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VOLUME 3: ASSESSMENT METHODS

Whale Tail Pit Project
Meadowbank Division

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REPORT

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EXECUTIVE SUMMARY – VOLUME 3 ASSESSMENT METHODS

Volume 3 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-economic 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 Components (VCs);
- Pathway Analysis;
- Spatial and Temporal Boundaries;
- Effects Analysis;
- Residual Impact Classification and Significance;
- Uncertainty; and
- Monitoring and Follow-up.

Valued 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. Valued components selected in 2005 are considered appropriate for this Final Environmental Impact Statement (FEIS) Amendment as they are consistent with the issues raised during 2005 FEIS process and recent public meetings with Agnico Eagle.

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 VCs. Pathways are determined to be primary, secondary, 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 VC when compared to baseline or guideline values;
- secondary – pathway could result in a minor environmental change, but would have a negligible residual effect on a VC 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 VC 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 VCs. Key properties are called “assessment endpoints”, and should be protected for their use by future human generations.

Spatial and temporal boundaries are defined for each VC 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. Cumulative effects assessment includes other human activities that overlap with the spatial and temporal distribution of a VC, and has the potential to substantially affect the environment, including past, present, and reasonably foreseeable future development.

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 VCs.

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 VC would not be worse than predicted is discussed. Monitoring programs are proposed to deal with the uncertainties associated with the impact predictions and environmental design features. In general, monitoring is used to test (verify) impact predictions and determine the effectiveness of environmental design features (mitigation). Monitoring is also used to identify unanticipated effects and implement adaptive management, where required.

ᓇᐃᓈᖅᓯᒪᔪᖅ – ᐅᖃᓕᒫᒐᖅ 3 ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᑦ

ᐅᖃᓕᒫᒐᖅ 3 ᐅᖃᐅᓯᖃᖅᑐᑦ ᐊᑐᖅᑕᐅᔪᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᑐᐃᓐᓇᓱᐊᖃᖅᑐᓂᒃ, ᐊᒻᒪᓗ ᐃᓂᓕᐅᖅᓱᕆᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓂᕐᒧᑦ ᐊᕙᑎᒥᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᑦ ᐱᓕᓴᐊᕐᒥᑦ ᐃᓂᐅᔪᒧᑦ ᐊᒻᒪᓗ ᐃᓄᐃᑦ-ᐱᕈᖅᐸᓪᓕᐊᓂᐅᐸ ᐊᕙᑎᖏᓐᓂᑦ.

ᐊᑐᖅᑕᐅᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᑐᐃᓐᓇᓱᐊᓕᕐᓂᑦ ᐱᓕᓴᐊᕐᒥᑦ ᐱᔪᓂᒃ ᐃᓂᐅᔪᒥᑦ ᐊᒻᒪᓗ ᐃᓄᐃᑦ-ᐱᕈᖅᐸᓪᓕᐊᓂᕐᒧᑦ ᐊᕙᑎᖏᓐᓂᑦ ᐊᕕᒃᑐᖅᑕᐅᓯᒪᔪᑦ ᐅᑯᓄᙵ:

- ᐃᒃᐱᒋᓂᖃᕐᕕᐅᔪᓄᑦ ᐃᓚᒋᔭᐅᔪᑦ (VC)
- ᐊᑉᖁᑎᒋᔭᐅᔪᒥᒃ ᖃᐅᔨᓴᐃᓂᖅ;
- ᐊᖏᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᑭᒡᓕᐅᔪᑦ;
- ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᖅ;
- ᕿᒪᒃᑎᑦᑐᓄᑦ ᐊᒃᑐᖅᓯᓂᖅ ᐃᓂᓕᐅᓇᓂᖅ ᐊᒻᒪᓗ ᖃᓄᑎᒋᐅᓂᖓ;
- ᓇᓗᓇᖅᑐᖅ; ᐊᒻᒪᓗ
- ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᖅ.

ᐃᒃᐱᒋᓂᖃᕐᕕᐅᔪᑦ ᐃᓚᒋᔭᐅᔪᑦ ᐱᖁᔨᑎᖃᖅᑐᖅ ᑎᒥᒥᒃ, ᐆᒪᓂᖃᕐᓂᕐᒥᒃ, ᐱᖅᑯᓯᕐᒥᑦ, ᐃᓅᖃᑎᒌᕐᒥᑦ, ᐊᒻᒪᓗ ᐱᕈᖅᐸᓪᓕᐊᓂᕐᒧᑦ ᐱᒋᔭᐅᔪᓂᒃ ᐊᕙᑎᒧᑦ ᒪᓕᒃᑰᖓᔪᓪᓗᓐᓃᑦ, ᒪᓕᒐᓕᐅᕐᕕᒃᑯᑦ, ᐃᓄᓗᒃᑖᒨᖓᔪᑦ, ᐅᕝᕙᓘᓐᓃᑦ ᐃᓕᓐᓂᐊᖅᓯᒪᓂᖃᕐᓂᒃᑯᑦ ᐃᓕᑕᕆᔭᐅᔪᑦ ᐱᒻᒪᕆᐅᓂᖏᓐᓄᑦ ᐃᓄᙵᓄᑦ. ᐃᒃᐱᒋᓂᖃᕐᕕᐅᔪᑦ ᐃᓚᒋᔭᐅᔪᑦ ᓂᕈᐊᖅᑕᐅᔪᑦ 2005-ᒥᑦ ᐃᓱᒪᒋᔭᐅᔪᑦ ᓈᒻᒪᒃᑑᓂᖏᓐᓄᑦ ᑖᑉᓯᒧᙵ ᑭᖑᓪᓕᖅᐹᖅ ᐊᕙᑎᒥᒃ ᐊᒃᑐᖅᓯᓂᕐᒧᑦ ᑎᑎᖅᑲᖅ (FEIS) ᐋᕿᒋᐊᖅᓯᓂᕐᒧᑦ ᐊᔾᔨᒋᖕᒪᕆᑦ ᐱᔾᔪᑕᐅᔪᑦ ᓴᖅᑭᑕᐅᔪᑦ 2005-ᒥᑦ FEIS-ᓕᕆᕙᓪᓕᐊᓂᕐᒥᑦ ᐊᒻᒪᓗ ᒫᓇᓵᖅ ᐃᓄᓗᒃᑖᓂᒃ ᑲᑎᒪᖃᑎᖃᖅᑎᓪᓗᒋᑦ ᐊᒡᓃᑯᒃᑯᑦ.

ᐊᑉᖁᑎᒋᔭᐅᔪᓂᒃ ᖃᐅᔨᓴᐃᓃᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᑦ ᐃᓕᑕᖅᓯᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓗᓂᓗ ᐊᒃᑐᐊᓂᖃᖅᑐᓂᒃ ᐱᓕᓴᐸ ᐃᓚᒋᔭᖏᓐᓄᑦ ᐅᕙᓘᓐᓃᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓄᑦ ᐊᒻᒪᓗ ᕿᒪᒃᑎᑦᑐᓂᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᖕᓇᖅᑐᓂᒃ (ᓲᕐᓗ ᖃᓄᐃᖓᓕᖅᑎᑦᑏᑦ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᖅᑳᖅᑎᓪᓗᒋᑦ) VC-ᓄᑦ. ᐊᑉᖁᑎᒋᔭᐅᔪᑦ ᖃᐅᔨᔭᐅᖃᑦᑕᖅᑐᑦ ᑖᒃᑯᓗᐊᖑᓂᖏᓐᓄᑦ, ᑐᓪᓕᐅᓂᖏᓐᓄᑦ, ᐅᕙᓘᓐᓃᑦ ᐊᒃᑐᐊᓂᖃᙱᓂᖏᓐᓄᑦ ᐊᑐᖅᓱᑎᒃ ᐃᓕᓐᓂᐊᖅᓯᒪᓂᒃᑯᑦ ᐊᒻᒪᓗ ᐱᖅᑯᓯᒃᑯᑦ ᖃᐅᔨᒪᓂᒃᑯᑦ, ᐱᔭᕆᐊᖃᕐᒪᑦ, ᐊᒻᒪᓗ ᐊᑐᖅᓯᒪᓂᑯᒃᑯᑦ ᐊᔾᔨᑦᓚᖏᓐᓂᒃ ᐱᕙᓪᓕᐊᓯᒪᔪᓂᒃ ᐊᒻᒪᓗ ᐊᕙᑎᒧᑦ ᐋᕿᒃᓯᒪᔪᓄᑦ. ᐊᑐᓂ ᐊᑉᖁᑕᐅᔪᓐᓇᖅᑐᑦ ᖃᐅᔨᓴᖅᑕᐅᖃᑦᑕᖅᑐᖅ ᐊᒻᒪᓗ ᐅᖃᐅᓯᐅᐸᓗᑎᒃ ᐃᒪᓇ:

- ᐊᒃᑐᐊᓂᖃᙱᑦᑐᖅ - ᐊᑉᖁᑎᒋᔭᐅᔪᖅ ᐋᖅᑕᐅᔪᑦ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐋᕿᒃᑕᐅᓯᒪᔪᓄᑦ (ᓲᕐᓗ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᖅ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᕐᒧᑦ) ᐱᓕᕆᐊᒥᑦ ᖃᓄᐃᖓᓂᐅᔪᑦ ᖃᐅᔨᓂᖅᑕᖃᑉᔮᖏᒪᑦ (ᐆᒃᑐᕋᖅᑕᐅᔪᖕᓇᖅᑐᖅ) ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐊᓯᐊᖑᕐᓂᐅᔪᒥᒃ ᐊᒻᒪᓗ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᑦ VC-ᓄᑦ ᑕᐅᑐᙳᖅᓱᕆᑦ ᑭᒡᓕᒋᔭᐅᔪᑦ ᐅᕙᓘᓐᓃᑦ ᒪᓕᒃᑕᐅᔭᕆᐊᓕᖕᓄᑦ ᓈᓴᐅᑎᓄᑦ;
- ᑐᓪᓕᐅᔪᖅ - ᐊᑉᖁᑎᒋᔭᐅᔪᖅ ᒥᑭᔪᒥᒃ ᐊᓯᐊᖑᖅᓯᓂᖃᕈᓐᓇᖅᑐᖅ ᐊᕙᑎᒧᑦ, ᑭᓯᐊᓂ ᒥᑭᑦᑐᒥᒃ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᖃᕐᓗᓂ VC-ᓄᑦ ᑕᐅᑐᙳᖅᓱᕆᑦ ᑭᒡᓕᒋᔭᐅᔪᑦ ᐅᕙᓘᓐᓃᑦ ᒪᓕᒃᑕᐅᔭᕆᐊᓕᖕᓄᑦ ᓈᓴᐅᑎᓄᑦ; ᐅᕙᓘᓐᓃᑦ
- ᑖᒻᓇᓗᐊᖅ - ᐊᑉᖁᑎ ᐆᒃᑐᕋᖅᑕᐅᔪᖕᓇᖅᑐᒥᒃ ᐊᓯᐊᖑᖅᑎᑦᑎᓂᖃᕈᓐᓇᖅᑐᖅ ᐊᕙᑎᒥᒃ ᐃᑲᔪᐃᔪᖕᓇᖅᓱᓂ ᕿᒪᒃᑎᑦᑐᓂᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᓂᒃ VC-ᓄᑦ ᑕᐅᑐᙳᖅᓱᕆᑦ ᑭᒡᓕᒋᔭᐅᔪᑦ ᐅᕙᓘᓐᓃᑦ ᒪᓕᒃᑕᐅᔭᕆᐊᓕᖕᓄᑦ ᓈᓴᐅᑎᓄᑦ.

ᐊᑉᖁᑕᐅᔪᑦ ᐊᒃᑐᐊᓂᖃᙱᓱᓂᒃ ᐃᓱᒪᒋᔭᐅᔪᑦ ᒥᑭᑦᑑᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ ᐊᕙᑎᒥᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᖃᒃᑲᖏᓂᖓᓄᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓐᓂᙱᓕᖅᓱᓂᒃ. ᐊᓯᐊᒍᖓᖅ, ᐊᑉᖁᑕᐅᓗᐊᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᖅᑕᖃᒃᑲᓐᓂᖃᑦᑕᖅᑐᑦ ᖃᐅᔨᓂᕐᒧᑦ ᐊᕙᑎᒥᒃ ᐱᔾᔪᑎᖃᖅᑐᓂᒃ ᐱᓕᓴᐊᕐᒥᑦ ᐱᔪᓂᒃ VC-ᓄᑦ ᐃᓚᒋᔭᐅᔪᓄᑦ. ᐃᓚᒋᔭᐅᔪᑦ ᑕᐃᔭᐅᔪᑦ "ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐃᓱᒋᔭᐅᔪᑦ", ᐊᒻᒪᓗ ᒥᐊᓂᕆᔭᐅᔭᕆᐊᖃᖅᑐᑦ ᑭᖑᕚᓄᑦ ᐊᑐᖅᑕᐅᓂᐊᕐᓂᕐᒧᑦ.

ᐊᖏᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᑭᒡᓕᐅᔪᑦ ᑐᑭᓕᐅᖅᑕᐅᔪᑦ ᐊᑐᓂ VC-ᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᖅᑕᖃᖅᖃᖅᑎᓐᓇᒍ. ᐊᖏᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᑭᒡᓕᐅᔪᑦ ᐊᑐᐊᓂᖃᖅᑐᑦ ᐃᓚᒋᔭᐅᔪᒎᖓᔪᐃᑦ ᐃᓕᖅᑯᓯᖏᓐᓄᑦ ᓈᒻᒪᒃᑐᒧᑦ ᐊᖏᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᐊᖏᓂᐅᔪᓄᑦ ᐊᑐᓂ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᕐᓄᑦ, ᐊᒻᒪᓗ ᑐᓂᓯᖃᑦᑕᖅᑐᑦ ᐊᖏᔪᒥᒃ ᑐᑭᐅᔪᓂᒃ ᑭᒡᓕᐅᔪᓄᑦ.

ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᖅ ᑐᓂᓯᖃᑦᑕᖅᑐᖅ ᐊᑐᖅᑕᐅᔪᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓐᓇᖅᑐᓂᒃ ᐊᒻᒪᓗ ᑲᑎᑉᐸᓪᓕᐊᔪᓂᒃ (ᐊᑐᖅᐸᑦ) ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᓂᒃ. ᑲᑎᑉᐸᓪᓕᐊᔪᓂᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᓄᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐃᓚᐅᔪᑦ ᐊᓯᖏᑦ ᐃᓄᐃᑦ ᖃᓄᐃᓕᐅᕐᓂᖏᑦ ᑲᑎᓐᓂᖃᖅᑐᑦ ᐊᖏᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᑐᓂᐅᖅᑲᐅᑕᐅᔪᑦ VC-ᒥᑦ, ᐊᒻᒪᓗ ᐊᑐᖅᓯᓂᖃᕐᔪᐊᕈᓐᓇᖅᓱᓂ ᐊᕙᑎᒥᒃ, ᐃᓚᐅᐸᓗᑎᒃ ᐊᓂᒍᖅᑐᒥᑦ, ᐅᐸᓗᒥᐅᔪᒥᑦ, ᐊᒻᒪᓗ ᖃᐅᔨᒪᓐᓇᖅᑐᒥᑦ ᓯᕗᓂᒃᓴᒥᑦ ᐱᕙᓪᓕᐊᓂᕐᒥᑦ.

ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᓄᑦ ᓇᐃᓈᖅᓯᒪᔪᖅ ᑕᑯᒃᓴᐅᑎᑦᑎᔪᖅ ᓈᓴᐅᑎᓂᒃ ᐊᒻᒪᓗ/ᐅᕙᓘᓃᑦ ᐊᒥᓱᵐᒍᕈᓐᓇᕐᓂᕐᒧᑦ ᓇᓗᓇᐃᔭᖅᓯᒪᔪᓂᒃ ᐊᖏᓂᐅᔪᒥᑦ, ᖃᓄᑎᒋ ᓄᓇᒥᒃ ᑎᑭᐅᑎᓯᒪᓂᖓ, ᖃᓄᑎᒋᐅᓂᖓ, ᐊᒻᒪᓗ ᖃᑉᔫᖅᑕᖃᑦᑕᕐᓂᖓ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑏᑦ ᐊᑐᓂ ᐊᑉᕿᑎᒋᔭᐅᔪᓂᑦ. ᓇᐃᓈᖅᓯᒪᔪᒥᑦ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒥᑦ, ᐊᑐᓂ ᐊᑉᕿᑕᐅᔪᑦ ᐊᒃᑐᐊᔪᑦ ᖃᐅᔨᓴᐃᓂᐅᑉ ᐃᓱᖓᓄᑦ ᐃᓂᓕᐅᖅᑕᐅᖃᑦᑕᖅᑐᖅ ᐊᑐᖅᓱᑎᒃ ᖃᓄᐃᑦᑑᓕᖓᔪᑦ ᐊᖏᓂᖏᑦ ᐊᑐᓂ ᐊᒃᑐᖅᑕᐅᓯᒪᔪᒧᑦ (ᓵᕐᓗ ᒥᑭᔪᖅ ᐊᖏᓂᕆᔭᖓ, ᐊᖏᓂᖅᓴᒥᒃ ᑎᑭᖅᑲᐅᒪᓂᖓ, ᐊᑯᓂᐅᔪᑦ ᑕᑭᑎᒋᓂᖓ, ᐊᖏᔪᒥᒃ ᐱᔪᓐᓇᖅᑐᖅ). ᖃᓄᐃᖓᓂᐅᔪᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐊᒻᒪᓗ ᕿᒪᒃᑎᑦᑐᓄᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᖅ ᐃᓂᓕᐊᖅᑕᐅᓂᖓ ᐊᑐᖅᑕᐅᓕᖅᓱᑎᒃ ᕿᒥᕐᕈᓂᕐᒧᑦ ᐊᖏᓂᕆᔭᖓ ᐊᒃᑐᖅᓯᓂᐅᑉ ᐱᓕᕆᐊᕐᒥᑦ ᐱᔪᓂᒃ VC-ᓄᑦ.

ᐊᑐᓂ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔨᓴᐃᓃᑦ, ᐱᕝᕙᐅᔪᑦ ᓇᓗᓇᖅᑐᓂᒃ ᑕᐃᒪᐅᔪᑦ, ᐊᒻᒪᓗ ᖃᓄᖅ ᓇᓗᓇᖅᑎᒋᓂᖓ ᐱᓕᕆᐊᖑᐸᓗᓂ ᐊᖏᒡᓕᒋᐊᖅᑎᓐᓂᕐᒧᑦ ᓇᓃᓐᓂᖓ ᓇᓗᓇᙱᓐᓂᐅᑉ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔾᔪᓇᖅᑐᑦ VC-ᒧᑦ ᐊᖏᓂᖅᓴᐅᓕᕐᓂᐊᖏᒪᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᒥᑦ ᐅᖃᐅᓯᐅᓕᖅᓱᓂ. ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᕐᒧᑦ ᑐᕌᖓᔪᑦ ᓴᖅᑭᑕᐅᖃᑦᑕᖅᑐᑦ ᐱᓕᕆᐊᕆᓂᕐᒧᑦ ᓇᓗᓇᖅᑐᐃᑦ ᐊᒃᑐᐊᔪᑦ ᐊᒃᑐᖅᓯᓂᕐᒧᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᓄᑦ ᐊᒻᒪᓗ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐋᕿᐅᒪᔪᓄᑦ ᐃᓚᒋᔭᐅᔪᓄᑦ. ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᖅ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᖅ ᐆᒃᑐᕋᐃᓂᕐᒧᑦ (ᓇᓗᓇᐃᖅᓯᓂᕐᒧᑦ) ᐊᒃᑐᖅᓯᓂᕐᒥᒃ ᓇᓚᐅᑦᑖᖅᑕᐅᔪᑦ ᐊᒻᒪᓗ ᖃᐅᔨᓗᓂ ᐊᑑᑎᖃᕐᓂᖓ ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐋᕿᒃᓯᒪᔪᒧᑦ ᐃᓚᒋᔭᐅᔪᑦ (ᐊᖏᓗᐊᖏᑭᐊᖅᑎᑦᑎᓂᖅ). ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᖅ ᐊᑐᖅᑕᐅᖃᑦᑕᕐᒥᔪᑦ ᐃᓕᑕᖅᓯᓂᕐᒧᑦ ᓂᕈᐅᓇᙱᑦᑐᓂᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐊᑐᓕᖅᓱᕆᑦ ᐊᐅᓚᑦᑎᔾᔪᑏᑦ, ᐱᔭᕇᐊᖃᖅᑐᓂᑦ.

SOMMAIRE DE GESTION – VOLUME 3 - LES MÉTHODES D'ÉVALUATION

Le Volume 3 décrit l'approche qui a été utilisée pour l'analyse des effets potentiels, ainsi que la classification et la détermination de l'importance environnementale des impacts du Projet sur les environnements biophysique et socio-économique.

Les approches et méthodes pour l'évaluation des effets potentiels du Projet sur les environnements biophysique et socio-économique sont divisées selon les éléments clés suivants :

- Les composantes valorisées (CV);
- L'analyse des trajectoires;
- Les limites spatiales et temporelles;
- L'analyse des effets;
- La classification et l'importance des impacts résiduels;
- L'incertitude; et
- La surveillance et le suivi.

Les composantes valorisées représentent les propriétés physiques, biologiques, culturelles, sociales et économiques de l'environnement qui sont reconnues légalement, politiquement, publiquement ou professionnellement comme importantes par la société. Les composantes valorisées sélectionnées en 2005 sont considérées comme appropriées pour cet Énoncé des incidences environnementales (EIE) puisqu'elles sont conformes aux questions et inquiétudes soulevées au cours du processus de l'EIE 2005 et lors des récentes rencontres publiques avec Agnico Eagle.

Des analyses de trajectoire sont utilisées pour identifier et évaluer les liens et relations entre les composantes ou activités du Projet et les effets résiduels potentiels (c.-à-d. les effets après atténuation) sur les CV. Les trajectoires sont déterminées comme primaires, secondaires ou n'ayant aucun lien, en utilisant les connaissances scientifiques et traditionnelles, la logique et l'expérience avec des éléments similaires de conception environnementaux et de développement. Chaque trajectoire potentielle est évaluée et décrite comme suit :

- aucun lien – la trajectoire est éliminée par des éléments de conception environnementaux (c.à-d. une atténuation des effets) afin que le Projet n'entraîne aucun effet résiduel sur une VC ni aucune modification environnementale détectable (mesurable) lorsque comparé aux valeurs de base ou préconisées;
- secondaire – la trajectoire pourrait entraîner une modification environnementale mineure, mais aurait un effet résiduel négligeable sur une CV lorsque comparé aux valeurs de base ou préconisées; ou
- primaire – la trajectoire est susceptible d'entraîner une modification environnementale mesurable qui pourrait contribuer à des effets résiduels sur une CV lorsque comparés aux valeurs de base ou préconisées.

Les trajectoires n'ayant aucun lien ou qui sont considérées comme mineures ne devraient pas occasionner d'effets importants sur l'environnement et ne sont pas analysées plus avant. Au contraire, les trajectoires primaires font l'objet d'une analyse additionnelle des effets afin de déterminer l'importance environnementale potentielle du Projet sur les propriétés clés des CV. Les propriétés clés sont appelées des « paramètres de mesure » et leur utilisation devrait être protégée et préservée pour les générations futures.

Les limites spatiales et temporelles sont définies pour chaque CV avant de procéder à l'analyse des effets. Les limites spatiales et temporelles relient les caractéristiques spécifiques des composantes aux échelles spatiale et temporelle appropriées aux fins des analyses des effets et procurent des définitions générales des limites et frontières.

L'analyse des effets procure l'approche générale visant à analyser les effets potentiels spécifiques au Projet et les effets potentiels cumulatifs (lorsqu'applicables). L'évaluation des effets cumulatifs inclut les autres activités humaines qui recoupent la répartition spatiale et temporelle d'une CV et a le potentiel d'affecter substantiellement l'environnement, incluant le développement passé, présent, et raisonnablement prévisible pour le futur.

Le résumé des effets résiduels présente une description quantitative et/ou qualitative de l'ampleur, l'étendue géographique, la durée et la fréquence des effets résiduels de chaque trajectoire. À partir du résumé des effets résiduels, chaque trajectoire qui est liée à un paramètre de mesure est classée en utilisant les échelles nominales pour chaque critère d'impact (ex. : faible ampleur, étendue géographique régionale, durée à long terme, probabilité élevée). Les résultats de l'analyse des effets et de la classification des impacts résiduels sont ensuite utilisés pour l'évaluation de l'importance des impacts du Projet sur les CV.

Pour chaque analyse des effets, des sources clés d'incertitude sont présentées, et une discussion se tient sur la façon dont l'incertitude est traitée afin d'augmenter le niveau de confiance que les effets potentiels sur la CV ne sera pas pire que ceux prévus. Des programmes de surveillance sont proposés pour traiter les incertitudes associées aux prévisions des impacts et aux éléments de conception environnementaux. En général, la surveillance est utilisée pour tester (vérifier) les prévisions des impacts et pour déterminer l'efficacité des éléments de conception environnementaux (atténuation). La surveillance est également utilisée pour identifier les effets imprévus et mettre en œuvre une gestion adaptative, lorsque nécessaire.

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APPENDICES

LIST OF ACRONYMS

EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FTPCCCEA	Federal/Provincial Territorial Committee on Climate Change & Environmental Assessment
IQ	Inuit Qaujimajatuqangit
NIRB	Nunavut Impact Review Board
the Project	Whale Tail Pit and Haul Road Project
VC	valued component

3.0 ASSESSMENT METHODS

3.1 Introduction

3.1.1 Context

This section describes the approach used for analyzing effects, and classifying and determining the environmental significance of impacts from the Project on the biophysical and socio-economic components in the Final Environmental Impact Statement (FEIS) Amendment to the FEIS (Cumberland 2005a). The approach described below was applied to the analysis and assessment of the potential effects from the construction, operations, and closure of the proposed Whale Tail Pit and Haul Road Project (referred to as the Project) using information from the Project Description (Volume 1, Sections 1.2 to 1.4), the various management and monitoring plans submitted in support of the FEIS Amendment and Type A Water Licence Application, and existing (baseline) conditions. Information from Inuit Qaujimajatuqangit (IQ) and land use is also used in the effects assessment.

3.1.2 Purpose and Scope

The purpose of this section is to provide a general overview of the approach and methods for analyzing, assessing, and determining the significance of potential environmental impacts. Key elements of the FEIS Amendment that are defined and described are as follows:

- **Section 3.2:** Valued Components (VCs) – defines VCs of the biophysical, economic, social, and cultural aspects of the environment potentially affected by the Project, and associated assessment endpoints and measurement indicators.
- **Section 3.3:** 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 3.4:** Pathway Analysis – provides the definition of pathways, environmental design features and mitigation, and approach and methods for evaluating relevant effects pathways between the Project and the biophysical, socio-economic, cultural, and heritage VCs. Provides the pathway analysis for the VCs.
- **Section 3.5:** Residual Effects Analysis – gives the general approach to analyzing project-specific and cumulative effects for biophysical and socio-economic components, after implementing environmental design features and mitigation.
- **Section 3.6:** Prediction Confidence and Uncertainty – introduces the key sources of uncertainty and discusses how uncertainty is addressed to increase the level of confidence that potential effects will not be worse than predicted.
- **Section 3.7:** Residual Impact Classification and Determination of Significance – introduces and provides definitions for residual impact criteria for the biophysical and socio-economic components, and presents an overview of the approach and method used to classify impacts and determine environmental significance.
- **Section 3.8:** Monitoring and Follow-Up – presents the concepts of adaptive management and different types of monitoring, and explains how monitoring and follow-up programs are used to test impact predictions, reduce uncertainty, and determine the effectiveness of mitigation.

The assessment approach presented herein is based on ecological, cultural, and socio-economic principles, and environmental assessment best practice. There is general consistency in the approach for identifying pathways that link the Project to potential effects on VCs and to determining the spatial and temporal boundaries for the effects analysis across the biophysical and socio-economic environment.

In contrast, the methods for analyzing effects, classifying residual impacts (e.g., direction, 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. While, biophysical components also are influenced simultaneously by natural and human-related forces many disciplines, project-specific effects can be quantified (e.g., incremental changes to air quality, soil, vegetation, and wildlife). Because the socio-economic status of different communities, subpopulations, and individuals may vary, a socio-economic effect may have both positive and negative aspects. An effect to a biophysical component is typically negative or positive.

The FEIS Amendment application has been completed consistent with the requirements of the Guidelines (NIRB 2004). The submission includes a Project Description (Volume 1), a core FEIS Amendment document, as well as a series of complementary documents to provide a full understanding of the technical and scientific aspects of the Project (Volumes 4 through 8). The scope of the FEIS Amendment is the development of the Whale Tail deposit and supporting infrastructure on the Amaruq property, including a haul road to the Meadowbank Mine for milling. The temporal extension of Meadowbank Mine infrastructure including, milling, tailing deposition in existing infrastructure, and use of camp infrastructure at the Meadowbank Mine and use of the existing All-Weather Access Road from Baker Lake to Meadowbank Mine, are also part of the assessment.

3.2 Valued Components, Assessment Endpoints, and Measurement Indicators

3.2.1 Identification of Valued Components

The VCs concept is defined in Section 4.19.1 of the FEIS (Cumberland 2005a) using the terminology Valued Ecosystem Component. Herein valued ecosystem components and valued socio-ecosystem components are referred to as VCs. Valued components represent physical, biological, cultural, social, and economic properties of the environment that are considered to be important by society. Rationale for VC selection is provided in the following documents:

- Cumberland FEIS, Section 4.19.2 and 4.21.4.1 (Cumberland 2005a);
- Terrestrial Ecosystem Impact Assessment, Section 2.3 (Cumberland 2005b);
- Cumulative Effects Assessment, Section 4.1.2 (Cumberland 2005c);
- Aquatic/Ecosystem/Fish Habitat Impact Assessment, Section 3. 1 (Cumberland 2005d);
- Socio-Economic and Archaeology Impact Assessment, Section 2.2. (Cumberland 2005e); and
- Volumes 4 through 7 of the FEIS Amendment.

For the most part, the VCs selected in 2005 are considered appropriate for the FEIS Amendment as they are consistent with the issues raised during 2005 FEIS process and recent public meetings with Agnico Eagle (NIRB 2014, 2015), including December 2014 and February 2016 public consultation workshops. The VCs were also accepted as meeting the Project Guidelines (2004) by the Nunavut Impact Review Board (NIRB) for the Meadowbank Mine and recent FEIS Amendment documents in support of the Vault Pit Expansion into Phaser Lake (Phaser Pit and BB Phaser Pit). Summary tables are provided in each Volume of the FEIS Amendment that provides the rationale for VC selection and exclusion. Biophysical and socio-economic VCs selected for the environmental assessment of the Project is provided in Table 3.2-1, with assessment endpoints and measurement indicators as described in Section 3.2.2.

While not defined as VCs, Project interactions with the following components will also be included in the FEIS Amendment:

- climate;
- vibration;
- groundwater quality and quantity;
- soil and terrain;
- species at risk;
- sediment quality;
- non-traditional land use;
- marine environment (Volume 3, Appendix 3-A);
- human and ecosystem health (Volume 3, Appendix 3-B);
- population demographics;
- economics;
- governance and leadership; and
- worker and public health.

These components are included to meet the Environmental Impact Statement (EIS) Guidelines for the Meadowbank Project (NIRB 2004), requirements of regulatory authorities, and to address additional issues that have been brought to Agnico Eagle through public meetings, other forms of consultation and are consistent with recent NIRB Guidelines at other projects in Nunavut.

3.2.2 Assessment Endpoints and Measurement Indicators

Assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations (i.e., incorporates sustainability). Assessment endpoints are general statements about what is being protected. For example, protection of water quality, maintenance of self-sustaining and ecologically effective wildlife and fish populations, and continued opportunities for traditional use of these ecological resources may be assessment endpoints for surface water, wildlife, fish, and traditional land use.

Assessment endpoints are typically not quantifiable and require the identification of one or more measurement indicators that can be directly linked to the assessment endpoint. Measurement indicators represent properties or attributes of the environment and VCs that, when changed, could result in, or contribute to, an effect on assessment endpoints. Measurement indicators may be quantitative (e.g., concentrations of metals in surface water) or qualitative (e.g., movement and behaviour of wildlife from disturbance to habitat and travel corridors). Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, are key variables for study in follow-up and monitoring programs.

The significance of effects from the Project on a VC is evaluated by linking changes in measurement indicators to effects on the assessment endpoint (Section 3.7). All VCs have measurement indicators, but not every VC has an explicit assessment endpoint. For example, VCs such as permafrost, are considered as measurement indicators for other VCs, and do not have assessment endpoints. The results of the analysis of changes in measurement indicators for VCs such as permafrost are provided to other VCs with assessment endpoints (e.g., vegetation and wildlife populations) for inclusion in the analysis and evaluation of significance of residual effects. Project interactions with components that are not VCs, such as soil and groundwater, are included in the analysis and evaluation of significance of residual effects of VCs with assessment endpoints.

Valued components with no explicit assessment endpoint are still analyzed for project-specific and cumulative changes in measurement indicators. The changes are characterized in terms of magnitude, duration, and geographic extent, but are not classified using typical definitions of impact criteria (e.g., low magnitude and long-term duration). These VCs may also be included in follow-up and monitoring programs. The pathway assessment approach and effects analysis is applied to VCs with and without assessment endpoints, except that effects on VCs without explicit assessment endpoints are not classified using impact criteria or evaluated for significance. Valued components, assessment endpoints, and measurement indicators used in this FEIS Amendment are presented in Table 3.2-1.

Table 3.2-1: Assessment Endpoints and Measurement Indicators Associated with Valued Components

Valued Component	Assessment Endpoints	Measurement Indicators
Climate	■ There is no assessment endpoint for climate because "…the contribution of an individual project to climate change cannot be measured" (FTPCCCEA 2003)	■ Greenhouse gas emissions
Air Quality	■ No assessment endpoint - VC represents measurement indicators and pathways for other VCs with assessment endpoints	Compliance with regulatory ambient air quality standards or guidelines for the following criteria air contaminants: ■ Carbon monoxide; ■ Sulphur dioxide; ■ Oxides of nitrogen; and ■ Particulate matter (e.g., dust)
Noise		Compliance with regulatory noise and blasting standards and guidelines: ■ A-weighted energy equivalent sound levels (L_{eq} in dBA) for steady-state noise – Alberta environmental noise limits

Table 3.2-1: Assessment Endpoints and Measurement Indicators Associated with Valued Components (continued)

Valued Component	Assessment Endpoints	Measurement Indicators
		■ Unweighted peak sound levels (L_{peak} in dBL) for blasting noise – Ontario blasting limits
Permafrost		■ Permafrost distribution
Vegetation	■ Self-sustaining and ecologically effective plant populations and communities	■ Habitat loss and degradation ■ Quantity, arrangement, and connectivity (fragmentation) of plant communities ■ Plant community diversity and health ■ Relative abundance and distribution of habitat for listed and traditional plant species
Terrestrial Wildlife and Birds: ■ Ungulates (caribou and muskox) ■ Predatory mammals (grizzly bear, wolverine, and wolves) ■ Raptors ■ Waterbirds (waterfowl, loons and shorebirds) ■ Upland birds (songbirds and ptarmigan)	■ Self-sustaining and ecologically effective wildlife populations	■ Changes to wildlife habitat quantity ■ Changes to wildlife habitat quality ■ Changes to wildlife survival and reproduction
Surface water quality	■ Protection of surface water quality for aquatic and terrestrial ecosystems, and human use	■ Physicochemical water quality parameters (e.g., pH, conductivity, turbidity, suspended solids) ■ Major ions and nutrients ■ Total and dissolved metals
Surface water quantity	■ Availability of the spatial and temporal distribution of water quantity for aquatic and terrestrial ecosystems	■ Flow rate and the spatial and temporal distribution of water ■ Surface topography, drainage boundaries, waterbodies, and water pathways
Fish and Fish Habitat: ■ Fish populations (lake trout, Arctic char, round whitefish, and Arctic grayling) ■ Fish habitat is not a VC; rather, fish habitat is a measurement indicator	■ On-going fisheries productivity	■ Habitat quantity and quality (includes surface water quality and quantity indicators) ■ Habitat arrangement and connectivity (fragmentation) ■ Survival and reproduction ■ Abundance and distribution of VCs and forage fish that support VCs ■ Lower trophic status (includes plankton and benthic invertebrate species composition, abundance, and biomass)

Table 3.2-1: Assessment Endpoints and Measurement Indicators Associated with Valued Components (continued)

Valued Component	Assessment Endpoints	Measurement Indicators
Archaeology	■ Protection of archaeological resources	■ Archaeological and sacred sites
Traditional Land Use	■ Continued opportunities for traditional land use	■ Access to traditional land use areas and resources ■ Availability of traditionally used resources (caribou, other wildlife, fish, and plants) ■ Availability of culturally important sites or areas
Socio-Economic VCs		
Employment	■ Maximizing local participation in the Project ■ Improving the capacity of the labour force	■ Local and regional employment ■ Employment rate ■ Unemployment rate ■ Participation rate ■ Incomes
Training	■ Encouraging further education in the interest of capacity building ■ Supporting educational service delivery	■ Labour force training initiatives ■ Educational attainment ■ Capacity of education services
Business Opportunities	■ Maximizing local business participation in the Project	■ Portion of Project procurement of goods and services spent locally
Community Wellness	■ Minimizing negative community health and wellbeing impacts	■ Physical and mental health ■ Family structure and welfare ■ Social and economic disparity ■ Public health and safety ■ Crime
Infrastructure and social services	■ Supporting and minimizing negative impacts on infrastructure capacity and service delivery	■ Housing stock and condition ■ Capacity and condition of transportation infrastructure ■ Airports ■ Roads ■ Capacity and condition of physical infrastructure ■ Solid waste disposal ■ Water and sanitation ■ Utilities ■ Capacity of social services ■ Capacity of healthcare services ■ Capacity of emergency response services ■ Capacity of protective services

dBA = A-weighted decibels; L_{eq} = equivalent energy noise level; L_{peak} = peak sound level; VC = valued component; FTPCCCEA = Federal/Provincial Territorial Committee on Climate Change & Environmental Assessment.

3.3 Spatial and Temporal Boundaries

3.3.1 Spatial Boundaries

Individuals, populations, and communities function within the environment at different spatial (and temporal) scales (Wiens 1989). In addition, the response of physical, chemical, and biological processes to changes in the environment can occur across several spatial scales at the same time (Hollings 1992; Levin 1992). Because the responses of physical, biological, cultural, and economic properties to natural and human-induced disturbance will be unique and occur across different scales, a multi-scale approach for describing baseline conditions (existing environment) and predicting effects from the Project on VCs has been adopted.

