impacts related to sensory disturbance on the Qamanirjuaq caribou herd.
- Roche Bay Project- This project has recently completed a feasibility study. It has been included to provide a conservative effect analysis for marine shipping only.

The RIHC Port Facility project released a request for proposal for an environmental assessment and design of a port facility in Rankin Inlet in January 2014. However, this Project is not considered part of the cumulative effects assessment as it is assumed that AEM, pending viable economics to the Meliadine project, would make use of this facility rather than building a separate port for Meliadine. A port facility at Itivia is part of the project description and subsequent effects assessment presented in this FEIS, Two port facilities in Rankin Inlet is considered an unlikely scenario at this time, and therefore was not assessed.

Each of these projects is described below. Table 4.5-3 provides a summary of areas of overlap between the Project and RFFD. The cumulative effects assessment will emphasize the cumulative effects on the VECs and VSECs that could potentially be mostly affected by the Project

**Table 4.5-3: Area of Overlap between the Project and Reasonably Foreseeable Future Developments**

| Project | Loss of Caribou Habitat and Changes to Abundance or Distribution | Changes to freshwater Hydrology or Water Quality | Changes to Marine Resources | Improvements to Access, Leading to Changes in Land Use Patterns | Changes to the Socio-Economic Environment |
|---|---|---|---|---|---|
| Effects from Project | The Project occurs within the Qamanirjuaq caribou range | Treated Effluent will be released to the Meliadine Lake, which flows via the Meliadine River into Rankin Inlet on Hudson Bay | | The road linking the Project to the community of Rankin Inlet will improve access at the local scale | The Project will provide employment to the Kivalliq region |
| Manitoba to Nunavut Road | **Valid pathway** Located within the Qamanirjuaq range | **Valid pathway** The road will cross the Meliadine watershed | **Invalid Pathway** | **Valid pathway** The road would improve access and change land use in the Kivalliq region | **Valid pathway** The road would change the socio-economic environment in the Kivalliq region |

**Table 4.5-3: Area of Overlap between the Projectr and Reasonably Foreseeable Future Developments (continued)**

| Project | Loss of Caribou Habitat and Changes to Abundance or Distribution | Changes to freshwater Hydrology or Water Quality | Changes to Marine Resources | Improvements to Access, Leading to Changes in Land Use Patterns | Changes to the Socio-Economic Environment |
|---|---|---|---|---|---|
| Ferguson Lake Project | **Valid pathway** Located within the Qamanirjuaq range | **Invalid pathway** Located in a different watershed | **Valid Pathway** Would affect shipping | **Valid Pathway** Would also use the Manitoba to Nunavut Road | **Valid Pathway** Would affect the socio-economics of the Kivalliq region |
| Churchill Diamond Project | **Valid Pathway**[1] Not within the range of the Qamanirjuaq herd | **Invalid pathway** Located in a different watershed | **Valid Pathway** Would affect shipping | **Valid pathway** Would also use the Manitoba to Nunavut Road | **Valid Pathway** Would affect the socio-economics of the Kivalliq region |
| Kiggavik Uranium Project | **Valid Pathway**[1] Not within the range of the Qamanirjuaq herd | **Invalid pathway** Located in a different watershed | **Valid Pathway** Would affect shipping | **Invalid pathway** Would not affect access to Rankin Inlet | **Valid Pathway** Would affect the socio-economics of the Kivalliq region |
| Roche Bay Project | **Invalid Pathway** Not within the range of the Qamanirjuaq herd | **Invalid pathway** Located in a different watershed | **Valid Pathway** Would affect shipping | **Invalid pathway** Would not affect access to Rankin Inlet | **Invalid Pathway** Considered as an advanced exploration project in the socio-economic assessment |

[1]Outside of the CESA. Included in the future developments because it is currently under review for full development as a mine and may have impacts related to sensory disturbance on the Qamanirjuaq caribou herd.

## The Manitoba to Nunavut Road

There have been investigations into a road route linking the community of Rankin Inlet to the Port of Churchill and the existing all-weather road transportation network in Manitoba, and to the National Highway System. The development strategy for the new route, including the link to Churchill, is based on initial staging as a winter road, followed in time by possible construction of a single-lane, all-weather road, then finally, construction of a two-lane, all-weather road. The respective governments see implementation of the new road as a means of supporting the objectives of healthy communities, simplicity and unity, self-reliance and continued learning. Furthermore, the road should enhance opportunities for resource development such as eco-tourism and mining; benefit employment, small business development and standard of living, and increase capital investment by reducing the cost of transporting people and goods between the Kivalliq Region and urban centres in Manitoba (Nishi-Khon/SNC Lavalin 2007).

While the route of the Manitoba to Nunavut Road is not determined by the location of potential mine sites (Nishi-Khon/SNC Lavalin 2007), the presence of the road may induce the development of deposits that are not currently economic. The Manitoba to Nunavut Road will also include the construction of an electrical transmission line running parallel with the road to bring hydro electricity from Manitoba to Nunavut, and the further possible development of hydro-electric power along the road route. As none of the potential hydroelectric sites identified on the Manitoba to Nunavut Road are on the same watershed as the Project, none of these were considered as RFFD.

The Manitoba to Nunavut Road is anticipated to have large environmental, economic and socio-economic effects to the region, relative to existing conditions.

### The Ferguson Lake Project

The Ferguson Lake Project is located about 240 km west of Rankin Inlet and 160 km south of Baker Lake. The property, which contains world class amounts of nickel and copper, was initially discovered in 1950, and is now owned by Starfield Resources. Starfield has continued to explore and define the resource. A recent scoping study suggested that the Ferguson Lake Project would initially consist of a small open pit mine. Plans call for further development into an underground mine within one year. Infrastructure is to include a processing plant onsite at Ferguson Lake to crush, clean and grind massive sulphides into slurry. A 285 km pipeline would transport the slurry from Ferguson Lake to a metallurgical processing plant site located at Arviat. The two facilities would also be connected by a 285 km 11-megawatt power line that follows the same path as the slurry pipeline (Starfield 2012).