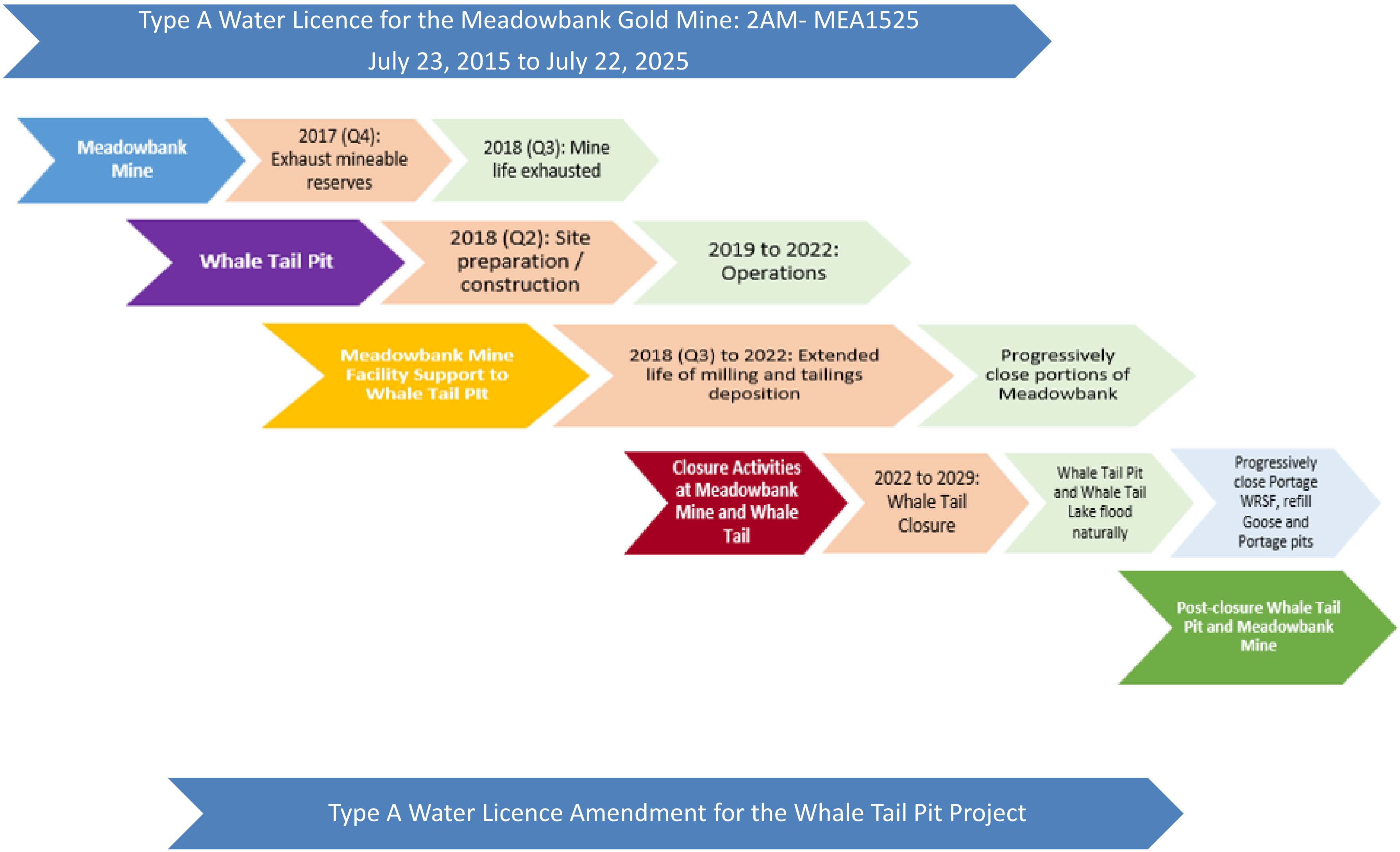
Selection of the boundary for effects study areas was based on the physical and biological properties of VCs. In addition, effects assessment areas were designed to capture the maximum spatial extent of potential effects from the Project and other previous, existing, and reasonably foreseeable future developments. The spatial scales selected are described in each discipline section (Volumes 4 through 7).

3.3.2 Temporal Boundaries

In the original FEIS, the Meadowbank Mine was assessed for two years of construction, up to 10 years of operations, and two years of closure activities for a total 14 year assessment period (or from 2008 to 2022). The Meadowbank Mine was licensed in 2008, began operations 2009 and is expected to cease production in Q3 of 2018 for a nine year operational life. The addition of the Whale Tail Pit will add an additional three to four years to the life of mine for Meadowbank Mine (including two years of active closure) as construction will occur starting in Q2 of 2018 at Whale Tail. The temporal boundary for construction, operations, and closure of the Project is about seven years (i.e., one year construction, three to four years operations, and two years closure). Operations at Whale Tail Pit will begin in 2019; as a result the Meadowbank Mill and Tailings Storage Facility will be operationally reduced as the focus shifts to mill refurbishment and repair for approximately one year. Equipment operators will continue to assist in construction activities at Whale Tail Pit and the closure of Meadowbank Mine facilities. This includes the encapsulation of Portage Waste Rock Storage facilities, reflooding of Vault Pit, encapsulation of Vault Waste Rock Storage Facility and decommissioning of various roads. Full scale operations at Whale Tail Pit is proposed to begin in 2019 and will continue for three to four years (i.e., 2019 to 2021/2022). Although there is an overlap with Whale Tail Pit construction and operations with the closure of the Meadowbank Mine, the closure period of the Meadowbank Mine was previously assessed. Key phases of the Meadowbank Mine and Whale Tail Deposit are presented in Figure 3.3-1. While milling and tailings deposition will extended at the Meadowbank Mine, progressive closure will occur, including filling of existing open pits.

Active closure is defined as the two year period when the majority of the mine infrastructure will be actively remediated, excluding water control structures, and active pumping of open pits will be initiated. For Whale Tail Pit closure is expected to begin in 2021/2022. A passive closure period will follow that is defined as the breaching of remaining water retention infrastructure. Details of closure are provided in the Interim Whale Tail Closure and Reclamation Plan (Volume 8, Appendix 8-F.1). Both active and passive closure are considered in the assessment.

Figure 3.3-1: Key Phases for the Whale Tail Deposit and Meadowbank Mine



For all VCs, residual effects are assessed for all phases of the Project. For some VCs and effects pathways, potential effects are analyzed and predicted from construction through closure, which generates the maximum extent of effects (e.g., removal and alteration of habitat is initiated in construction and continues to a period of time during closure). Alternately, for other VCs, the assessment was completed for those phases of the Project where predicted effects would be expected to peak or at several key snapshot points in time.

Similarly, the temporal boundaries identified for cumulative effects assessments are specific to the VCs being assessed. Temporal boundaries include the duration of residual effects from previous and existing developments that overlap with potential residual effects of the Project, and the period of time over which the residual effects from reasonably foreseeable developments will overlap with residual effects from the Project (if applicable). The temporal boundaries considered for each VC are defined in the associated discipline sections.

3.4 Pathway Analysis

Pathway analysis identifies and assesses the linkages between the Project components or activities, and the correspondent potential residual effects to VCs (e.g., surface water quality, soil, wildlife, and socio-economics). The first step in the pathway analysis is to identify all potential effects pathways through which the Project could affect VCs. Each pathway is initially considered to have a linkage to potential effects on VCs.

Potential pathways through which the Project could affect VCs were identified from a number of sources including the following:

- a review of Project description, and scoping of potential effects by the environmental, socio-economic, and engineering teams;
- a review of Project Guidelines;
- a review of relevant legislation (*Migratory Bird Convention Act*, *Fisheries Act*, *Nunavut Wildlife Act*, *Species at Risk Act*, etc.).
- results of Agnico Eagle’s public consultation;
- IQ;
- scientific knowledge and experience with other northern mines; and
- consideration of potential effects identified for the Project.

A matrix table of all Project activities or components was completed for each of the environmental and socio-economic components (Volume 3, Appendix 3-C). 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 VCs. The pathway analysis for each VC is also provided in Volume 3, Appendix 3-C.

This step is followed by the development of environmental design features and mitigation that can be incorporated into Project designs to remove a pathway or limit (mitigate) the effects to VCs. Project designs and mitigation can utilize IQ, such as avoiding important esker habitat. Environmental design features are developed through an iterative process between Agnico Eagle’s engineering and environmental teams and include Project design elements, environmental best practices, management policies and procedures, spill response and emergency contingency plans, and social programs.

Knowledge of the environmental design features is 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 VCs. Changes to the environment can alter physical measurement indicators (e.g., water chemistry) and biological measurement indicators (e.g., animal behaviour) (Table 3.2-1). For an effect to occur there has to be a source (Project activity) that results in a measurable environmental change (pathway) and a correspondent effect on a VC.

Project activity → change in environment → effect on VC

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential effects pathways for the 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 VCs.

Pathways are determined to be primary, secondary, or as having no linkage. Each potential pathway is assessed and described as follows:

- No linkage – Analysis of the potential pathway reveals that there is no effect to the measurement indicator, or the pathway is removed by environmental design features or mitigation such that the Project would not be expected to result in a measurable change to the measurement indicator. Therefore, the pathway would have no residual effect on a VC relative to the Baseline Case (Section 3.5.2.2) or guideline values (e.g., air, soil, or water quality guideline).
- Secondary – Pathway could result in a measurable minor change to measurement indicators, but would have a negligible residual effect on a VC relative to the Baseline Case or guideline. Therefore, the pathway is not expected to contribute to effects of other existing, approved, or reasonably foreseeable projects to cause a significant effect.
- Primary – Pathway is likely to result in a measurable change to measurement indicators that could contribute to residual effects on a VC relative to the Baseline Case or guideline values.

Pathways that are assessed as no linkage or secondary are not assessed further because environmental design features or mitigation will remove or limit the pathway to a negligible residual effect.

3.5 Effects Analysis

3.5.1 Project-Specific Effects

The effects analysis considers all primary pathways that are likely to result in measurable environmental changes and residual effects on VC measurement indicators (Section 3.4). Residual effects on measurement indicators may have more than one primary pathway that link a Project activity to an interaction with the environment and a subsequent effect on a VC. For example, the pathways for effects on the ability of fish populations and fish habitat to remain self-sustaining and ecologically effective could include alteration of local flows, water levels, and water quality.

A description of the methods used to analyze residual effects from the Project on VCs is provided in each discipline section (Volumes 4 through 7). Where possible and appropriate, the analyses are quantitative, and include data from field studies, modelling results, scientific literature, government publications, effects monitoring reports, and personal communications. Available IQ and community information is incorporated into the analysis and results, where information is available. Due to the amount and type of data available, some analyses are qualitative and include professional judgement or experienced opinion.

Results from the effects analyses are used to describe the direction, magnitude (intensity), duration and geographic (spatial) extent of the predicted residual changes to VCs. 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 or a guideline value. Duration of the change is estimated relative to Project phases, and the geographic extent of effects is expressed in area (ha) or distance (m, km) from the Project. In addition, the likelihood and frequency of effects is also described, where applicable.

Expressions such as “short-term” duration or “moderate” magnitude are not used in the summary of residual effects. These expressions are reserved for the classification of impacts, where definitions of these expressions are provided (Section 3.7.1).

3.5.2 Approach to Cumulative Effects

3.5.2.1 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 mining and other industrial development, and some changes may be associated with natural phenomenon, such as an extreme rainfall event. Where information is available, the cumulative effects assessment estimates or predicts the contribution of effects from the Project and other developments on VCs, in the context of natural changes in the system.

Not every VC 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 VC (Section 3.3).

Cumulative effects are identified, analyzed, and assessed in each discipline section, where applicable. The approach is the same as that used for the Project-specific effects analysis (Section 3.5.1), and residual impact classification and determination of significance (Section 3.7).

3.5.2.2 Assessment Cases

For VCs that require cumulative effects analysis, the concept of assessment cases is applied to the associated spatial boundary (effects study area) to estimate the incremental and cumulative effects from the Project and other developments (Table 3.5-1). 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 3.5-1: Contents of Each Assessment Case

Baseline Case	Application Case	Future Case
Range of conditions from little or no development to 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 assessment (study) area before application of the Project. Environmental conditions on the landscape prior to human development (e.g., mining, mineral exploration, outfitting, and transportation), which represent reference conditions, were considered independently within the Baseline Case, where possible. Observations collected during baseline studies represent part of the range of variation in the ecological and socio-economic systems produced by historical and current environmental selection pressures (both human and natural). Thus, the Baseline Case includes the cumulative effects from all previous and existing developments within the effects study area of a VC.

The temporal boundary of the Application Case begins with the anticipated start of construction of the Project, and continues until the predicted effects are reversed (Section 3.3.2). For several VCs, the temporal extent of some effects likely will be greater than the lifespan of the Project because the effects will not be reversible until beyond closure.

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 case is the expected operational lifespan of the Project, which in the case of the Project is three to four years.

Analyses of the effects for the Baseline and Application cases are largely quantitative; effects analyses for the Future Case are 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 VC. There are also uncertainties in the direction, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of the Project effects.

The cumulative effects study area and the reasonably foreseeable future developments used in the assessment are provided in Volume 3, Appendix 3-D.

3.6 Prediction Confidence and Uncertainty

Most assessments of impacts embody some degree of uncertainty. The purpose of the uncertainty section is to identify the key sources of uncertainty and discuss how uncertainty is 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 dust deposition);

- 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 Project).

Uncertainty in these elements can decrease confidence in the prediction of environmental significance. Where possible, a strong attempt is made to reduce uncertainty in the EIS to increase the level of confidence in impact predictions through the following:

- using the results from several models (where feasible) and analyses to help reduce bias and increase precision in predictions;
- using data from effects monitoring programs at existing mines and 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 and in follow-up and monitoring programs. Each discipline includes a discussion of sources of uncertainty and how uncertainty is addressed.

3.7 Residual Impact Classification and Determination of Significance

3.7.1 Residual Impact Classification

The purpose of the residual impact classification is to describe the residual incremental and cumulative adverse effects from the previous and existing developments, the Project (i.e., the Application Case), and future developments (i.e., the Future Case, if applicable) on VC measurement indicators using a scale of common words rather than numbers and units. The use of common words or criteria is accepted practice in environmental assessment. It is difficult (and not appropriate) to provide definitions for all residual adverse effects criteria and significance that are universally applicable to all of the VCs. Consequently, specific definitions are provided for each VC in Volume 3, Appendix 3-E.

The classification of residual impacts from associated primary pathways and the determination of environmental significance are only completed for those VCs that have assessment endpoints. This is because assessment endpoints represent the key properties of the VC that should be protected for their use by future human generations (Section 3.2.2). Results from the residual impact classification are then used to determine the environmental significance of the Project (and other developments) on assessment endpoints.

To provide clarity and consistency across VCs with assessment endpoints, effects are described using the following criteria:

Direction: Direction indicates whether the effect on the measurement indicator is negative (i.e., less favourable), positive (i.e., an improvement), or neutral (i.e., no change). The main focus of an environmental assessment is to predict if the Project is likely to cause a significant adverse effect on the environment or cause public concern. Neutral and positive effects are not assessed for significance.

Magnitude: Magnitude is a measure of the intensity of an effect to the measurement indicator, or the degree of change caused by the Project relative to baseline conditions or a guideline value. Magnitude is often classified as negligible, low, moderate, or high. The number and definitions of scales of magnitude are specific to VCs. Where possible, magnitude is reported in absolute and relative terms.

Geographic Extent: Geographic (spatial) extent refers to the area (or distance covered or range) of the effect to the measurement indicator, and is different from the spatial boundary (i.e., effects study area) for the effects analysis. The study area for the effects analysis represents the maximum area used for the assessment and is related to the spatial distribution and movement of VCs (Section 3.3.1). Geographic extent is categorized as site (where applicable), local, regional, and beyond regional. The beyond regional scale includes cumulative residual effects from the Project and other developments that extend beyond the effects study area.

Duration: Duration is VC-specific and is defined as the amount of time from the beginning of an effect to when the effect on a VC is reversed, and is typically expressed relative to the Project development phases (usually in years). Duration has two components: the amount of time between the start and end of a Project activity or stressor (which is related to Project development phases: construction, operations, and closure), plus the time required for the effect to be reversed.

Some residual effects may be reversible soon after the stressor has ceased (e.g., change in distribution of some wildlife species following the decrease in noise and activity levels after closure), while other residual effects may take longer to be reversed (e.g., change in abundance of some species on Project-altered habitat after reclamation and revegetation). By definition, residual effects that are short-term, medium-term, or long-term in duration are reversible.

Reversibility: After removal of the Project activity or stressor, reversibility is the likelihood that the Project will no longer influence a VC at a future predicted time (e.g. reversible or irreversible). The time frame is provided for reversibility (i.e., duration) if an impact is reversible. Permanent impacts are considered irreversible. Available scientific information and experienced opinion may predict that the residual effect is irreversible or the duration of the residual effect may not be known, except that it is expected to be extremely long and well beyond the temporal boundary of the Project. In this case, the residual effect is classified as 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 diverted to facilitate recovery (Volume 3, Appendix 3-E).

Frequency: Frequency refers to how often an effect 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 the effect occurs (e.g., once at the beginning of the Project).

Likelihood: Likelihood is the probability of an effect occurring and is described in parallel with uncertainty. Definitions are provided in Volume 3, Appendix 3-E.

For criteria such as frequency and likelihood, the scales can be applied consistently across all biophysical VCs. Socio-economic criteria 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 and socio-economic VC. The definitions for these scales are ecologically, socially, or logically based on the VC. The scales for these criteria are specifically defined for each VC (Volume 3, Appendix 3-B).

3.7.2 Determination of Significance

The classification of primary pathways and the associated predicted changes in measurement indicators provide the foundation for determining the significance of potential incremental and cumulative effects from the Project and other existing, approved, and possible future developments on VC assessment endpoints. The significance of the contribution of incremental effects from the Project on VC measurement indicators is provided, but the evaluation is focused on determining the significance of cumulative effects on assessment endpoints of the biophysical and socio-economic environments.

The key factors considered in the determination of environmental significance on VCs of the biophysical and socio-economic assessment endpoints include the following:

- results from the residual impact classification of primary pathways and associated predicted changes in measurement indicators;
- magnitude is the primary criterion used to determine significance, with geographic extent and duration providing important context for assigning magnitude; frequency and likelihood act as modifiers, where applicable; and
- the level of confidence in predicted effects, scientific and socio-economic principles (e.g., resilience and stability), and scientific interpretation and uncertainty is high and the cumulative effect might be either significant or not significant, the assessment conservatively identified the effect as significant and provided additional follow-up actions to reduce uncertainty.

Duration is a function of resilience, which is the ability of the population to recover or bounce back from a disturbance (e.g., rate and degree of fluctuation in population abundance and distribution after a disturbance). Resilience is largely a function of demographic and behavioural life history traits such as size and number of litters or number of eggs and survival of fry, age at reproduction, lifespan of individuals, habitat selection, and effective dispersal. The capacity or ability of individuals in a population to change and accommodate disturbance is also related to resilience.

Resilience can vary with population size, stability, and the likelihood of demographic rescue from neighbouring populations. During periods of low abundance, animal and plant populations can become less resilient to natural environmental and human-related disturbances, which may reduce stability (i.e., trajectory of the population). Stable populations exhibit no long-term increasing or declining trend in abundance outside of natural fluctuations and cycles (e.g., predator-prey cycles). Resilience and stability are properties of a population that influence the amount of risk to VCs from development (Weaver et al. 1996).

As much as possible, effects are classified and significance determined using established guidelines, thresholds or screening values, and scientific principles. For some VCs, such as water quality, guideline or threshold values are known, which provides confidence in effects predictions and determining environmental significance. For other VCs, social and ecological benchmarks or effects thresholds are not known and are challenging to define, which creates uncertainty in determining the significance of predicted effects. Subsequently, magnitude classification was applied conservatively to increase the level of confidence that effects will not be worse than predicted (Section 3.6). Furthermore, the determination of significance considers the key sources of uncertainty in the effects analysis, the management of uncertainties, and the correspondent level of confidence in effects predictions.

The evaluation of significance for biophysical VCs considers the entire set of primary pathways that influence a particular assessment endpoint rather than explicitly assigned to each pathway. The relative contribution of each primary pathway and measurement indicator is used to determine the significance of the Project (and other developments) on an assessment endpoint. The relative effect from each primary pathway is discussed; however, primary 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. This method is used to identify predicted residual adverse effects that have sufficient magnitude, duration, and geographic extent to cause fundamental changes to a VC, and therefore, result in significant effects.

Classification of residual effects and determination of significance for the socio-economic environment generally follow the methods used for biophysical VCs; however, there are some differences in the selection and definition of effects criteria (Volume 3, Appendix 3-D). For socio-economic VCs, direction, magnitude, geographic extent, and duration are the criteria used to classify effects and evaluate the significance of changes to assessment endpoints. The assessment of significance considers the scale of these criteria and professional opinion, which is based on the context of the communities involved, and the informed value and judgement of interested and affected organizations and specialists. The level of significance also assesses the efficacy of the proposed mitigation (i.e., policies, practices, and investments) and benefit enhancement programs to limit negative effects and foster positive effects on the continued persistence of long-term sustainable social, cultural, and economic features of the environment.

3.8 Monitoring and Follow-Up

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

Compliance monitoring and inspection: monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and conditions of approval, and of Company commitments (e.g., inspecting the installation of a silt fence; monitoring mine water discharge quality and volumes).

Follow-up: programs designed to test the accuracy of impact predictions, reduce uncertainty, determine the effectiveness of environmental design features, and provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices. Results from follow-up programs can be used to increase the certainty of impact predictions in future environmental assessments. Where applicable, the results from follow-up programs completed at the Meadowbank Mine were considered in the assessment of the Project.

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 by Agnico Eagle. This may include increased monitoring, changes in monitoring plans, or additional mitigation. Proposed monitoring programs are provided for the various disciplines in Volumes 4 through 7.

3.9 References

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APPENDIX 3-A

Marine Environment Summary

3.A-1 INTRODUCTION

Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) is proposing to develop Whale Tail Pit and Haul Road (Project), a satellite deposit located on the Amaruq property, to continue mine operations and milling at Meadowbank Mine. The Amaruq property is a 408 square kilometre site located on Inuit Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of Meadowbank Mine in the Kivalliq Region of Nunavut. The deposit will be mined as an open pit (i.e., Whale Tail Pit), and ore will be hauled to the approved infrastructure at Meadowbank Mine for milling.

The Project, consisting of an extension of the Meadowbank Mine through operations of Whale Tail Pit, will transport supplies required for construction and operation on ocean freight systems to marshalling and storage facilities at Baker Lake. While not a requirement of the Cumberland Environmental Impact Statement (EIS) for the Meadowbank Mine, a description of existing marine resource conditions in the Project area, as well as an assessment of Project effects on the marine environment has been completed for the final environmental impact statement (FEIS) amendment due to IQ concerns around shipping (NIRB 2015), and the most current EIS guidelines issued for mining projects.

3.A-1.1 Purpose

This document summarizes the assessment of Project effects on marine water quality and wildlife (marine fish, marine mammals, and marine birds) and their associated habitats in the Project area. The following sections provide a summary of the existing environment, an analysis of potential Project-related effects on selected Valued Components (VCs) in the marine environment, proposed mitigation measures to minimize or avoid adverse effects, identification of residual impacts following implementation of mitigation, and a determination of significance with respect to Project impacts on marine wildlife VCs.

3.A-2 STUDY AREAS

The Local and Regional study areas (LSA and RSA) for the Marine Environment encompasses the proposed Project shipping corridor in the channel of Chesterfield Inlet, Hudson Bay, and Hudson Strait (Figure 3-A-1). The proposed shipping corridor has been broken down into the following three shipping route segments: i) eastern Hudson Strait to the mouth of Chesterfield Inlet, ii) the mouth of Chesterfield Inlet to Baker Lake via Chesterfield Narrows, and iii) the mouth of Chesterfield Inlet to the Port of Churchill (ocean-going vessel and/or tug-assisted barge).

3.A-3 VALUED COMPONENTS

While the marine environment was not identified as a VC in the FEIS (Cumberland 2005), VCs were identified to facilitate the assessment of the marine environment. Table 3-A-1 lists all VCs selected for Marine Resources and the rationale for their inclusion.

3.A-4 INCORPORATION OF INUIT QAUJIMAJATUQANGIT

The following publicly available Inuit Qaujimajatuqangit (IQ) sources relevant to the Project were reviewed for IQ specific information related to the VCs and incorporated into marine effects assessment:

- IQ studies conducted in 2015 by Golder to support the Project EIS (Volume 7, Appendix 7-A).
- IQ workshop held in the community of Chesterfield Inlet in January 2010 (Agnico Eagle 2013) and meetings with Kivalliq communities (Agnico Eagle 2014a).

- IQ studies conducted by Nanuk Enterprises in 1997-1998 and 2010-2011 in Rankin Inlet, Chesterfield Inlet, and Whale Cove (Nanuk 1999).
- IQ studies conducted by Nanuk Enterprises / Outcrop Ltd. during 2012, consisting of interviews with local hunters, fishers, tour operators, and experienced seamen representing the communities of Rankin Inlet, Chesterfield Inlet, and Whale Cove (Agnico Eagle 2014b).
- Interview conducted on 15 July 2011 by Nunami Stantec in Rankin Inlet with representatives from the Kangiqliniq Hunters and Trappers Organization (Kangiqliniq HTO 2011).
- Interviews by Higdon et al. (2013) summarising information on killer whales gathered during interviews in 11 eastern Nunavut communities (Kivalliq and Qikiqtaaluk regions) between 2007 and 2010.
- A vessel reconnaissance tour to collect IQ on traditional resource use with informal questioning of two Inuit guides conducted by Stantec in 2009 (AREVA 2014).
- Review of literature summarizing historical Traditional Resource Use in the Hudson Bay/ Hudson Strait region including the Nunavut Atlas (CCI 1992) and the Inuit Land and Occupancy Project (Freeman and Murty 1976).

Inuit Qaujimajatuqangit was used in VC selection by reviewing documented Traditional Knowledge (TK) information, consultation with local communities, concerns raised through consultation with regulators (GNDoE and NIRB), and a review of VCs identified in other Nunavut mine projects. The Project Guidelines required that special consideration be given to species of particular social, cultural and economic importance, including those for human consumption (Cumberland 2005).

Inuit Qaujimajatuqangit related to marine wildlife (marine fish, marine mammals and marine birds) in the Project area was incorporated into baseline reporting, including information on marine wildlife abundance and distribution, migration patterns, breeding areas, critical habitat features (e.g. walrus haul-out locations), harvesting patterns, and the effects of climate change on marine wildlife populations and on harvesting activities.

IQ was incorporated in the assessment by considering Project-specific questions and concerns related to marine environment and marine wildlife that were raised by local community members. Particular emphasis was placed on assessing the impacts from shipping on marine wildlife.

3.A-5 PROJECT COMPONENTS ASSESSED

Project components assessed for potential effects on VCs were limited to marine shipping activities including vessel transportation in the shipping corridor within the assessment boundaries (Hudson Bay, Hudson Strait and the channel of Chesterfield Inlet) and ship lightering activities (ship-to-ship transfer / loading).

As an extension of the Meadowbank Mine, the Project will continue to use shipping arrangements already in use for the Meadowbank Mine and will not incur a net increase in shipping volume within Hudson Bay and Hudson Strait or a change in shipping procedures. Meadowbank Mine and Whale Tail operations will rely on marine transportation (sealift) for most of their supplies including fuel, construction and operation equipment, materials and consumables, including dangerous goods, food, household goods, and other non-perishable supplies. Shipping takes place during the open water season between July and early October. The majority of dry cargo for the Meadowbank Mine is delivered to Baker Lake from Becancour, Quebec using three to six cargo shipments per year, representing a total annual cargo volume of ~60,000 m^3. Up to three cargo shipments per year also occurs between the Port of Churchill and Baker Lake. Volume of cargo is anticipated to remain consistent with current shipping requirements. Additional details are provided in Volume 1, Section 1.2.6.

3.A-6 SUMMARY OF EXISTING ENVIRONMENT

3.A-6.1 Physical Environment

Ice cover directly influences the oceanographic and ecological processes in the water column. Other factors that affect oceanographic conditions in Hudson Bay include temperature and salinity driven exchange with the Arctic Ocean, tidal exchange with the Atlantic Ocean, wind-stress during the open-water season, and large freshwater input from both runoff and ice melt. Non-tidal (residual) currents in Hudson Bay are wind-driven and density-driven which creates a general cyclonic (counter-clockwise) movement of surface water in Hudson Bay (Figure 3-A-2). The water column in Hudson Bay is characterized by a seasonal cycle in vertical salinity and temperature distribution at the surface (Figure 3-A-3) and there is a noticeable difference in oceanographic conditions between nearshore and offshore waters in Hudson Bay (Prinsenberg 1986).

Figure 3-A-4 summarizes ice freeze-up and ice break-up for Hudson Bay and Hudson Strait including the frequency of ice occurrence in late winter and late summer. In the channel of Chesterfield Inlet, maximum ice thickness was observed between April and June at between 1.6 and 2.3 metres (m) (Loucks and Smith 1989).

3.A-6.2 Biological Environment

The distribution and abundance of marine biota in Hudson Bay is largely determined by regional ice conditions, with areas of highest biological productivity associated with upwelling areas near polynyas and the edge of the sea ice. Timing of sea ice formation and ice melt influences the seasonal distribution and movement of marine mammals and marine birds including species targeted for subsistence, recreational and commercial harvesting as well as species of special concern.

At least 60 species of fish are known to occur in marine waters of Hudson Bay and at least 88 species are known to occur in Hudson Strait (Canadian Arctic Resources Committee (CARC) 1991; Coad and Reist 2004; Stewart and Lockhart 2004). An overview on the biology and distribution of fish species occurring within the proposed shipping corridor is summarized in Table 3-A-2. Southern Hudson Bay and James Bay support fish communities comprised of marine, estuarine, and freshwater species; while western and northern Hudson Bay support more deep-water species (Stewart and Lockhart 2004). Several marine and anadromous fish within the marine study areas serve as key prey species for marine mammal and bird populations in the study area, and are targeted by human populations through commercial and subsistence harvesting, including Arctic char; Arctic cod, Greenland cod, polar cod, Greenland halibut and capelin. Arctic char are of particular importance to commercial and subsistence harvests. Greenland halibut and capelin are also commercially harvested while Arctic cod, fourhorn sculpin, and capelin are also targeted for subsistence harvest. Information on the distribution of Arctic char and other important fish species (Dolly Varden, anadromous coregonids (whitefish), Pacific herring and landlocked Atlantic cod) is presented in Figure 3-A-5.

At least 11 species of marine mammals have the potential to occur within the study areas at different times throughout the year (Table 3-A-4). This includes four species of cetaceans, six species of pinnipeds and polar bears (Figure 3-A-6 to Figure 3-A-16). Atlantic walrus, bearded seal, ringed seal, and harbour seal are year-round residents in the area. The distribution of narwhal and beluga in the study area varies seasonally, with key summer habitats identified in Hudson Bay and Hudson Strait for both species. Harp seal, hooded seal and killer whale frequent the study area during the open water season. Bowhead whale mainly utilize Hudson Strait and Hudson

Bay as overwintering habitat and as a migratory corridor between winter and summer seasons. Polar bears move to offshore areas during early November, and retreat inshore to terrestrial summering areas during the ice-free season.

Currently, marine mammals in the region are mainly taken for subsistence harvest and for sport. Marine mammal harvesting is still an important part of the local Aboriginal and Inuit economy and traditional culture (Table 3-A-3). Two species of marine mammals (bowhead and polar bear) are listed under the federal *Species at Risk Act* (SARA), and six species (narwhal, beluga, bowhead, killer whale, polar bear and walrus) are conservation listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). A summary of habitat, seasonal occurrence and status of marine mammal species occurring within the Project shipping corridor is provided in Table 3-A-4 with information on species distribution presented in Figure 3-A-6 to Figure 3-A-16.

Concerns were raised through TK and IQ and expert information interviews and reports regarding changes observed in recent years related to the distribution of marine wildlife species and their habitat use within the study area. Many of these reported changes are associated with climate change, including an increased presence of killer whales in Hudson Bay / Hudson Straight due to declining summer ice, which may in turn effect on other marine mammals (i.e., their prey) (e.g., bowhead whales), as well as increased number of polar bears encountered near human residencies and garbage dumps (Higdon et al. 2013; Kangiqliniq HTO 2011; Agnico Eagle 2014b; AREVA 2014).

A number of ecologically and/or culturally important marine bird species use the study area and are presented in Table 3-A-5. Black guillemot is hunted locally for subsistence purposes. Five bird species present in the region (Ross's gull, ivory gull, red-necked phalarope, peregrine falcon, and red knot) are listed under SARA and by COSEWIC. A number of key marine habitat sites for migratory birds have been identified along the shipping route and are presented in Figure 3-A-17 and Figure 3-A-18.

Protected areas which overlap with the study area include Wapusk and Ukkusiksalik National Parks, the McConnell River Migratory Bird Sanctuary south of Arviat, and the Harry Gibbons and East Bay Migratory Bird Sanctuaries on the southeast coast of Southampton Island. The study areas also contain Ecologically and Biologically Significant Areas and Areas of High Biological Importance distributed throughout Hudson Bay and Hudson Strait (Table 3-A-6; Figure 3-A-19), Bowhead Whale Critical Habitats between Rankin Inlet and eastern Hudson Strait (Figure 3-A-20 and Figure 3-A-21), and areas identified as important habitat for marine birds (Figure 3-A-22). Notable large breeding colonies include colonies of thick-billed murre on Akpatok Island in Hudson Strait, and colonies of lesser snow goose in the McConnell River Migratory Bird Sanctuary and on the islands of Hudson Bay (Table 3-A-7).

3.A-6.3 Shipping and Navigation

The Hudson Bay / Hudson Strait area is a critical corridor for marine transport into and out of Nunavut (LOOKNorth 2014). Vessel traffic occurs mostly during the open-water season extending from July to early October (WWF 2015). Table 3-A-8 summarizes vessel traffic through Hudson Strait for each industry sector between 2007 and 2013. Table 3-A-9 provides a breakdown of vessel types present in the Project area throughout the same period.

Between 2008 and 2014, reported annual landings at Baker Lake ranged between 17 and 45 shipments per year (Agnico Eagle 2014a; Figure 3-A-23), of which only a portion were in direct support of the Meadowbank Mine; the remaining were supporting community of Baker Lake resupply. This includes tug-assisted barges transporting both goods and fuel, as well as shuttle tankers transporting fuel. Aside from barge and shuttle tanker traffic, vessel activities in the channel of Chesterfield Inlet are mainly restricted to small fishing vessels and pleasure crafts, given there is only one small public dock in this area (Aarluk 2011). The total number of annual barge trips arriving at Baker Lake from Chesterfield Inlet between 2008 and 2014 is summarized in Figure 3-A-23.

For vessels to reach Baker Lake, they are required to transit through Chesterfield Narrows, with a minimum clearing distance of 0.04 nautical mile from certain navigational hazards relative to the established safe course of passage in this area (based on high tide conditions for a vessel draught of 4.6 m). The Sailing Directions for Hudson Strait, Hudson Bay and Adjoining Waters indicate that Chesterfield Narrows, and the area east of it, is suitable only for daytime navigation in good visibility due to strong currents. While most shipments through the channel of Chesterfield Inlet are made during daylight, some passages are made during darkness, particularly near the end of the season, when there are fewer daylight hours. Because the transit through Chesterfield Narrows must take place during a 30 to 60-minute window, which occurs about every 12 hours at high water slack tide, the possibilities to pass through the narrows during daylight are limited (TSBC 2012). Since 2007, there have been 4 instances where Canadian Coast Guard (CCG) was notified of vessel groundings in Baker Lake and the channel of Chesterfield Inlet. Two of these groundings occurred in Chesterfield Narrows (TSBC 2012).

3.A-7 PATHWAY ANALYSIS AND POTENTIAL PROJECT-RELATED EFFECTS ASSESSMENT

Analysis of the potential pathways for potential Project effects on Marine Resource VCs during construction, operations, and closure is provided in Table 3-A-10. Project activities considered in the pathway analysis are limited to those directly associated with marine shipping, which will occur during all phases of the Project (construction, operations, and closure). Only primary pathways relevant to Marine Resources are discussed herein.

The assessment endpoint for Marine Wildlife consists of ‘self-sustaining and ecologically effective marine wildlife populations and on-going marine fisheries productivity’. Marine Water Quality has no assessment endpoint, as it represents a measurement indicator and pathway for Marine Wildlife VCs. Residual effects were analyzed using measurable indicators for Marine Wildlife VCs and are expressed as effects statements, including the following:

- changes in habitat (quality and quantity);
- changes in survival and health risk; and
- changes in behavior.

The primary pathways that require further effects analysis to determine the environmental significance from the Project on Marine Resource VCs are provided in Sections 3.A-8.1, 3.A-8.2, 3.A-8.3, and 3.A-8.4.

3.A-8 EFFECT ANALYSIS

Generic definitions have been provided for each of the impact criteria in the Assessment Approach (Volume 3, Section 3.7.1). For criteria such as geographic extent, duration, frequency, and likelihood, the definitions can be applied consistently across all marine VCs. The likelihood of an impact was determined based on the probability of the event occurring and the implementation of mitigation measures. Reversibility is defined as the likelihood and time required for a component (e.g., population) or system to recover after removal of the stressor and is a function of resilience. Reversibility is applied to all combinations of magnitude, geographic extent, and duration. Definitions for each criterion are provided in Volume 3, Appendix 3-E. A brief summary of the effects on each VC is provided below.

3.A-8.1 Marine Water Quality

3.A-8.1.1 Effects Analysis

Potential environmental effects of the Project on marine water quality include the following:

- Accidental fuel spills may result in changes to marine water quality (e.g. contaminant concentrations in water above ambient water quality guidelines).

A number of fuel types will be present on Project vessels that could accidently be released to the marine environment, including aviation fuel and ultra-low sulfur diesel. Diesel is the largest fuel type by volume that will be transported by fuel tankers. A minimal amount of intermediate and heavy fuel oils (IFOs and HFOs) will also be present on-board the vessels, limited to volumes required for vessel engine consumption during transit. Intermediate and heavy fuel oils are denser and have a higher viscosity than diesel fuels and do not dissipate quickly; they have a tendency to remain for longer periods than lighter fuels, and, therefore, can pose a longer-term threat to the environment (ITOPF 2002). Diesel and aviation fuel, on the other hand, have lower density and viscosity and tend to be less persistent in the environment, albeit more toxic; dispersion and evaporation of diesel and Jet A will occur at a faster rate (Edgerton et al 1987; NOAA 2016).

Accidental spills have the potential to occur throughout the life of the Project. This could include minor fuel spills such as those resulting from leaks from on-board equipment or fuel containers (e.g. fuel drums); or major fuel spills resulting from a malfunction during fuel transfer activities or as a result of a vessel accident, such as sinking, running aground, collisions with other ships, or an on-board fire or explosion. A fuel spill is more likely to occur during vessel lightering operations near Helicopter Island at the head of Chesterfield Inlet than during transit along the shipping corridor in Hudson Strait and Hudson Bay. Also, navigation in the channel of Chesterfield Inlet involves a higher risk of running aground than navigation in Hudson Strait and Hudson Bay due to the narrower passage and stronger tidal currents in this area, and the proximity of rocky shores and small islands along this segment of the navigational route.

The expected spill rate per year for the Project was calculated by multiplying the total volume of fuel (ULSD and Jet A) to be transported in a given year for the Project by estimated spill frequencies derived from historical statistics (SL Ross 1999). Approximately 66.8 million litres (66,800 square metres [m^3]) of fuel is delivered per year of operations. Based on this total and the estimated spill rates reported by SL Ross (1999), the overall likelihood of a fuel spill for the Project was predicted to be once every 69 years for a small spill (from 0.17 to 8.3 m^3) and once every 1,000 years for a large spill (more than 167 m^3). Also, historical incident records (e.g., spills, accidents) for the Meadowbank Mine were reviewed to determine if any spills had occurred in the marine environment since the start of mining operation, with no spills identified on-record.

The fate and effect of a fuel spill depends on its chemical properties (specific gravity, pour point, viscosity, and constituent components), volume released, surface area of spreading, and the environmental conditions involved (wind speed and direction, water depth, wave energy, sea state, solar radiation, current speed, water temperature, and distance to land) (ITOPF 2002). Weathering processes[1] include dispersion, evaporation, dissolution,

[1] For light hydrocarbon fuels such as diesel, evaporation and dissolution are the most influential weathering processes (ITOPF 2002).

sedimentation, spreading, biodegradation, emulsification, and photo oxidation. The rate at which a spill will disperse once it enters the marine environment is largely dependent upon the type of fuel released and the sea state conditions at the time of the spill. Dispersion occurs most rapidly with low viscosity oils and in the presence of breaking waves (ITOPF 2002). The rate of evaporation depends on ambient temperatures, wind speeds, and the type of fuel.

Dispersion, evaporation, and spreading are the primary processes for determining fate and transport of diesel fuel, which is the primary fuel type being used for the Project. As diesel fuel has a low viscosity, it will weather rapidly when spilled into the marine environment (NOAA 2006). With a lower density than water, diesel fuel is readily dispersed by wave action. Over 90% of a small spill of diesel in the marine environment is either evaporated or naturally dispersed over a time scale of several hours to days (NOAA 2016). The larger-magnitude impacts from fuel spills are typically encountered when spills occur near land, in shallow waters, or in areas with reduced water circulation (Patin 1999).

Spilled hydrocarbons can deteriorate water quality by contaminating the water with a number of constituents, mainly aromatic hydrocarbons and alkanes, in excess of local and international water quality guidelines and standards. Released hydrocarbons will spread rapidly over the sea surface resulting in a thin layer (a slick) that tends to disperse within the upper layer of water column.

A semi-quantitative risk assessment was undertaken for Agnico Eagle's Meliadine Project FEIS (Agnico Eagle 2014b) to determine the likelihood and extent of a potential ULSD (P-50) fuel spill during fuel transfer activities near Rankin Inlet and during transport along the shipping route. Fuel for the Meliadine Project is delivered to Rankin Inlet (approximately 130 km south of Chesterfield Inlet) at a rate of 122,000 m^3/year. This represents approximately twice as much volume of fuel as that required for the Project. The behavior of a potential fuel spill in the marine environment for the Meliadine FEIS was assessed at six different hypothetical spill locations. Two locations were selected near Melvin Bay corresponding with ship-to-shore and ship-to-ship fuel transfer sites where a higher potential for fuel spills would occur. Four locations were assessed along the shipping route corresponding with known sensitive/important areas for marine mammals and/or marine birds, including Walrus Island, Coats Island, Ungava Peninsula, and Eastern Hudson Strait. The risk assessment considered a worse case spill scenario of 2000 m^3 occurring at each of the 6 sites (representing the total volume of diesel carried by a single tanker), and an additional spill scenario of 100 m^3 occurring at the fuel transfer sites near Melvin Bay, representing smaller spills that could occur during fuel transfer activities.

For both spill scenarios assessed at the fuel transfer locations near Melvin Bay, the weathering half-life of a potential ULSD spill was determined to be <19 hours (h). The time required for the spill to reach shore varied from approximately 6 minutes (0.1 h) to 1 h 20 minutes. It was further predicted that between 89% and 98% of the total volume of spilled diesel fuel would ultimately reach shore if no responsive mitigation was implemented (Agnico Eagle 2014b).

For the spill sites modelled along the shipping route, the weathering half-life was predicted to be less than 19 h for all scenarios. Depending on the distance to shore and wind scenario, the time to shore varied from about 7 h to 94 h (approximately 4 days). Depending on different wind conditions and spill locations, the amount of fuel predicted to be deposited on shore varied from 2% to 26% of the original spill volume. Mean and 50-year (extremal) wind speed estimates and mean fetch values for the four locations along the shipping route were used to estimate the slick distance traveled until the fuel remaining represented 1% of the original quantity. Modeling results indicated that, assuming average wind speed conditions, the fuel slick would travel approximately 26 km over a

48-h period prior to being reduced to 1% of its original spill volume through natural weathering effects. Using 50-year wind speed values, the fuel slick would travel approximately 38 km over a 12-h period prior to being reduced to 1% of its original volume (or 26 km over an 8-hour period prior to being reduced to 7% of its original volume) (Agnico Eagle 2014b).

While it is not appropriate to fully apply the Meliadine FEIS model prediction to determine the behavior of a potential spill for the Project since the fuel volumes for both Projects are not the same, and environmental conditions at the fuel transfer points are also known to be different (hydrodynamic conditions in Chesterfield Inlet are different than those near Rankin Inlet), qualitative inferences can be made to apply this information for assessing the potential impact from a spill on the marine environment and establishing a 'hypothetical spill limit' - or the maximum spatial extent that a diesel fuel slick could potentially reach for the purposes of this assessment. It is most likely that a fuel spill in the channel of Chesterfield Inlet would spread rapidly in a downstream direction (given prevalent current conditions in this area) and reach the shoreline within several hours if no immediate spill response was implemented. In open water areas (Hudson Bay and Hudson Strait), a spill for the Project is likely to behave in a similar way to that described for the Meliadine Project.

3.A-8.1.2 Residual Effect Classification and Significance

Marine Water Quality has no assessment endpoint, as it represents a measurement indicator and pathway for Marine Wildlife VCs with the following assessment endpoints: self-sustaining and ecologically effective marine wildlife populations, and on-going marine fisheries productivity.

Characterization of residual impacts on marine water quality is intended to inform the assessment of residual impacts on marine wildlife VCs, and in particular impacts on habitat quality for marine wildlife VCs. Where there are assessed residual impacts on marine water quality due to Project activities, those changes have been characterized and carried forward, regardless of significance, into the assessment of residual impacts on marine wildlife VCs.

3.A-8.2 Marine Fish and Fish Habitat

3.A-8.2.1 Effects Analysis

Potential environmental effects of the Project on marine fish include the following:

- potential mortality or reduced health due to exposure to accidental fuel spills; and
- loss / degradation of habitat due to altered water quality from potential accidental fuel spills.

In the event of fuel spill, the fate of released hydrocarbon material will primarily depend on the quantities and properties of released materials. The most common fuel type by volume for the Project is marine diesel. Diesel fuel is lighter than water and spreads to a thin film on the water surface once released to the marine environment (NOAA 2016). The fate of diesel spills in marine water and the effectiveness of dispersion and cleaning activities depends on several environmental factors. Because diesel is only moderately volatile, wave actions may disperse the non-evaporated portion of spilled diesel over the area before it can be contained (NOAA 2016). This can leave a residue of up to one-third of the amount spilled after several days. In Alaska, diesel spilled into marine environmental at small volumes (1,900 to 19,000 litres) usually evaporates and disperses naturally into the water column within one day or less, particularly when winds are at 5 to 7 knots and breaking waves are present (NOAA 2016). If a diesel spill reaches lands, it can leave a film on intertidal resources and can potentially cause longer-term bio-contamination if it becomes buried in sediments along the foreshore or on the seabed.

Fuel spills can result in adverse impacts on marine fish through degradation of sensitive fish habitats (e.g., spawning grounds), and through acute and chronic toxicological effects by means of uptake by the gills, ingestion of oil or oiled prey, and reduced survival of eggs and larvae (US FWS 2004). Diesel fuel is considered to be one of the most acutely toxic oil types (NOAA 2016) as it consists primarily of volatile petroleum hydrocarbons, benzene, and other aromatic hydrocarbons (Hoffman 1982). These compounds are highly toxic to aquatic life and there are numerical standards for these chemicals under the Canadian water quality guidelines for the protection of aquatic life (CCME 2014). Fish that come in direct contact with a diesel spill may be killed (NOAA 2016). Spilled fuel accumulated in intertidal sediments can be directly toxic to benthic invertebrates and intertidal organisms (USFWS 2004). Bio-accumulation of toxic compounds within benthic organisms can also result in the transfer of these toxic compounds through the food chain to higher trophic levels. Diesel spills along the shoreline tend to penetrate porous sediments quickly, but will be washed off quickly by waves and tidal flushing (NOAA 2016). Diesel oil is also degraded by naturally occurring microbes, under time frames of one to two months (NOAA 2016).

The toxic effect of spilled fuel depends on their chemical properties, volume released, surface area of spreading and the environmental conditions involved (ITOPF 2002). Small spills in open water are rapidly diluted with the result that fish kills in this type of environment have never been reported; however, fish kills have been reported for small spills in confined, shallow water (NOAA 2016). Fish species in shallower and nearshore areas are more susceptible to toxic effects than fish in deeper offshore areas (Schreiber and Burger 2002). An accidental fuel spill occurring in the nearshore environment or in shallow or confined waters such as the channel of Chesterfield Inlet could result in high mortality of adult fish, fish eggs, and larvae (Boertman and Mosbech 2011). An offshore spill may have less extensive adverse effects on marine fish due to higher dispersion rates in this environment. Local fisheries may be impacted by nearshore spills through temporary closures of affected fisheries due to concerns of toxic fish (Yender et al. 2002) and potentially damaging the reputation of the fisheries within the affected area (Schreiber and Burger 2002).

3.A-8.2.2 Residual Effect Classification

The potential adverse residual impacts of the Project on marine fish include loss or alteration of fish habitat due to an accidental spill, as well as potential mortality or health risk due to exposure to an accidental fuel spill. Table 3-A-11 summarizes the rating classifications for all residual Project impacts on marine fish.

A minor diesel spill is likely to result in temporary localized exceedances of water quality guidelines for the protection of aquatic life (CCME 2014), and therefore there exists the potential for acute or chronic effects on fish within the immediate area of the spill, but not at levels beyond natural variability. A major diesel spill would result in measurable effects in excess of water quality standards (CCME 2014) and potential for mortality of adult fish, eggs and larvae at levels beyond natural variability, thus representing a potential change of state from baseline conditions. Under both spill scenarios, the effect is considered fully reversible, due to the rapid rate of dispersion and evaporation of diesel fuel in the marine environment, as well as the natural degradation of landed diesel by microbes and normal wave / tidal action. Further, any resulting acute effects on fish are predicted to be reversible through natural recruitment, meaning the number of new fish that will enter the population over time will offset the number of fish mortalities or injuries potentially resulting from a spill. Changes at the population level are not anticipated. Given the estimated spill rate for both spill types, and taking into consideration that no marine spills have occurred on the Meadowbank Mine since the start of the mine (Section 3.A-8.1.1), the likelihood of an accidental spill (major or minor) in the marine environment is considered low (unlikely) provided prescribed industry-standard prevention and response measures are in place.

3.A-8.3 Marine Mammals

3.A-8.3.1 Effects Analysis

Potential environmental effects of the Project on marine mammals include the following:

- mortality and health risk due to accidental fuel spills;
- loss / degradation of habitat due to altered water quality from potential accidental fuel spills;
- mortality and injury risk due to collisions with vessels; and
- change in behaviour due to underwater noise from Project vessels.

3.A-8.3.1.1 Accidental Fuel Spills

A number of known sensitive habitat areas for marine mammals overlap or are adjacent to the shipping route and could potentially be affected in the event of an accidental major fuel spill along the shipping corridor (Figure 3-A-6 to Figure 3-A-16). Modelling conducted for Meliadine FEIS (Agnico Eagle 2014b) identified a zone extending 26-km on either side of the shipping route as a 'hypothetical spill limit' - or the maximum spatial extent that a diesel fuel slick could potentially reach. The most likely travel direction of the plume identified was southeast due to the northwest wind direction that is prevalent during summer.

A hypothetical diesel spill occurring along the western portion of the Project shipping route was shown to more likely affect sensitive marine mammal habitats than a spill in the eastern portion of the Project shipping route. The coastal waters near Southampton Island and the north end of Coats Island are identified as bowhead whale and beluga summer concentration areas. These areas also support important haul-out areas for walrus year-round. Core summer habitat areas for narwhal are also present near Southhampton Island and near Repulse Bay (Figure 3-A-11). Killer whales commonly frequent waters offshore of Chesterfield and Rankin Inlets during summer (Figure 3-A-15). Modeling conducted for Meliadine FEIS (Agnico Eagle 2014b) indicated that the slick from a diesel fuel spill could extend as far south as the north end of Coats Island (located ~ 37 km south off the shipping route) under 50-year wind conditions, but not under average wind conditions. Southhampton Island and Repulse Bay were shown to be outside of the modelled spill limit under all wind condition scenarios, and opposite of the expected plume trajectory given prevalent wind direction during summer.

Marine mammals reported in the channel of Chesterfield Inlet during summer include beluga whale, walrus, seals and polar bear, with many of these species harvested by local communities (Agnico Eagle 2008, 2009; AREVA 2014). Using worst case assumptions, these species would therefore be at highest risk from a potential fuel spill in this area during the open-water shipping season.

Important marine mammal areas (e.g. beluga whale core summer estuarine habitats) are also located along the southwestern coast of Hudson Bay, southeastern coast of Hudson Bay, Frobisher Bay, and Ungava Bay. These coastal areas would not likely be impacted by a spill event given their location relative to the modelled hypothetical spill limits, assuming that fuel transport for the Project would not include transits between Churchill and the mouth of Chesterfield Inlet.

Potential effects of hydrocarbon exposure to marine mammals include the following:

- direct contact of oil / fuel with eyes may cause eye irritation / inflammation;

- direct contact of oil / fuel with skin or coat may reduce thermoregulation abilities; cause skin irritation / inflammation;
- inhalation of hydrocarbon vapours could result in inflammation of mucous membranes, pneumonia, and neurological damage;
- ingestion of oil or oil contaminated prey may result in toxicological effects, gastrointestinal inflammation, ulcers, bleeding, diarrhea, or maldigestion;
- oil in the water could foul the baleen of baleen whales, leading to reduced filtering / feeding efficiency;
- oil / fuel in the water could cause marine mammals to avoid the area, thus potentially resulting in temporary displacement from some feeding or migratory areas (temporary habitat loss /degradation); and
- reduced prey availability through prey displacement.

Whales are generally not considered to be at a great risk for adverse thermoregulation effects as a result of oiling of the skin as they rely on blubber for insulation (Geraci 1990). However, hydrocarbons can foul the coat of seals or fur of polar bears, thus reducing its natural insulation properties. Heavy oil may also coat the baleen of baleen whales, such as the bowhead whale, impacting their feeding ability and efficiency (Geraci and St Aubin 1988). Polar bears may also ingest hydrocarbons as a result of grooming themselves (Stirling 1990; Neff 1990). Hydrocarbons can also cause severe irritation to the eyes and other mucous membranes, which may reduce hunting and foraging abilities in these species (Short 2003; Geraci and St. Aubin 1988).

Inhalation of light hydrocarbon compounds above certain levels may cause toxic effects in all marine mammals, such as central nervous system disorders, brain degeneration, liver damage, and reproductive failure (Engelhardt 1983; Geraci and St. Aubin 1980 in Short 2003; Geraci 1990, Geraci and St Aubin 1988; Matkin et al. 2008). However, light compounds generally dissipate during the first few days of a spill. Due to the content of the diesel fuel to be shipped, the majority of the components would likely dissipate within several days of the spill event.

Individual marine mammals occurring in open-water areas directly overlapping with the plume would be at risk of direct exposure to diesel fuel (e.g., oiling effects) for a relatively short period. The Meliadine FEIS oil spill modeling provides a maximum conservative period of up to 48 h after which 99% of spilled fuel would have dissipated (Agnico Eagle 2014b). However, indirect effect on marine mammals (e.g., reduced health due to ingestion of oiled prey) may last for an undetermined period thereafter.

3.A-8.3.1.2 Collision with Vessels

There is a potential for accidental collisions of Project-related ships with marine mammals. Most marine mammals are fast and manoeuvrable in the water, and have sensitive underwater hearing, enabling them to avoid approaching vessels. Odontocetes (toothed whales, e.g., beluga whale) and pinnipeds (seals and walrus) are known to be highly manoeuvrable and are rarely struck by vessels (Laist et al. 2001; Jensen and Silber 2003). There are very few documented cases of seal mortality as a result of a vessel strike (Richardson et al. 1995a). Of all records, mysticetes (baleen whales, e.g., bowhead whale) are the most commonly struck by transiting vessels (Laist et al. 2001; Jensen and Silber 2003). Baleen whales are relatively large and slow-moving and perhaps unable to exhibit a rapid avoidance response to approaching vessels.

A vessel strike on a marine mammal may result in either injury or direct mortality. Injuries are typically the result of two mechanisms: either blunt force trauma from impact with the vessel or from lacerations from contact with the propellers. Depending on the severity of the strike and the injuries inflicted, the mammal may or may not recover. Most strikes occur between slow moving whales, when ships are 80 m and longer and are travelling at 14 knots or faster (Laist et al. 2001). Recent research shows that vessel speed is positively correlated with the probability of a vessel strike (Kite-Powell et al. 2007; Vanderlaan and Taggart 2007). Serious or lethal strikes to whales are infrequent at vessel speeds of less than 14 knots, and are rare at speeds of less than 10 knots (Laist et al. 2001).

Marine mammals that spend a considerable amount of time at or near the surface are at increased risk of vessel strikes. They are physically in the way of approaching vessels and research has shown that sound levels are lower near the surface, potentially explaining why baleen whales are often unresponsive to approaching vessels (Richardson et al. 1995b). Acoustic modeling around the hull of a ship further shows that underwater sound levels may be lowest directly off the bow ahead of an oncoming vessel, compared to the sides and behind stern (Terhune and Verboom 1999). Baleen whales, therefore, are more likely susceptible to potential ship strikes when occurring in the direct path of a vessel than other whales.

3.A-8.3.1.3 Disturbance by Underwater Vessel Noise

Marine mammals rely on underwater sound as a primary method of communication, navigation, and prey detection. Therefore, underwater anthropogenic noise is considered an important stressor for marine mammals because of their reliance on underwater hearing (Richardson et al. 1995a; Ketten 1998). Effects of underwater sound on marine mammals are generally measured through observations of behavioral responses to sounds used as a surrogate measure for sensitivity or susceptibility (McCauley 1994, Richardson et al. 1995a). Potential effects range from subtle changes in behaviour at low received levels to strong disturbance effects or temporary/permanent hearing impairment (injury) at high received levels.

Effect of the underwater noise on marine mammals depends on the sound pressure level received and the effect threshold or sensitivity of the animal to the sound. Marine mammal sensitivity to sound levels depends on their physiological characteristics and varies from one group to another. Marine mammals are acoustically diverse, with wide variations in ear anatomy, frequency and hearing range and amplitude sensitivity (Ketten 1998).

Vessels in transit generate underwater noise resulting from a combination of the ship's machinery, propellers, and water flow around the hull. Most noise originates from propeller cavitation, or the formation of bubbles from the rotation of the blades (Mitson 1995). The ship noise depends on the ship characteristics and, in general, increases with ship size, power, load and speed (Mitson 1995; Nowacek et al. 2007; JASCO 2010; McKenna et al. 2012). Literature sources available suggest that the ships of the sizes used for the Project, travelling at the speed of 14 knots and less will generate sound levels below the marine mammal injury threshold levels (180 decibels (dB) for cetaceans and 190 dB for pinnipeds (NOAA 2014)). The highest sound level produced by a chemical tanker (26,200 gross tonnage) traveling at a speed of 13.1 knots, available from literature, is 177 dB re 1 µPa@1m (0.02-1 kHz)(McKenna et al 2012). Therefore it is unlikely that the Project ships will generate noise-related injuries in marine mammals.

The behavioural disturbance acoustic threshold for all marine mammals is 120 dB re 1 µPa@1m for non-pulsed (continuous) noise sources such as shipping noise (NOAA 2014). The sound levels produced by the Project ships at the source (1 m) are above this threshold. Noise attenuation modeling studies and field measurements conducted for similar or larger ships than used for the Project in open-ocean background conditions demonstrated that noise levels can exceed the behavioral acoustic threshold for marine mammals at distances up to 5 km from the source (JASCO 2006; JASCO 2011; McKenna et al. 2012; AREVA 2014).

The rate of exposure of a marine mammal to ship's noise is impossible to predict because marine mammals may travel at various speed and directions. However, a stationary individual marine mammal in the way of a Project ship travelling at 14 knots will be exposed to the sound level above the behavioral threshold (120 dB) for a maximum of 23 minutes (while the ship travels for 10 km), assuming the animal remains stationary. It is highly unlikely that the same animal will be exposed to underwater noise generated by two or more ships traveling days apart due to high mobility of marine mammals. In addition, the sound levels emitted forward of the ship are typically much lower than those emitted in the stern direction (McKenna et al. 2012).

3.A-8.3.2 Residual Effect Classification

The potential adverse residual impacts of the Project on marine mammals include loss or alteration of habitat due to an accidental spill, potential mortality or health risk due to an accidental spill, potential mortality / injury due to vessel collisions, and potential changes in behavior due to underwater noise from vessel operations. Table 3-A-11 summarizes the rating classifications for all residual Project impacts on marine mammals.

A minor diesel spill along the proposed shipping corridor is not likely to result in measurable effects on marine mammals in the Project area, although a major spill could result in a number of adverse impacts on marine mammals including habitat degradation, decreased prey availability, decreased health, or death. Potential species most at risk are bowhead whales (SARA-listed species), beluga, narwhal and killer whale, as the proposed shipping route overlaps with important summer habitat (e.g. foraging and migratory areas) for each of these species. Other marine mammal species potentially affected include walrus, seals (5 species) and polar bear.

Given the estimated spill rate for both spill types, and taking into consideration that no marine spills have occurred on the Meadowbank Mine since the start of the mine (Section 3.A-8.1.1), the likelihood of an accidental spill (major or minor) in the marine environment is considered low (unlikely) as prescribed industry-standard prevention and response measures are in place.

Whenever a vessel is in transit through known marine mammal habitat, the potential exists for a marine mammal/vessel interaction. Project shipping will occur throughout the life of the Project, so the potential for a marine mammal vessel strike will persist over this same period. Baleen whales such as bowhead whales would be most susceptible to this impact, due to their large size, slower travel and maneuvering speeds, lower avoidance capability, and use of summer foraging areas and migratory corridors that overlap with the shipping route. The shipping route also overlaps with summer habitat for killer whale, beluga whale, and narwhal; however, core summer concentration areas for beluga whale and narwhal are located outside the LSA and RSA, thereby further limiting the potential for vessel strikes with these populations.

To date, no vessel strikes on marine mammals have been recorded since the start of the Meadowbank Mine. The proposed frequency of shipping for the extension of the Meadowbank Mine through development of the Whale Tail Pit will remain the same as that for Meadowbank (no net increase in shipping activity). To further minimize the potential for a vessel strike, Agnico Eagle has developed a Shipping Management Plan (Volume 8, Appendix 8-D.5) that includes specific mitigation measures for interactions with marine wildlife, including vessel speed restrictions (<14 knots), and minimum approach distances from any observed marine mammals. Given application of the proposed mitigation, the likelihood of a vessel strike is considered low. In the rare event that a marine mammal strike were to occur, the consequence would likely be a non-lethal injury (laceration from propeller and/or blunt force injury) than direct mortality. The low vessel speeds that prevail during operations will greatly reduce the likelihood of ship strikes on marine mammals by providing ample time for animals to avoid oncoming vessels, as well as time for crew on Project vessels to detect and avoid marine mammals during active vessel operations.

The total cumulative increase in shipping in the region as a result of the Whale Tail Project in combination with Meliadine, Kiggavik, and other reasonably foreseeable future development (RFFD) Projects is estimated at 79% to 85% during operations (Agnico Eagle 2014b), thus increasing the potential for a vessel-mammal interaction. As such, the potential cumulative effect of ship strikes on marine mammals is considered moderate in magnitude and regional to beyond regional in geographic scale. Effects may be measurable in other parts of the home range of all marine mammal species, if outside of Nunavut. The effects of any injuries or fatalities on marine mammal populations are expected to be reversible through natural recruitment, meaning the number of new young marine mammals that will enter the populations over time will offset the number of marine mammal mortalities or injuries resulting from potential vessel strikes. With proposed mitigation in place (e.g., reduced speeds, minimum safety distances), the probability of a fatality or injury from a vessel strike is considered low although possible. In the event that one or several animals were lost over the lifetime of the Project, the long-term viability of marine mammal populations in the RSA are unlikely to be affected.

Underwater noise generated by Project vessels during shipping will likely exceed the acoustic threshold for eliciting changes in marine mammal behaviour, albeit these changes are difficult to predict. Behavioral changes may include evasive maneuvers such as diving or changes in swimming direction and/or speed. The period of exposure to shipping noise above the disturbance threshold will vary depending on the speed and direction of travel of both the animal and the ship. The maximum propagation distance for ship noise above the disturbance threshold is predicted to be less than 5 km. Based on available literature, marine mammals will either habituate to vessel sounds and remain in area, or leave temporality and return once the noise has subsided. Changes in behavior, therefore, are considered to be temporary and reversible with no effects at the population level anticipated.

3.A-8.4 Marine Birds

3.A-8.4.1 Effects Analysis

Potential environmental effects of the Project on marine birds include the following:

- potential mortality and health risk due to accidental fuel spills;
- loss / degradation of habitat due to altered water quality from accidental fuel spills;
- potential mortality and injury risk from collision with vessels due to sensory disturbance from ship lighting; and
- change in behaviour due to sensory disturbance from in-air noise and ship lighting.

3.A-8.4.1.1 Accidental Spills

Marine birds are particularly sensitive to hydrocarbons and may be indirectly or directly affected by an accidental fuel spill through coating of their plumage, ingestion of polluted food sources and/or loss of food sources (Robertson et al. 2012). Some species of marine birds in the RSA (e.g., murres, alcids, eiders) are relatively weak flyers, dive for their prey, and have flightless feather-moulting stages, making them particularly susceptible to spills (Lock et al. 1994; Piatt et al. 1985, Dickins et al. 1987). In addition, thick-billed murres (alcid family) may be particularly susceptible to spills during their flightless swimming migration in August when molting adult birds and fledglings depart from colonies in the Hudson Bay on a swimming migration through Hudson Strait to offshore areas of Newfoundland and Labrador (Mallory and Fontaine 2004).

Depending on the magnitude of the spill, effects can occur at the individual, population or ecosystem level (Mazet et al. 2002). Hydrocarbon spills affect marine birds through a number of pathways. Direct exposure can result in eye and skin irritation, burns, and coating of plumage by hydrocarbons resulting in a loss of insulating and buoyancy properties. The resulting reduced ability to swim, fly and feed, can lead to a reduced ability to meet metabolic needs, potentially leading to death by hypothermia, starvation or drowning (Mazet et al. 2002, Albers 2003, Islam and Tanaka 2004; O'Hara and Morandin 2010). Hydrocarbon ingestion is known to cause a range of lethal, sub-lethal, and chronic effects in marine birds, including effects on behaviour, blood, liver, and kidney disorders, impaired immunity, salt gland function and reproduction and reduced egg hatching success (Mazet et al. 2002, Albers 2003, Islam and Tanaka 2004; O'Hara and Morandin 2010). Marine birds may also be indirectly affected by changes in water quality or food availability. Contamination or loss of food sources may occur by causing direct mortality of fish and other lower trophic organisms on which birds feed themselves and their young feed. The magnitude of the effect of diesel on marine birds is comparatively lower than of other heavier types of fuel because of the shorter residency time of diesel on the water surface, and the lower viscosity and potential for heavy coating of individuals. Reports of small diesel spills in Alaskan waters indicate that that relatively few birds are directly affected by diesel spills (NOAA 2016). If a major diesel fuel spill were to occur in the marine environment, there would potentially be a localized increase in mortality, and a temporary loss in habitat (foraging grounds or staging areas) immediately following the spill event. Potential loss or degradation of marine bird habitat is an indirect effect from reduced water quality and contamination of forage fish prey species.

The Hudson Bay ecosystem is an environmentally sensitive area for marine birds, particularly during the summer, as it provides important habitat for breeding, feeding, and molting activities for colonies of birds. These birds and their habitats are particularly vulnerable to hydrocarbon spills (Schreiber and Burger 2002). A number of key marine habitat sites for migratory birds have been identified along the shipping route (Figure 3-A-17). The majority are located more than 50 km from the proposed shipping route. Four of these sites are located in closer proximity or overlap with the shipping route: Coats Island, Digges Sound, Frobisher Bay, and Button Islands. These marine areas delineate key feeding areas for marine birds; however, marine birds may forage beyond these areas (Mallory and Fontaine 2004). Marine birds nesting at these sites are particularly sensitive to pollution of their feeding areas (Mallory and Fontaine 2004). Depending on the spatial extent of an offshore spill, key marine habitat sites including offshore feeding areas as well as land-based breeding and moulting habitats could be temporarily or permanently disrupted. Nesting areas of marine birds are generally located in areas where they would not be directly impacted by a spill event if it reached shore. Nesting and chick survival may also be disrupted should parents become oiled while out at sea (Eppley and Rubega 1990).

The coastal areas and islands of Chesterfield Inlet contain important habitat for a number of marine bird species. The entire length of Chesterfield Inlet contains nesting habitat for thousands of oldsquaw (AREVA 2014). The eastern end (mouth) of Chesterfield Inlet and the surrounding islands contain nesting and breeding habitat for common eiders; the southern coast in particular has been identified as an important bird rearing area (CCI 1992). The area near Primrose Island and Barbour Bay contains large numbers of marine birds during certain times of the year including, but not limited to, Arctic terns, whistling swans, and various species of loon. Canadian geese and snow geese are also known to use the channel of Chesterfield Inlet during their migration. Several species of marine birds were sighted in waters and coastal areas of Chesterfield Inlet and Baker Lake during summer navigation months by marine wildlife observers onboard Meadowbank Mine supply vessels. This included gulls, snow geese, Arctic terns, ducks, and swans (Agnico Eagle 2008; 2009; 2012 and 2013). These birds and their habitats have the potential to be adversely affected in the event of a fuel spill in the channel of Chesterfield Inlet.

3.A-8.4.1.2 Light Disturbance

Ship lighting in low visibility conditions may represent a risk for marine birds. Under conditions of poor visibility such as low cloud cover or fog, nocturnal migrating birds have difficulty navigating; they may lose celestial navigation aids and become attracted or confused by artificial lights possibly resulting in collisions with structures and/or exhaustion (Montevecchi et al. 1999). Birds are also known to become disoriented by lights, particularly during overcast or foggy conditions, and fly continuously around them consuming energy and delaying foraging or migration (Avery et al. 1978; Bourne 1979; Sage 1979; Wood 1999). Factors, such as magnitude of bird movement and weather, may enhance bird injury and mortality from collision with artificial structures (Crawford 1981). Moisture droplets in the air during conditions of drizzle and fog refract the light and greatly increase the illuminated area thus enhancing the attraction (Montevecchi et al. 1999). Injury or mortality may also be higher during migration periods, when large numbers of birds may be forced down to a lower flight path or to the ground by inclement weather. Some nocturnal predators of marine birds are more successful when hunting in illuminated areas, potentially increasing the risk of bird predation in areas with anthropogenic lighting (Crawford 1981).

Vessel lighting at night may also attract migrating birds to the lightering area. Birds may also become disoriented by bright lighting, particularly during overcast or foggy conditions, and fly continuously around ships consuming energy and delaying foraging or migration (Avery et al. 1978; Bourne 1979; Sage 1979; Wood 1999).

However, the lightering area is located approximately 1 km away from the nearest shore (Helicopter Island) and no large concentrations of birds were observed in this area by Inuit marine wildlife observers onboard Meadowbank Mine supply vessels (Agnico Eagle 2008; 2009; 2012 and 2013). Therefore, it is predicted that a relatively low number of marine birds may potentially be displaced from feeding areas due to in-air vessel noise. Also, the operations take place during the Arctic summer when periods of low to no light are relatively brief.

3.A-8.4.1.3 In-Air Noise Disturbance

In-air noise generated by cargo and fuel transfer activities during ship lightering may result in sensory disturbance to marine birds, including avoidance and displacement behavior. This could potentially include disruptions of migration, and consequently their availability for harvest.

3.A-8.4.2 Residual Effects Classification

The potential adverse residual impacts of the Project on marine birds include loss or alteration of habitat due to an accidental spill, potential mortality or health risk due to an accidental spill, potential mortality or injury due to collisions with ships due to sensory disturbance from ship lighting, and behavioural changes due to sensory disturbance (in-air noise and lighting). Table 3-A-11 summarizes the impact rating classifications of Project impacts on marine birds.

The potential residual effects from a diesel spill on marine birds depends on a number of situational and environmental factors. Given the relatively small scale of a minor spill and preparedness for its containment, the magnitude of its effect on marine birds is predicted to be low, short-term in duration and local in geographic extent for both incremental and cumulative scenarios. The magnitude of a major spill on marine birds is considered high for both incremental and cumulative scenarios, since the spill could potentially result in the death of a SARA listed species and would be likely to impact key marine bird habitat areas with large aggregations of migratory birds, many of which have a reduced ability to actively avoid the affected area due to sensitive moulting stages (particularly the thick-billed murre). Also, a major spill has the potential to result in population-level effects beyond the rate of natural variability, and may result in mortalities of SARA-listed species, such as Ross's gull and the

Ivory gull. The effect of a major spill on marine birds is considered medium-term in duration, and beyond regional (incremental and cumulative) in geographic extent, due to extensive home ranges of most birds species in the RSA. For both major and minor spills, the frequency of the effect is considered isolated in occurrence, and effects are reversible through natural processes. Given the estimated spill rate for both spill types, and taking into consideration that no marine spills have occurred on the Meadowbank Mine since the start of the mine (Section 3.A-8.1.1), the likelihood of an accidental spill (major or minor) in the marine environment is considered low (unlikely) provided prescribed industry-standard prevention and response measures are in place.

The potential for injury or mortality of marine birds by means of striking the ship as a result of sensory disturbance due to vessel lighting is considered to be low in magnitude, medium-term (over the life of the Project), and isolated in frequency for both incremental and cumulative scenarios. The effects of any injuries or fatalities on a marine bird population as a whole are expected to be reversible through natural recruitment. With proposed mitigation in place (e.g., shielded lights), the probability of a fatality or injury from a collision with vessels due to lighting is considered unlikely.

The potential for behavioral changes (sensory disturbance) in marine birds due to in-air noise from lightering activities (e.g., vessel operations and spud barge installation) is considered low for the incremental effect, since the lightering operations area is located away from important birds' nesting and breeding areas and no considerable aggregations of birds in this area have been observed (Agnico Eagle 2008, 2009, 2012, 2013), and moderate for cumulative effect. Limiting operations to day-light hours and reducing illumination during non-operation hours will also limit a potential effect from lighting.

3.A-9 CUMULATIVE EFFECTS

Cumulative effects were considered in all pathways based on the summary of past, present and RFFDs (Appendix 3-D). The main sources of cumulative effects are shipping operations for residential and mineral and oil and gas exploration supplies, commercial shipping, shipping for commercial, recreational and subsistence fisheries and wildlife harvest, research vessels, governmental activities and tourism. Figure 3-A-1 provides an outline of shipping lanes used in past, present and RFFDs in the marine study area.

Considering the RFFDs, all of the eight possible future projects considered in Appendix 3-D will definitely or likely use shipping lanes through the study area at some extent and, thus, have valid assessment pathways. Therefore, all of these projects were considered in the cumulative effect assessment. Table 3-A-11 provides a summary of cumulative effects.

3.A-10 ASSESSMENT OF SIGNIFICANCE

Significance ratings are presented in Table 3-A-11 along with residual impact classifications. Project effects of low to high magnitude are anticipated, extending to 'beyond regional' in scale when considering the effects of a major fuel spill. The effects will be short-term to medium term in duration. High magnitude impacts were predicted to be isolated in frequency and unlikely to occur. Conversely, the majority of low magnitude Project pathways were predicted to be likely to highly likely to occur.

Overall, the weight of evidence indicates that the identified Project-environment pathways for marine VCs are predicted to not result in significant impacts on marine fisheries productivity, or the structure and function of self-sustaining and ecologically effective marine wildlife populations relative to natural factors occurring over the same period of time and space. The scale of combined impacts from the Project pathways, independently or cumulatively with other RFFDs, will not be large enough to result in irreversible changes at the population level.

By extension, the Project should not have a significant adverse impact on the continued opportunity for traditional and non-traditional use of marine resources in the region.

3.A-11 UNCERTAINTY

Potential uncertainties in the present assessment are related to the following elements:

- adequacy of baseline data, in particular, for understanding current conditions and future changes unrelated to the Project (e.g., extent of future developments, climate change, catastrophic events);
- limited available data in the region that would provide better understanding of potential impacts;
- understanding/forecasting of future developments in the area, both human-related (e.g., mining, energy development, market conditions, climate change and etc.) and natural (climate change, sea level rise and etc.);
- understanding of Project-related impacts on complex ecosystems that contain interactions across different scales of time and space (e.g., how the Project will impact migratory marine birds and mammals); and
- knowledge of the effectiveness of the environmental design features and mitigation for reducing or removing impacts (e.g., vessel speed restrictions).

Uncertainty has been addressed by applying a conservative estimate of effects in the residual impact classification and in the determination of significance. Like all scientific results and inferences, residual impact predictions must be tempered with uncertainty associated with the data and the current knowledge of the system. It is anticipated that the baseline data is moderately sufficient for understanding existing conditions, and that there is a moderate level of understanding of Project-related impacts on the ecosystem. Some uncertainties may be addressed through monitoring and follow-up activities.

3.A-12 MONITORING AND FOLLOW UP

Agnico Eagle will require all contracted shipping companies to provide full-time marine mammal and seabird monitoring during shipping operations using trained observers and established data collection and recording protocols. Monitoring plans will include provisions for all marine mammal and seabird species listed under the SARA and for the COSEWIC. Any incidents of bird mortalities associated with lighting infrastructure, construction activities, and Project vessel operations will be recorded and reported to Environment Canada (Canadian Wildlife Services). Additional monitoring and follow-up will be conducted in the channel of Chesterfield inlet by Inuit marine wildlife monitors onboard the Project vessels. Any incidents of vessel strikes with marine mammals will be recorded and reported to Fisheries and Oceans Canada.

In the unlikely event of a major spill, follow-up monitoring on marine mammals and their habitats, seabirds and their habitats and fish species and their habitats would be proposed. The scope of such follow-up monitoring would be decided at the time of the event and determined in consultation with Fisheries and Oceans Canada at the time of the event.

3.A-13 MITIGATION MEASURES

Following is a summary of mitigation measures proposed to minimize, eliminate and/or offset adverse effects from the Project on marine resources in the Project area:

- Agnico Eagle has developed and implemented a Shipping Management Plan (Volume 8, Appendix 8-D.5) outlining management practices and procedures for all Project shipping and lightering activities with respect to marine navigational safety, accidents and collisions, spill prevention and response, pollution prevention measures, ballast water management, waste management, marine wildlife management, radio equipment and communications, and occupational health and safety. This plan has been developed in accordance with federal legislation, notably the Canada Shipping Act and the Arctic Waters Pollution Prevention Act, as well as all other applicable national and international safety regulations, such as requirements established by the International Maritime Organization, the International Convention for the Safety of Life at Sea (SOLAS 1974), and Guidelines for Ships Operating in Polar Waters (IMO 2010).
- The Project's Shipping Management Plan, in accordance with Spill Contingency Plan and Emergency Response Plan, will address a range of spill prevention and control measures including engineering design, personnel training and competence, documented procedures, inspection and maintenance, record keeping and adequate resource allocation.
- Each ship will have onboard emergency notification and response equipment, including alarm systems, fire-fighting equipment, and spill response kits. All vessels will have a Shipboard Oil Pollution Emergency Plan (SOPEP) or Shipboard Marine Pollution Emergency Plan in accordance with MARPOL 73/78, Annex I, IMO Res. MEPC. 78(43). Each ship has an Emergency Response Team consisting of competent and trained personnel responsible to deal with emergency situations including fire, explosions, and oil spills.
- The Shipping Management Plan will include marine routes hazard identification and risk analysis addressing navigation safety in the Arctic waters particularly in the channel of Chesterfield Inlet and Chesterfield Narrows.
- The Shipping Management Plan will include mitigation measures to eliminate or reduce potential adverse effects of Project shipping on marine wildlife including, but not limited to, provision of full-time marine mammal and seabird monitoring onboard Project vessels, speed restrictions (<14 knots), safe approach distances from marine mammals, wildlife sightings record-keeping, ship lighting modifications, adherence to ballast water regulations.
- The proposed shipping route has been selected to avoid the majority of the key marine habitat areas for migratory birds, migratory bird sanctuaries, and known important bird areas to the extent possible, as safe navigation allows.