The proposed Nunavut-Manitoba road could provide benefits for the future exploration phases of the Ferguson Lake Project. If a mine is opened, the proposed Rankin Inlet-Sundance road could be used as a segment of the Ferguson Lake resupply route as well as for the transport of ore or refined products.

### The Churchill Diamond Project

The Churchill Diamond Project is comprised of mineral rights to more than 800 000 hectares located between the communities of Rankin Inlet and Chesterfield Inlet. This project is owned by joint venture partners Shear, Stornoway and BHP Billiton. To date, the joint venture has identified 88 kimberlites, 11 of which are considered high-grade. Although the project has not been scoped to the level of a mine, it is likely that a future mining operation would include several open pits (Shear 2012).

The proposed Manitoba to Nunavut Road would improve the economics of the Churchill Diamond Project, possibly leading to an induced development (Nishi-Khon/SNC Lavalin 2007).

### The Kiggavik Uranium Project

AREVA Resources Canada Inc. is proposing to construct, operate and decommission a uranium mine, called the Kiggavik Project (Project), in the Kivalliq Region of Nunavut. The Kiggavik Project is located approximately 80 km west of the community of Baker Lake. Four uranium ore deposits will be mined using open pit methods and one deposit will be mined using underground methods. All extracted ore will be processed through a mill. Some of the mined out pits will be used as tailings management facilities. The uranium product will then be packaged in sealed barrels and transported using aircraft to southern transportation networks. The Kiggavik Project will be serviced by ship and barge and a winter access road. An all-season road between Baker Lake and the Project is a secondary option under consideration in case the winter road cannot adequately support the Kiggavik Project. Based on existing resources, mine life is estimated at 14 years of operation with additional years for construction and decommissioning. Direct job estimates are up to 750 and 600 workers for construction and operations stages, respectively. Indirect and induced jobs may be as high as 400 during construction and 1300 during operations. The total taxes and royalties to be paid on the Kiggavik Project would be approximately $1 billion payable to Nunavut Tunngavik Inc., the Government of Nunavut, and the Government of Canada (Areva 2012). The Kiggavik Project is currently under review by NIRB, and the Draft Environmental Impact Statement was re-submitted in May 2012. This project continues to move through the NIRB review process and as of January 2014 the Final EIS has not been submitted. As noted above, this project is formally outside of the CESA; however, it was conservatively included as a future development in the cumulative effects assessment as it is currently under review for full development as a mine and it would have impacts to the socio-economics of the region, and may have impacts related to sensory disturbance on the Qamanirjuaq caribou herd.

### The Roche Bay Project

The Roche Bay Project is a proposed iron ore mine situated in the ocean off the Melville Peninsula of Baffin Island in Roche Bay (Advance Exploration Inc. 2013a). This potential mining project is located approximately 50 km northeast of Hall Beach, and 95 km north-northeast of the community of Igloolik, NU. A 140 km banded iron formation has been identified at this location, with an estimated resource of over 500 million tonnes. Further exploration is ongoing to determine the extent and potential of deposits to the north, south, and west of Roche Bay in addition to the current estimated resource quantity. A feasibility of study has been completed and baseline data has been collected (Advance Exploration Inc. 2013b). The Project has been included to provide a conservative cumulative effects analysis for shipping only.

## 4.5.3 Application of Residual Impact Classification

In the FEIS, the term “effect” used in the effects analyses and residual effects summary (Section 4.5) is regarded as an “impact” in the residual impact classification. An effect represents an unclassified change in a VEC or VSEC. The term “impact” is only used during the classification process. Therefore, in the residual impact classification, all residual effects are discussed and classified in terms of impacts to VECs and VSECs.

Quantitative and qualitative descriptions of the direction, magnitude, geographic extent, and duration of changes to measurement endpoints for all VECs with primary pathways are provided in the residual effects summary for each environmental discipline (Section 4.5). Frequency and likelihood of effects also are described where applicable. However, the classification of residual impacts (and associated pathways) and determination of environmental significance were only completed for those VECs or VSECs that have assessment endpoints. This is because assessment endpoints represent the key properties of the VEC or VSEC that should be protected for use by future human generations (i.e., assessment endpoints consider sustainability). Results from the residual impact classification were then used to determine the environmental significance from the Project on assessment endpoints.

## 4.5.4 Residual Impact Criteria and Definitions

The purpose of the residual impact classification is to describe the residual effects from the Project on VECs and VSECs using a scale of common words rather than numbers and units. The use of common words or criteria is accepted practice in environmental assessment and follows those suggested in the Guidelines for the Project (NIRB 2012). The following criteria are used to assess the residual impacts from the Project in the FEIS:

- direction or nature of the impacts;
- magnitude and complexity;
- geographic extent;
- frequency;
- duration;
- reversibility; and
- likelihood or probability of effects.

Generic definitions for each of the residual impact criteria are provide below.

**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 main 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 the Project also are reported. Neutral changes are not assessed.

**Complexity and Magnitude**: Complexity is the degree of intricacy relative to the baseline 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 the Project relative to baseline conditions or a guideline value. The degree of complexity is incorporated within magnitude and is then classified into 4 scales: negligible, low, moderate, and high. For each VEC or VSEC, the scales of magnitude are defined. Magnitude can relate to a percentage change (e.g., change from baseline), 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 4 scales; local, regional, beyond regional, and transboundary. Local-scale impacts mostly represent changes that are directly related to the Project footprint and activities, but may also include small-scale indirect impacts. Changes at the regional scale are largely associated with indirect impacts from the Project, and represent the maximum predicted spatial extent of impacts from the Project (zone of influence). Impacts beyond the regional scale are mostly associated with VECs that have large spatial distributions and are influenced by cumulative effects from the Project and other developments, such as groundwater and socio-economics. For the purposes of this Project, transboundary is defined as effects from the Project that result outside of the NSA.

**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 Project). 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 Project phases. Thus, duration is a function of the length of time that the VEC or VSEC is exposed to Project 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 Project. 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. In terms of the socio-economic environment, the manageability of impacts is considered rather than their reversibility. 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).