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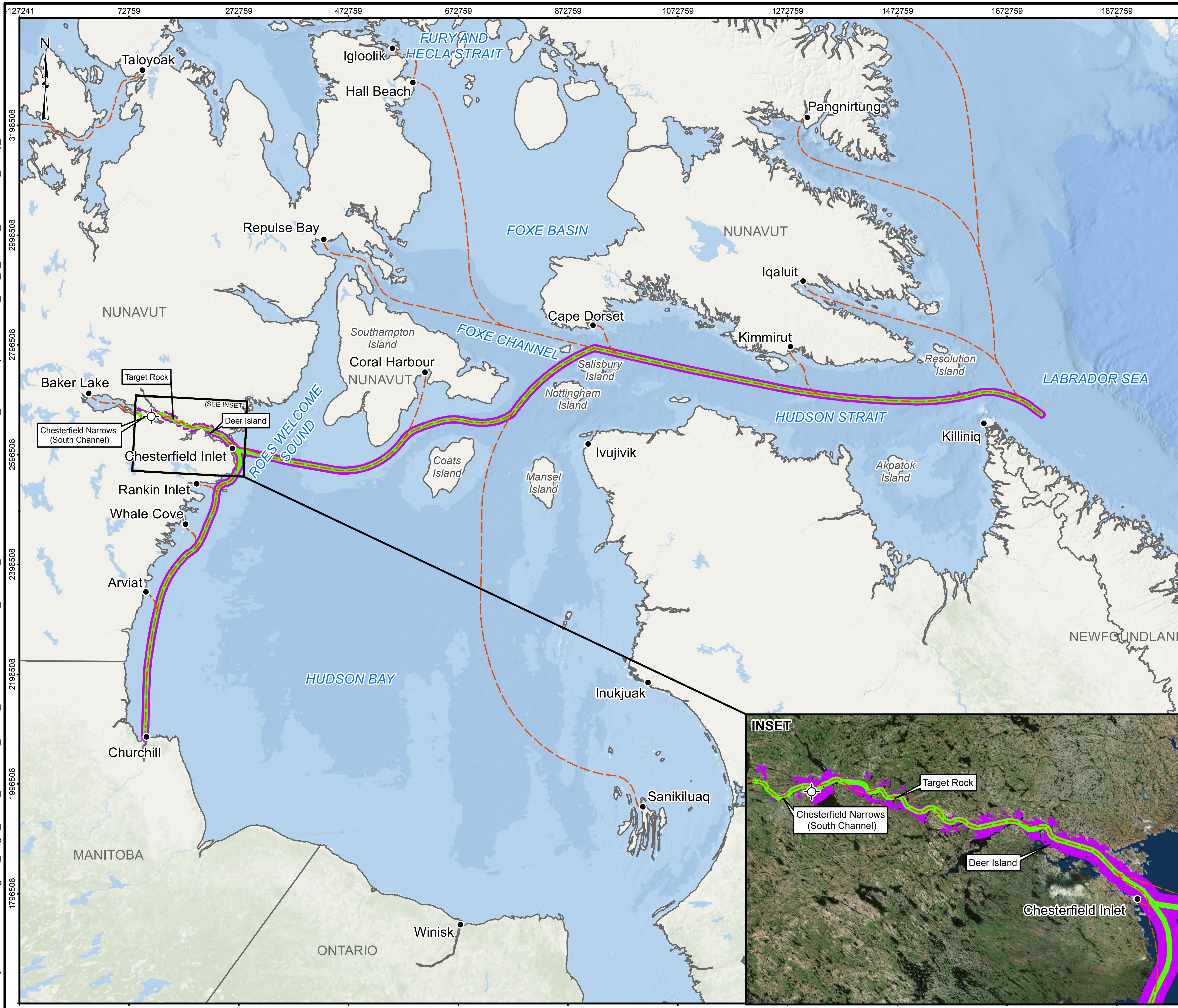
ATTACHMENT 3-A.1

Figures



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LEGEND

- ● POPULATED AREA
- LIGHTERING POINT (HELICOPTER ISLAND)
- MAJOR ARCTIC NAVIGATION ROUTES
- LOCAL STUDY AREA (LSA)
- REGIONAL STUDY AREA (RSA)
- PROVINCE / TERRITORY BOUNDARY

REFERENCE

1. BASE DATA ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS
2. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. PROVINCE AND POPULATED AREA DATA OBTAINED FROM ESRI.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

150 0 150
KILOMETRES

PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE
MARINE RESOURCES STUDY AREA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	KA	15 OCT. 2015	SCALE AS SHOWN	REV. 0
GIS	MH	11 MAY 2016		
CHECK	AO	06 Jun. 2016	FIGURE 3.A.1	
REVIEW	PR	06 Jun. 2016		

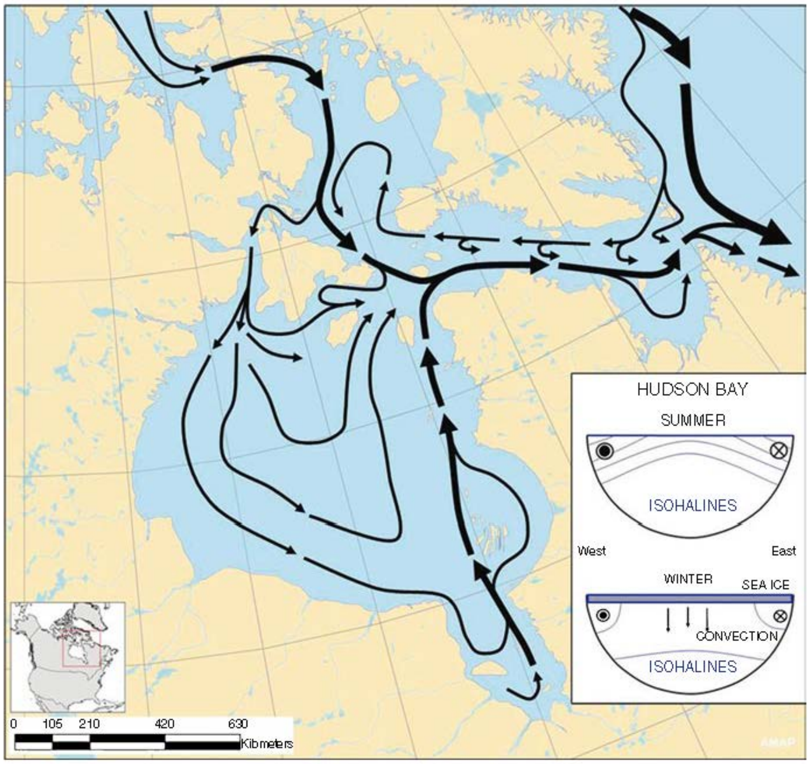


Figure 3-A-2: Summer Circulation of Water in the Hudson Bay Complex. (Extracted from Stewart and Barber (2010); inset after Ingram and Prinsenberg (1998))

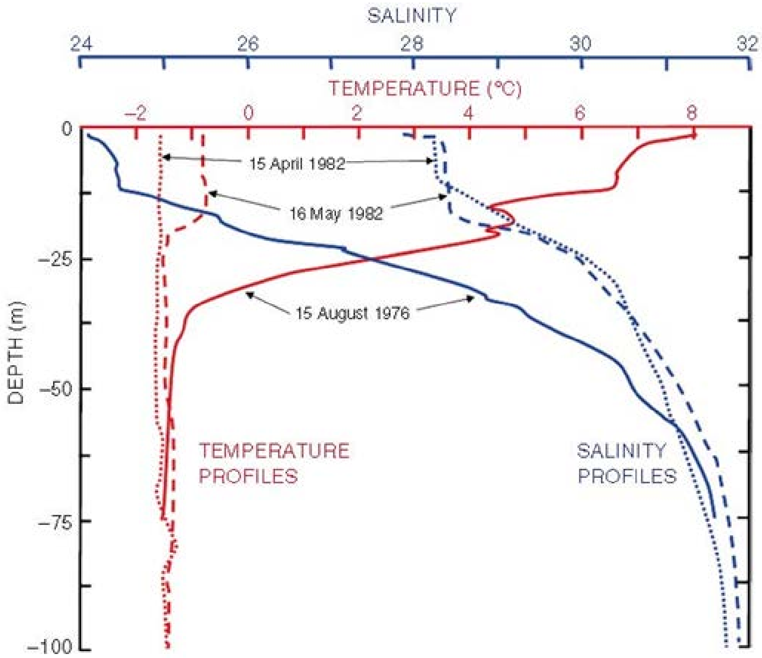
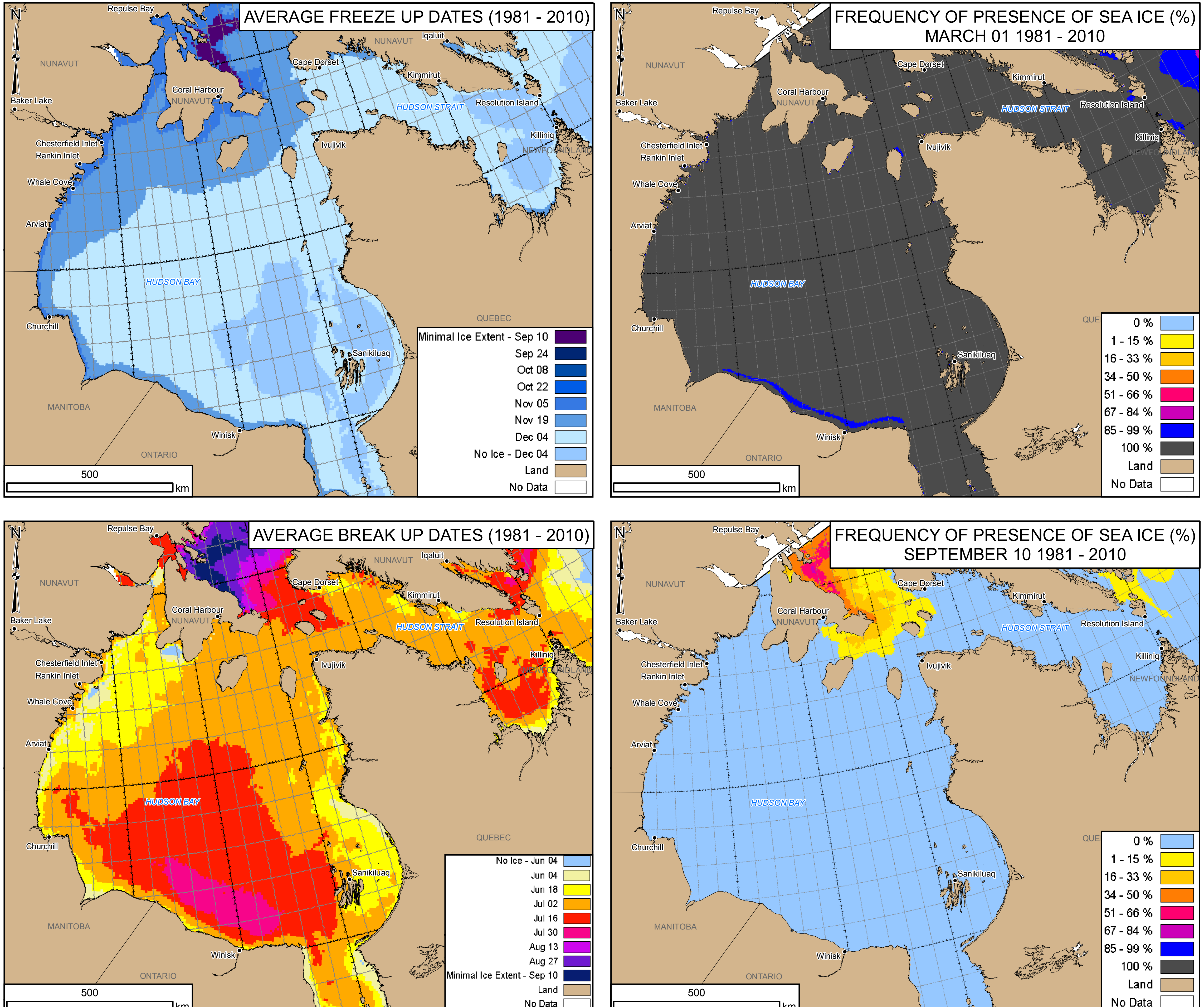


Figure 3-A-3: Representative Vertical Profiles of Temperature and Salinity in Southeastern Hudson Bay in April (dashed line), May (dashed-dotted line), and August (solid line). (Extracted from Ingram and Prinsenberg (1998))



LEGEND

- ● POPULATED AREA
- PROVINCE / TERRITORY BOUNDARY

REFERENCE

1. SEA ICE DATA OBTAINED FROM THE GOVERNMENT OF CANADA 30 YEAR SEA ICE ATLAS.
2. PROVINCE AND POPULATED AREA DATA OBTAINED FROM ESRI.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

ICE FREEZE UP AND BREAK UP, AND FREQUENCY OF SEA ICE IN LATE WINTER AND SUMMER, IN HUDSON BAY AND HUDSON STRAIT BASED ON 30 YEARS OF ICE DATA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	KA	15 OCT. 2015	SCALE AS SHOWN	REV. 0
GIS	CD	21 OCT. 2015		
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.4**	
REVIEW	PR	06 Jun. 2016		

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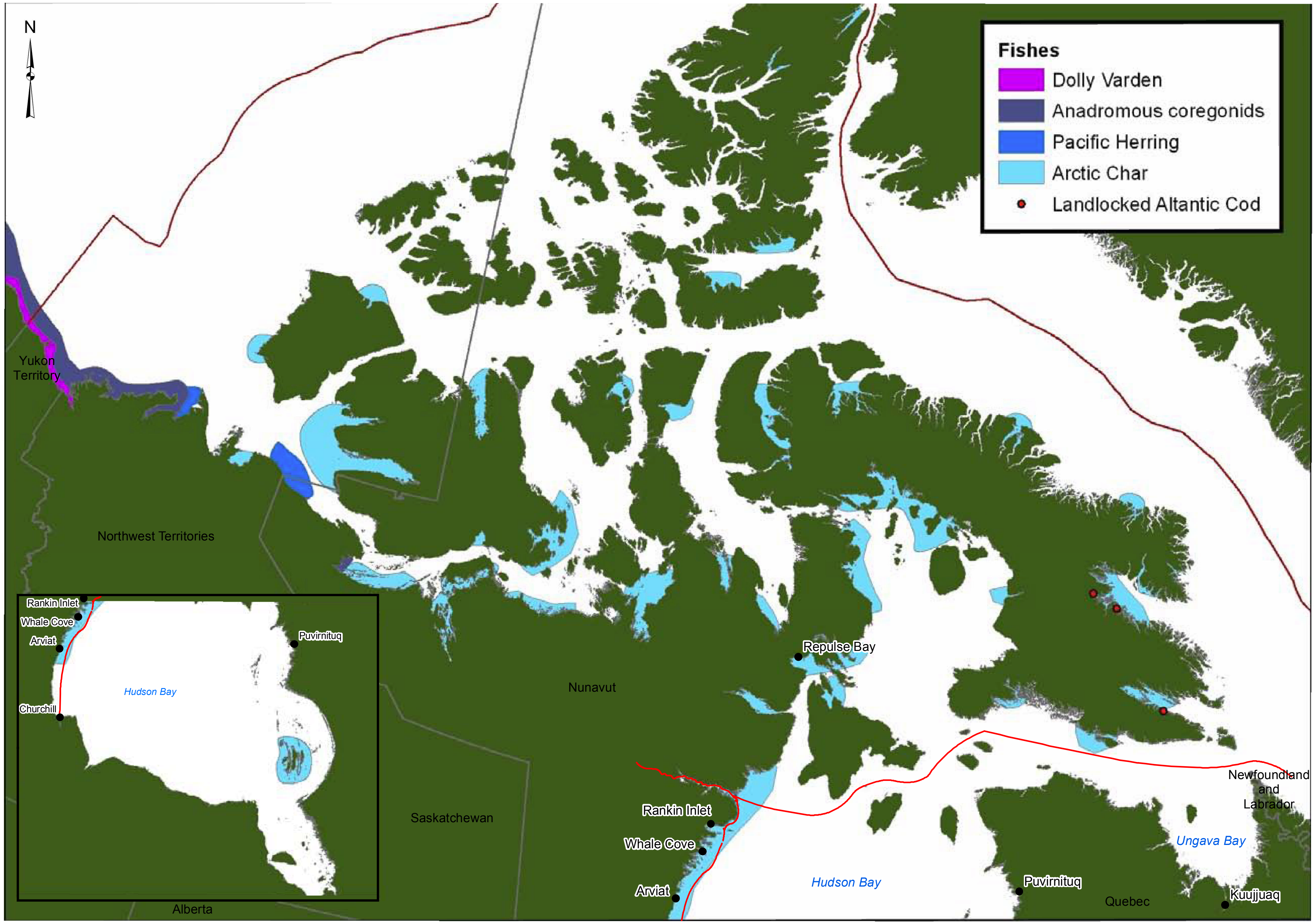

LEGEND

SHIPING ROUTE

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF ARCTIC CHAR (*Salvelinus alpines*) AND OTHER SELECTED FISH SPECIES IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.	
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	DSC	20 Jul. 2012		
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.5**	
REVIEW	PR	06 Jun. 2016		

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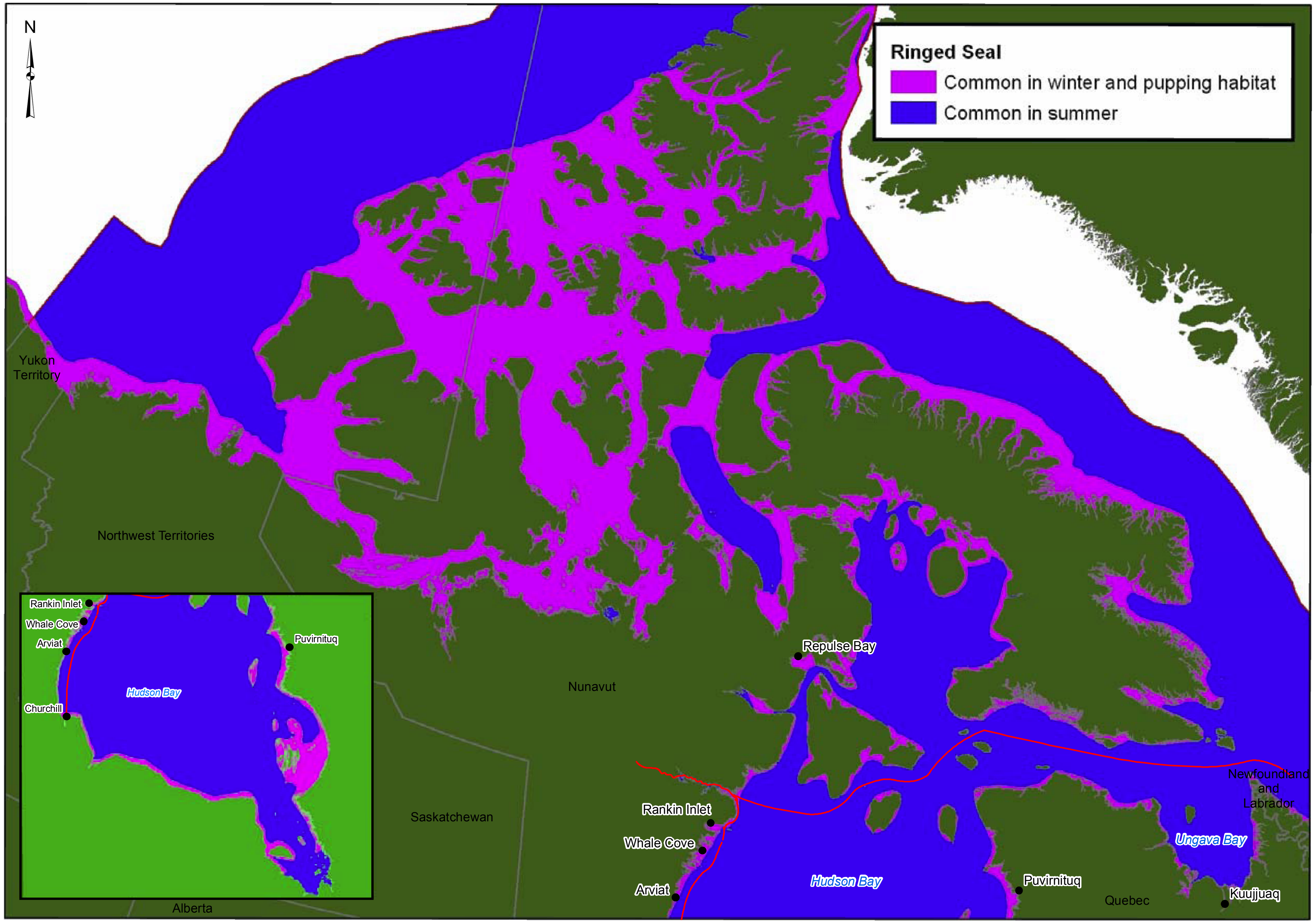

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SHIPING ROUTE

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF RINGED SEAL (*Phoca hispida*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.	
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	DSC	19 Jul. 2012		
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.6**	
REVIEW	PR	06 Jun. 2016		

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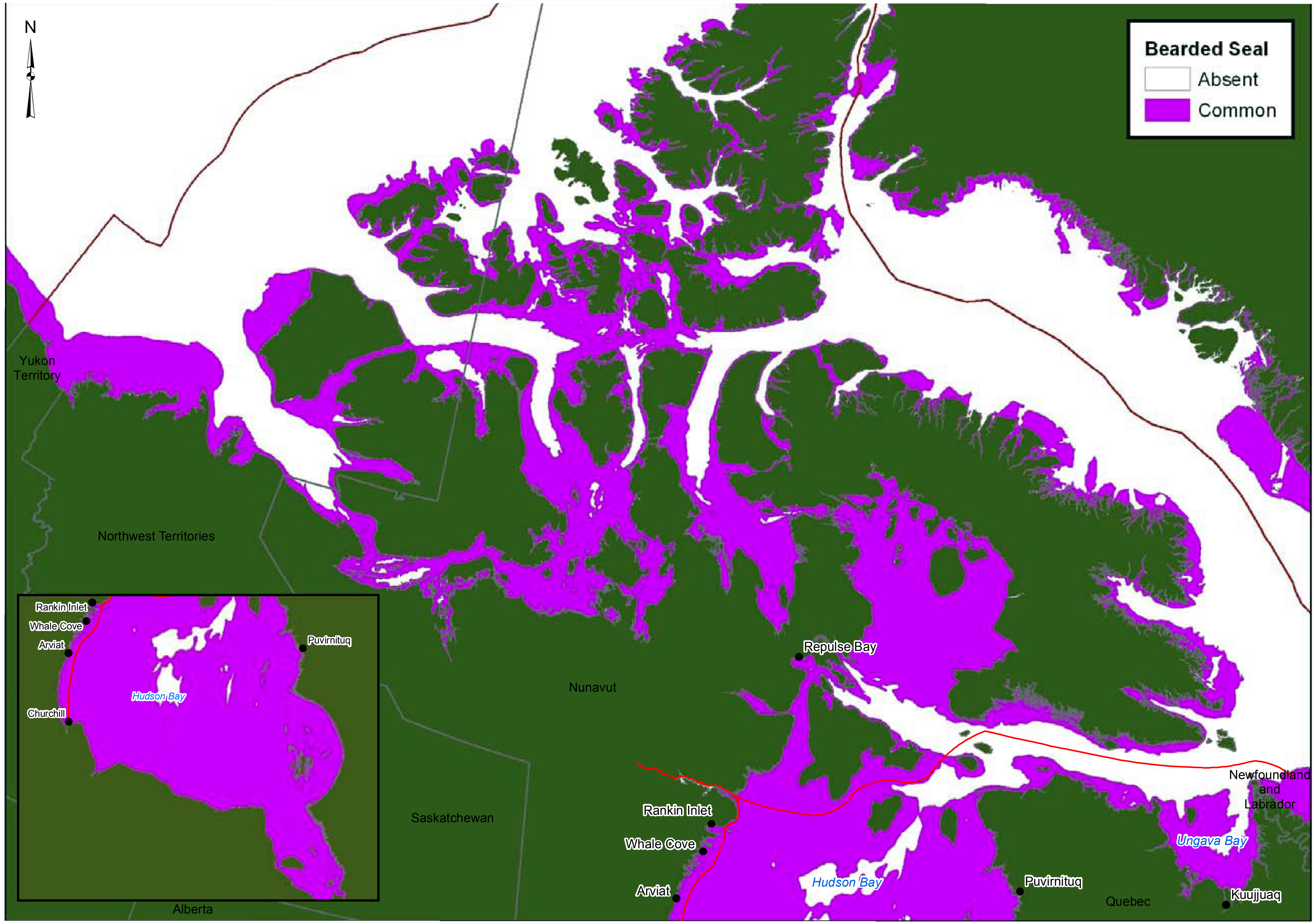

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SHIPING ROUTE

REFERENCE

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2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF BEARDED SEAL (*Erignathus barbatus*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	23 Jul. 2012	
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.7**
REVIEW	PR	06 Jun. 2016	

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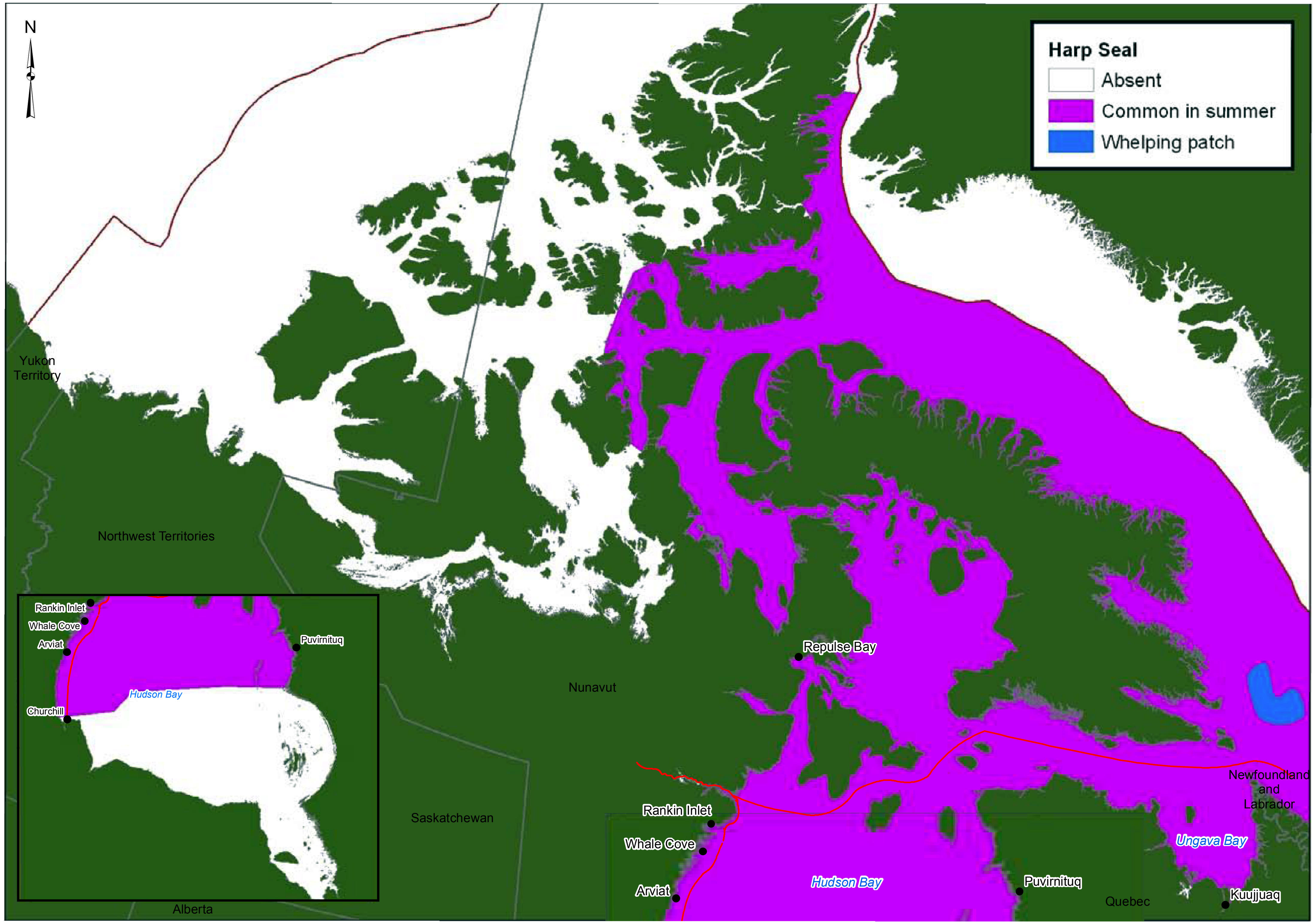

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SHIPING ROUTE

REFERENCE

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3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF HARP SEAL (*Pagophilus groenlandica*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	23 Jul. 2012	
CHECK	AO	06 Jun. 2016	FIGURE 3.A.8
REVIEW	PR	06 Jun. 2016	

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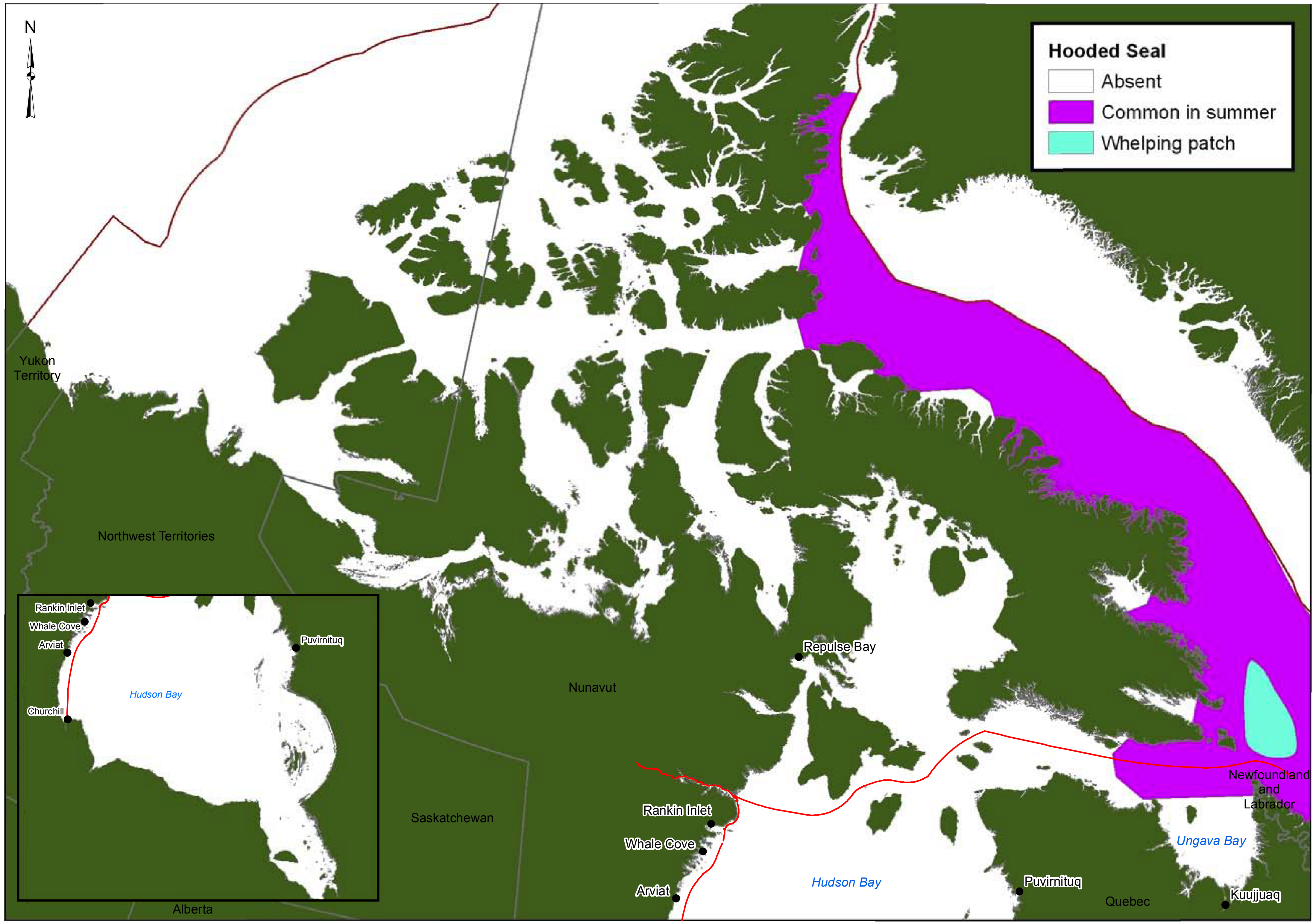

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SHIPING ROUTE

REFERENCE

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2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF HOODED SEAL (*Cystophora cristata*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.	
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	DSC	23 Jul. 2012		
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.9**	
REVIEW	PR	06 Jun. 2016		

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LEGEND

SHIPING ROUTE

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF HARBOUR SEAL (*Phoca vitulina concolor*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.	
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	DSC	23 Jul. 2012		
CHECK	AO	06 Jun. 2016	FIGURE 3.A.10	
REVIEW	PR	06 Jun. 2016		

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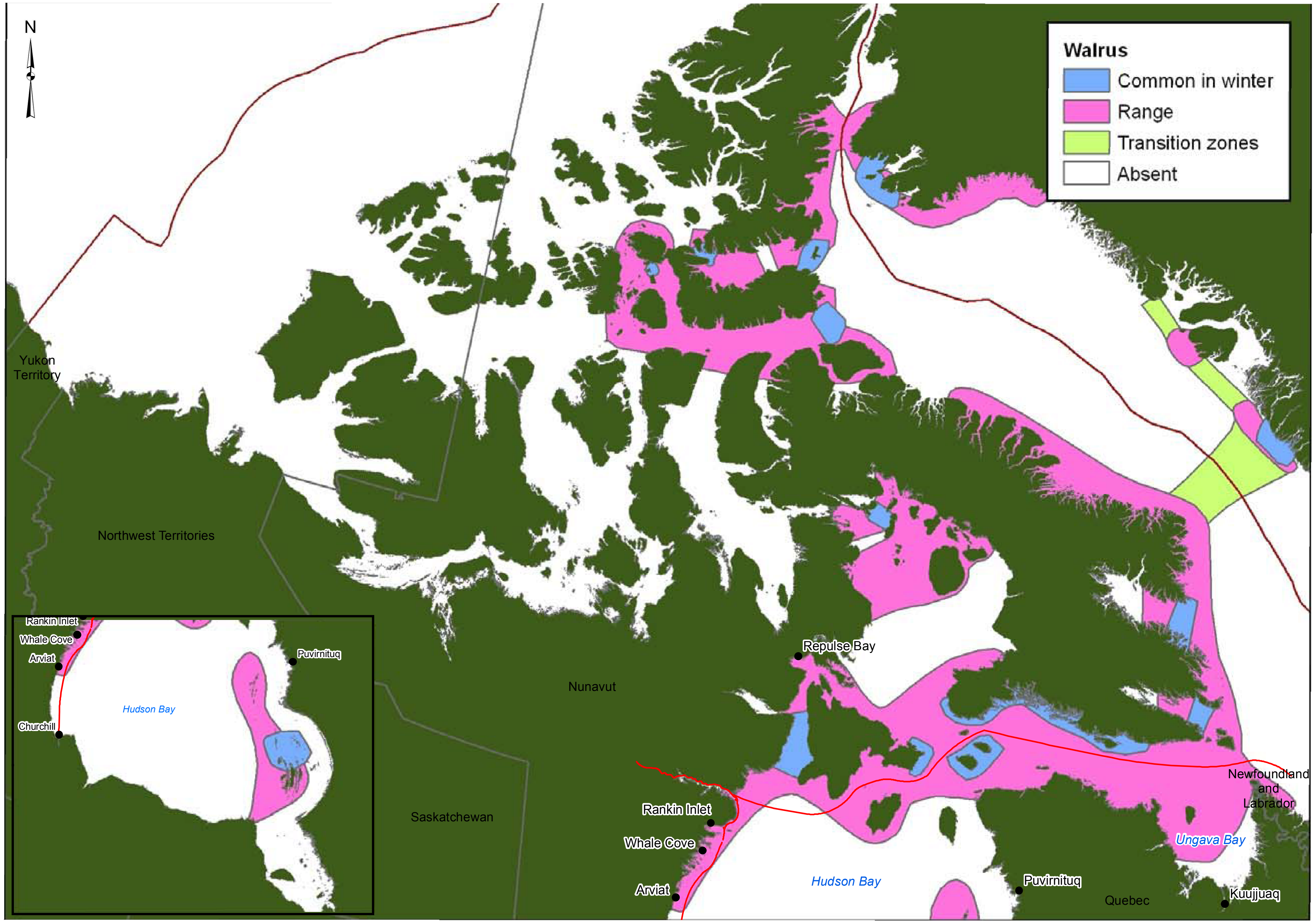

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SHIPING ROUTE

REFERENCE

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3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

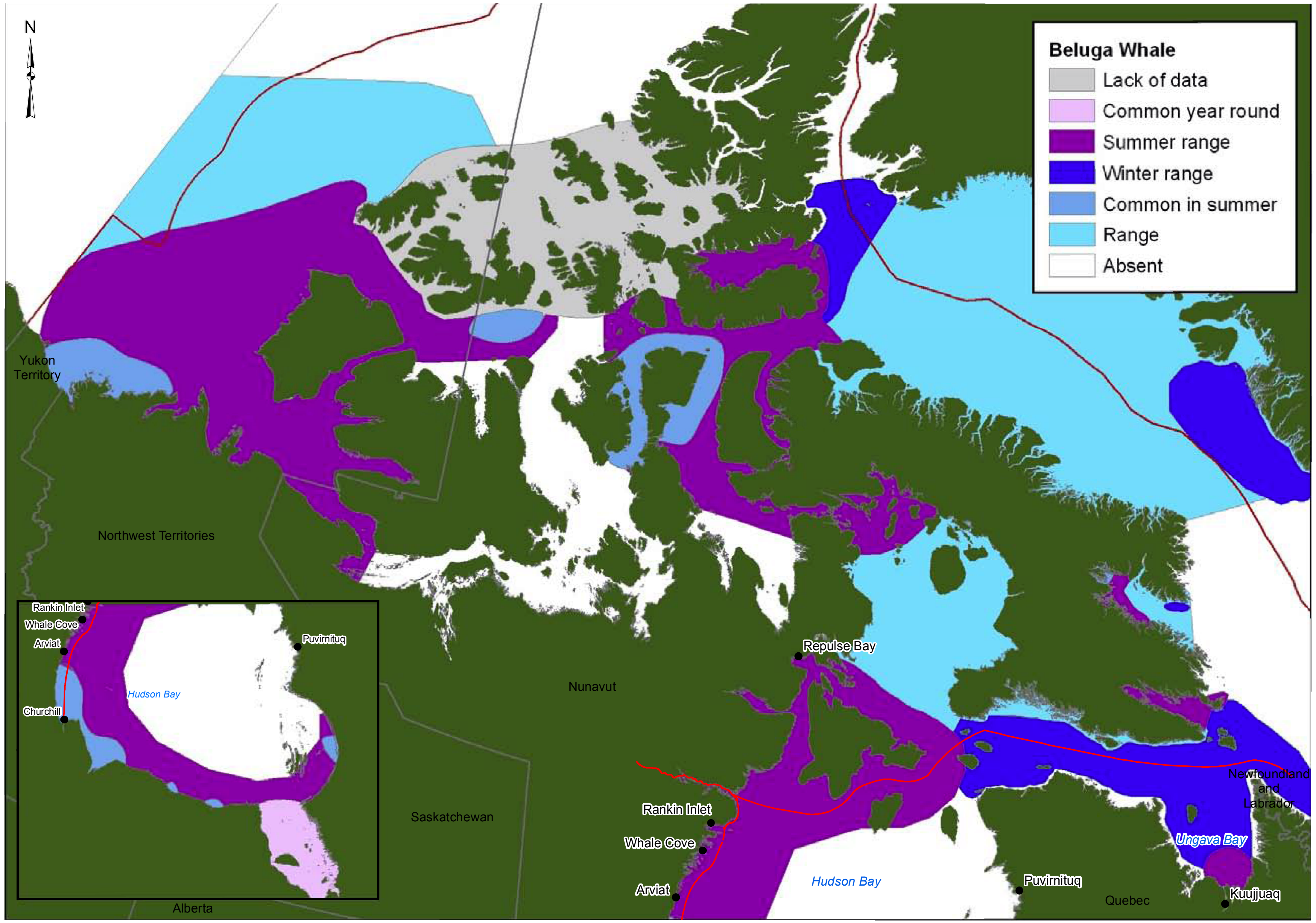
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF ATLANTIC WALRUS (*Odobenus rosmarus rosmarus*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	23 Jul. 2012	
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.11**
REVIEW	PR	06 Jun. 2016	