For criteria such as frequency and likelihood, the scales can be applied consistently across all biophysical VECs (e.g., isolated, periodic, or continuous frequency). Socio-economic VSECs do not include frequency and likelihood as it is assumed that the impacts have a high likelihood to occur continuously during the assessment period. The scale of classifications for direction, magnitude, geographic extent, and duration are dependent on each biophysical VEC and socio-economic VSEC. To provide transparency in the FEIS, the definitions for these scales were ecologically, socially, or logically based on the VEC or VSEC. Although professional judgement is inevitable in some cases, a strong effort was made to classify impacts using scientific principles and supporting evidence. The scales for these criteria are specifically defined for each VEC or VSEC in the FEIS.

### 4.5.5 Residual Impact Classification and Significance

As explained in Section 4.5.1, effects statements are used to focus the analysis of changes to VECs or VSECs that are associated with one or more valid pathways. The residual effects summary presents a numerical and/or qualitative description of magnitude, geographic extent, duration, and frequency of residual effects from each pathway. From the summary of residual effects, each pathway that is linked to an assessment endpoint is classified using categorical scales for each impact criterion (e.g., low magnitude, regional geographic extent, long-term duration, high likelihood). The residual effects classifications for each valid pathway are described and summarized in table format in FEIS Volumes 5 through 10, where applicable.

The classification of residual impacts on valid pathways provides the foundation for determining environmental significance of the Project on assessment endpoints. Magnitude, geographic extent, and duration are the principal criteria used to predict significance (FEARO 1994). Other criteria, such as frequency and likelihood are used as modifiers (where applicable) in the determination of significance. Duration of impacts, which includes reversibility, is a function of ecological resilience, and these ecological principles are applied to the evaluation of significance.

Although difficult to measure, resilience is the capacity of the system to absorb disturbance, and reorganize and retain the same structure, function, and feedback responses (i.e., properties of the social-ecological system) (Holling 1973; Walker et al. 2004; Folke 2006). Resilience includes resistance, capability to adapt to change, environmental sensitivity, and how close the system is to a threshold before shifting states (i.e., precariousness). Highly resistant systems require stronger disturbances over a longer duration and larger geographic area to change the system's current path or trajectory, even if it is close to a threshold. In contrast, a similar system with lower resistance would be less able to adapt to a weaker disturbance, and may generate a change in state or a regime shift with a subsequent impact on the ecosystem and society (Folke et al. 2004; Walker et al. 2004).

The adaptive capability of a system is related to the evolutionary history and adaptations accumulated by communities, species, and populations while experiencing a range of disturbances and fluctuations through space and time (Holling 1973; Gunderson 2000). If the frequency, duration, geographic extent, and/or magnitude of a disturbance are beyond that historically encountered by the system, and outside the adaptive capability of species, then the likelihood of a regime shift increases. Regime shifts and changes in state of the population or ecosystem can be reversible or irreversible.

Due to the complex relationships among biophysical components and unpredictable events, the recovery of the system following disturbance can result in the same or altered state (Gunderson 2000; Folke 2006). In other words, the impact from disturbance may be reversible, but the exact nature of ecosystem properties and services, and human uses are different. In some cases, the shift in ecological properties and services may not be reversible and will have a consequence to socio-economics and land use (Gunderson 2000; Scheffer and Carpenter 2003; Folke et al. 2004; Carpenter and Brock 2006).

Human development and natural disturbances erode the resilience of existing ecosystems by stressing and disrupting the relationships among species and their environment. Through the implementation of management and policy, humans also can increase or maintain resilience by making the system more resistant, moving the system away from threshold boundaries, and/or moving the boundary further away from the system (Folke et al. 2004; Walker et al. 2004). People have the ability to exert change across several spatial and temporal scales and levels of organization in the system, although some more strongly and quickly than others. Through the actions of adaptive management, mitigation, and changes to land use practices, humans have the ability to modify resilience in a positive way, and potentially decrease environmental significance.

In the FEIS, the determination of significance from Project impacts and cumulative effects on the assessment endpoint for the socio-economic environment is completed on a subset of VSECs (e.g., quality of life, employment, income, education, and community services), and typically each VSEC is directly associated with an individual pathway. Since people have an ability to modify the system across several spatial and temporal scales, each pathway can result in different levels of effects on individuals, communities, and the region. Consequently, it is more practical to independently classify and predict the significance of the impact from each pathway on a socio-economic VSEC than it is to classify the entire set of pathways and generate a single evaluation of significance on the socio-economic environment. However, after evaluating the significance of the pathways associated with the subset of VSECs, the overall significance of the Project on the assessment endpoint for the socio-economic environment is provided.

In contrast, the evaluation of significance for biophysical VECs considers the entire set of pathways that influence a particular assessment endpoint, including cumulative effects. The relative contribution of each pathway is then used to determine the significance of the Project on assessment endpoints. For example, a pathway with a high magnitude, large geographic extent, and long-term duration would be given more weight in determining significance relative to pathways with smaller scale effects. The relative impact from each pathway is discussed; however, pathways that are predicted to have the greatest influence on changes to assessment endpoints are assumed to contribute the most to the determination of environmental significance.

The following is an example of definitions for assessing the significance of impacts on wildlife assessment endpoints (Table 4.2-1), and the associated continued opportunity for traditional and non-traditional use of wildlife. Definitions for assessing the significance of impacts on other VECs and VSECs are provided in Volumes 5 through 10, as applicable.

- **Not significant** – impacts are measurable at the individual level, and strong enough to be detectable at the population level, but are not likely to decrease resilience and increase the risk to population maintenance and opportunities for traditional and non-traditional use.
- **Significant** – impacts are measurable at the population level and likely to decrease resilience and increase the risk to population maintenance and impact opportunities for traditional and non-traditional use. A number of high magnitude and irreversible impacts at the population level (regional scale) would likely be significant.

These lower and upper bounds on the determination of significance are relatively straightforward to apply. It is the area between these bounds where ecological principles and professional judgment are applied to determine significance.