LEGEND

SHIPING ROUTE

REFERENCE

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2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF BELUGA WHALES (*Delphinapterus leucas*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	24 Jul. 2012	
CHECK	AO	06 Jun. 2016	FIGURE 3.A.12
REVIEW	PR	06 Jun. 2016	

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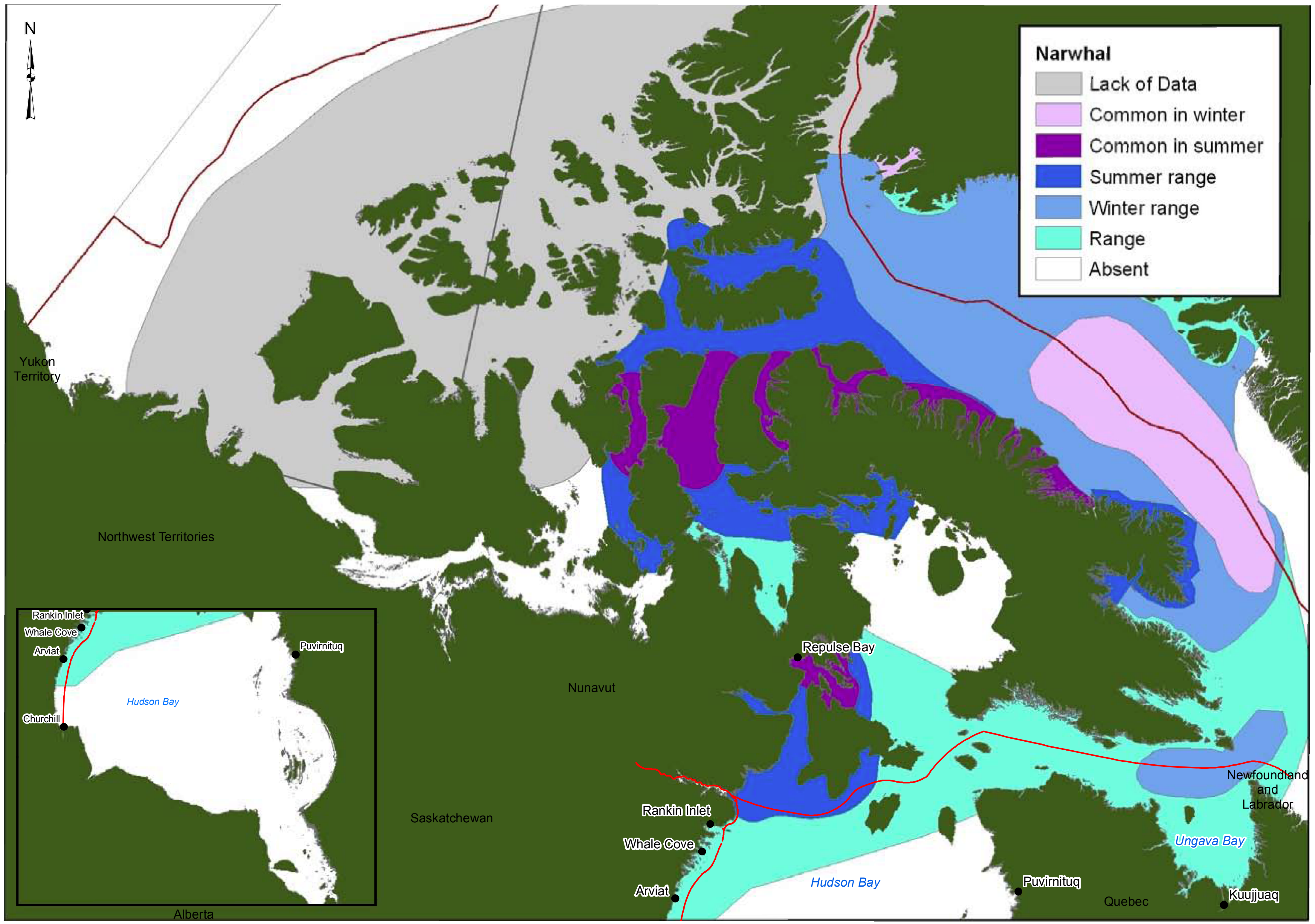

LEGEND

SHIPING ROUTE

REFERENCE

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2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF NARWHAL (*Monodon monoceros*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	24 Jul. 2012	
CHECK	AO	06 Jun. 2016	FIGURE 3.A.13
REVIEW	PR	06 Jun. 2016	

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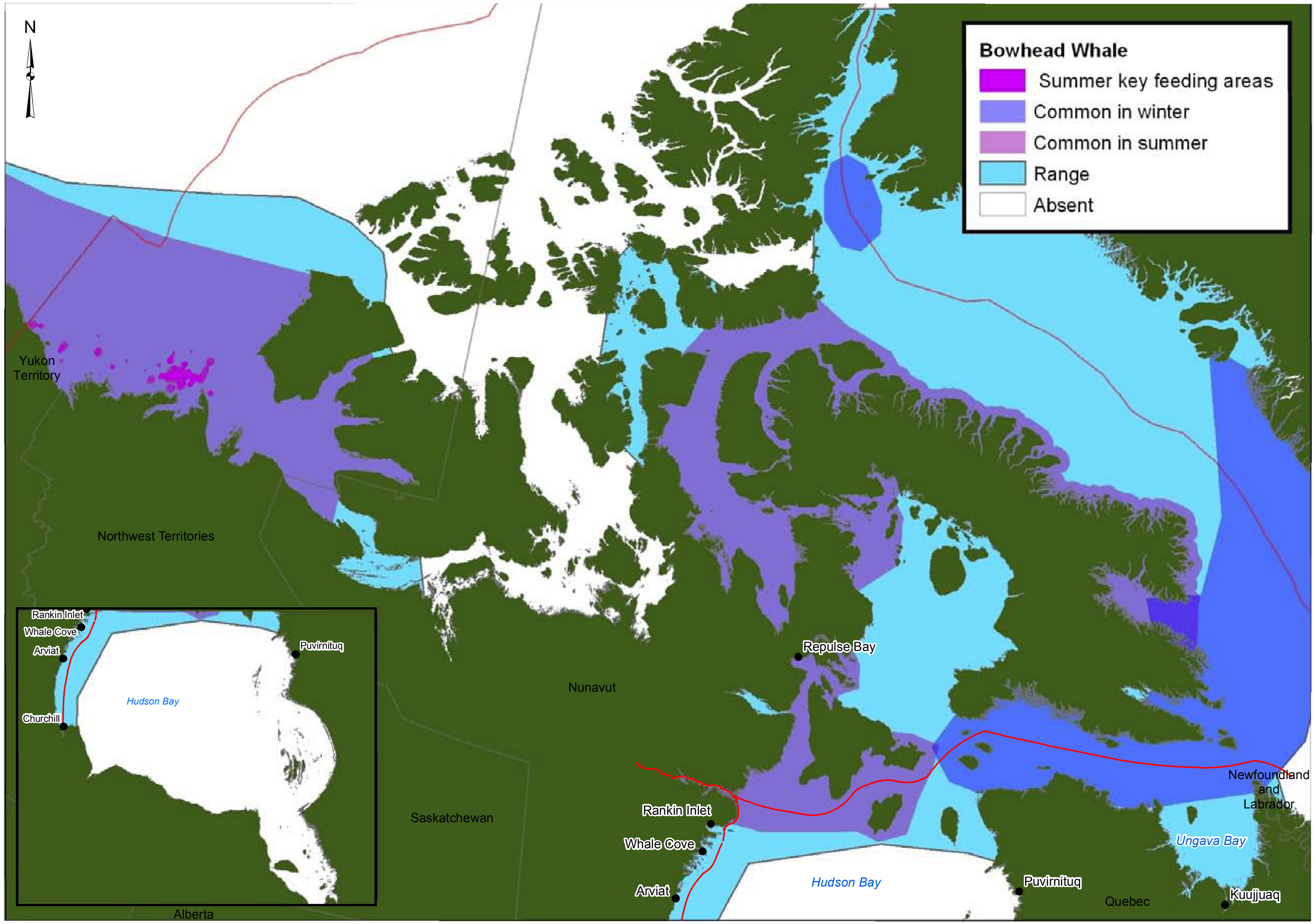

LEGEND

SHIPING ROUTE

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF BOWHEAD WHALES (*Balaena mysticetus*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	24 Jul. 2012	
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.14**
REVIEW	PR	06 Jun. 2016	

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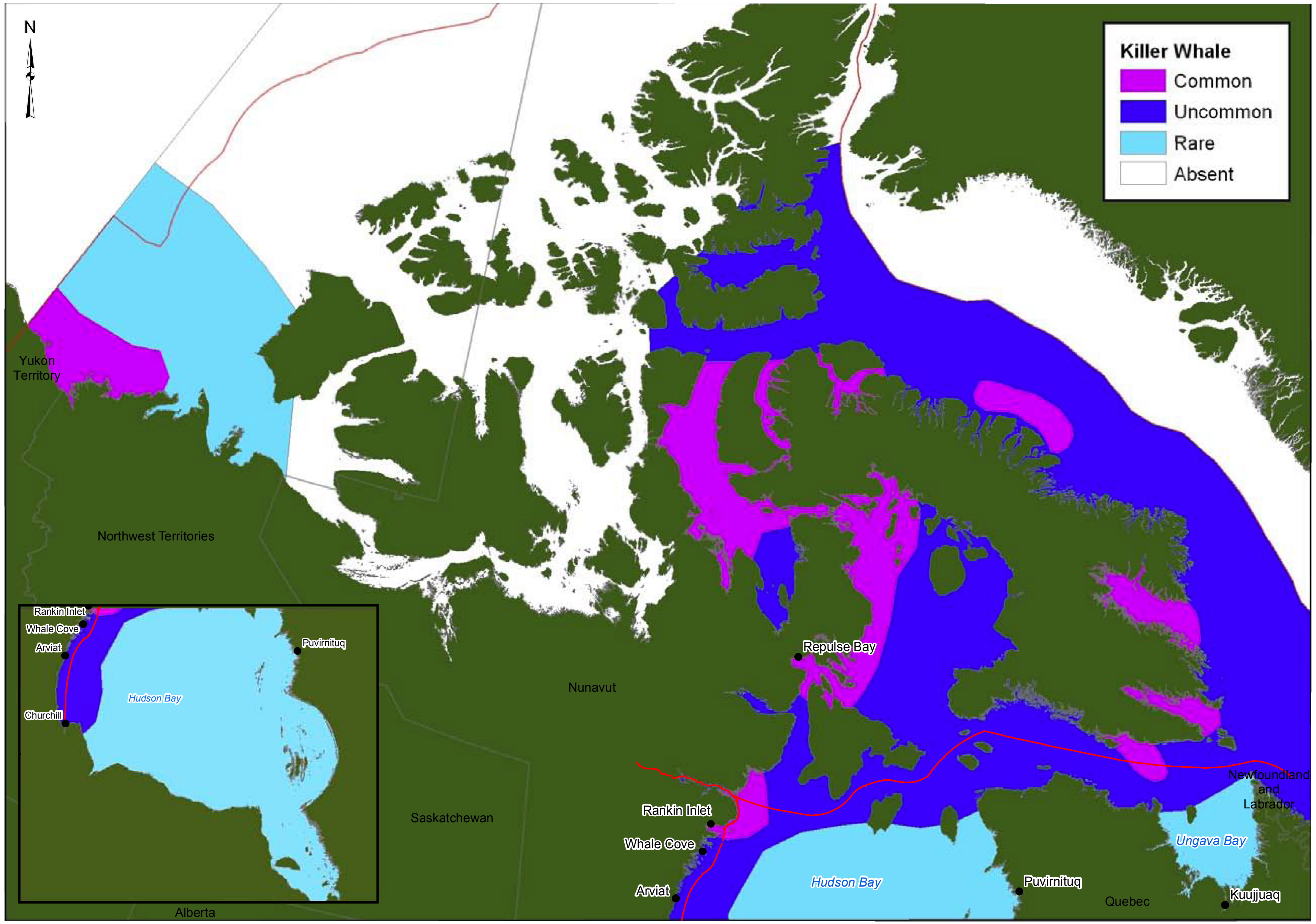


LEGEND

SHIPING ROUTE

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

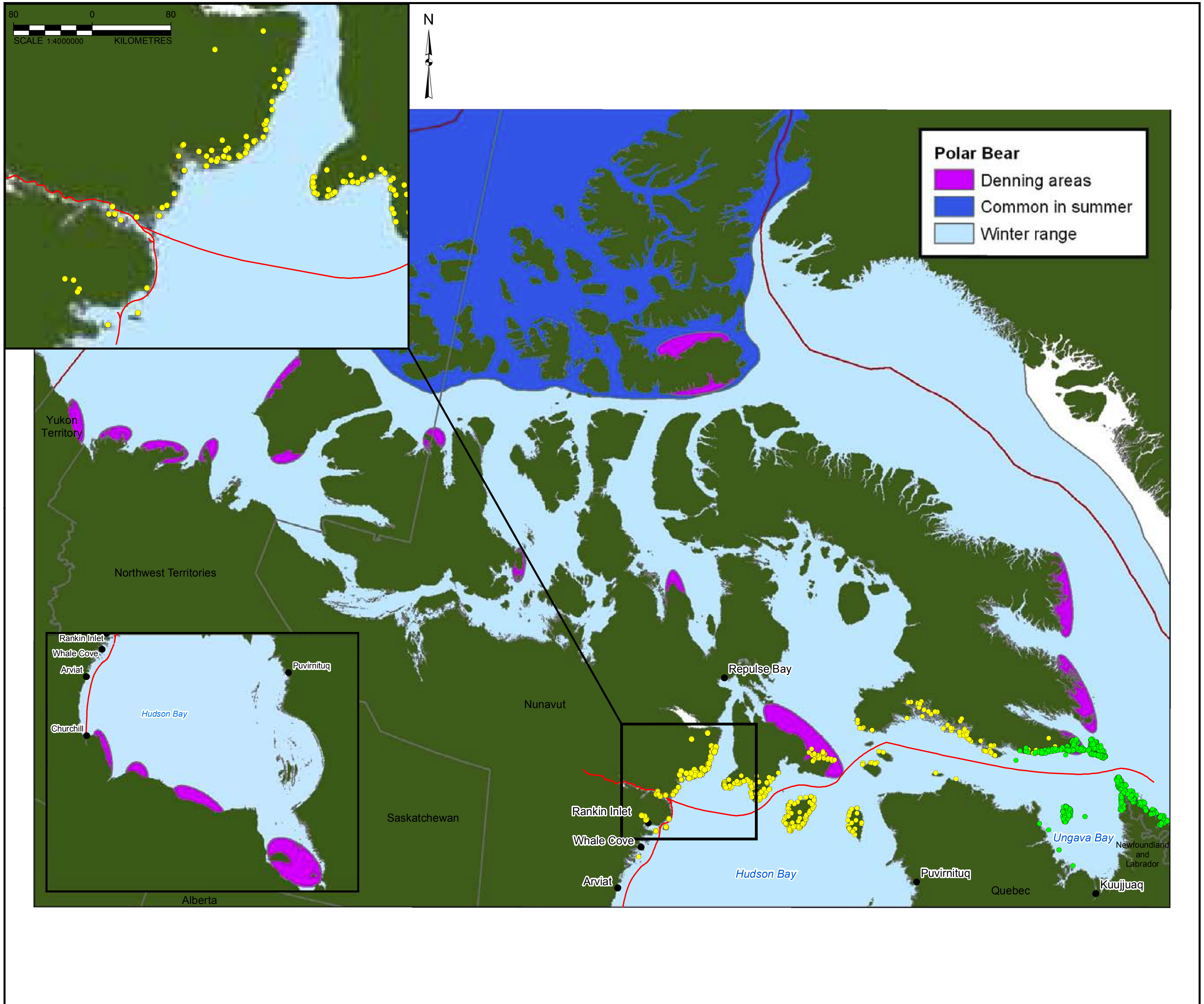
TITLE

DISTRIBUTION OF KILLER WHALE (*Orcinus orca*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	24 Jul. 2012	
CHECK	AO	06 Jun. 2016	**FIGURE 3.A.15**
REVIEW	PR	06 Jun. 2016	

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\3600_Marine\Report\1541520_FIG_15_Distribution_of_Killer_Whales.mxd



LEGEND

POLAR BEAR SIGHTINGS

- POLAR BEAR SURVEY SITING (2009 - 2011)
- POLAR BEAR SURVEY SITING (2005 - 2007)
- SHIPING ROUTE

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010
3. GOVERNMENT OF NUNAVUT (GN) UNPUBLISHED DATA PROVIDED BY M.DYCK (2014)
4. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240
KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF POLAR BEAR (*Ursus maritimus*) IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.	
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	DSC	24 Jul. 2012	FIGURE 3.A.16	
CHECK	AO	06 Jun. 2016		
REVIEW	PR	06 Jun. 2016		

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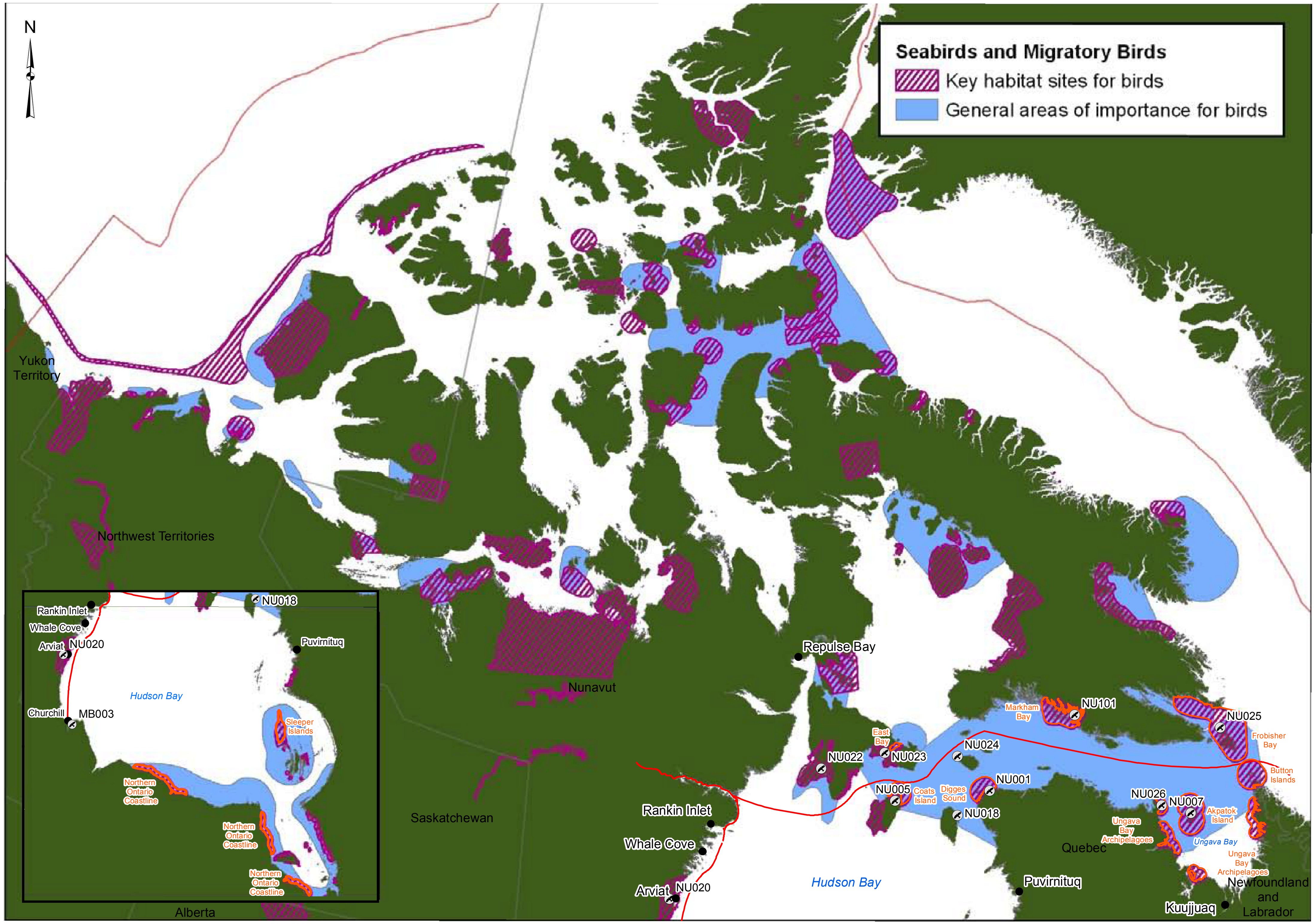
Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\3600_Marine\Report\1541520_FIG_17_Key_Habitat_Areas_Birds.mxd



LEGEND

- IMPORTANT BIRD AREAS
- COMMUNITY
- SHIPING ROUTE
- KEY MARINE HABITAT AREAS FOR MIGRATORY BIRD

ID#	Important Bird Areas
NU022	Harry Gibbons Migratory Bird Sanctuary (federal)
MB003	Wapusk National Park (federal)
NU005	Cape Pembroke
MB013	Seal River Estuary Heritage River (federal)
NU020	McConnell River Migratory Bird Sanctuary (federal) & Ramsar Site
NU023	East Bay Migratory Bird Sanctuary (federal)
NU024	Fraser Island
NU001	Digges Sound
NU101	Markham Bay Eider Colony
NU026	Eider Islands
NU007	Akpatok Island
NU018	Mansel Island
NU025	Hantzsch Island

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010, IBA 2012
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240
KILOMETRES

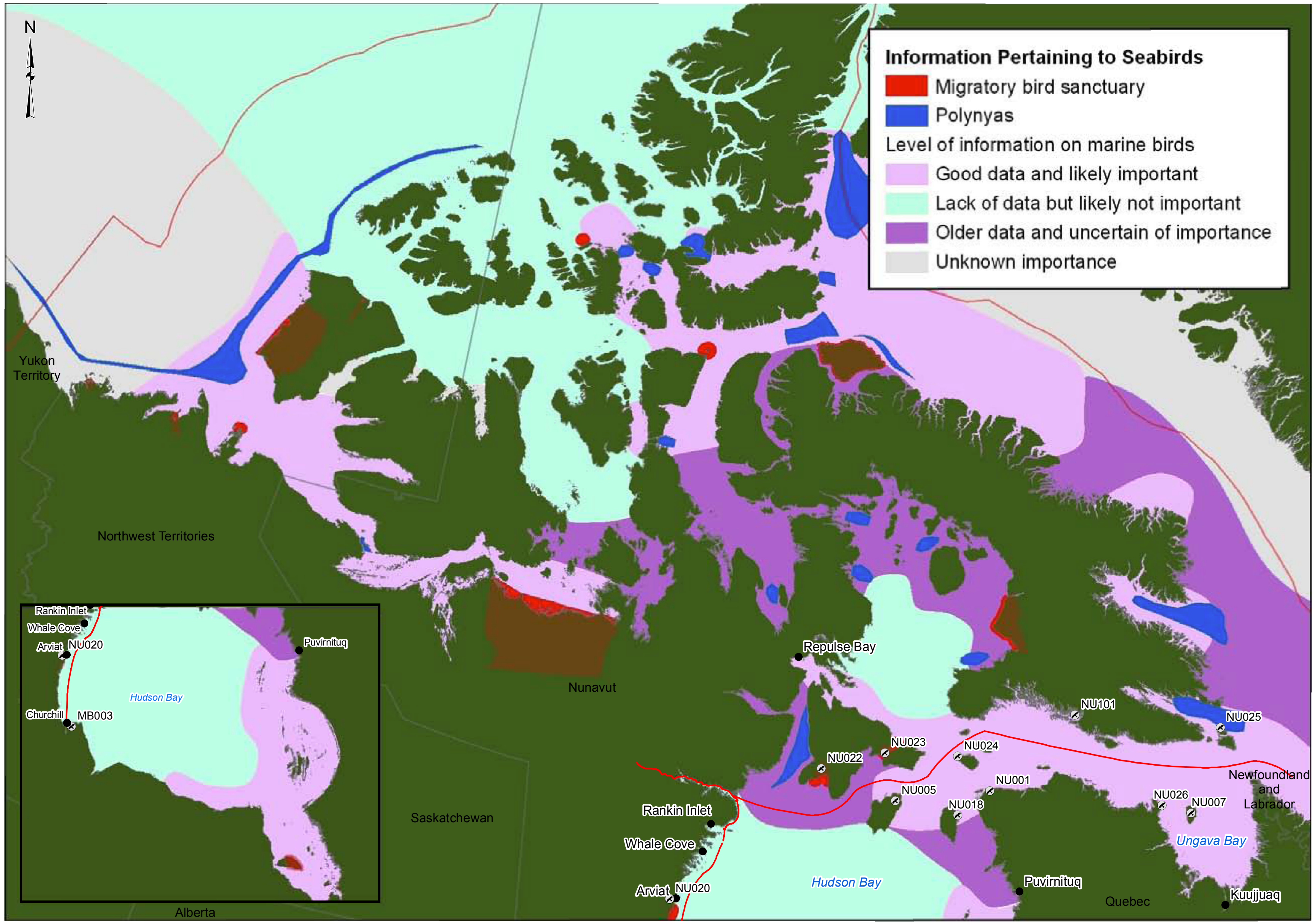
PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

KEY MARINE HABITAT AREAS FOR MIGRATORY BIRDS

Golder Associates

PROJECT NO.		1541520	FILE No. 7000/7300	
DESIGN	KZ	06 Feb. 2014	SCALE AS SHOWN	REV. 0
GIS	MH	06 Feb. 2014		
CHECK	AO	06 Jun. 2016	FIGURE 3.A.17	
REVIEW	PR	06 Jun. 2016		



LEGEND

SHIPING ROUTE

ID#	Important Bird Areas
NU022	Harry Gibbons Migratory Bird Sanctuary (federal)
MB003	Wapusk National Park (federal)
NU005	Cape Pembroke
MB013	Seal River Estuary Heritage River (federal)
NU020	McConnell River Migratory Bird Sanctuary (federal) & Ramsar Site
NU023	East Bay Migratory Bird Sanctuary (federal)
NU024	Fraser Island
NU001	Digges Sound
NU101	Markham Bay Eider Colony
NU026	Eider Islands
NU007	Akpatok Island
NU018	Mansel Island
NU025	Hantzsch Island

REFERENCE

1. PROVINCIAL DATA OBTAINED FROM E.S.R.I.
2. BASE IMAGE OBTAINED FROM STEPHENSON AND HARTWIG, 2010, IBA 2012
3. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

240 0 240

KILOMETRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DISTRIBUTION OF MARINE BIRDS AND BIRD HABITAT IN HUDSON BAY, HUDSON STRAIT AND ADJACENT ARCTIC WATERS

Golder Associates

PROJECT NO.		1541520	FILE No.
DESIGN	AK	19 Jul. 2012	SCALE AS SHOWN REV. 0
GIS	DSC	24 Jul. 2012	
CHECK	AO	06 Jun. 2016	FIGURE 3.A.18
REVIEW	PR	06 Jun. 2016	

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\3600_Marine\Report\1541520_FIG_18_Distribution_of_Birds.mxd

Figure 3-A-19: Preliminary EBSA Identification Results for Foxe Basin (in solid red; 1.1 to 1.3) and for Hudson Bay / Hudson Strait (in red hatched lines; 1.4 to 1.12) as Determined through a Series of Workshops Conducted in 2009. Sources: DFO (2010); extracted from Cobb 2011.

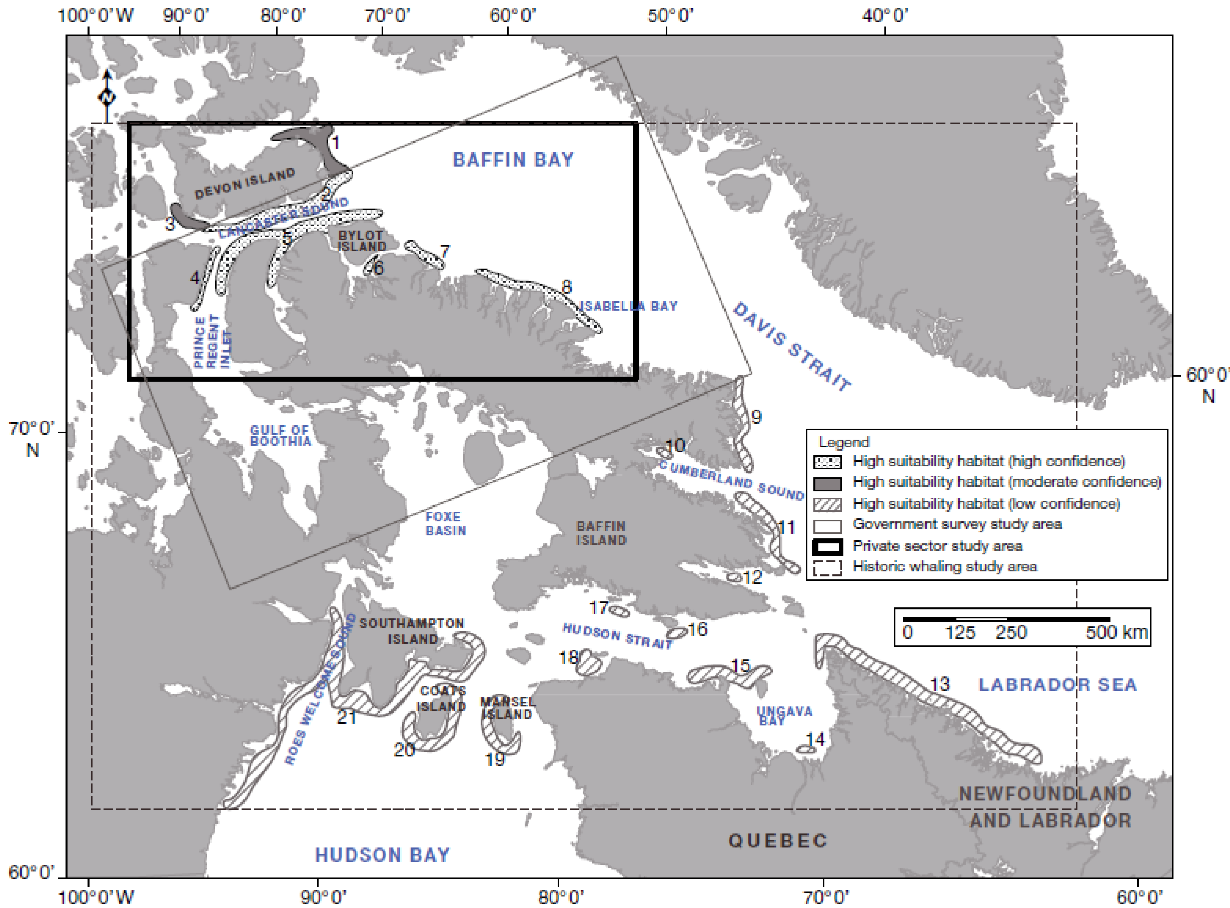


Figure 3-A-20: Discrete Areas of Highly Suitable Bowhead Whale Habitat Identified for Three or More Months from June to October in the Eastern Canadian Arctic (by analytical confidence). Produced by Ecological Niche Factor of Three Bowhead Location Datasets and Associated Eco-Geographical Variables. Source: extracted from Wheeler et al. (2012).

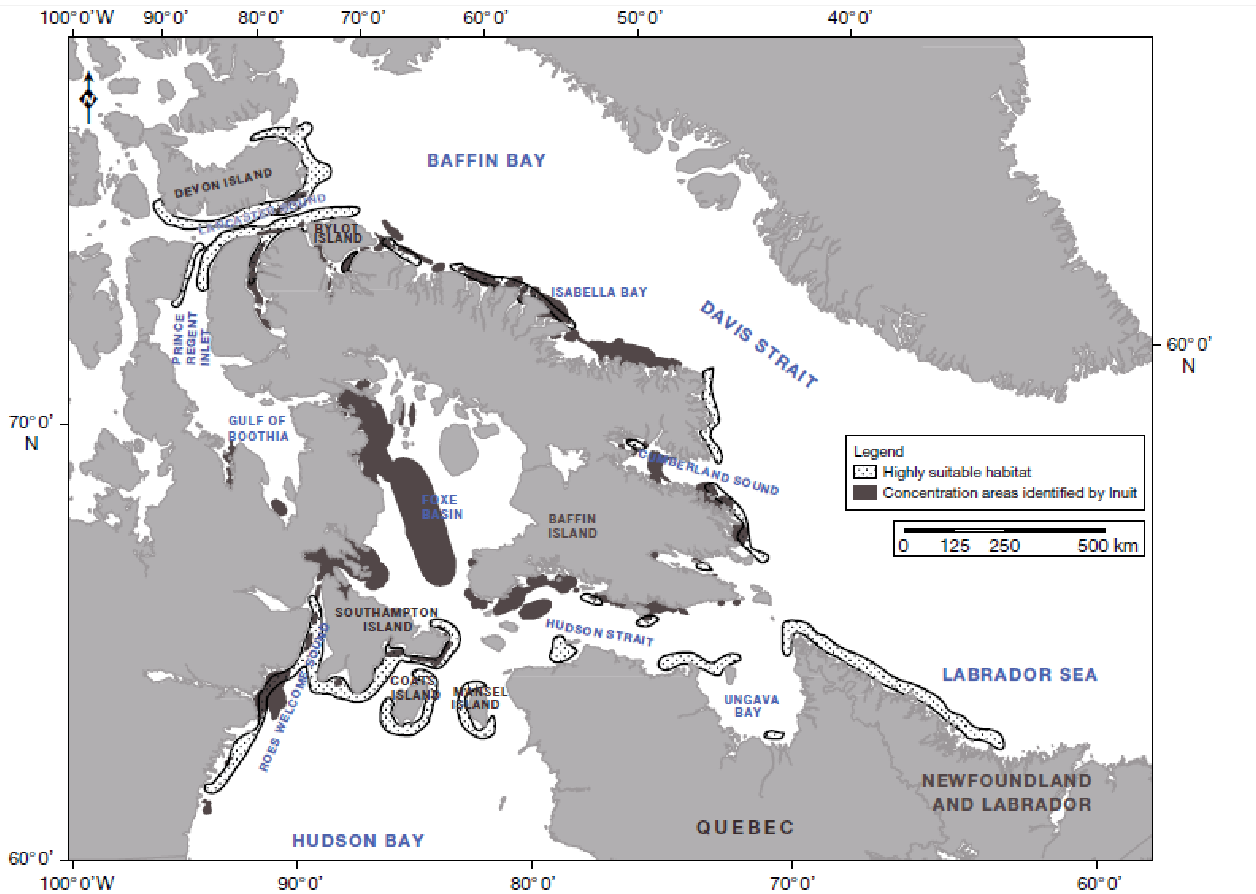


Figure 3-A-21: Comparison of Highly Suitable Bowhead Whale Habitat Predicted by Ecological Niche Factor Analyses with Bowhead Concentration Areas Identified by Inuit in Nunavut, Canada, in Late Spring, Summer, and Early Fall Source: Adapted from NWMB (2000) and Wheeler et al. (2012).

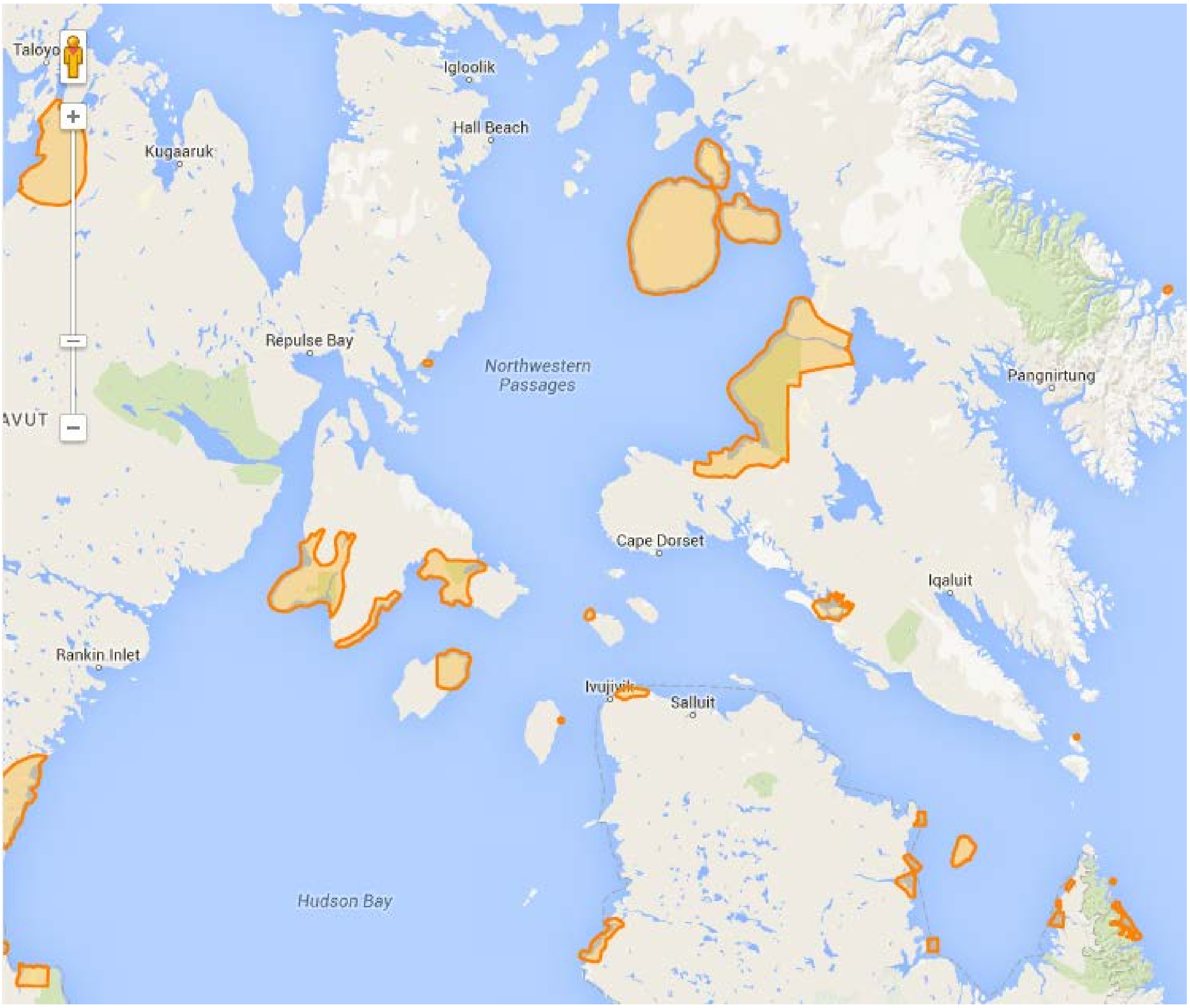


Figure 3-A-22: Important Bird Areas within and Adjacent to the Study Area. Source: Extracted from IBA Canada (2015).

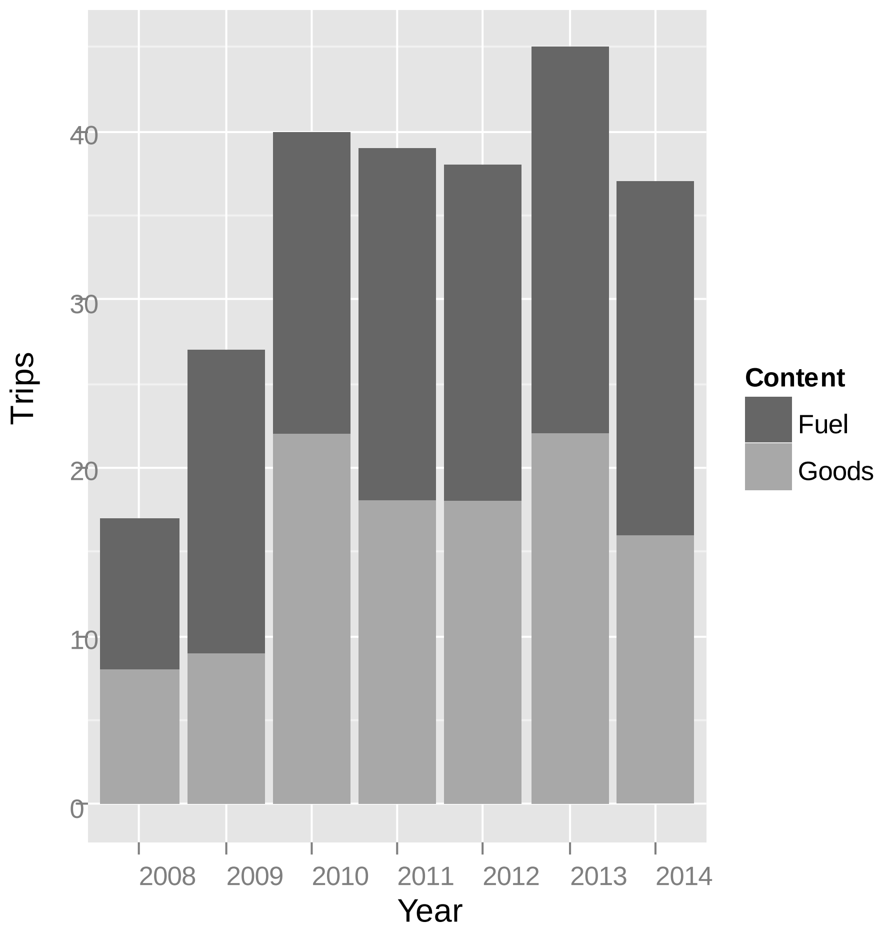


Figure 3-A-23: Barge traffic (number of trips/year) arriving in Baker Lake from Chesterfield Inlet since 2008 (adapted from the Meadowbank 2014 annual report (Agnico Eagle 2014a)).

ATTACHMENT 3-A.2

Tables

Table 3-A-1: Marine Environment and Marine Wildlife Valued Components

Valued Component	Rationale for Inclusion
Marine Water Quality	▪ Aboriginal, regulatory, conservation, and other stakeholder importance ▪ Project shipping activities have the potential to affect chemical properties of marine water in shipping corridor ▪ Marine water quality is important for the health of marine wildlife, and human uses that rely on those resources ▪ Pathway component with direct and indirect linkage to marine fish, marine mammal and marine bird VCs
Marine Fish	▪ Commercial, social, cultural, and ecological importance in Project area ▪ Potential to be affected by Project activities ▪ Identified as important during Traditional Knowledge studies
Marine Mammals	▪ Commercial, social, cultural, and ecological importance in Project area ▪ Biological indicators for marine and terrestrial ecosystem health ▪ Potential to be affected by Project activities ▪ Include several federally listed species ▪ Identified as important during IQ studies
Marine Birds	▪ Cultural and aesthetic value to society ▪ Ecological importance in Project area ▪ Biological indicators for marine and terrestrial ecosystem health ▪ Migratory and non-migratory species protected by provincial and federal regulations ▪ Include several federally listed species ▪ Potential to be affected by Project activities ▪ Identified as important during IQ studies

VC = valued component

Table 3-A-2: Overview of Marine Fish Species within the Study Area

Common Name	Species	Habitat	SARA Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Arctic char	*Salvelinus alpinus*	Anadromous fish found in coastal waters of the marine environment and occupying depths between 30 and 70 m.	No Status	Not Assessed	Yes
Greenland cod	*Gadus ogac*	Demersal[c] fish occurring in coastal waters up to 400 m in depth.	No Status	Not Assessed	Yes
Polar cod	*Arctogadus glacialis*	Cryopelagic[d] or epontic[e] or epontic fish found in both shallow and deep waters up to 1,000 m in depth.	No Status	Not Assessed	Yes
Arctic cod	*Boreogadus saida*	Cryopelagic or epontic fish found in both shallow coastal and deep waters to a depth of 1,400 m.	No Status	Not Assessed	Yes
Fourhorn sculpin (marine form)	*Myoxocephalus quadricornis*	Benthic fish occurring in shallow coastal and estuarine environments. It migrates to deep waters during summer months, generally between 45 and 100 m in depth.	No Status	Not at Risk	Yes
Arctic staghorn sculpin	*Gymnocanthus tricuspis*	Benthic fish occurring in coastal environments with preference of sandy-bottom areas.	No Status	Not Assessed	Yes
Arctic sculpin	*Myoxocephalus scorpioides*	Benthic fish found in shallow marine environments up to 275 m.	No Status	Not Assessed	Yes
Slender eel blenny	*Lumpenus fabricii*	Benthic fish found in sandy and rocky habitats with preference of seagrass and macroalgae presence.	No Status	Not Assessed	No
Greenland halibut	*Reinhardtius hippoglossoides*	Epibenthic[f] fish occurring in shallow to deep waters up to 2,000 m in depth.	No Status	Not Assessed	Yes
Capelin	*Mallotus villosus*	Forage fish that ranges from shallow coastal waters to 700 m in depth and prey on plankton, worms and small fish.	No Status	Not Assessed	Yes
Thorny skate	*Amblyraja radiata*	Benthic species ranging from shallows to over 900 m in depth (Coad and Reist 2004).	No Status	Special Concern	Yes
Greenland shark	*Somniosus microcephalus*	Epibenthic and pelagic[g] species ranging from shallows to over 1,000 m in depth.	No Status	Not Assessed	Yes

[a] SARA (*Species at Risk Act*). The Act is a key federal government commitment to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity (extracted from SARA 2012).

[b] COSEWIC (Committee on the Status of Endangered Wildlife in Canada) is a committee of experts that assesses and designates which wildlife species are in some danger of disappearing from Canada. It is up to Government to legally protect wildlife species designated by COSEWIC. The potential impacts of legal listing are for Government to analyse, and the *Species at Risk Act* (SARA) applies only to wildlife species on the SARA legal list (extracted from COSEWIC 2015).

[c] live on or near the seafloor.

[d] cold, deep marine environments.

[e] associated with the lower interface of the sea ice.

[f] live upon the seafloor.

[g] neither close to the bottom nor close to the shore.

No Status = species found in COSEWIC or SARA database but with no designation indicated; Not Assessed = species could not be found in either COSEWIC or SARA database; Special Concern = species at low density that does not qualify for threatened status; Not at Risk = species that has been evaluated and determined to be not at risk of extinction.

Table 3-A-3: Marine Mammals Harvested throughout the Year by Coastal Inuit Communities in Nunavut

Target species	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Ringed seal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bearded seal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Harp seal	✓			✓		✓	✓	✓	✓	✓	✓	
Hooded seal							✓	✓	✓	✓	✓	✓
Harbour seal							✓	✓	✓	✓	✓	
Walrus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Beluga	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Narwhal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bowhead								✓				
Polar bear	✓	✓	✓	✓	✓					✓	✓	✓

Source: Priest and Usher (2004).

Table 3-A-4: Overview of Marine Mammal Species within the Hudson Bay / Hudson Strait Area

Common Name	Species	Seasonal Occurrence	Habitat	SARA Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Ringed seal	*Pusa hispida*	Year-round	Shore-fast ice and pack-ice	No Status	Not at Risk	Yes
Harp seal	*Pagophilus groenlandica*	Open-water season (July-Sept)	Pack-ice	No Status	No Status	Yes
Bearded seal	*Erignathus barbatus*	Year-round	Pack-ice	No Status	Data Deficient	Yes
Harbour seal	*Phoca vitulina concolor*	Year-round	Coastal terrestrial areas and edge of shore-fast ice	Not at Risk	Not at Risk	Yes
Hooded seal	*Cystophora cristata*	Open-water season (July-Sept)	Pack-ice	No Status	Not at Risk	Yes
Atlantic walrus	*Odobenus rosmarus*	Year-round	Pack-ice or coastal waters during summer; floe-edge / polynyas during winter	No Status	Special Concern	Yes
Polar bear	*Ursus maritimus*	Year-round	Spring: shore-fast ice; Summer: coastal areas and inland; and Winter: shore fast-ice and coastal areas for denning	Special Concern (Schedule 1)	Special Concern	Yes
Beluga whale	*Delphinapterus leucas*	Winter (Nov-May) and Summer	Spring: ice-edges/leads; Summer: shallow coastal areas (around Southampton Island and western Hudson Bay); Fall: deep water (foraging); Winter: offshore pack-ice (Hudson Strait)	Threatened (St. Lawrence River population), No status (Western Hudson Bay , Eastern Hudson Bay, Baffin Bay, Ungava Bay and Cumberland Sound populations)	Special Concern (Western Hudson Bay Population, Baffin Bay population) Endangered (Eastern Hudson Bay Population, Ungava Bay Population) Threatened (Cumberland Sound population, St. Lawrence River population)	Yes
Narwhal	*Monodon monoceros*	Year-round	Winter: deep water / edge of banks; Summer: fjords / coastal waters	No Status	Special Concern	Yes

Table 3-A-4: Overview of Marine Mammal Species within the Hudson Bay / Hudson Strait Area

Common Name	Species	Seasonal Occurrence	Habitat	SARA Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Bowhead whale	*Balaena mysticetus*	Winter (Feb-Jun)	Spring : along the ice-edge; Summer: open-water / pack-ice; Winter: heavy pack-ice	No Status (Eastern Canada-West Greenland Population)	Special Concern (Eastern Canada-West Greenland Population)	Yes
Killer whale	*Orcinus orca*	Jun-Aug	Coastal / offshore	No Status	Special Concern	No

[a] SARA (*Species at Risk Act*). The Act is a key federal government commitment to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity (extracted from SARA 2012).

[b] COSEWIC (Committee on the Status of Endangered Wildlife in Canada) is a committee of experts that assesses and designates which wildlife species are in some danger of disappearing from Canada. It is up to Government to legally protect wildlife species designated by COSEWIC. The potential impacts of legal listing are for Government to analyse, and the *Species at Risk Act* (SARA) applies only to wildlife species on the SARA legal list (extracted from COSEWIC 2015).

No Status = species found in COSEWIC or SARA database but with no designation indicated; Not Assessed = species could not be found in either COSEWIC or SARA database; Special Concern = species at low density that does not qualify for threatened status; Data Deficient = information is insufficient to determine criteria or assign any status; Not at Risk = species that has been evaluated and determined to be not at risk of extinction; Threatened = species that is likely to become an endangered if nothing is done to reverse factors.

Table 3-A-5: Ecologically and Culturally Important Seabird Species Potentially Present within the Study Area

Common Name	Species	Seasonal Occurrence	Distribution	Other relevant information	*SARA* Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Black guillemot	*Cepphus grylle*	year-round	coastal / offshore	Harvested for subsistence. Nests in small colonies on steep shores on Southampton and Coats islands.	No Status	Not Assessed	Yes
Thick-billed murre	*Uria lomvia*	summer	coastal / offshore	Large breeding colony (520 000 pairs) on Akpatok Island in Hudson Strait. TK and IQ suggests that murres winter in large numbers in areas of open water west of the Belcher Islands in southeast Hudson Bay. Moulting adult birds with their young complete swimming migration in August from a number of known bird colonies in Hudson Bay through the Hudson Strait to offshore areas of Newfoundland and Labrador (Mallory and Fontaine 2004).	No Status	Not Assessed	Yes
King eider	*Somateria spectabilis*	year-round	coastal	Widely distributed in James Bay and Hudson Bay.	No Status	Not Assessed	Yes
Common eider	*Somateria mollissima*	year-round	coastal / offshore	Hudson Bay subspecies that overwinters in areas where open water and shallow depth coincide. Breeds along rocky coasts or tundra throughout Hudson Bay. Present along ice edge and at polynyas. Feed exclusively on blue mussel.	No Status	Not Assessed	Yes
Northern fulmar	*Fulmarus glacialis*	summer/ fall	coastal / offshore	Rare visitor to James Bay in late fall. Observed at Coats Island.	No Status	Not Assessed	No
Black-legged kittiwake	*Rissa tridactyla*	summer	coastal / offshore	Occurs on the open waters of northern Hudson Bay in July and August, and occasionally at Churchill in early summer.	No Status	Not Assessed	No
Dovekie	*Alle*	year-round	coastal / offshore	Winter offshore in Hudson Bay, Hudson Strait and Gulf of St. Lawrence.	No Status	Not Assessed	No
Long-tailed duck	*Clangula hyemalis*	May-Oct	coastal	Occur in large numbers close to shore in Hudson Bay and James Bay. Some individuals also overwinter on open water of James Bay.	No Status	Not Assessed	No
Canada goose	*Branta canadensis*	summer and fall	coastal	Spring and fall transient. Breeds in large numbers along the coasts (McConnell River Migratory Bird Sanctuary) and on the islands of Hudson Bay and James Bay (e.g., Southampton Island).	No Status	Not Assessed	Yes

Table 3-A-5: Ecologically and Culturally Important Seabird Species Potentially Present within the Study Area

Common Name	Species	Seasonal Occurrence	Distribution	Other relevant information	*SARA* Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Lesser snow goose	*Anser caerulescens*	May – Sept	coastal	Migratory species. Breeding colonies occur along the coasts (McConnell River Migratory Bird Sanctuary) and on the islands of Hudson Bay (e.g., Southampton Island). Hudson Bay supports over 50% of the eastern Arctic breeding population.	No Status	Not Assessed	Yes
Atlantic Brant	*Branta bernicla*	April to October	coastal	Migratory species. Breed on Southampton Island. During the fall migration, > 50% of the population frequents eelgrass habitat in James Bay.	No Status	Not Assessed	No
Glaucous gull	*Larus hyperboreus*	summer	coastal / offshore	Breed along the northern coasts of Hudson Bay, the Belchers, and widely throughout the Canadian Arctic.	No Status	Not Assessed	No
Herring gull	*Larus argentatus*	April-Nov	coastal / offshore	Migratory species. Breed along the coasts of Hudson Bay and James Bay in summer and in the Belchers.	No Status	Not Assessed	No
Ross's gull	*Rhodostethia rosea*	spring and autumn	coastal / offshore	Established nesting areas near Churchill, McConnell River Migratory Bird Sanctuary, and in the Canadian High Arctic (Devon Island). May overwinter in polynyas.	Threatened (Schedule 1)	Threatened	No
Ivory gull	*Pagophila eburnean*	year-round	coastal / offshore	Occur in Hudson Bay during both summer and winter, but breed in the Canadian High Arctic.	Endangered (Schedule 1)	Endangered	No
Sabine's gull	*Xema sabini*	summer	coastal / offshore	Migratory species. Breeds on colonies along the northern coasts of Hudson Bay. Pelagic outside breeding season.	No Status	Not Assessed	No
Thayer's gull	*Larus thayeri*	summer	coastal / offshore	Migratory species. Breeds along the coasts of northern Hudson Bay during summer including Coats and Southampton islands.	No Status	Not Assessed	No
Arctic tern	*Sterna paradisaea*	summer	coastal / offshore	Migratory species that breeds throughout the Hudson Bay and Hudson Strait.	No Status	Not Assessed	No
Pacific loon	*Gavia pacifica*	summer	coastal	Migratory species. Arctic breeding species common and numerous along the mainland and island coasts of the Hudson Bay coast.	No Status	Not Assessed	No
Red-throated loon	*Gavia stellata*	summer	coastal	Migratory species. Arctic breeding species common and numerous along the mainland and island coasts of Hudson Bay.	No Status	Not Assessed	No

Table 3-A-5: Ecologically and Culturally Important Seabird Species Potentially Present within the Study Area

Common Name	Species	Seasonal Occurrence	Distribution	Other relevant information	*SARA* Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Common loon	*Gavia immer*	summer	coastal	Migratory species. Common in southeastern Hudson Bay and James Bay.	No status	Not at Risk	No
Black scoter	*Melanitta americana*	summer	coastal	Migratory species. Common on the Belchers and along the coast from southeastern Hudson Bay west to Churchill. May overwinter in small numbers in James Bay.	No Status	Not Assessed	No
Red-breasted merganser	*Mergus serrator*	summer	coastal	Migratory species. Common along the coasts of James Bay and southwestern Hudson Bay. Males and non-breeding birds frequent coastal marine waters.	No Status	Not Assessed	No
Red-necked phalarope	*Phalaropus lobatus*	summer	coastal / offshore	Migratory species. Breeds widely across the Arctic and throughout Nunavut.	No status	Special Concern	No
Red phalarope	*Phalaropus fulcarius*	summer	coastal / offshore	Migratory species. Breeds along the west coast of Hudson Bay, on the Ungava Peninsula and on the southern end of Baffin Island in Nunavut.	No Status	Not Assessed	No
Parasitic jaeger	*Stercorarius parasiticus*	summer	coastal / offshore	Migratory species. Breed along the coast and islands of Hudson Bay.	No Status	Not Assessed	No
Long-tailed jaeger	*Stercorarius longicaudus*	summer	coastal / offshore	Migratory species. Breeds along the Quebec coast of Hudson Bay, on Southampton Island, and along the Kivalliq coast.	No Status	Not Assessed	No
Pomarine jaeger	*Stercorarius pomarinus*	summer	coastal / offshore	Migratory species. Breeds along the Quebec coast of Hudson Bay and on Southampton Island.	No Status	Not Assessed	No
Sandhill crane	*Grus canadensis*	summer	coastal	Migratory species. Summer visitors to the southern and western coasts of James Bay and Hudson Bay, from Boatswain west and north. Also reported on the Belchers and Southampton islands.	No status	Not at Risk	No
Dunlin	*Calidris alpina*	summer	coastal	Migratory species. Breeds along the west coast of Hudson Bay, on Southampton and Coats islands and on the southern end of Baffin Island in Nunavut.	No Status	Not Assessed	No
Semi-palmated sandpiper	*Calidris pusilla*	summer	coastal	Migratory species. Breeds in Hudson Bay including Southampton Island, Coats Island and the southern end of Baffin Island.	No Status	Not Assessed	No

Table 3-A-5: Ecologically and Culturally Important Seabird Species Potentially Present within the Study Area

Common Name	Species	Seasonal Occurrence	Distribution	Other relevant information	*SARA* Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Least sandpiper	*Calidris minutilla*	summer	coastal	Migratory species. Common breeder on the mainland shores of Hudson Bay south of Chesterfield Inlet in the west and Inukjuak in the east	No Status	Not Assessed	No
White-rumped sandpiper	*Calidris fuscicollis*	summer	coastal	Migratory species that breeds on the southern tip of Baffin Island and on the northwestern side of the Hudson Bay.	No Status	Not Assessed	No
Baird's sandpiper	*Calidris bairdii*	summer	coastal	Migratory species that breeds on the northern end of Baffin Island and in the coastal areas of the northern Foxe Basin.	No Status	Not Assessed	No
Pectoral sandpiper	*Calidris melanotos*	summer	Coastal	Migratory species that breeds along the northwest coast of the Hudson Bay, on Southampton and Coats islands in Nunavut.	No Status	Not Assessed	No
American golden plover	*Pluvialis dominica*	summer	Coastal	Migratory species that breed along the shores of Hudson Bay and James Bay and Southampton Island.	No Status	Not Assessed	No
Semi-palmated plover	*Charadrius semipalmatus*	summer	Coastal	Migratory species that breed along the shores of Hudson Bay and James Bay.	No Status	Not Assessed	No
Black-bellied plover	*Pluvialis squatarola*	summer	Coastal	Migratory species that breeds on the shores of northern Hudson Bay and Southampton Island.	No Status	Not Assessed	No
Ruddy turnstone	*Arenaria interpres*	summer	Coastal	Migratory species that breeds on the southern end of Baffin Island, along the coastal areas of the northern Foxe Basin, and on Southampton Island and Coats Island.	No Status	Not Assessed	No
Sanderling	*Calidris alba*	spring / summer	Coastal	Migratory species. Common spring migrant along the coast near Churchill en-route to its breeding grounds in the Arctic.	No Status	Not Assessed	No

Table 3-A-5: Ecologically and Culturally Important Seabird Species Potentially Present within the Study Area

Common Name	Species	Seasonal Occurrence	Distribution	Other relevant information	*SARA* Status[a]	COSEWIC Status[b]	Of Cultural, Economic or Subsistence Importance
Red knot	*Calidris canutus*	summer	Coastal	Migratory species. Hudson Bay ecosystem provides critical resources for this species.	Endangered *rufa* ssp. (Schedule 1) Threatened-*roselaari* ssp. (Schedule 1) Special Concern-*islandica* ssp. (Schedule 1)	Endangered -*rufa* ssp. Threatened-*roselaari* ssp. Special Concern-*islandica* ssp.	No
Peregrine falcon	*Falco peregrinus*	summer	coastal	Breed and hunt along the coasts of Hudson Bay and James Bay in summer. Breed in areas with high to moderate relief along the Hudson Bay coast of Manitoba, Nunavut, and northern Quebec and on Southampton, Coats and the Belcher and Nastapoka islands	Special Concern-*anatum/tundrius* ssp. (Schedule 1)	Special Concern-*anatum/tundrius* ssp.	No
Snowy owl	*Bubo scandiacus*	summer	coastal	Breed and forage along the coasts of Hudson Bay and James Bay	No status	Not at Risk	No

[a] SARA (*Species at Risk Act*). The Act is a key federal government commitment to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity (extracted from SARA 2012).

[b] COSEWIC (Committee on the Status of Endangered Wildlife in Canada) is a committee of experts that assesses and designates which wildlife species are in some danger of disappearing from Canada. It is up to Government to legally protect wildlife species designated by COSEWIC. The potential impacts of legal listing are for Government to analyse, and the *Species at Risk Act* (SARA) applies only to wildlife species on the SARA legal list (extracted from COSEWIC 2015).

No Status = species found in COSEWIC or SARA database but with no designation indicated; Not Assessed = species could not be found in either COSEWIC or SARA database; Special Concern = species at low density that does not qualify for threatened status; Data Deficient = information is insufficient to determine criteria or assign any status; Not at Risk = species that has been evaluated and determined to be not at risk of extinction; Threatened = species that is likely to become an endangered if nothing is done to reverse factors; Endangered = species facing imminent extinction.

Table 3-A-6: Ecologically and Biologically Significant Areas (EBSAs) in the Vicinity of the Study Areas

Region	EBSA	Key Ecological and Biological Features
Hudson Bay	Southhampton Island (including Coats Island) (EBSA 1.5)	▪ High marine productivity driven by dynamic oceanographic mixing ▪ Habitat for Atlantic walrus (Special Concern under COSEWIC) during summer and winter ▪ Migration routes for beluga and EC-WG bowhead whales (Special Concern under COSEWIC) during spring and fall ▪ Important polar bear denning and summer refuge habitat ▪ Important nesting habitat for thick-billed murre, common eider, and black guillemot
	Western Hudson Bay (Whale Cove to Arviat) (EBSA 1.6)	▪ Important habitat for beluga and killer whales ▪ Dense kelp beds along coastline ▪ Important Arctic char stocks which, along with marine mammal populations, are used for subsistence harvesting (DFO 2011b)
	Western Hudson Bay / Churchill / Nelson / Seal River Estuaries (EBSA 1.7)	▪ World's largest summer aggregation of beluga whales (in the Nelson River estuary) ▪ Important Western Hudson Bay polar bear denning and feeding habitat; the Western Hudson Bay polar bear population is listed as Threatened under *The Endangered Species Act* of Manitoba (Government of Manitoba 1990) ▪ Important bird habitat in the Seal River estuary, identified as an Important Bird Area in 1999 and significant migrating habitat for global Black Scoter populations
Hudson Strait	West and Central Hudson Strait (1.10)	▪ Unique oceanographic environment with influence of Arctic and Atlantic ocean waters ▪ Seasonal migration route for marine mammal species (i.e. beluga whales, bowhead whales, narwhal) which spend at least part of their year in Hudson Bay, Foxe Basin, Hudson Strait and/or Davis Bay ▪ Winter habitat for walrus on shorelines, ice flows and islands ▪ Nesting and feeding habitat for thick-billed murre, common eider, and a small population of Atlantic puffin
	Eastern Hudson Strait (EBSA 1.11)	▪ Overwintering habitat for Hudson Bay beluga and thousands of bowhead whales ▪ Important area for shrimp; part of Canadian Shrimp Fishing Area #3 overlaps with eastern Hudson Strait ▪ Habitat for Greenland halibut ▪ High concentrations of soft corals and sponge beds near outflow of Hudson Strait (Kenchington et al. 2011)
	Ungava Bay (EBSA 1.12)	▪ Habitat for Ungava Bay beluga population listed as *Endangered* under COSEWIC (under consideration for designation under SARA) ▪ Nesting and breeding habitat for black guillemot, common eider and largest number of breeding thick-billed murres in Canada ▪ Denning and rearing habitat for Davis Strait population of polar bear in summer

Table 3-A-7: Environment Canada Key Marine Habitat Sites for Migratory Birds in the Vicinity of the Project Area

Site Name	Sensitivities	Biological Significance	Status	Size (km^2)	
				Marine	Land
Coats Island near Cape Pembroke	Sensitive to disturbance of important nesting sites along coast, important foraging grounds and staging / breeding areas in the marine environment, and key migratory corridors. Concerns around increases in vessels in the area coming close to Coats and Walrus islands.	Important nesting areas occur on Coats Island for seabirds (thick-billed murre, common eider, and black guillemot), which feed on aggregations of marine fish (e.g., capelin and Arctic cod). Glaucous gull and peregrine falcon can be found along the cliffs at the colonies. Home to a large Iceland gull (*Larus glaucoides*) colony and the largest single colony of common eider in Nunavut occurs in East Bay.	International Biological Programme site (Region 9, Site No. 6-3) and an IBA (NU005).	1,918	0
Digges Sound	Sensitive to disturbance of important nesting sites along coast, important foraging grounds and staging / breeding areas in the marine environment, and key migratory corridors. Concerns around increases in vessels in the area. Colonies are considered to be some of the most disturbed by human activities in the Canadian Arctic.	20% of North American population of thick-billed murre and a small colony of Atlantic puffin (*Fratercula arctica*) and razorbill (*Alca torda*) occur near Digges Sound. 10% of the Canadian population of common eider breed and feed near Markham Bay. Other species that also breed here are black guillemot, glaucous gull, Iceland gull, herring gull, and Arctic tern.	International Biological Programme site (Region 9, Site No. 6-7) and an IBA in Canada (NU001).	2,207	102
Frobisher Bay	Sensitive to disturbance of important nesting sites along coast, important foraging grounds and staging / breeding areas in the marine environment, and key migratory corridors. Concerns around increases in vessels in the area and potential hydrocarbon exploration. The complex nature of currents in the region suggests that a potential oil spill in southern Davis Strait could reach this marine area.	Colony represents 3% of the Canadian thick-billed murre population. Glaucous gull, black-legged kittiwake, and possibly Northern fulmar breed here. Nearby Loks Land is thought to support Nunavut's largest known colony of razorbill (not been visited since 1953). Dovekies congregate off the Hall Peninsula in August. An important nesting, feeding, and migration stop-over for common eider, Iceland gull, ivory gull, and harlequin duck (*Histrionicus histrionicus*). Canada goose and long-tailed ducks may also be found here.	Hantzsch Island is an International Biological Programme site (Region 9, Site No. 7-10) and a Canadian IBA (NU025).	12,442	1,336

Table 3-A-7: Environment Canada Key Marine Habitat Sites for Migratory Birds in the Vicinity of the Project Area

Site Name	Sensitivities	Biological Significance	Status	Size (km^2)	
				Marine	Land
Button Islands	Sensitive to disturbance of important nesting sites along coast, important foraging grounds and staging / breeding areas in the marine environment, and key migratory corridors. Concerns around increases in vessels in the area and potential hydrocarbon exploration. The complex nature of currents in the region suggests that oil spills in southern Davis Strait could enter this marine area. Oil spills associated with shipping could endanger a large number of marine birds and pollute their feeding areas.	Black-legged kittiwake and northern fulmar forage near the Button Islands. Ivory gulls and common eider have been observed. Thick-billed murre breed here.	International Biological Programme site (Region 9, Site No. 6-8).	3,909	81
Akpatok Island	Sensitive to disturbance of important nesting sites along coast, important foraging grounds and staging / breeding areas in the marine environment, and key migratory corridors - particularly for murres. Shoreline around Akpatok Island is considered to be “high hazardous risk of oil spills”. Concerns around increases in vessels in the area and potential hydrocarbon exploration. The complex nature of currents in the region suggests that oil spills in southern Davis Strait could reach this marine area. Oil spills associated with shipping could endanger a large number of marine birds and pollute their feeding areas.	Large breeding colony of thick-billed murre. Black guillemots also nest along the Akpatok Island coast. Black guillemot nest along the island’s coast. Peregrine falcon and glaucous gull also breed here.	International Biological Programme site (Region 9, Site No. 6-6) and an IBA in Canada (NU007).	4,943	859

Table 3-A-7: Environment Canada Key Marine Habitat Sites for Migratory Birds in the Vicinity of the Project Area

Site Name	Sensitivities	Biological Significance	Status	Size (km^2)	
				Marine	Land
Ungava Bay Archipelagoes	Sensitive to disturbance of important nesting sites along coast, important foraging grounds and staging / breeding areas in the marine environment, and key migratory corridors.	Support a large portion of breeding common eider. Eider occur in this area from April through October	The Plover and Payne, Gyrfalcon, and north eastern Ungava Bay islands are Canadian IBA (NU027, NU028, NU029).	5,624	5
Sleeper Islands	Degradation of staging and foraging areas, particularly for eiders. Potential hydrocarbon exploration. Prevailing west and north west winds render the east coast of the Bay most susceptible to oil damage.	Common eiders nest here in the summer months. Over 30 species of birds have been observed in the Sleeper Islands.	IBA site (NU033).	1,880	90
Belcher Islands	Degradation of staging and foraging areas, particularly for eiders. Excessive harvest of down from breeding colonies. Potential hydrocarbon exploration. Prevailing west and north west winds render the east coast of the Bay most susceptible to oil damage.	Common eider nest here in the summer. In the winter, polynyas and the floe edge support substantial numbers of common eider and long-tailed duck.	The North Belcher and South Flaherty islands are Canadian IBA (NU031, NU100).	5 to 15 recurrent, small polynyas	
Northern Ontario Coastline	Degradation of staging and foraging areas, particularly for ducks. Potential hydrocarbon exploration.	Black scoter moult along this marine area feeding on blue mussels and other molluscs. Common eiders are year-round residents. Canada geese and lesser snow geese make use of coastal areas.	Waters in James Bay are part of the James Bay Preserve.	7,860	41

Table 3-A-7: Environment Canada Key Marine Habitat Sites for Migratory Birds in the Vicinity of the Project Area

Site Name	Sensitivities	Biological Significance	Status	Size (km^2)	
				Marine	Land
Markham Bay	Disturbance and sensitivity to potential pollution of foraging, staging and migrating areas.	Support a large portion of breeding common eider. Support substantial numbers of Kumlien's gull (*Larus glaucoides kumlieni*) and black guillemot. Eiders occur in this area from April through October.	No special designation.	4,015	423
East Bay	Disturbance and sensitivity to potential pollution of foraging, staging and migrating areas.	Supports Arctic Canada's largest single colony of common eider. Supports colony of black guillemot and a large population of lesser snow goose. Substantial numbers of Atlantic brant and Sabine's gull also breed here. Supports some of the highest known breeding densities of shorebirds in the eastern Arctic. Red phalarope are the most common shorebirds.	Migratory Bird Sanctuary and a Canadian IBA (NU023).	274	1

km^2= square kilometres.

Table 3-A-8: Summary of Vessel Traffic Encountered in Hudson Strait by Industry Sector between 2007 and 2013

Sector	% of Traffic	Traffic Assessment
Domestic Supply	54	Domestic resupply/sealift operations for communities in Eastern Arctic which are dependent on operations for consumer, commercial, and construction needs.
Mining and Mineral Extraction	14	Supply to and export from Ragland and Nunavik mines, supply to Baker Lake.
Oil and Gas Exploration	1	Currently no development occurring in Hudson Strait. Vessels use Strait to access Hudson Bay and enter/exit Arctic Archipelago and Northwest Passage.
Shipping	15	Frequent bulk carrier exports of grain to foreign destinations.
Fishing	1	Small numbers of fishing vessels pass through Hudson Strait in transit between NAFO fishing zones and home ports.
Government Activities	9	Coast Guard icebreakers perform research activities, navigational assistance, community visits, etc.
Tourism	5	Passenger vessels used to access interior Arctic and Hudson Bay.
Other	1	Scientific research and ocean survey vessels perform research, tugs assist with towage.

Source: adapted from WWF Canada (2015).

Table 3-A-9: Vessels in Hudson Strait between 2007 and 2013

Vessel Type	Average Annual Vessels	Average Annual Transits
Bulk Carrier	17	27
General Cargo	13	71
Fishing Vessel	3	5
Tanker	8	34
Tug	6	14
Passenger Vessel	5	9
Government Icebreaker	6	11
Other	2	3

Source: adapted from WWF Canada (2015).

Table 3-A-10: Potential Pathways for Effects on Marine Environment and Marine Wildlife

#	Project Activity	Valued Components				Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
		Water quality	Marine Mammals	Marine Fish	Marine Birds			
1	Marine operations including navigation in the shipping corridor and the channel of Chesterfield Inlet and reloading (lightering) of fuel and dry goods from ocean-going ships onto barges	X	X	X	X	Solid waste, grey water, and bilge water discharges from ships may result in direct adverse effects on marine water quality in the proposed shipping corridor and associated adverse effects on marine wildlife and their habitats.	Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO 2008; MARPOL 73/78). Adherence to mitigation outlined in Agnico Eagle's Shipping Management Plan (Volume 8, Appendix 8-D.5).	Secondary
2			X	X	X	Introduction of exotic marine species (including pathogens) from ship ballast water exchange during seasonal shipping events can affect native marine wildlife VCs.	Adherence to Ballast Water Management Plan (BWMP) as defined in the Shipping Management Plan (Volume 8, Appendix 8-D.5). Adherence to mitigation outlined in Agnico's Shipping Management Plan (Volume 8, Appendix 8-D.5).	Secondary
3		X	X	X	X	Antifouling toxins (e.g., tributyltin) potentially leaching from Project vessels can have an effect on the marine environment and bio-accumulation in marine food chains.	Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO 2008; MARPOL 73/78). Adherence to mitigation outlined in Agnico Eagle's Shipping Management Plan (Volume 8, Appendix 8-D.5).	Secondary

Table 3-A-10: Potential Pathways for Effects on Marine Environment and Marine Wildlife

#	Project Activity	Valued Components: Water quality	Valued Components: Marine Mammals	Valued Components: Marine Fish	Valued Components: Marine Birds	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
4	Marine operations including navigation in the shipping corridor and the channel of Chesterfield Inlet and reloading (lightering) of fuel and dry goods from ocean-going ships onto barges	X	X	X	X	Accidents and malfunctions could result in fuel spills with direct adverse effects on marine water quality and associated adverse effects on marine wildlife VCs and their habitats.	Adherence to Spill Contingency Plan (Volume 8, Appendix 8-D.6). Adherence to Emergency Response Plan (Volume 8, Appendix 8-D.3). Adherence to Shipping Management Plan (Volume 8, Appendix 8-D.5). Adherence to Oil Pollution Emergency Plan (OPEP; Volume 8, Section 8.3.4.6). Compliance with Shipboard Oil Pollution Emergency Plan (SOPEP). Adherence to MARPOL Convention, Protocols and Annexes as set out by the International Maritime Organization (IMO 2008; MARPOL 73/78); *Canada Shipping Act*; and *Arctic Waters Pollution Prevention Act*. Operational activities have been engineered to use contained handling systems to minimize the risk of accidental spills into the marine environment.	Primary
5		X	X	X	X	Accidental spills from spills of dry cargo (loading and offloading barges) can have direct adverse effects on marine water quality and associated adverse effects on marine wildlife VCs and their habitats.	See Item 4	Secondary

Table 3-A-10: Potential Pathways for Effects on Marine Environment and Marine Wildlife

#	Project Activity	Valued Components: Water quality	Valued Components: Marine Mammals	Valued Components: Marine Fish	Valued Components: Marine Birds	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
6	Marine operations including navigation in the shipping corridor and the channel of Chesterfield Inlet and reloading (lightering) of fuel and dry goods from ocean-going ships onto barges		X	X	X	Alteration in marine wildlife behavior due to underwater noise from vessel activities	Vessels will follow established navigation lanes in LSA, maintaining a constant course and constant speed.	Primary (Marine Mammals); Secondary (Marine Fish); No Linkage (Marine Birds)
							Implementation of vessel speed restrictions: <14 knots in shipping lanes. Avoidance of rapid accelerations.	
							To the extent possible, vessel will shut-down vessel engines and propellers while anchored.	
							Vessels will not approach within 300 m of a walrus or polar bear on sea ice, or any mammal engaged in feeding activities. For all other mammal encounters, vessels will not approach within 100 m.	
							If a mammal approaches within 100 m of a vessel, the vessel shall reduce its speed and, if possible, cautiously move away from the animal. If a vessel is unable to detour around a stationary marine mammal, it shall reduce its speed and wait until the animal(s) moves at least 100 m from the vessel prior to resuming speed.	
							The vessel shall not be operated in such a way as to separate an individual member(s) of a group of marine mammals from other members of the group.	
							Adherence to all other mitigation outlined in Agnico Eagle's Shipping Management Plan (Volume 8, Appendix 8-D.5).	

Table 3-A-10: Potential Pathways for Effects on Marine Environment and Marine Wildlife

#	Project Activity	Valued Components: Water quality	Valued Components: Marine Mammals	Valued Components: Marine Fish	Valued Components: Marine Birds	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment
7	Marine operations including navigation in the shipping corridor and the channel of Chesterfield Inlet and reloading (lightering) of fuel and dry goods from ocean-going ships onto barges		X		X	Vessel movements in the shipping corridor may result in collisions with marine mammals	Adherence to mitigation outlined in Agnico Eagle's Shipping Management Plan (Volume 8, Appendix 8-D.5) (see above).	Primary
8					X	Vessel lighting at night may result in marine bird mortality or injury due to collisions with vessels (sensory disturbance)	Where feasible, lights on ships will be minimized to mandatory navigational lighting or shielded and/or angled to minimize direct illumination and reflection of the sea surface. Navigation will occur during summer when daylight is extended, minimizing the need for lighting. Vessels will maintain a minimum distance of 200 m from nesting locations in accordance with best management practices for raptor conservation (Demarchi et al. 2005)	Primary
9					X	Alteration of marine bird behavior due to vessel lighting at night and in-air noise during ship-to-ship loading (lightering)	Activities will be scheduled during daylight hours whenever practical to minimize the need for staging lights. Work will occur during summer when daylight is extended, minimizing the need for site lighting. Lightering occurs at approximately 1 km distance from the shore and no large bird concentrations were previously reported in this area, therefore in-air noise disturbance for birds will be negligible	Primary

Table 3-A-11: Residual Impacts Classification and Determination of Significance on Marine Wildlife Valued Components

Pathway	Magnitude		Geographic Extent		Duration	Frequency	Reversibility	Likelihood	Significance for Assessment Endpoint
	Incremental	Cumulative	Incremental	Cumulative					
Marine Fish and Fish Habitat									
Mortality and health effect from minor fuel spill	Moderate	Moderate	Local	Local	Short-term	Isolated	Reversible	Unlikely	Not Significant
Mortality and health effect from major fuel spill	High	High	Regional to Beyond Regional	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Change in Habitat Quality due to minor spill	Moderate	Moderate	Local	Local	Short-term	Isolated	Reversible	Unlikely	Not Significant
Change in Habitat Quality due to Major spill	High	High	Regional to Beyond Regional	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Marine Mammals									
Mortality and health effect from minor fuel spill	Low	Low	Local	Local	Short-term	Isolated	Reversible	Unlikely	Not Significant
Mortality and health effect from major fuel spill	High	High	Regional to Beyond Regional	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Change in Habitat Quality due to minor spill	Low	Low	Local	Local	Short-term	Isolated	Reversible	Unlikely	Not Significant
Change in Habitat Quality due to Major spill	High	High	Regional to Beyond Regional	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Mortality and Injury Risk due to Vessel Collision	Low	Moderate	Local	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Possible	Not Significant
Change in Behaviour due to Underwater Noise	Low	Moderate	Regional	Regional to Beyond Regional	Short-term	Periodic	Reversible	Likely	Not Significant
Marine Birds									
Mortality and Health Effect from Minor Fuel Spill	Low	Low	Local	Local	Short-term	Isolated	Reversible	Unlikely	Not Significant

Table 3-A-11: Residual Impacts Classification and Determination of Significance on Marine Wildlife Valued Components

Pathway	Magnitude		Geographic Extent		Duration	Frequency	Reversibility	Likelihood	Significance for Assessment Endpoint
	Incremental	Cumulative	Incremental	Cumulative					
Mortality and Health Effect From Major Fuel Spill	High	High	Regional to Beyond Regional	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Change in Habitat Quality due to minor spill	Low	Low	Local	Local	Short-term	Isolated	Reversible	Unlikely	Not Significant
Change in Habitat Quality due to Major spill	High	High	Regional to Beyond Regional	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Mortality and Injury Risk due to Collision with Vessels	Low	Low	Local	Regional to Beyond Regional	Medium-term	Isolated	Reversible	Unlikely	Not Significant
Change in behaviour due to In-air Noise and Vessel Lighting	Low	Moderate	Local	Regional to Beyond Regional	Medium-term	Periodic	Reversible	Likely	Not Significant

APPENDIX 3-B

Human Health and Ecological Risk Assessment Summary

3.B-1 INTRODUCTION

This appendix was prepared by Golder Associates Ltd. (Golder), on behalf of Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle), to summarize the potential risks to human health and the environment as a result of the Whale Tail Pit and Haul Road (the Project).