Environmental significance was used to identify predicted impacts that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to a VEC. It is difficult to provide definitions for environmental significance that are universally applicable to each VEC assessment endpoint. Consequently, specific definitions are provided for each assessment endpoint in the FEIS. The evaluation of significance used ecological principles, to the extent possible, but also involved professional judgement, experienced opinion, traditional knowledge (IQ), and opinion from affected communities, individuals and organizations, where appropriate. IQ

In summary, results from the effects analysis and residual impact classification of primary pathways were used in the evaluation of the significance of impacts from the Project on VECs and VSECs. Quantitative and qualitative key factors were considered in the determination of environmental significance as follows:

- results from the residual impact classification of primary pathways;
  - magnitude, geographic extent (local, regional, beyond regional), and duration (which includes reversibility and considers the number of phases of the Project across which the impact extends) of the impact were the principal criteria used, with frequency and likelihood as modifiers;
  - likelihood for cumulative adverse effects; and
  - professional judgment and ecological principles, such as resilience, were used to predict the duration and associated reversibility of impacts.
- ecological or socio-economic context/value, including the “state of health” of ecosystems and the capacity of resources to meet present and future needs;
- historical, cultural, and archaeological significance of the geographic area likely to be affected by the Project; and
- value attached to the individual VEC or VSEC, identified through IQ and based on consultation with potentially affected communities and relevant individuals and organizations. IQ

The socio-economic context/value includes how the effect will impact traditional and non-traditional land use, including the extent of the impact to harvesting. The size of the human and wildlife populations and habitat are also considered in the significance determination. These factors are an inherent component to ecological and socio-economic context, as well as in the potential magnitude of an effect. For example, if the population is small then a change in the population would be of greater significance. Where appropriate, conclusions about impact significance were also considered in context with relevant guidelines or regional policies.

## 4.6 Uncertainty

Most assessments of impacts embody some degree of uncertainty. The purpose of the uncertainty section of the FEIS is to identify the key sources of uncertainty and discuss how uncertainty was addressed to increase the level of confidence that effects will not be worse than predicted. Confidence in effects analyses can be related to many elements, including the following:

- adequacy of baseline data for understanding existing conditions and future changes unrelated to the Project (e.g., extent of future developments, climate change, catastrophic events);
- model inputs (e.g., estimates of the spatial distribution of salt concentrations in deep groundwater);
- understanding of Project-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., how and why the Project will influence wildlife); and
- knowledge of the effectiveness of the environmental design features for reducing or removing impacts (e.g., environmental performance of the all-weather access road).

Uncertainty in these elements can result in uncertainty in the prediction of environmental significance. Where possible, attempt was made to increase the level of confidence in impact predictions in the FEIS by reducing the uncertainty, as shown in the following examples:

- using the results from several models and analyses to help reduce bias and increase precision in predictions;
- using existing data from effects monitoring programs at existing northern mines (particularly Agnico Eagle's Meadowbank Gold Mine) and from the literature as inputs for models rather than strictly hypothetical or theoretical values; and
- implementing a conservative approach when information is limited so that impacts are typically overestimated.

Where appropriate, uncertainty may also be addressed by additional mitigation, which would be implemented as required through adaptive management. Each discipline section includes a discussion of how uncertainty has been addressed and provides a qualitative evaluation of the resulting level of confidence in the effects analyses and impact classifications.

## 4.7 Monitoring and Follow-Up

In the FEIS, monitoring programs (or Post-Project Analysis or PPA, as referred to by NIRB) 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. Typically, monitoring includes one or more of the following categories, which may be applied during the development of the Project.

- **Compliance inspection:** monitoring the activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and regulatory conditions of approval and company commitments.
- **Environmental and Socio-economic monitoring:** monitoring to track conditions or issues during the development lifespan, and subsequent implementation of adaptive management.

- **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 these programs can be used to increase the certainty of impact predictions in future environmental assessments.

These programs form part of the environmental management system for the Project. 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. Adaptive management is defined as a planned and systematic approach for continuously improving environmental management practices by learning through outcomes (Canadian Environmental Assessment Agency 2012). This may include increased monitoring, changes in monitoring plans, or additional mitigation.

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# APPENDIX 4.1-A

## Matrix Tables

**Table 4.1-A-1: Linkage Matrix Between Project Activities and Atmospheric Components**

| Project Components and Activities | Air Quality | Climate and Meteorology | Greenhouse Gases and Climate Change | Noise | Vibration |
|---|---|---|---|---|---|
| **CONSTRUCTION** | | | | | |
| Earth moving (excavation, drilling, grading, trenching, backfilling) | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |
| Blasting activities | 1 | 0 | 1 | 1 | 1 |
| Borrow pits and management of overburden | 1,2 | 0 | 1,2 | 1,2 | |
| Presence of temporary buildings (footprint and height) | 0 | 0 | 0 | 1,3 | |
| Construction of infrastructures and facilities | 1,3 | 0 | 1,3 | 1,3 | |
| Use of heavy equipment, vehicle circulation and helicopter use | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1,2,3 | 0 | 0 | 1,2,3 | |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 0 | 1 | 1 | |
| Sewage treatment and disposal | 1 | 0 | 1 | 1 | |
| Waste management (landfill and biopile) | 1 | 0 | 1 | 1 | |
| Snow clearing and stockpiling | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |
| Shipping and unloading (marine and land) | 1,2,3,4 | 0 | 1,2,3,4 | 1,2,3,4 | |
| Investments, expenditures, taxes and royalties | 0 | 0 | 0 | 0 | |
| Creation, presence and movement of workforce | 1,2,3,4 | 0 | 1,2,3,4 | 1,2,3,4 | |
| **OPERATION** | | | | | |
| Underground mining, open pit mining and waste rock management | 1 | 0 | 1 | 1 | |
| Mill operation | 1 | 0 | 1 | 1 | |
| Tailings area storage facility | 1 | 0 | 0 | 1 | |
| Presence of infrastructures and facilities (footprint and height) | 0 | 0 | 0 | 1,3 | |
| Presence of roads and road network | 1 | 0 | 1 | 1 | |
| Use of heavy equipment, vehicle circulation and helicopter use | 1,2,3,4 | 0 | 1,2,3,4 | 1,2,3,4 | |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |

**Table 4.1-A-1: Linkage Matrix Between Project Activities and Atmospheric Components (continued)**

| Project Components and Activities | Air Quality | Climate and Meteorology | Greenhouse Gases and Climate Change | Noise | Vibration |
|---|---|---|---|---|---|
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 0 | 1 | 1 | |
| Waste management (landfill and biopile) | 1 | 0 | 1 | 1 | |
| Snow clearing and stockpilling | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |
| Shipping and unloading (marine and land) | 1,2,3,4 | 0 | 1,2,3,4 | 1,2,3,4 | |
| Investments, expenditures, taxes and royalties | 0 | 0 | 0 | 0 | |
| Creation, presence and movement of workforce | 1,2,3,4 | 0 | 1,2,3,4 | 1,2,3,4 | |
| **TEMPORARY, FINAL AND POST-CLOSURE** | | | | | |
| Pit and underground portal management | 1 | 0 | 1 | 1 | |
| Demolition and removal of infrastructures and facilities | 1,2, 3 | 0 | 1,2,3 | 1,2,3 | |
| Hydrological reconnection | 1 | 0 | 1 | 1 | |
| Grading, reclamation and re-vegetation | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |
| Waste management (landfill and biopile) | 1 | 0 | 1 | 1 | |
| Creation, presence and movement of workforce | 1,2,3,4 | 0 | 1,2,3,4 | 1,2,3,4 | |
| Monitoring and follow-up | 1,2,3 | 0 | 1,2,3 | 1,2,3 | |

Legend:

0. No linkage
1. Mine site
2. Phase II AWAR
3. Rankin Inlet
4. Itivia harbour including marine shipping

**Table 4.1-A-2: Linkage Matrix Between Project Activities and Terrestrial Components**

| Project Activities | Geology | Permafrost | Soil and Terrain | Vegetation | Terrestrial Wildlife and Wildlife Habitat | Birds and Bird Habitat |
|---|---|---|---|---|---|---|
| **CONSTRUCTION** | | | | | | |
| Earth moving (excavation, drilling, grading, trenching, backfilling) | 1.2,3 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1,2 |
| Blasting activities | 1,2 | 1,2 | 1,2 | 1,2 | 1,2 | 1,2 |
| Borrow pits and management of overburden | 1,2 | 1,2 | 1,2,3 | 1,2 | 2 | 2 |
| Presence of temporary buildings (footprint and height) | 1,3 | 1,3 | 1 | 1 | 1 | 1 |
| Construction of infrastructures and facilities | 1,2,3 | 1,2,3 | 1,3 | 1 | 1 | 1 |
| Use of heavy equipment, vehicle circulation and helicopter use | 1,2,3 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1,2 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1,3 | 1,3 | 1,2,3 | 1,2 | 1,2 | 1,2 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 0 | 1,2,3 | 1,2 | 1,2 | 1,2 | 1,2 |
| Sewage treatment and disposal | 0 | 1,3 | 1 | 1 | 1 | 1 |
| Waste management (landfill and biopile) | 0 | 1 | 1 | 1 | 1 | 1 |
| Snow clearing and stockpilling | 0 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1,2 |
| Shipping and unloading (marine and land) | 0 | 3 | 1,2,3,4 | 1,2,3,4 | 1,2,4 | 1,2,4 |
| Purchases of goods and services | 0 | 0 | 0 | 0 | 0 | 0 |
| Presence and movement of workforce | 0 | 0 | 1,2,3,4 | 0 | 1,2,4 | 1,2,4 |
| **OPERATION** | | | | | | |
| Underground mining, open pit mining and waste rock management | 1,2 | 1,.2 | 1 | 1 | 1,2 | 1,2 |
| Mill operation | 0 | 1 | 1 | 1 | 1 | 1 |
| Tailings area storage facility | 0 | 1 | 1 | 1 | 1,2 | 1,2 |
| Presence of infrastructures and facilities (footprint and height) | 1 | 1,2,3 | 1,3 | 1 | 1 | 1 |
| Presence of roads and road network | 1,2 | 1,2 | 1,2 | 2 | 2 | 2 |
| Use of heavy equipment, vehicle circulation and helicopter use | 0 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 1,2 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1,3 | 1,3 | 1,2,3 | 1,2 | 1,2 | 1,2 |

**Table 4.1-A-2: Linkage Matrix Between Project Activities and Terrestrial Components (continued)**

| Project Activities | Geology | Permafrost | Soil and Terrain | Vegetation | Terrestrial Wildlife and Wildlife Habitat | Birds and Bird Habitat |
|---|---|---|---|---|---|---|
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 0 | 1,2,3 | 1,2 | 1,2 | 1,2 | 1,2 |
| Waste management (landfill and biopile) | 0 | 1 | 1 | 1 | 1 | 1 |
| Snow clearing and stockpilling | 0 | 1,2,3 | 1,2,3 | 1,2 | 1,2 | 0 |
| Shipping and unloading (marine and land) | 0 | 3 | 1,2,3,4 | 1,2,3,4 | 1,2, 4 | 1,2,4 |
| Purchases of goods and services | 0 | 0 | 0 | 0 | 0 | 0 |
| Presence and movement of workforce | 0 | 0 | 1,2,3,4 | 0 | 1,2, 4 | 1,2,4 |
| **TEMPORARY, FINAL AND POST-CLOSURE** | | | | | | |
| Pit and underground portal management | 1 | 1 | 0 | 1 | 1 | 1 |
| Demolition and removal of infrastructures and facilities | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2 | 1,2 |
| Hydrological reconnection | 0 | 1,2,3 | 1,2 | 1,2 | 1,2 | 1,2 |
| Grading, reclamation and re-vegetation | 0 | 1,2,3 | 1,2,3, | 1,2,3 | 1,2 | 1,2 |
| Waste management (landfill and biopile) | 0 | 1 | 1 | 1 | 1,2 | 1,2 |
| Creation, presence and movement of workforce | 0 | 0 | 0 | 0 | 0 | 0 |
| Monitoring and follow-up | 0 | 0 | 1.2.3 | 1,2,3 | 1,2 | 1,2 |

Legend:

0. No linkage
1. Mine site
2. Phase 2 AWAR
3. Rankin Inlet
4. Itivia harbour including marine shipping


AGNICO EAGLE Golder Associates

**Table 4.1-A-3: Linkage Matrix Between Project Activities and Freshwater Environment Components**

| Project Activities | Hydrogeology and Groundwater Quality | Hydrology | Surface Water and Sediment Quality | Plankton and Benthos | Fish and Fish Habitat |
|---|---|---|---|---|---|
| **CONSTRUCTION** | | | | | |
| Earth moving (excavation, drilling, grading, trenching, backfilling) | 0 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 |
| Blasting activities | 0 | 0 | 1,2 | 1,2 | 1,2 |
| Borrow pits and management of overburden | 0 | 1 | 1 | 1 | 1 |
| Presence of temporary buildings (footprint and height) | 0 | 1 | 1 | 1 | 1 |
| Construction of infrastructures and facilities | 0 | 1,2 | 1 | 1,2 | 1,2 |
| Use of heavy equipment, vehicle circulation and helicopter use | 0 | 0 | 1,2,3 | 1,2,3 | 1,2,3 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1 | 0 | 1,3 | 1 | 1 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 1,2 | 1 | 1,2 | 1,2 |
| Sewage treatment and disposal | 1 | 1 | 1 | 1 | 1 |
| Waste management (landfill and biopile) | 1 | 1 | 1 | 1 | 1 |
| Snow clearing and stockpilling | 0 | 1,2,3 | 1,3 | 1,2,3 | 1,2,3 |
| Shipping and unloading (marine and land) | 0 | 0 | 0 | 0 | 0 |
| Purchases of goods and services | 0 | 0 | 0 | 0 | 0 |
| Presence and movement of workforce | 0 | 0 | 0 | 0 | 1,2 |
| **OPERATION** | | | | | |
| Underground mining, open pit mining and waste rock management | 1 | 1 | 1 | 1 | 1 |
| Mill operation | 0 | 1 | 1 | 1 | 1 |
| Tailings area storage facility | 1 | 1 | 1 | 1 | 1 |
| Presence of infrastructures and facilities (footprint and height) | 0 | 1 | 0 | 1 | 1 |
| Presence of road and road network | 0 | 1,2,3 | 1,2 | 1,2,3 | 1,2,3 |

**Table 4.1-A-3: Linkage Matrix Between Project Activities and Freshwater Environment Components (continued)**

| Project Activities | Hydrogeology and Groundwater Quality | Hydrology | Surface Water and Sediment Quality | Plankton and Benthos | Fish and Fish Habitat |
|---|---|---|---|---|---|
| Use of heavy equipment, vehicle circulation and helicopter use | 0 | 0 | 1,2,3 | 0 | 0 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1 | 0 | 1,3 | 1 | 1 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 1,2 | 1 | 1,2 | 1,2 |
| Waste management (landfill and biopile) | 1 | 0 | 1 | 1 | 1 |
| Snow clearing and stockpilling | 0 | 1,2,3 | 1,3 | 1,2,3 | 1,2,3 |
| Shipping and unloading (marine and land) | 0 | 0 | 0 | 0 | 0 |
| Purchases of goods and services | 0 | 0 | 0 | 0 | 0 |
| Presence and movement of workforce | 0 | 0 | 0 | 0 | 1,2 |
| **TEMPORARY, FINAL AND POST-CLOSURE** | | | | | |
| Pit and underground portal management | 1 | 1 | 1 | 1 | 1 |
| Demolition and removal of infrastructures and facilities | 1 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 |
| Hydrological reconnection | 1 | 1,2 | 1 | 1,2 | 1,2 |
| Grading, reclamation and revegetation | 0 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 |
| Waste management (landfill and biopile) | 1 | 1 | 1 | 1 | 1 |
| Creation, presence and movement of workforce | 0 | 0 | 0 | 0 | 1,2 |
| Monitoring and follow-up | 1 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 |

Legend:

0. No linkage
1. Mine site
2. Phase 2 AWAR
3. Rankin Inlet (laydown area)
4. Itivia harbour including marine shipping

**Table 4.1-A-4: Linkage Matrix between Project Activities and Freshwater Environment and Marine Environment**

| Project Activities | Freshwater Environment | | | | | Marine Environment | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hydrogeology and Groundwater Quality | Hydrology | Surface Water and Sediment Quality | Plankton and Benthos | Fish and Fish Habitat | Marine Water Quality | Marine Sediment Quality | Plankton and Benthos | Marine Vegetation | Fish and Fish Habitat | Marine Birds | Marine Mammals |
| **CONSTRUCTION** | | | | | | | | | | | | |
| Earth moving (excavation, drilling, grading, trenching, backfilling) | 0 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blasting activities | 0 | 0 | 1,2 | 1,2 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Borrow pits and management of overburden | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Presence of temporary buildings (footprint and height) | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction of infrastructures and facilities | 0 | 1,2 | 1 | 1,2 | 1,2 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| Use of heavy equipment, vehicle circulation and helicopter use | 0 | 0 | 1,2,3 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1 | 0 | 1,3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 1,2 | 1 | 1,2 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sewage treatment and disposal | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Waste management (landfill and biopile) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Snow clearing and stockpilling | 0 | 1,2,3 | 1,3 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shipping and unloading (over water and land) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3,4 |
| Purchases of goods and services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Presence and movement of workforce | 0 | 0 | 0 | 0 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **OPERATION** | | | | | | | | | | | | |