This Human Health and Ecological Risk Assessment (HHERA) addresses the requirements of the EIS Guidelines for the Meadowbank Mine (NIRB 2004) in terms of assessing potential risks to human health, wildlife, and aquatic life as a result of changes to environmental quality from the predicted emissions and discharges from the Project. Changes to environmental quality include direct effects to air quality and water quality, and indirect effects to soil quality, vegetation quality, and traditional food quality including fish and wild game, such as caribou.

The HHERA follows the principles of risk assessment frameworks from such agencies as Health Canada (e.g., Health Canada 2012), Canadian Council of Ministers of the Environment (CCME 1996, 1997), and United States Environmental Protection Agency (U.S. EPA 1989).

3.B-1.1 Valued Components

In broad terms, changes to environmental quality as predicted by other disciplines were quantitatively evaluated for each of the valued components (VCs) described below for human health (Table 3-B-1), wildlife (Table 3-B-2) and aquatic life (Table 3-B-3).

Table 3-B-1: Valued Components and Rationale for Selection – Human Health

	Valued Component		**Rationale for Selection**
Health and Safety	Workers	Inuit	Inuit may be employed at the mine and reside at the accommodations provided at Whale Tail Pit
		Non-Inuit	Non-Inuit may be employed at the mine and reside at the accommodations provided at Whale Tail Pit
	Public	Inuit	Inuit are known to reside in Baker Lake and use the lands around Whale Tail Pit for hunting, gathering, and other traditional purposes
		Non-Inuit	Non-Inuit are known to reside in Baker Lake and may use the area around Whale Tail Pit for recreational purposes.

While the health of workers was initially identified as a VC for human health, worker health was not quantitatively evaluated in the human health risk assessment (HHRA). It was considered that worker health and safety would comply with all applicable occupational health and safety requirements. Additionally, potable water will be supplied from Nemo Lake, which is not proposed to undergo Project-related changes to water quality. As a result, only members of the public were retained in the HHRA.

Table 3-B-2: Valued Components – Wildlife

Valued Component	Species Identified	Receptor Evaluated in HHERA
Ungulates	Barren-ground caribou, muskox	Barren-ground caribou
Predatory Mammals	Grizzly bear, wolverine, Arctic wolf	Wolverine
Raptors	Peregrine falcon, gyrfalcon, rough-legged hawk, short-eared owl, snowy owl	Peregrine falcon
Water Birds	Common loon, red-throated loon, pacific loon, yellow-billed loon, Canada goose, snow goose, long-tailed duck	Common loon, Canada goose
Upland Birds	Lapland longspur, horned lark, savanna sparrow, rock ptarmigan, red-necked phalarope, semipalmated sandpiper	Rock ptarmigan, semipalmated sandpiper
Small Mammals	Arctic hare, Arctic ground squirrel (Sik Sik), collared lemming, northern red-backed vole	Arctic hare, Arctic ground squirrel (Sik Sik)

Note: Species of concern (national, territorial or Committee on Status of Endangered Wildlife in Canada [COSEWIC] status) are indicated with underlined text.

Receptor characteristics (including established body weights, food ingestion rates, and other key factors) are not available for all of the species identified as VCs. As a result, representative species for which receptor characteristics are available were selected for assessment in the HHERA, and only one receptor was selected to represent each feeding guild.

Table 3-B-3: Valued Components and Rationale for Selection – Aquatic Life

Valued Component	Rationale for Selection
Fish (Arctic Char, Arctic Grayling[a], Lake Trout, Round Whitefish)	▪ Fish are an important food source for the residents of Baker Lake and fishing activities occur year round ▪ Fish are a prey item for piscivorous wildlife ▪ Several forage and sport fish species were identified in the Project area
Aquatic Invertebrates	▪ Includes planktonic and benthic invertebrates; benthic invertebrates play a vital role in nutrient cycling and the breakdown of detritus in the aquatic environment; important food source for fish; sensitive to contamination; various species identified in Project area
Aquatic Plants and Algae	▪ Important food source for fish; aquatic plants provide habitat to other aquatic organisms; various species identified in the Project area

[a] The Arctic Grayling is classified as a sensitive species in the Northwest Territories.

3.B-1.2 Spatial and Temporal Boundaries

The spatial and temporal boundaries as defined by air quality and water quality were adopted for the HHERA (Volume 4, Section 4.1.3 and Volume 6, Section 6.1.3.1.3).

3.B-1.3 Pathway Analysis

The evaluation of Project effects on human health, wildlife and aquatic life considers the changes to measurement indicators and associated pathways (Table 3-B-4).

Table 3-B-4: Measurement Indicators and Pathways for the Human Health and Ecological Risk Assessment

Measurement Indicator	Associated Primary Pathway
Changes to Air Quality	▪ Fugitive dust sources and deposition of dust (including from blasting during mining) can change water and sediment quality, which may affect the health of terrestrial life, aquatic life, human food and water sources including country foods ▪ Air emission of sulphur dioxide, nitrogen oxides, and particulates may change water and sediment quality, which may affect the health of terrestrial life, aquatic life, human food and water sources including country foods ▪ Project activities will result in air emissions, which may cause changes in air concentrations and, as a result, soil concentrations, which may affect the health of terrestrial life ▪ Project vehicles along the haul road will result in air emissions, which may cause changes in air concentrations and as a result, soil concentrations which may affect the health of terrestrial life ▪ Fuel combustion will result in air emissions, which may contribute to territorial and national greenhouse gas emissions, which may directly affect human health ▪ Changes in air concentrations may also result in alterations to soil concentrations, which may affect human food and water sources including country foods
Changes to Water Quality	▪ Project footprint, which will physically alter watershed areas and drainage patterns, rates, and quantities of diverted non-contact water to new watersheds, may change downstream flows, water levels, channel/bank stability in streams and may affect water and sediment quality, which may affect the health of terrestrial life, aquatic life, human food and water sources including country foods ▪ Dewatering of lakes may change flows, water levels, channel/bank stability, and water quality (e.g., suspended sediments, nutrients, metals) in receiving and downstream waterbodies, which may affect the health of terrestrial, aquatic life, human food and water sources including country foods ▪ Release of mine wastewater (including sewage) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations), which may affect the health of terrestrial, aquatic life, human food and water sources including country foods ▪ Water quality in flooded pits may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality, which may affect the health of terrestrial, aquatic life, human food and water sources including country foods
Changes to Noise	▪ Sensory disturbance (i.e., noise) can directly affect human health ▪ Sensory disturbance (i.e., noise) can indirectly affect human health by affecting migration patterns of wildlife populations (e.g., caribou) and subsequently human food sources including country foods

Previous risk assessments have been completed at the Meadowbank Mine in 2006 and 2014 (Wilson Scientific Consulting Inc. 2006; Azimuth Consulting Group Inc. 2006; Agnico Eagle 2012; Agnico Eagle 2015a, b), which have assessed the potential risks to human health and wildlife as a result of changes to soil quality (metals) due to dust deposition from the ongoing Meadowbank operations and have been considered herein, where applicable.

As indicated in Volume 7, Section 7.5 of the FEIS Amendment, the FEIS for the Meadowbank Mine (Cumberland 2005) predicted that the construction of the mine would result in temporary nuisance effects on people's quality of life, as related to dust, noise, changes in air quality and visual disturbances. This prediction was related to construction of infrastructure at the mine (e.g., fuel tank farm, lay down and warehouse facilities, transportation of infrastructure construction equipment) and the road, and was considered to be of low significance given mitigation and the duration of effects. The Project will use existing infrastructure at the Meadowbank Mine, and on-site construction activities at Whale Tail Pit and the haul road are expected to be similar or less than those generated for the Meadowbank Mine. Additionally, as indicated in Volume 4, Section 4.4.4 of the FEIS Amendment, noise levels will either decay to ambient noise levels or be compliant with AER Directive 038 Criteria at the local study area boundary during construction and operations, with the exception of blasting, which will comply with NPC-119. While members of the public may potentially pass through the Project area on-route to traditional or cultural sites or access other important traditional areas, the public is expected to be primarily outside the local study area, with limited exposure to noise over ambient levels or the AER Directive 038 Criteria. Based on the wildlife assessment (Volume 5, Section 5.5.4.1) noise impacts will have a moderate effect on wildlife over the medium-term but are reversible at closure. Based on the results of the noise assessment and wildlife assessment, noise was considered a secondary pathway in the HHERA for both human health and wildlife and was not assessed further.

To complete the effects assessment for the measurement indicators identified above, the following environmental media were assessed with respect to potential changes to environmental quality that may have an effect on human health, wildlife and aquatic life:

- air quality, which was predicted for receptor locations in the local study area (LSA) by the air quality discipline;
- soil quality, which was calculated based upon predicted deposition rates;
- country food quality, which was calculated based upon changes to soil (and vegetation) quality;
- water quality, which was predicted for waterbodies in the LSA by the water quality discipline; and
- fish tissue quality, which was calculated based upon changes to water quality.

Although changes to sediment quality were identified in the pathways analysis table above (Table 3-B-4), sediment quality was not assessed in the HHERA as changes to sediment quality were assessed qualitatively and no significant changes were identified(Volume 6, Section 6.3).

Predicted changes to environmental media were assessed (modeled) by other disciplines for one or more phases of the Project as appropriate (Table 3-B-5).

Table 3-B-5: Phases Modelled for Environmental Quality Predictions

Environmental Medium	Project Phases			
	Construction	Operations	Closure	Post-Closure
Air quality	○	●	—	○
Soil quality[a]	○	●	—	○
Country foods quality[a]	○	●	—	○
Water quality[b]	○	●	●	●
Fish quality[c]	○	●	●	●

[a] Potential changes to soil quality and country foods quality were calculated in the HHERA using predicted concentrations of metals in dustfall modelled by air quality.

[b] Potential changes to water quality varied from water body to water body; therefore, each water body was assessed individually in the effects assessment.

[c] Potential changes to fish tissue quality were calculated in the HHERA using predicted changes to water quality.

— = Phase not considered; ○ = Phase considered, but not assessed; ● = Phase assessed.

Mitigation measures were incorporated into the predictive modeling for changes to air quality and surface water quality. The mitigation measures are described in detail in the relevant sections of the FEIS. No additional mitigation measures were considered in the HHERA.

3.B-2 EXISTING ENVIRONMENT AND BASELINE

The existing environment and baseline conditions, relevant to the HHERA were summarized by other disciplines in the Volumes 4 through 6, with the exception of soil and vegetation quality beyond the Project footprint, provided in Attachment A.

3.B-3 EFFECTS ASSESSMENT FOR HUMAN HEALTH

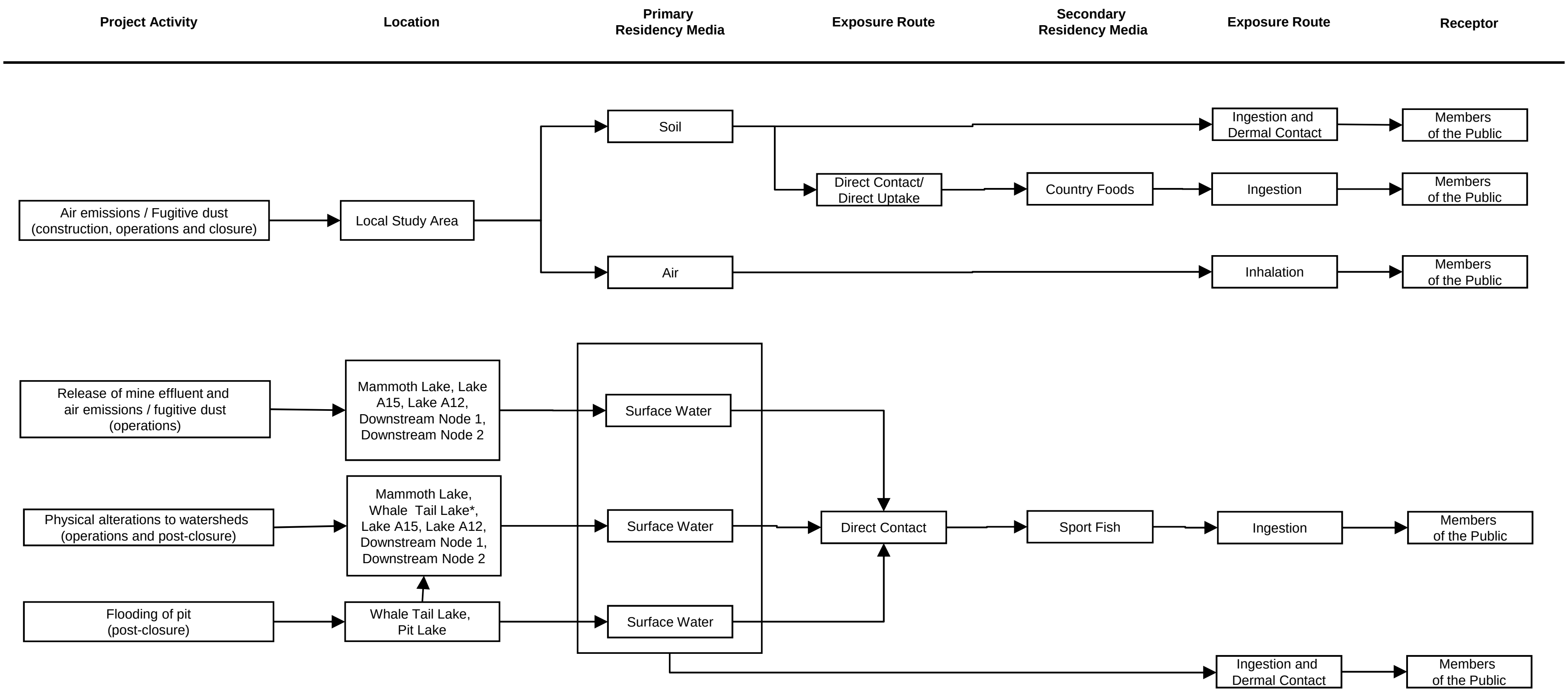
3.B-3.1 Conceptual Site Model

A conceptual site model (CSM; Figure 3-B-1) was developed for human health based upon the primary pathways identified above (Table 3-B-4). The exposure pathways between Project activities, intermediate residency media (i.e., the aspects of the environment that that may experience a change in quality due to Project activities/emissions), and receptors are shown to be either complete or incomplete. Where pathways are incomplete, quantitative assessment was not carried out given that environmental quality was not anticipated to change as a result of the Project. Complete pathways on the figure indicate that a change to environmental quality was predicted and a quantitative assessment of the potential effects to human health was carried out. A brief summary of the complete exposure pathways are provided below for Inuit and non-Inuit members of the public:

- inhalation of air;
- incidental ingestion and dermal contact with soil;
- ingestion and dermal contact with surface water; and
- consumption of country foods (e.g., caribou, fish).

Conceptual Site Model for the Project – Human Health

FIGURE 3-B-1



LEGEND

- - - ▶ Pathway incomplete and/or not evaluated

——▶ Pathway complete and evaluated

* For post-closure phase only

Date: June 17, 2016	Golder Associates	CAD: AA
Project: 1541520 (3500)		CKD: TMG

3.B-3.2 Air Quality

3.B-3.2.1 Problem Formulation

Problem formulation consists of identification of receptors, pathways, and chemicals of potential concern (COPCs).

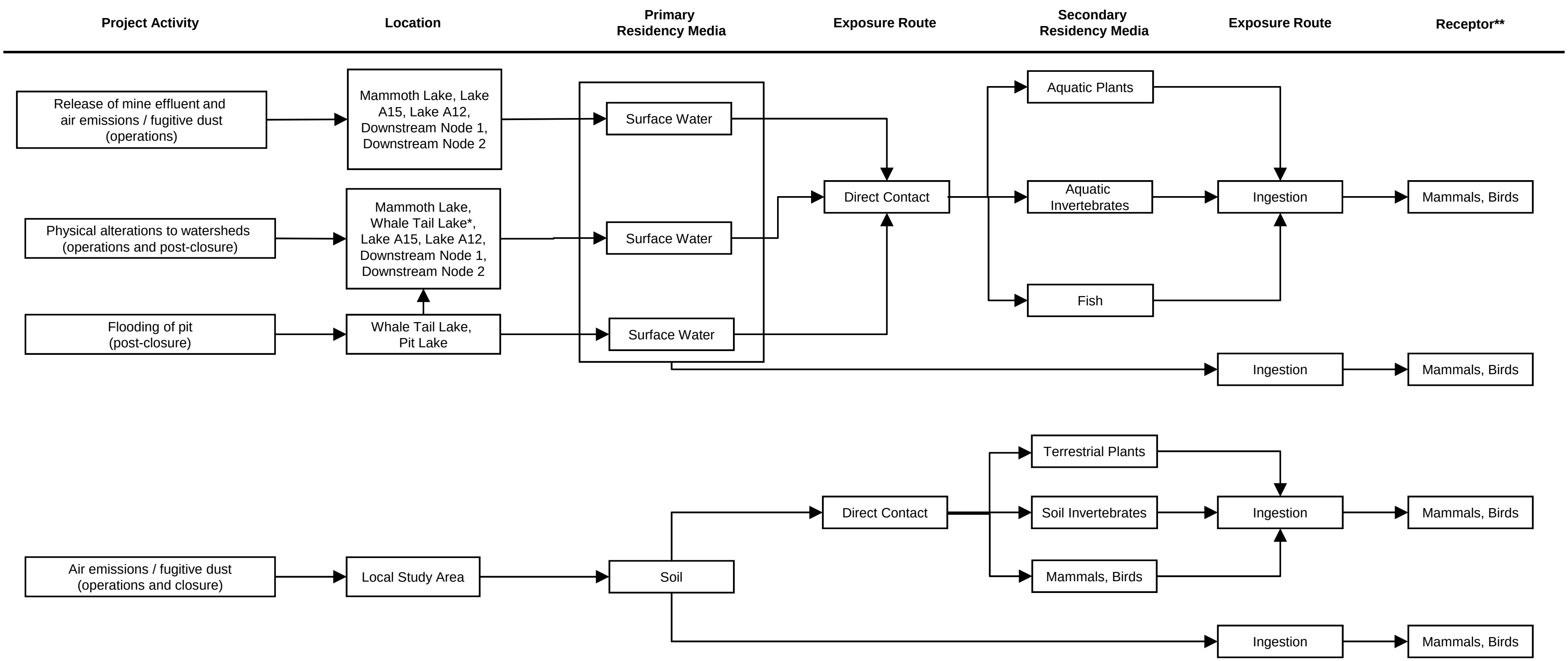
Effects on human health were evaluated based on the traditional use of the area. Locations that were identified as part of the IQ Baseline Study (Agnico Eagle 2014) were identified as human receptor locations for the purposes of predicting changes to air quality. Sixteen receptor locations were identified (Table 3-B-6; Figure 3-B-2).

Table 3-B-6: Human Health Receptor Location Descriptions for Air Quality

Receptor Name	Description
Grave Site 2	Grave site near Nutipilik Lake, southeast of Whale Tail Pit
Grave Site 3	Grave site west of Whale Tail Pit
Grave Site 4	Grave site west of Whale Tail Pit
Grave Site 5	Grave site south of Whale Tail Pit
Grave Site 27	Grave site west of Whale Tail Pit
Grave Site 28	Grave site west of Whale Tail Pit
Grave Site 29	Grave site west of Whale Tail Pit
Grave Site 30	Grave site within secondary disturbance area of Whale Tail Pit
Fishing Marker	Fishing area on Pipedream Lake, southeast of Whale Tail Pit, near proposed haul road to Meadowbank Mine
Muskox	Muskox hunting area, east of Whale Tail Pit
Muskox 2	Muskox hunting area, south of Whale Tail Pit
To Iglu	Location along winter travel route to Iglujaalik (Garry Lake), Chantrey Inlet, Gjoa Haven, Hanninajuaq (Middle Back River), northeast of Whale Tail Pit
Fishing Area	Fishing area on Nutipilik Lake, identified camping area, southeast of Whale Tail Pit
Caching Area	Caching area near Nutipilik Lake, southeast of Whale Tail Pit
Track	Tracking area (foxes and wolves), east of Whale Tail Pit
Caching	Caching area near Tahinajuk Lake, east of Whale Tail Pit

Conceptual Site Model for the Project – Wildlife

FIGURE 3-B-2



NOTES

* For post-closure phase only.

** The receptors have been simplified to mammals and birds. The species of mammals and birds selected as receptors are described in Section 3-B-1.1 of Appendix 3-B of the FEIS Amendment.

LEGEND

- - - ▶ **Pathway incomplete and/or not evaluated**

——▶ **Pathway complete and evaluated**

Date: June 17, 2016	Golder Associates	CAD: AA
Project: 1541520 (3500)		CKD: TMG

Predicted concentrations for chemicals in air (i.e., criteria air contaminants and metals) were compared to the health-based thresholds for the relevant averaging period (i.e., 1-hour, 24-hour and annual) from Government of Nunavut Department of Environment (NDOE 2011). If a threshold was not available from NDOE, the most conservative (i.e., protective) of the available health-based thresholds was selected from the following agencies:

- CCME (CCME 1999a);
- Ontario Ministry of the Environment (OMOE 2012);
- Agency for Toxic Substances and Disease Registry (ATSDR 2016);
- California Environmental Protection Agency (CalEPA 2014);
- World Health Organization (WHO 2000, 2005); and
- Texas Commission on Environmental Quality (TCEQ 2015).

Additionally, comparison to baseline concentrations (where available) plus 10% was completed. If predicted concentrations for chemicals in air were greater than the available health-based thresholds and baseline concentrations plus 10% (where available), the chemical was identified as a COPC.

Based upon the screening process outlined above, the following COPCs (Table3-B-7) were identified:

Table3-B-7: Chemicals of Potential Concern for Air Quality

Averaging Period	Chemical	Location	Concentration (µg/m^3)
24-hour	Arsenic	Grave Site 30	0.0175
24-hour	Iron	Grave Site 4	5.68
24-hour	Iron	Grave Site 30	12.0
24-hour	Iron	Muskox 2	4.63
24-hour	Manganese	Grave Site 30	0.124
Annual	$PM_{2.5}$	Grave Site 30	8.87

µg/m^3 = micrograms per cubic metre.

3.B-3.2.2 Toxicity Assessment

The toxicity assessment involves the determination of the dose to which a receptor can be exposed without experiencing adverse health effects (i.e., dose-response analysis); this dose is called the toxicity reference value (TRV). Toxicity reference values for the inhalation pathway (i.e., reference concentrations or RfCs) were compiled from the following agencies:

- Ontario Ministry of the Environment (OMOE 2011, 2012);
- Health Canada (Health Canada 2012);
- United States Environmental Protection Agency's (U.S. EPA's) Integrated Risk Information System (IRIS) (U.S. EPA 2016a);
- CalEPA (CalEPA 2014);
- ATSDR (ATSDR 2016);

- WHO (WHO 2000, 2005); and
- Netherlands National Institute of Public Health and the Environment (RIVM 2001).

The most protective of the available RfCs were selected for use in the assessment (Table 3-B-8).

Table 3-B-8: Selected Toxicity Reference Values for Chemicals of Potential Concern Evaluated in the Air Quality Assessment

COPC	Selected RfC (mg/m^3)	Endpoint	Source
Arsenic	0.00003	Neurobehavioural development in children	CalEPA 2014
Iron	0.004	Health	OMOE 2012
Manganese	0.00005	Impairment of neurobehavioural function in workers	U.S. EPA 2016a

COPC = chemical of potential concern; RfC = reference concentration; mg/m^3 = milligrams per cubic metre.

There are no TRVs for $PM_{2.5}$, therefore the selected annual screening threshold (8.8 $\mu g/m^3$) was adopted as the TRV for the assessment of the annual prediction concentration.

3.B-3.2.3 Exposure Assessment

Exposure assessment was completed considering the predicted 24-hour and annual concentrations and the amount of time members of the public could spend at the receptor locations with identified COPCs (Table 3-B-9).

Table 3-B-9: Exposure Assumptions for Air Quality

Exposure Parameter	Grave Sites 4 and 30	Muskox 2
Exposure time	1.5 hours per day	24 hours per day
Exposure frequency	10 days per year	14 days per year
Rationale	Assumed people stop to visit a grave site each time they pass through the area, assuming five round-trips to Back River each year	Assumed a two-week hunting trip or up to seven weekend trips

Considering the assumptions described above (Table 3-B-9) and the approach to calculating inhalation exposure described by Health Canada (2010), exposure doses were calculated for each location and COPC (Table 3-B-10).

Table 3-B-10: Exposure Assessment for Air Quality

Averaging Period	Chemical	Location	Exposure Dose ($\mu g/m^3$)
24-hour	Arsenic	Grave Site 30	3.0E-07
24-hour	Iron	Grave Site 4	9.7E-06
24-hour	Iron	Grave Site 30	2.1E-05
24-hour	Iron	Muskox 2	1.8E-04
24-hour	Manganese	Grave Site 30	2.1E-07
Annual	$PM_{2.5}$	Grave Site 30	1.5E-05

$\mu g/m^3$ = micrograms per cubic metre.

3.B-3.2.4 Risk Characterization

Using the approach described by Health Canada (2010) to calculate hazard quotients (HQs) for air contaminants and using a target HQ of 0.2, HQs were calculated for each location and COPC (Table 3-B-11).

Table 3-B-11: Risk Characterization for Air Quality

Averaging Period	COPC	Location	Hazard Quotient
24-hour	Arsenic	Grave Site 30	0.001
24-hour	Iron	Grave Site 4	0.002
24-hour	Iron	Grave Site 30	0.005
24-hour	Iron	Muskox 2	0.04
24-hour	Manganese	Grave Site 30	0.004
Annual	$PM_{2.5}$	Grave Site 30	0.002

COPC = chemical of potential concern.

All HQs were less than the target HQ of 0.2; therefore, health risks due to members of the public are considered to be negligible. As a result, no COPCs in air were retained for further analysis in the residual impact classification.

3.B-3.3 Soil Quality

3.B-3.3.1 Problem Formulation

Changes to soil quality as a result of the Project were predicted using wet and dry particulate deposition rates for the non-volatile parameters (i.e., metals) predicted to be present in emissions. In brief, particulate deposition rates were predicted as part of the air quality modeling and methods described in the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (U.S. EPA 2005a) were used to predict incremental changes to soil quality. The incremental changes to soil quality were then added to the measured baseline soil quality data as described in Section 3.B-2 to predict the changes to soil quality as a result of the Project.

Predicted concentrations of chemicals in soil were screened against the CCME Canadian Soil Quality Guidelines for the Protection of Environment and Human Health (CCME 1999b) for residential land use and the U.S. EPA Regional Screening Levels (U.S. EPA 2016b) for residential soils. If predicted concentrations for chemicals in soil were greater than the screening values and maximum baseline concentrations plus 10%, the chemical was identified as a COPC.

All concentrations in soil met their respective screening values and/or baseline plus 10%; as a result, no COPCs were retained in soil and no residual impacts due to changes to soil quality were identified.

Previous risk assessments completed at the Meadowbank Mine in 2006 and 2014 (Wilson Scientific Consulting Inc. 2006; Azimuth Consulting Group Inc. 2006; Agnico Eagle 2012; Agnico Eagle 2015a; Agnico Eagle 2015b) concluded that no significant changes to soil quality, and subsequent changes to vegetation and country food quality, would be expected due to the atmospheric emissions from the Meadowbank Mine (i.e., risks would be negligible). Therefore, given that Project emissions are expected to be lower than those from the Meadowbank Mine, potential changes to soil quality (and vegetation and country food quality) and risks to human health and wildlife would be similarly negligible. These conclusions support the effects assessments for human health with respect to atmospheric pathways to soils and country foods.

3.B-3.4 Country Foods Quality

Given that no COPCs were identified in soil (Section 3.B-3.3), concentrations of chemicals in country foods (i.e., plants and animals consumed by people) were not anticipated to change in country foods. As a result, country foods were not assessed further with respect to potential human health effects and no residual impacts due to changes to country food quality were identified.

3.B-3.5 Water Quality

3.B-3.5.1 Problem Formulation

Effects on human health were evaluated based on the traditional use of the area and the waterbodies expected to be affected by discharges from the Project. Locations that were identified by the water quality effects assessment (Volume 6, Section 6.4) were assessed in the HHERA, with the exceptions of the Whale Tail Waste Rock Storage Facility and Whale Tail Attenuation Pond, which were not considered to be aquatic habitat nor used by people for traditional or non-traditional purposes. Seven receiving waterbodies were identified (Table 3-B-12; Figure 3-B-3).

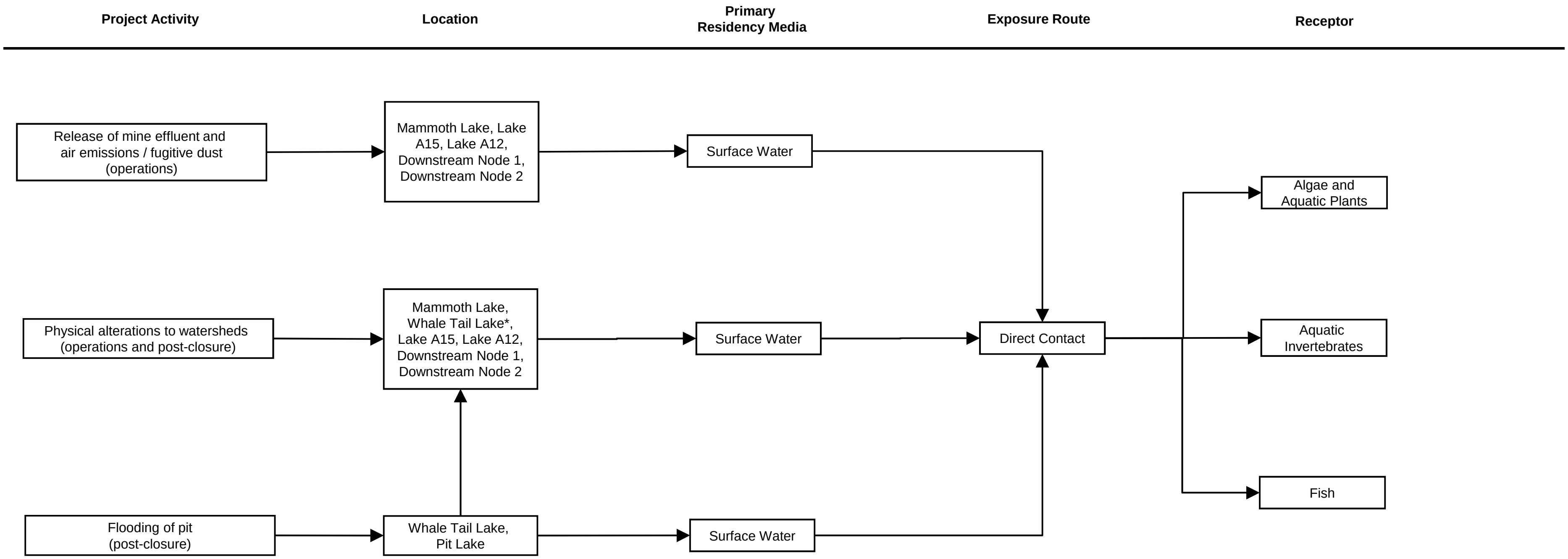
Table 3-B-12: Human Health Receptor Location Descriptions for Water Quality

Receptor Name	Description	Project Phase(s)
Mammoth Lake	Lake located downstream from Whale Tail Lake	Operations, Post-Closure
Lake A15	Lake located downstream from Mammoth Lake	Operations, Post-Closure
Lake A12	Lake located downstream from Lake A15	Operations, Post-Closure
Downstream Node 1	Stream located at the end of downstream path 1 (west and north direction)	Operations, Post-Closure
Downstream Node 2	Stream located at the end of downstream path 2 (east and north direction)	Operations, Post-Closure
Whale Tail Lake (North Basin)	Northern portion of Whale Tail Lake	Post-Closure
Flooded Pit	The open pit that will be allowed to flood once the mine is closed	Post-Closure

Predicted total concentrations for chemicals in water (i.e., metals) were compared to relevant health-based guidelines to identify COPCs. This initial screening step was reported in Volume 6, Section 6.4, and included comparison to the Canadian Drinking Water Quality Guidelines from Health Canada (Health Canada 2014), as well as the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999b) for the purposes of assessing potential effects to aquatic life (Section 3.B-4). Additionally, comparison to maximum baseline concentrations (where available) plus 10% was completed as part of the screening step. If predicted concentrations for chemicals in water were greater than screening values and baseline concentrations plus 10%, the chemical was identified as a COPC.

Conceptual Site Model for the Project – Aquatic Life

FIGURE 3-B-3



NOTES

* For post-closure phase only.

LEGEND

- - - ▶ **Pathway incomplete and/or not evaluated**

——▶ **Pathway complete and evaluated**

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Predictions were provided for several water quality parameters (e.g., acidity), nutrients (e.g., phosphorus), and inorganics (e.g., calcium) for which health-based guidelines are not available nor have been developed. These parameters and substances are not considered to be directly toxic to human health and were therefore not considered in the water quality screening.

Some parameters did not have screening values; if predicted concentrations were within 10% of maximum baseline concentrations, these parameters were not retained for further assessment. Otherwise, if the parameter could be associated with health effects or it is uncertain, a second tier of screening was completed as part of the HHERA. For substances without guidelines, the U.S. EPA Regional Screening Levels for tap water adjusted to a target HQ of 0.2 were used for comparison purposes (U.S. EPA 2016b).

Based upon the screening process outlined above, the following COPCs are identified in Table 3-B-13.

Table 3-B-13: Chemicals of Potential Concern for Water Quality

Chemical	Location(s)	Project Phase(s)	Concentration (µg/L)	Guideline (µg/L)
Arsenic	Mammoth Lake	Operations	18	10 (MAC)
		Closure	20	
	Lake A15	Operations	16	
		Closure	17	
	Lake A12	Operations	15	
		Closure	15	
Manganese	Mammoth Lake	Operations	74	50 (AO)
		Closure	121	
	Lake A15	Operations	65	
		Closure	96	
		Post-Closure (Year 1)	53	
	Lake A12	Operations	61	
		Closure	85	
		Post-Closure (Year 1)	54	
	Flooded Pit	Long-Term	51	

µg/L = microgram per litre; MAC = Maximum Acceptable Concentration (Health Canada 2014); RSL = Regional Screening Level (U.S. EPA 2015).

Although the concentration of aluminum was greater than its Health Canada drinking water quality guideline, the value for aluminum is based upon an operational guideline for water treatment. However, a health-based guideline of 4,000 µg/L is available from the U.S. EPA (2016b). As a result, aluminum was not retained as a COPC for the human health effects assessment.

No guidelines are available for bismuth, but concentrations of this substance greater than baseline + 10% were predicted for Lake A15, Lake A12, and Downstream Node 2 for the operations, closure, and post-closure (year 1) phases of the Project. Bismuth is most commonly used an ingredient in over-the-counter preparations for gastrointestinal distress (e.g., Pepto-Bismol®). A probable lethal dose of between 0.5 and 5 grams per kilogram body weight has been identified (Gosselin et al. 1976; as summarized in HSDB 2002). Bismuth was identified at a maximum concentration of 0.033 µg/L. At this concentration, assuming an adult consumes 1.5 L/day (Health Canada 2010), the total daily dose would be 1E-09 grams per kilogram body weight, which is orders of magnitude less than the probable lethal dose. Therefore, bismuth was not considered further as a COPC.

3.B-3.5.2 Toxicity Assessment

Toxicity reference values (termed reference doses or RfDs for non-carcinogenic substances and slope factors or SFs for carcinogenic substances) were compiled from the following agencies:

- Health Canada (Health Canada 2012);
- U.S. EPA's IRIS (U.S. EPA 2016a);
- CalEPA (CalEPA 2014);
- Agency for Toxic Substances and Disease Registry (ATSDR 2016); and
- Netherlands National Institute of Public Health and the Environment (RIVM 2001; 2009).

The most protective of the available TRVs were selected for use in the assessment (Table 3-B-14).

Table 3-B-14: Selected Toxicity Reference Values for Chemicals of Potential Concern Evaluated in the Water Quality Assessment

COPC	Selected TRV	Endpoint	Source
Arsenic	RfD: 0.0003 mg/kg-d SF: 1.8 $(mg/kg\text{-}d)^{-1}$	RfD: Skin lesions RfD: Skin cancer	U.S. EPA 2016a Health Canada 2012
Manganese	RfD (adult): 0.156 mg/kg-d	Parkinsonian-like neurotoxicity	Health Canada 2012

COPC = chemical of potential concern; mg/kg-d = milligram per kilogram body weight per day; $(mg/kg\text{-}d)^{-1}$ = cancer incidence per milligram per kilogram body weight per day; RfD = oral reference dose; SF = oral slope factor; TRV = toxicity reference value.

3.B-3.5.3 Exposure Assessment

The exposure assessment was completed considering the amount of time members of the public could rely on surface water as a potable water source at the locations with identified COPCs (Table 3-B-15).

Table 3-B-15: Exposure Assumptions for Water Quality

Exposure Parameter	Potable Water Scenario	Rationale/Source
Water consumption rate	1.5 litres per day	Health Canada 2010
Exposure frequency	14 days per year	Assume a two-week hunting trip each year throughout the life of the Project
Exposure duration	Phase-dependent: Construction/Operation – 5 years Closure – 2 years 1-year Post-Closure – 10 years Long-Term – 43 years	No predictions were available for the Construction Phase, therefore predictions for Operations were conservatively adopted for Construction. Long-term predictions were assumed to represent the remainder of the adult life stage

Considering the assumptions described above (Table 3-B-15) and the approach to calculating water consumption exposure described by Health Canada (2010), exposure doses were calculated for each location and COPC (Table 3-B-16). Exposure doses were calculated for adults given this is the age group most likely to be on extended hunting trips in the area, during which they may rely on nearby lakes for their potable water.