**Table 4.1-A-4: Linkage Matrix Between Project Activities and Freshwater Environment and Marine Environment (continued)**

| Project Activities | Freshwater Environment | | | | | Marine Environment | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hydrogeology and Groundwater Quality | Hydrology | Surface Water and Sediment Quality | Plankton and Benthos | Fish and Fish Habitat | Marine Water Quality | Marine Sediment Quality | Plankton and Benthos | Marine Vegetation | Fish and Fish Habitat | Marine Birds | Marine Mammals |
| Underground mining, open pit mining and waste rock management | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mill operation | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tailings area storage facility | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Presence of infrastructures and facilities (footprint and height) | 0 | 1 | 0 | 1 | 1 | 3 | 0 | 0 | 0 | 3 | 3 | 0 |
| Presence of road and road network | 0 | 1,2,3 | 1,2 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of heavy equipment, vehicle circulation and helicopter use | 0 | 0 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1 | 0 | 1,3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 1,2 | 1 | 1,2 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Waste management (landfill and biopile) | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Snow clearing and stockpilling | 0 | 1,2,3 | 1,3 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shipping and unloading (marine and land) | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 3 | 3,4 |
| Purchases of goods and services | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Presence and movement of workforce | 0 | 0 | 0 | 0 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TEMPORARY, FINAL AND POST-CLOSURE** | | | | | | | | | | | | |
| Pit and underground portal management | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Demolition and removal of infrastructures and facilities | 1 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.1-A-4: Linkage Matrix Between Project Activities and Freshwater Environment and Marine Environment (continued)**

| Project Activities | Freshwater Environment | | | | | Marine Environment | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hydrogeology and Groundwater Quality | Hydrology | Surface Water and Sediment Quality | Plankton and Benthos | Fish and Fish Habitat | Marine Water Quality | Marine Sediment Quality | Plankton and Benthos | Marine Vegetation | Fish and Fish Habitat | Marine Birds | Marine Mammals |
| Hydrological reconnection | 1 | 1,2 | 1 | 1,2 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grading, reclamation and revegetation | 0 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Waste management (landfill and biopile) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Creation, presence and movement of workforce | 0 | 0 | 0 | 0 | 1,2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Monitoring and follow-up | 1 | 1,2,3 | 1,2,3 | 1,2,3 | 1,2,3 | 3 | 0 | 0 | 0 | 3 | 0 | 3 |

Legend:

0. No linkage
1. Mine site
2. Phase 2 AWAR
3. Rankin Inlet (Itivia Harbour and laydown area)
4. Marine shipping corridor

**Table 4.1-A-5: Linkage Matrix Between Project Activities and Socio-economic Components**

| Project Activities | Population Demographics | Traditional Activities and Knowledge | Economic Development and Opportunities | Education and Training | Individual and Community Wellness | Community Infrastructure and Public Services | Governance and Leadership | Non-traditional Land and Resource Use | Public and Worker Safety | Cultural, Archaeological and Paleontological Resources |
|---|---|---|---|---|---|---|---|---|---|---|
| **CONSTRUCTION** | | | | | | | | | | |
| Earth moving (excavation, drilling, grading, trenching, backfilling) | | | | | | | | | | X |
| Blasting activities | | | | | | | | | | X |
| Borrow pits and management of overburden | | | | | | | | | | X |
| Presence of temporary buildings (footprint and height) | | | | | | | | | | X |
| Construction of infrastructures and facilities | | | | | | | | X | | X |
| Use of heavy equipment, vehicle circulation and helicopter use | | | | | | | | | | X |
| Tankfarm, use of petroleum products and maintenance of vehicles | | | | | | | | | | X |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | | | | | | | | | | X |
| Sewage treatment and disposal | | | | | | | | | | X |
| Waste management (landfill and biopile) | | | | | | | | | | X |
| Snow clearing and stockpilling | | | | | | | | | | X |
| Shipping and unloading (marine and land) | | X | | | | | | X | | X |
| Investments, expenditures, taxes and royalties | | | X | | | X | X | | | 0 |
| Creation, presence and movement of workforce | X | X | | | X | X | | X | X | X |
| Employment and Income | X | X | X | X | X | X | | | X | |
| **OPERATION** | | | | | | | | | | |
| Underground mining, open pit mining and waste rock management | | | | | | | | | | 0 |
| Mill operation | | | | | | | | | | 0 |
| Tailings area storage facility | | | | | | | | | | 0 |
| Presence of infrastructures and facilities (footprint and height) | | | | | | | | X | | 0 |
| Presence of roads and road network | | X | | | | | | X | | |

**Table 4.1-A-5: Linkage Matrix Between Project Activities and Socio-Economic Components (continued)**

| Project Activities | Population Demographics | Traditional Activities and Knowledge | Economic Development and Opportunities | Education and Training | Individual and Community Wellness | Community Infrastructure and Public Services | Governance and Leadership | Non-traditional Land and Resource Use | Public and Worker Safety | Cultural, Archaeological and Paleontological Resources |
|---|---|---|---|---|---|---|---|---|---|---|
| Use of heavy equipment, vehicle circulation and helicopter use | | | | | | | | | | 0 |
| Tankfarm, use of petroleum products and maintenance of vehicles | | | | | | | | | | 0 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | | | | | | | | | | 0 |
| Waste management (landfill and biopile) | | | | | | | | | | 0 |
| Snow clearing and stockpiling | | | | | | | | | | X |
| Shipping and unloading (marine and land) | | X | | | | | | X | | 0 |
| Investments, expenditures, taxes and royalties | | | X | | | X | X | | | 0 |
| Creation, presence and movement of workforce | X | X | | | X | X | | X | X | 0 |
| Employment and Income | X | X | X | X | X | X | | | X | |
| **TEMPORARY, FINAL AND POST-CLOSURE** | | | | | | | | | | |
| Pit and underground portal management | | | | | | | | | | 0 |
| Demolition and removal of infrastructures and facilities | | | | | | X | | | | X |
| Hydrological reconnection | | | | | | | | | | 0 |
| Grading, reclamation and re-vegetation | | X | | | | | | X | | X |
| Waste management (landfill and biopile) | | | | | | | | | | 0 |
| Creation, presence and movement of workforce | X | | | | | | | X | X | X |
| Employment and Income | X | | X | | | | | | | |
| Monitoring and follow-up | | | | X | X | | | | | 0 |

Legend:

0. No linkage
1. Mine site
2. Phase 2 AWAR
3. Rankin Inlet
4. Itivia harbour including marine shipping

**Table 4.1-A-6: Linkage Matrix Between Project Activities and Risk Assessment Components**

| Project Activities | Human Health Risk Assessment | Environmental Risk Assessment |
|---|---|---|
| **CONSTRUCTION** | | |
| Earth moving (excavation, drilling, grading, trenching, backfilling) | 1,2,3 | 1,2,3 |
| Blasting activities | 1,2 | 1,2 |
| Borrow pits and management of overburden | 1 | 1 |
| Presence of temporary buildings (footprint and height) | 1 | 1 |
| Construction of infrastructures and facilities | 1 | 1 |
| Use of heavy equipment, vehicle circulation and helicopter use | 1,2,3 | 1,2,3 |
| Tankfarm, use of petroleum products and maintenance of vehicles | 1,3 | 1,3 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 1 |
| Sewage treatment and disposal | 1 | 1 |
| Waste management (landfill and biopile) | 1 | 1 |
| Snow clearing and stockpilling | 1,3 | 1,3 |
| Shipping and unloading (marine and land) | 0 | 0 |
| Investments, expenditures, taxes and royalties | 0 | 0 |
| Creation, presence and movement of workforce | 0 | 0 |
| **OPERATION** | | |
| Underground mining, open pit mining and waste rock management | 1 | 1 |
| Mill operation | 1 | 1 |
| Tailings area storage facility | 1 | 1 |
| Presence of infrastructures and facilities (footprint and height) | 0 | 0 |
| Presence of roads and road network | 1,2 | 1,2 |
| Use of heavy equipment, vehicle circulation and helicopter use | 1,2,3 | 1,2,3 |

**Table 4.1-A-6: Linkage Matrix Between Project Activities and Risk Assessment Components (continued)**

| Project Activities | Human Health Risk Assessment | Environmental Risk Assessment |
|---|---|---|
| Tankfarm, use of petroleum products and maintenance of vehicles | 1,3 | 1,3 |
| Water management (dams, drainage, diversion, intake, discharge and dewatering) | 1 | 1 |
| Waste management (landfill and biopile) | 1 | 1 |
| Snow clearing and stockpilling | 1,3 | 1,3 |
| Shipping and unloading (marine and land) | 0 | 0 |
| Investments, expenditures, taxes and royalties | 0 | 0 |
| Creation, presence and movement of workforce | | |
| **TEMPORARY, FINAL AND POST-CLOSURE** | | |
| Pit and underground portal management | 1 | 1 |
| Demolition and removal of infrastructures and facilities | 1,2,3 | 1,2,3 |
| Hydrological reconnection | 1,2 | 1,2 |
| Grading, reclamation and re-vegetation | 1,2,3 | 1,2,3 |
| Waste management (landfill and biopile) | 1 | 1 |
| Creation, presence and movement of workforce | 0 | 0 |
| Monitoring and follow-up | 1,2,3 | 1,2,3 |

Legend:

0. No linkage
1. Mine site
2. Phase 2 AWAR
3. Rankin Inlet
4. Itivia harbour including marine shipping

# APPENDIX 4.1-B

## Reason of Value for Valued Components

**Table 4.1-B-1: Reason of Value for Valued Components (VECs or VSECS)**

| Valued Components (VECs or VSECs) | Reason of Value | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ecosystem | Social | Traditional Knowledge (IQ) | Economic | Recreation | Tourism | Aesthetic |
| **Atmospheric Envrionment** | | | | | | | |
| Air Quality | X | X | | | | X | X |
| Noise | X | X | | | X | X | X |
| Groundwater quality | X | | | | | | |
| Hydrology | X | | | | | | |
| Surface water quality and sediment quality | X | X | X | | X | X | X |
| **Freshwater Aquatic Ecology** | | | | | | | |
| Fish habitat | X | X | | X | X | X | |
| Arctic char | X | X | X | X | X | X | |
| Lake trout | X | X | X | X | X | X | |
| Arctic grayling | X | X | X | X | X | X | |
| Benthic invertebtrates | X | | | | | | |
| **Marine Environment** | | | | | | | |
| Water quality | X | X | X | | X | X | X |
| Fish | X | X | X | X | X | X | |
| Habitat | X | X | X | X | X | X | |
| Mammals | X | X | X | X | X | X | |
| Marine birds | X | X | X | X | X | X | |
| Soil | X | | | | | | |
| **Vegetation** | | | | | | | |
| Plant populations and communities | X | | | | | | X |
| Listed rare plants | X | | | | | X | X |
| Traditional plant use | X | X | X | X | X | X | X |
| **Wildlife** | | | | | | | |
| Water birds | X | X | X | | X | X | |
| Upland birds, migratory birds | X | X | X | | X | X | |
| Raptors | X | | X | | | X | |
| Caribou, caribou habitat and behaviour | X | X | X | X | X | X | X |
| Wolves | X | | | | | | |
| **Species Health** | | | | | | | |
| Caribou, Arctic fox, key prey species for carnivores, raptors, migratory birds, waterbirds, fish, benthic invertebrates, plankton | X | X | | X | X | X | X |
| Heritage resources | | X | X | | | | |
| Employment and business opportunities | | X | | X | X | X | |

**Table 4.1-B-1: Valued Components (VECs or VSECS) and Rational (continued)**

| Valued Components (VECs or VSECs) | Reason of Value | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ecosystem | Social | Traditional Knowledge (IQ) | Economic | Recreation | Tourism | Aesthetic |
| Population demographics | | X | | X | | | |
| Education and training | | X | | X | | | |
| Individual, family, and community wellbeing | | X | | X | | | |
| Community infrastructure and public services | | X | | X | | | |
| Worker and publich health and safety | | X | | X | | | |
| Goverance and leadership | | X | | X | | | |
| Traditional activity and knowledge | | X | X | X | X | X | |
| Non-traditional land use and resource use | | X | X | X | X | X | |
| **Human Health** | | | | | | | |
| Workers | | X | | X | X | | |
| Public (Inuit and non-Inuit) | | X | | X | X | X | |
| Cultural impacts | | X | X | | | X | |

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