Table 3-B-16: Exposure Assessment for Water Quality

COPC	Project Phase(s)	Location(s)	Exposure Dose (mg/kg-d)
Non-cancer Endpoints			
Arsenic	Mammoth Lake	Operations	2.6E-07
		Closure	2.8E-07
	Lake A15	Operations	2.3E-07
		Closure	2.4E-07
	Lake A12	Operations	2.1E-07
		Closure	2.1E-07
Manganese	Mammoth Lake	Closure	1.7E-04
	Lake A15	Closure	1.3E-04
Cancer Endpoints			
Arsenic	Mammoth Lake	Construction/Operations	9.2E-07
		Closure	4.1E-07
		1-Year Post-Closure	8.6E-07
		Long-Term	1.2E-06
	Lake A15	Construction/Operations	8.1E-07
		Closure	3.5E-07
		1-Year Post-Closure	8.4E-07
		Long-Term	1.1E-06
	Lake A12	Construction/Operations	7.6E-07
		Closure	3.1E-07
		1-Year Post-Closure	8.2E-07
		Long-Term	1.0E-06

COPC = chemical of potential concern; mg/kg-d = milligrams per kilogram body weight per day.

3.B-3.5.4 Risk Characterization

Using the approach described by Health Canada (2010) to calculate health risks for contaminated water and using a target HQ of 0.2 and target incremental lifetime cancer risk (ILCR) of 1E-05 (or 1 in 100,000), HQs and ILCRs were calculated for each location and COPC (Table 3-B-17).

Table 3-B-17: Risk Characterization for Water Quality

COPC	Project Phase(s)	Location(s)	Estimated Risks
Non-cancer Endpoints – Hazard Quotients			
Arsenic	Mammoth Lake	Operations	0.0006
		Closure	0.0006
	Lake A15	Operations	0.0005
		Closure	0.0005
	Lake A12	Operations	0.0005
		Closure	0.0005
Manganese	Mammoth Lake	Closure	0.0006
	Lake A15	Closure	0.0005
Cancer Endpoints – Incremental Lifetime Cancer Risks			
Arsenic	Mammoth Lake	Construction/Operations	1.6E-06
		Closure	7.3E-07
		1-Year Post-Closure	1.6E-06
		Long-Term	2.2E-06
		Total ILCR	7E-06
	Lake A15	Construction/Operations	1.5E-06
		Closure	6.2E-07
		1-Year Post-Closure	1.5E-06
		Long-Term	2.0E-06
		Total ILCR	6E-06
	Lake A12	Construction/Operations	1.4E-06
		Closure	5.5E-07
		1-Year Post-Closure	1.5E-06
		Long-Term	1.9E-06
		Total ILCR	6E-06

COPC = chemical of potential concern; ILCR = incremental lifetime cancer risk.

All calculated HQs and ILCRs were less than their targets of 0.2 and 1E-05, respectively. Therefore, health risks are not expected for members of the public that may rely on Mammoth Lake, Lake A15, and Lake A12 as their potable water supply should these receptors spend time in the area.

3.B-3.6 Fish Tissue Quality

3.B-3.6.1 Problem Formulation

Given that there were predicted changes to water quality (i.e., arsenic and manganese), changes to fish tissue quality of these COPCs may also be possible.

3.B-3.6.2 Toxicity Assessment

The same TRVs for arsenic and manganese used for water quality (Section 3.B-5.2) were used to assess potential risks due to changes in fish tissue quality.

3.B-3.6.3 Exposure Assessment

Changes to fish tissue quality were predicted for the COPCs that were predicted to change in water (i.e., arsenic and manganese) using site-specific water-to-fish bioconcentration factors (BCFs) derived from the average baseline water and fish tissue concentrations (Table 3-B-18).

Table 3-B-18: Site-Specific Water-to-Fish Bioconcentration Factors

COPC	Average Baseline Fish Tissue Concentration (mg/kg wet weight)	Average Baseline Water Quality Concentration (mg/L)	Site-Specific Water-to-Fish Bioconcentration Factor (L/kg)
Arsenic	0.0322	0.00026	124
Manganese	0.139	0.00307	45

COPC = chemical of potential concern; mg/kg = milligram per kilogram; mg/L = milligrams per litre; L/kg = litres per kilogram

Using these site-specific BCFs, changes to fish tissue quality for each lake and phase of the Project were predicted (Table 3-B-19).

Table 3-B-19: Predicted Fish Tissue Concentrations

COPC	Project Phase(s)	Location(s)	Predicted Fish Tissue Concentrations (mg/kg wet weight)
Arsenic	Mammoth Lake	Construction/Operations	2.23
		Closure	2.48
		1-Year Post-Closure	1.05
		Long-Term	0.35
	Lake A15	Construction/Operations	1.98
		Closure	2.11
		1-Year Post-Closure	1.03
		Long-Term	0.32
	Lake A12	Construction/Operations	1.86
		Closure	1.86
		1-Year Post-Closure	1.00
		Long-Term	0.30
Manganese	Mammoth Lake	Closure	5.48
	Lake A15	Closure	4.35

COPC = chemical of potential concern; mg/kg = milligram per kilogram

Considering the assumptions described above for water quality (Table 3-B-15) and the approach to calculating food consumption exposure described by Health Canada (2010), exposure doses were calculated for each location and COPC (Table 3-B-20).

Table 3-B-20: Exposure Assessment for Fish Tissue Quality

COPC	Project Phase(s)	Location(s)	Exposure Dose (mg/kg-d)
Non-cancer Endpoints			
Arsenic	Mammoth Lake	Operations	2.7E-05
		Closure	3.0E-05
	Lake A15	Operations	2.4E-05
		Closure	2.5E-02
	Lake A12	Operations	2.2E-05
		Closure	2.2E-05
Manganese	Mammoth Lake	Closure	6.5E-05
	Lake A15	Closure	5.2E-06
Cancer Endpoints			
Arsenic	Mammoth Lake	Construction/Operations	1.7E-06
		Closure	7.4E-07
		1-Year Post-Closure	1.6E-06
		Long-Term	2.2E-06
	Lake A15	Construction/Operations	1.5E-06
		Closure	6.3E-07
		1-Year Post-Closure	1.5E-06
		Long-Term	2.0E-06
	Lake A12	Construction/Operations	1.4E-06
		Closure	5.5E-07
		1-Year Post-Closure	1.5E-06
		Long-Term	1.9E-06

COPC = chemical of potential concern; mg/kg-d = milligrams per kilogram body weight per day.

3.B-3.6.4 Risk Characterization

Using the approach described by Health Canada (2010) to calculate health risks for contaminated food and using a target HQ of 0.2 and target ILCR of 1E-05 (or 1 in 100,000), HQs and ILCRs were calculated for each location and COPC (Table 3-B-21).

Table 3-B-21: Risk Characterization for Fish Tissue Quality

COPC	Project Phase(s)	Location(s)	Estimated Risks
Non-cancer Endpoints – Hazard Quotients			
Arsenic	Mammoth Lake	Operations	0.09
		Closure	0.1
	Lake A15	Operations	0.08
		Closure	0.08
	Lake A12	Operations	0.07
		Closure	0.07
Manganese	Mammoth Lake	Closure	0.004
	Lake A15	Closure	0.003
Cancer Endpoints – Incremental Lifetime Cancer Risks			
Arsenic	Mammoth Lake	Construction/Operations	3.0E-06
		Closure	1.3E-06
		1-Year Post-Closure	2.8E-06
		Long-Term	4.0E-06
		Total ILCR	1E-05
	Lake A15	Construction/Operations	2.7E-06
		Closure	1.1E-06
		1-Year Post-Closure	2.8E-06
		Long-Term	3.7E-06
		Total ILCR	1E-05
	Lake A12	Construction/Operations	2.5E-06
		Closure	1.0E-06
		1-Year Post-Closure	2.7E-06
		Long-Term	3.4E-06
		Total ILCR	1E-05

COPC = chemical of potential concern; ILCR = incremental lifetime cancer risk.

All calculated HQs were less than their target of 0.2, and the calculated total ILCRs met the target of 1E-05. Therefore, health risks are not expected for members of the public that may rely on Mammoth Lake, Lake A15 and Lake A12 for fish should these receptors spend time in the area. However, given that the calculated risks are equal to the target, restrictions on fishing may be considered in follow-up monitoring and maintenance should the measured fish tissue concentrations be higher than those predicted.

3.B-4 EFFECTS ASSESSMENT FOR WILDLIFE

3.B-4.1 Conceptual Site Model

The CSM for wildlife receptors (Figure 3-B-2) was based upon the primary pathways identified above (Table 3-B-4). The exposure pathways between Project activities, intermediate residency media (i.e., the aspects of the environment that that may experience a change in quality due to project activities/emissions), and receptors are shown to be either complete or incomplete. Where pathways are incomplete, quantitative assessment was not carried out given that environmental quality was not anticipated to change as a result of the Project. Complete pathways on the figure indicate that a change to environmental quality was predicted and a quantitative assessment of the potential effects to human health was carried out. A brief summary of the complete exposure pathways are provided below for wildlife:

- incidental ingestion of soil;
- ingestion of surface water; and
- consumption of plants and animals as prey (e.g., sedges and forage fish).

3.B-4.2 Air Quality

Direct effects to wildlife as a result of changes to air quality was not identified as a primary pathway. However, indirect effects due to particulate deposition onto soils and changes in soil quality were assessed further (see Section 3.B-4.3, below).

3.B-4.3 Soil Quality

3.B-4.3.1 Problem Formulation

Changes to soil quality as a result of the Project were predicted as described in Section 3.B-3.3.1. For the protection of wildlife, concentrations of chemicals in soil were screened against the CCME Canadian Soil Quality Guidelines for the Protection of Environment and Human Health (CCME 1999b) for residential land use and the U.S. EPA Ecological Soil Screening Levels (U.S. EPA 2005b). If predicted concentrations for chemicals in soil were greater than the screening values and maximum baseline concentrations plus 10%, the chemical was identified as a COPC.

All concentrations in soil met their respective screening values and/or baseline plus 10%; as a result, no COPCs were retained in soil and no residual impacts due to changes to soil quality were identified. Furthermore, given that no COPCs were identified for soil, no residual impacts to vegetation quality were identified. This result is consistent with the results of the conclusions of the previous risk assessments conducted at the Meadowbank Mine.

3.B-4.4 Prey Quality

Given that no COPCs were identified in soil (Section 3.B-4.3), concentrations of chemicals in prey items (i.e., plants and animals consumed as prey) were not anticipated to change. As a result, prey items were not assessed further with respect to potential wildlife health effects and no residual health impacts due to changes to prey item quality were identified.

3.B-4.5 Water and Fish Quality

3.B-4.5.1 Problem Formulation

Similar to the human health assessment, effects on wildlife health were evaluated based on the waterbodies expected to be affected by discharges from the Project. Locations that were identified by the water quality effects assessment were assessed in the HHERA (Table 3-B-12 in Section 3.B-5.1). The concentrations of the COPCs identified in Section 3.B-5.1 (Table 3-B-13) were based upon comparison to screening values that are protective of human health and aquatic life; the only available screening values for application to wildlife are the Livestock Watering Guidelines from CCME and the British Columbia Ministry of Environment (BCMOE). For substances for which screening guidelines were available, all predicted concentrations were less than these guidelines; however, given that these guidelines are generally only for select parameters and are not intended to be protective of fish consumption (with the exception of selenium), screening values have been derived (Table 3-B-22) using the methods described in Sample et al. (1996) except allometric scaling of TRVs was not undertaken (Allard et al. 2010). The common loon was selected to represent fish-eating birds; no fish-eating mammals were identified (Table 3-B-22).

Table 3-B-22 provides the derived screening values for the common loon for those substances that were predicted at concentrations greater than baseline +10%.

Table 3-B-22: Chemicals of Potential Concern for Water Quality

Chemical	Maximum Concentration (µg/L)	CCME / BC MOE Livestock Watering (µg/L)	Screening Value for the Common Loon (µg/L)
Aluminum	322	5,000	800
Antimony	3.0	NV	NV
Arsenic	20	25	100
Barium	19	NV	200
Beryllium	0.025	100	NV
Bismuth	0.033	NV	NV
Cadmium	0.015	80	7
Chromium	9.0	50	6,900
Cobalt	0.53	1,000	NV
Copper	1.8	300	900
Iron	754	NV	NV
Lithium	1.5	NV	NV
Manganese	51	NV	NV
Molybdenum	1.5	25	250
Nickel	4.6	1,000	4,400
Selenium	0.59	2	1.7
Strontium	34	NV	NV
Tin	0.017	NV	370,000
Uranium	2.8	200	NV
Vanadium	1.2	100	NV
Zinc	2.0	2,000	44

µg/L = micrograms per litre; NV = no value.

All predicted concentrations were less than these derived screening values. In the absence of a guideline, the aquatic life guidelines were used for screening purposes given that these would be considered protective of wildlife. Aquatic life guidelines are typically more protective than those set for the protection for wildlife and as a result, this is considered to be a conservative approach. As shown in the effects assessment for aquatic life (Section 3.B-5, below), these substances without derived screening guidelines were less than their respective aquatic life guidelines or toxicity benchmarks. As a result, no COPCs in water (or fish) were identified for evaluation of effects to wildlife, and no residual impacts due to changes in water and fish quality were identified.

3.B-5 EFFECTS ASSESSMENT FOR AQUATIC LIFE

3.B-5.1 Problem Formulation

The problem formulation develops a focussed understanding of how environmental quality might affect aquatic life near the Project. The problem formulation identifies the aquatic life expected to occur near the Project (i.e., receptors), the exposure pathways between aquatic life and chemicals released by the Project and the chemicals released by the Project that may be harmful to aquatic life (i.e., COPCs). The information from the problem formulation is summarized in a CSM, which illustrates the sources of COPCs (i.e., Project activities resulting in changes in environmental quality), the pathways of exposure and the receptors that are evaluated in the assessment.

Section 3.B-1.3 summarizes the environmental media that were assessed with respect to potential changes to environmental quality that may have an effect on human health, wildlife and aquatic life. Of these media, water quality is applicable and was considered further with respect to aquatic life.

Effects on aquatic life were evaluated based on the waterbodies expected to be affected by the Project. Locations that were identified by the water quality effects assessment were assessed for aquatic life. These locations were identified previously in Section 3.B-3.5.1.

3.B-5.1.1 Receptors

The aquatic valued components identified in Section 3.B-1.1 (Table 3-B-3) were selected as receptors for the effects assessment for aquatic life. These receptors include: algae, aquatic plants, aquatic invertebrates and fish (arctic char, arctic grayling, lake trout and round whitefish). Rationale for selection of these receptors for the effects assessment is provided in Section 3.B-1.1.

3.B-5.1.2 Exposure Pathways

Aquatic receptors may come in contact with, or be exposed to, chemicals in surface water by direct contact with surface water and this exposure pathway was considered further in the effects assessment.

3.B-5.1.3 Chemicals of Potential Concern

Screening Process

Chemicals of potential concern in surface water were identified using a three-step process:

1) Step 1 of the screening process was previously described in Section 3.B-3.5.1. Parameters identified in Step 1 of the screening process were carried forward to Step 2 of the screening process.

2) In Step 2 of the screening process, maximum predicted concentrations were compared to long-term or chronic water quality guidelines protective of freshwater aquatic life. The following water quality guidelines were selected for the assessment:

   - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-PFALs) (CCME 2016);
   - Federal Environmental Quality Guidelines (FEQGs) and screening assessments conducted on high priority substances as part of the Chemicals Management Plan pursuant to the *Canadian Environmental Protection Act*, 1999 (for vanadium, Environment Canada and Health 2010; for cobalt, Environment Canada 2013);

- United States Environmental Protection Agency (U.S. EPA) National Recommended Water Quality Criteria for Aquatic Life (U.S. EPA 2016c) and other U.S. state criteria (for total dissolved solids [TDS] only);
- British Columbia Water Quality Guidelines (approved and working water quality guidelines (BCMOE 2016; and BCMOE 2015); and
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000).

Preference was given to the CWQG-PFALs, and in the absence of these, the FEQGs/screening assessments. In the absence of these, the other available guidelines were used. These guidelines were considered appropriate for use because supporting documentation that details the development of the guidelines is available and they have been developed using approaches similar to those used in the development of the CWQG-PFALs and FEQGs/screening assessments.

For some parameters, guidelines are dependent on pH, temperature or hardness. For temperature and pH, measured baseline levels were used. Hardness was calculated from predicted calcium and magnesium concentrations in Mammoth Lake. For chromium, which has a guideline that is dependent on speciation, the most conservative guideline was used (i.e., hexavalent chromium).

Comparison to guidelines was considered to represent a conservative evaluation of the potential for the predicted concentrations to elicit adverse effects. Therefore, parameters with predicted concentrations below guidelines were considered to pose no risk to aquatic life and were not identified as COPCs. If the predicted concentration was greater than the guideline, the parameter was identified as a COPC and carried forward in the effects assessment. Parameters without guidelines were carried forward to the next step of the screening process.

3) In Step 3, the modelled parameters were assessed to determine which had the potential to adversely affect aquatic life and which parameters could be excluded from further consideration for one of the following reasons:

- The parameter has been shown to have limited potential to affect aquatic life (i.e., innocuous substances);
- Potential effects associated with the parameter was assessed elsewhere in the FEIS; and/or
- The parameter is a component of another parameter which is a more suitable focus point for the aquatic life effects assessment.

Parameters excluded during this step of the screening process were:

- *Phosphorus*, because potential effects related to eutrophication are assessed elsewhere in the FEIS; and
- *Alkalinity, calcium, magnesium, potassium and sodium*, because they are components of TDS, another modelled parameter included in the assessment.

Results

Based on the screening process outlined above, the following COPCs were identified for aquatic receptors for each modelled location and Project phase (Table 3-B-23 through Table 3-B-26):

Table 3-B-23: Chemicals of Potential Concern in Surface Waters during Operations

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Arsenic	✓	✓	✓	×	✓
Lithium	✓	✓	✓	✓	✓
Strontium	✓	✓	✓	✓	✓

✓ = chemical identified as a COPC for noted location; × = chemical not identified as a COPC for noted location; COPC = chemical of potential concern.

Table 3-B-24: Chemicals of Potential Concern in Surface Waters during Closure

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Fluoride	✓	×	×	×	×
Arsenic	✓	✓	✓	×	✓
Chromium	✓	×	×	×	×
Lithium	✓	✓	✓	✓	✓
Strontium	✓	✓	✓	✓	✓

✓ = chemical identified as a COPC for noted location; × = chemical not identified as a COPC for noted location; COPC = chemical of potential concern.

Table 3-B-25: Chemicals of Potential Concern in Surface Waters during Post-Closure Year 1

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Arsenic	✓	✓	✓	×	×
Lithium	✓	✓	✓	✓	✓
Strontium	✓	✓	✓	✓	✓

✓ = chemical identified as a COPC for noted location; × = chemical not identified as a COPC for noted location; COPC = chemical of potential concern.

Table 3-B-26: Chemicals of Potential Concern in Surface Waters during Long-Term Post-Closure

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2	Whale Tail Lake	Flooded Pit
Aluminum	×	×	×	×	×	✓	×
Arsenic	×	×	×	×	×	✓	✓
Chromium	×	×	×	×	×	✓	×
Iron	×	×	×	×	×	✓	×
Lithium	✓	✓	✓	✓	✓	×	✓
Strontium	✓	✓	✓	✓	✓	×	✓

✓ = chemical identified as a COPC for noted location; × = chemical not identified as a COPC for noted location; COPC = chemical of potential concern.

3.B-5.1.4 Conceptual Site Model

A CSM was developed for aquatic life based upon the primary pathways identified in Section 3.B-1.3 (Figure 3-B-3). The exposure pathways between Project activities, intermediate residency media (i.e., the aspects of the environment that may experience a change in quality due to project activities/emissions) and receptors are shown to be either complete or incomplete. Where pathways are incomplete, quantitative assessment was not carried out given that environmental quality was not anticipated to change as a result of the Project. Complete pathways indicate that a change to environmental quality was predicted and a quantitative assessment of potential effects to aquatic life was carried out.

To summarize, the effects assessment for aquatic life considered direct contact with surface water by algae, aquatic plants, aquatic invertebrates, and fish.

3.B-5.2 Exposure Assessment and Toxicity Assessment

3.B-5.2.1 Exposure Assessment

The exposure assessment determines the amount of COPC to which each of the receptors is exposed via each complete exposure pathway. For aquatic life, exposure is expressed as the concentrations of the COPCs in the media to which the receptor is exposed (i.e., in µg/L in water). This permits the evaluation of exposure relative to the toxicity benchmarks that are also expressed in this way.

Exposure of aquatic receptors to COPCs was assessed using predicted maximum concentrations in water at the locations and for the Project phases summarized in Table 3-B-12. A COPC was only assessed for the locations and phases for which it was identified as a COPC. The predicted maximum concentrations for those locations and phases are provided in Table 3-B-27 through Table 3-B-30.

Table 3-B-27: Exposure Concentrations for Surface Water during Operations

COPC	Units	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Arsenic	µg/L	18	16	15	-	6.3
Lithium	µg/L	1.7	1.5	1.5	0.58	0.95
Strontium	µg/L	43	39	38	11	22

Exposure concentrations are the predicted maximum concentrations; µg/L = micrograms per litre; "-" = not a COPC for this phase and location.

Table 3-B-28: Exposure Concentrations for Surface Water during Closure

COPC	Units	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Fluoride	mg/L	0.14	-	-	-	-
Arsenic	µg/L	20	17	15	-	6
Chromium	µg/L	1.1	-	-	-	-
Lithium	µg/L	2.7	2.3	2.1	0.57	1
Strontium	µg/L	65	53	48	10	21

Exposure concentrations are the predicted maximum concentrations; µg/L = micrograms per litre; mg/L = milligrams per litre; "-" = not a COPC for this phase and location.

Table 3-B-29: Exposure Concentrations for Surface Water during Post-Closure Year 1

COPC	Units	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Arsenic	µg/L	8.5	8.3	8.1	-	-
Lithium	µg/L	1.9	1.8	1.7	0.64	1.1
Strontium	µg/L	45	42	40	12	25

Exposure concentrations are the predicted maximum concentrations; µg = micrograms per litre; "-" = not a COPC for this phase and location.

Table 3-B-30: Exposure Concentrations for Surface Water during Long-Term Post-Closure

COPC	Units	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2	Whale Tail Lake	Flooded Pit
Aluminum	µg/L	-	-	-	-	-	322	-
Arsenic	µg/L	-	-	-	-	-	5.7	10
Chromium	µg/L	-	-	-	-	-	9	-
Iron	µg/L	-	-	-	-	-	754	-
Lithium	µg/L	1.1	1.1	1	0.57	0.81	-	1.5
Strontium	µg/L	26	24	23	10	17	-	34

Exposure concentrations are the predicted maximum concentrations; µg/L = micrograms per litre; "-" = not a COPC for this phase and location.

3.B-5.2.2 Toxicity Assessment

The toxicity assessment characterizes potential effects associated with COPCs. It provides a basis for evaluating what is an acceptable exposure and what level of exposure may adversely affect the receptors. This involves determining concentrations that receptors can be exposed to without adverse effects. For aquatic life, this is expressed as an acceptable concentration in the media to which the receptor is exposed (i.e., in water in µg/L) and is referred to as the toxicity benchmark. These values are used as thresholds for comparison with exposure concentrations during risk characterization.

A toxicity assessment was completed to develop toxicity benchmarks for each of the COPCs identified in Section 3.B-5.1.3. The chronic toxicity benchmark derivation approach for each COPC was as follows:

- **Fluoride and Arsenic**: For fluoride, selection of a chronic toxicity benchmark recently derived using the Species Sensitivity Distribution (SSD) approach (McPherson et al. 2014) and for arsenic, development of a chronic toxicity benchmark using the SSD approach (Volume 6, Appendix 6-N). The SSD approach incorporates toxicity data from multiple species and allows for the determination of a benchmark that is protective of the aquatic community.
- **Aluminum**: Adoption of the U.S. EPA criterion continuous concentration (CCC) for freshwater aquatic life (U.S. EPA 2016c) as the chronic toxicity benchmark. Recent publications indicate that the complexation of aluminum under natural conditions yields reduced bioavailability and toxicity relative to the test conditions used in laboratory exposures (Wilson 2012). Factors that ameliorate toxicity of aluminum to freshwater aquatic life include complexation to dissolved organic matter (DOM), high water hardness and antagonistic (protective) effects of other elements including calcium, fluoride, and silicon (Gensemer and Playle 1999). In particular, aluminum toxicity is strongly influenced by the pH of the local environment, with increases in

solubility/bioavailability and toxicity occurring as pH decreases below 6.5. Therefore, it was considered prudent to consider these exposure and toxicity modifying factors (ETMFs) in the development of a toxicity benchmark for aluminum. However, a technically defensible benchmark that reflects the full suite of ETMFs likely to be relevant to the Project could not be derived due to a lack of data. For example, focusing the literature review to exclude data with pH values that are not applicable to the Project (i.e., pH <6.5) would result in the exclusion of the majority of the data. The remaining limited dataset would reflect a range of exposure regimes that would also likely overstate the bioavailability of aluminum because they do not address the other factors known to ameliorate toxicity. As a result, the U.S. EPA criterion was adopted as the benchmark for aluminum. The U.S. EPA criterion was adopted over the CWQG-PFAL because of the lack of information regarding how the later was derived.

- **Chromium, lithium and strontium**: Selection of the lowest acceptable chronic toxicity values for use as the toxicity benchmarks. A search of the ECOTOXicology (ECOTOX) database (U.S. EPA 2016d) was done to identify the lowest acceptable chronic toxicity values for use as the toxicity benchmarks. The search included endpoints based on development, growth, population changes, reproduction and survival. The selection of toxicity values as benchmarks was based on the following order of precedence:
  - EC_x/IC_x representing a no-effects threshold;
  - EC_{10}/IC_{10};
  - EC_{11-25}/IC_{11-25};
  - Maximum Allowable Toxicant Concentration (MATC), calculated by taking the geometric mean of the NOEC and LOEC reported for a given test. The procedure can yield results that are comparable to IC_{25} results, as discussed for example in U.S. EPA (2007);
  - No Observed Effect Concentration (NOEC);
  - Lowest Observed Effect Concentration (LOEC);
  - EC_{26-49}/IC_{26-49}; and
  - Non-lethal EC_{50}/IC_{50}.
- **Iron**: Selection of a bioassessment-based benchmark. Iron bioavailability and toxicity to aquatic life in freshwater environments is complex and it is challenging to obtain meaningful toxicity data for this metal from laboratory studies. As an alternative approach to assess iron toxicity in the freshwater environment, Linton et al. (2007) established bioassessment-based benchmarks for total iron using field-based research. In brief, the decline in the maximum abundance of organisms along a gradient of increasing iron concentrations for eight different families of benthic invertebrates was modelled using field data from streams of West Virginia, USA. Two benchmarks were derived: 210 µg/L, which corresponds to no or minimal changes in community structure and function, and 1,740 µg/L, which corresponds to slight to moderate changes in community structure and function. These field-based benchmarks represent the most recent, available field-based research on iron toxicity and they address both the direct (toxic) and indirect (physical) effects of iron. The benchmarks were derived based on stream invertebrates such as mayflies, which have been reported as the most sensitive to iron (Phippen et al. 2008). The upper benchmark is similar to benchmarks derived by other researchers (e.g., 1.7 mg/L by Randall et al. [1999] based on

laboratory tests with *Daphnia magna*) and to international criteria for iron (e.g., U.S. EPA 2016c; BCMOE 2016). The British Columbia Ministry used the work of Linton et al. (2007) in support of their guideline of 1 mg/L (Phippen et al. 2008). The US EPA acute criterion of 1 mg/L for total iron was assumed to be protective of aquatic life "*based on field observations principally"* (U.S. EPA 1976). Thus, 1.74 mg/L was selected as the toxicity benchmark for iron.

The toxicity benchmarks for each COPC are summarized in Table 3-B-31.

Table 3-B-31: Toxicity Benchmarks for Chemicals of Potential Concern in Surface Water

COPC	Units	Toxicity Benchmark	Basis and Source of Toxicity Benchmark
Fluoride	mg/L	1.94	Generic chronic effect benchmark derived using the SSD approach (McPherson et al. 2014); HC_5 of 16 aquatic species (5 fish, 7 invertebrates, 4 algae/aquatic plants); considered to be conservatively protective because does not consider factors that can reduce toxicity (e.g., water hardness and temperature).
Aluminum	µg/L	87	U.S. EPA criterion continuous concentration (U.S. EPA 2016c).
Arsenic	µg/L	28	Toxicity benchmark derived using the SSD approach; HC_5 of 28 aquatic species (3 fish, 1 amphibian, 9 invertebrates, 15 algae/aquatic plants).
Chromium	µg/L	5	Lowest reported and acceptable chronic toxicity value in the U.S. EPA ECOTOX database (U.S. EPA 2016d); 14-d MATC for reproduction in *Ceriodaphnia dubia* exposed to Cr(VI) (Hickey 1989).
Iron	µg/L	1,740	Bioassessment-based benchmark for total iron developed using field-based research (Linton et al., 2007); allows for slight to moderate change to benthic community population structure while protecting the structure and function of the ecosystem.
Lithium	µg/L	250	Lowest reported and acceptable chronic toxicity value in the U.S. EPA ECOTOX database (U.S. EPA 2016d); 26-d MATC for growth of fathead minnow (*Pimephales promelas*) (Long et al. 1998).
Strontium	µg/L	315	Lowest reported and acceptable chronic toxicity value in the U.S. EPA ECOTOX database (U.S. EPA 2016d); 7-d LC_{18} for *Hyalella azteca* (Borgmann et al. 2005).

COPC = chemical of potential concern; HC_5 = hazardous concentration to 5% of species; d = day; MATC = maximum acceptable toxicant concentration; LC_{18} = lethal concentration required to kill 18% of the test population; Cr(VI) = hexavalent chromium; SSD = species sensitivity distribution; mg/L = milligrams per litre; µg/L = micrograms per litre.

3.B-5.3 Risk Characterization

Risk characterization determines the potential for risks to aquatic receptors. Risks to aquatic receptors were assessed on a quantitative basis by calculating HQs. The HQ is the ratio of the estimated exposure concentration from the exposure assessment (i.e., predicted concentration of COPC in surface water) to the chronic toxicity benchmark developed in the toxicity assessment. A target HQ of one was used in the assessment which is consistent with current guidance (CCME 1996). An HQ of less than one indicates that risks to aquatic life are not expected. An HQ of greater than one indicates the potential for risks to aquatic life. Chemicals of potential concern with HQs greater than one were considered further in the residual impact classification (Section 3.B-6).

3.B-5.3.1 Fluoride, Arsenic, Iron, Lithium and Strontium

The HQs for fluoride, arsenic, iron, lithium and strontium were less than one for all modelled locations and Project phases, indicating that risks to aquatic life from these COPCs are negligible (Table 3-B-32 through Table 3-B-35).

Table 3-B-32: Hazard Quotients for Surface Water during Operations

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Arsenic	0.64	0.57	0.54	-	0.23
Lithium	0.0068	0.0060	0.0060	0.0023	0.0038
Strontium	0.14	0.12	0.12	0.035	0.070

Shaded and bold text = hazard quotient > 1; "-" = Not a COPC for this phase and location; COPC = chemical of potential concern.

Table 3-B-33: Hazard Quotients for Surface Water during Closure

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Fluoride	0.072	-	-	-	-
Arsenic	0.71	0.61	0.54	-	0.21
Chromium	0.22	-	-	-	-
Lithium	0.011	0.0092	0.0084	0.0023	0.0040
Strontium	0.21	0.17	0.15	0.032	0.067

Shaded and bold text = hazard quotient > 1; "-" = Not a COPC for this phase and location; COPC = chemical of potential concern.

Table 3-B-34: Hazard Quotients for Surface Water during Post-Closure Year 1

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2
Arsenic	0.30	0.30	0.29	-	-
Lithium	0.0076	0.0072	0.0068	0.0026	0.0044
Strontium	0.14	0.13	0.13	0.038	0.079

Shaded and bold text = hazard quotient > 1; "-" = Not a COPC for this phase and location; COPC = chemical of potential concern.

Table 3-B-35: Hazard Quotients for Surface Water during Long-Term Post-Closure

COPC	Mammoth Lake	Lake A15	Lake A12	Downstream Node 1	Downstream Node 2	Whale Tail Lake	Flooded Pit
Aluminum	-	-	-	-	-	**3.7**	-
Arsenic	-	-	-	-	-	0.20	0.36
Chromium	-	-	-	-	-	**1.8**	-
Iron	-	-	-	-	-	0.43	-
Lithium	0.0044	0.0044	0.0040	0.0023	0.0032	-	0.0060
Strontium	0.083	0.076	0.073	0.032	0.054	-	0.11

Shaded and bold text = hazard quotient > 1; "-" = Not a COPC for this phase and location; COPC = chemical of potential concern.

3.B-5.3.2 Aluminum and Chromium

Hazard quotients for aluminum and chromium were less than one for all modelled locations and Project phases with the exception of the HQs for Whale Tail Lake during post-closure (HQs of 3.7 and 1.8 for aluminum and chromium, respectively) (Table 3-B-32 through Table 3-B-35). Therefore, aluminum and chromium in Whale Tail Lake during post-closure were considered further in the residual impact classification (Section 3.B-6).

3.B-6 RESIDUAL IMPACT CLASSIFICATION

Residual impact classification was carried out using the methods described in Volume 3, Section 3.7. The residual impact classification was carried out for VCs and substances that may be associated with a potential residual impact as identified in the HHERA. No residual impacts were identified for human health or wildlife, but residual impacts were identified for aquatic life.

As discussed in Section 3.B-5.3.2, the HQs for aluminum and chromium for aquatic life were greater than the target HQ of one for Whale Tail Lake during post-closure. Therefore, these COPCs were considered further in the residual impact classification. The following subsections evaluate potential residual impacts associated with these two COPCs.

3.B-6.1 Aluminum

The result of the residual impact assessment for aluminum in Whale Tail Lake during post-closure is provided in Table 3-B-36. When all criteria are considered, impacts to aquatic life resulting from aluminum at this location and for this phase of the Project are expected to be not significant.

3.B-6.2 Chromium

The result of the residual impact assessment for chromium in Whale Tail Lake during post-closure is provided in Table 3-B-37. When all criteria are considered, impacts to aquatic life resulting from chromium at this location and for this phase of the Project are expected to be not significant.

Table 3-B-36: Residual Impact Assessment for Aquatic Life for Aluminum

Assessment Criterion	Assigned Level	Rationale for Assigned Level
Direction	Negative	The toxicity benchmarks are intended to identify the potential for risks to aquatic life; therefore, where an HQ is greater than one, it indicates that risks to aquatic life are possible.
Magnitude[a]	Low	A low level was assigned because the calculated HQ was 3.7 (i.e., HQ was greater than 1 but less than 10).
Geographic Extent	Local	The potential effect is confined to Whale Tail Lake.
Duration	Unknown	The potential effect is evident during the one year of monthly predictions representing Year 10 of post-closure.
Frequency	Continuous	The potential effect is evident during the one year of monthly predictions representing Year 10 of post-closure.
Reversibility	Reversible	The effect may result in impacts on sensitive individuals but it is unlikely to result in population-level effects.
Likelihood	Unlikely	The likelihood of an effect on aquatic life is considered unlikely because: ▪ Aluminum can be extremely toxic under acidic (pH<6) or alkaline (pH>8) conditions, but has relatively low toxicity to freshwater aquatic life between pH 6 and 8 such that “it is not a toxicological problem in the majority of freshwater environments” (Wilson 2012, p 70). Baseline pH in Whale Tail Lake ranges upwards from pH 6.5. ▪ As summarized in Wilson (2012), the U.S. EPA criterion (and toxicity benchmark used in this assessment) is highly conservative. For example, the criterion is based on “acid soluble” aluminum (acidified to pH <2 then 0.45 µm filtered) rather than dissolved aluminum. The criterion does not consider the formation of exposure and toxicity modifying complexes. In particular, complexation with DOC reduces aluminum bioavailability and toxicity; however, aluminum also forms complexes with chloride, fluoride, sulphate, nitrate and phosphate. Furthermore, differences in the aging of aluminum stock solutions before their dilution and delivery to toxicity test exposure tanks may have resulted in unrealistic toxicity in the criteria database – “transient and highly toxic effects can occur within the first seconds after a dosing solution is prepared, which can disappear following a suitable again period that can be as short as a few minutes (Wilson 2012, p 77). ▪ HQs were calculated using total aluminum concentrations and a benchmark based on total aluminum. However, total aluminum may include forms that are not biologically reactive such as those organically complexed or adsorbed to particulates. Thus, use of total aluminum concentrations and a benchmark based on total aluminum can overestimate toxicity. It is widely accepted that the dissolved fraction of the total concentration is a better indicator of the bioavailable and toxic concentration to aquatic biota (BCMOE 1988). The BCMOE provides a long-term average water quality guideline for freshwater aquatic life at pH ≥6.5 for dissolved aluminum of 50 µg/L. The maximum concentration of dissolved aluminum in Whale Tail Lake during post-closure of 0.1 µg/L is well below the BCMOE guideline. ▪ Low-level exposure to aluminum over time as in the case of waters downstream of the Project can provide increased resistance from chronic toxicity. As noted by Wilson (2012, p 104) tolerance with slow exposure to increasing aluminum concentrations “may explain the continued presence of fish populations in acidified soft waters containing levels of aluminum in excess of the threshold predicated by acute toxicity tests”. ▪ The assumptions used in the water quality model are highly conservative and as such, the predicted concentrations of aluminum have likely been overestimated (for a summary of the conservative assumptions used in the water quality model refer to Volume 6, Section 6.4.3).

[a] Magnitude for aquatic life risk is as follows: Low = 1< HQ ≤10; Moderate = 10 < HQ ≤ 100; High = HQ > 100.

DOC = dissolved organic carbon; HQ = hazard quotient.

Table 3-B-37: Residual Impact Assessment for Aquatic Life for Chromium

Assessment Criterion	Assigned Level	Rationale for Assigned Level
Direction	Negative	The toxicity benchmarks are intended to identify the potential for risks to aquatic life; therefore, where an HQ is greater than one, it indicates that risks to aquatic life are possible.
Magnitude[a]	Low	A low level was assigned because the calculated HQ was 1.8 (i.e., HQ was greater than 1 but less than 10).
Geographic Extent	Local	The potential effect is confined to Whale Tail Lake.
Duration	Unknown	The potential effect is evident during the one year of monthly predictions representing Year 10 of post-closure.
Frequency	Continuous	The potential effect is evident during the one year of monthly predictions representing Year 10 of post-closure.
Reversibility	Reversible	The effect may result in impacts on sensitive individuals but it is unlikely to result in population-level effects.
Likelihood	Unlikely	The likelihood of an effect on aquatic life is considered unlikely because: ▪ Predicted exposure concentrations for Whale Tail Lake are for total chromium. Chromium can exist in nine different oxidation forms; however, it is found most commonly in the trivalent (Cr^{3+}, or Cr [III]) and hexavalent (Cr^{6+}, or Cr [VI]) states in the environment. The toxicity, mobility, and bioavailability of chromium are highly dependent on these two valence states. In natural waters, Cr [VI] is more soluble, mobile and toxic than Cr [III]. Cr [VI] is the principal species found in surface waters (CCME 1999); therefore, the benchmark developed for chromium is for chromium (VI). However, if some fraction of the total concentration in Whale Tail Lake is Cr(III), the benchmark based on Cr (VI) may overestimate toxicity. ▪ The toxicity benchmark represents the lowest reported and acceptable chronic toxicity value in the U.S. EPA ECOTOX database (U.S. EPA 2016d) and is thus considered to be conservative. The benchmark is a 14-d MATC of 5 µg/L for reproduction in *Ceriodaphnia dubia* exposed to Cr(VI) (Hickey 1989). In another study with *Ceriodaphnia dubia*, Baral et al. (2006) identified a 7-d IC_{25} for reproduction of 20 µg/L. Predicted chromium concentrations in Whale Tail Lake (9 µg/L) are below the effect concentration reported by Baral et al. (2006). The next lowest reported and acceptable toxicity value is a 28-d IC_9 for growth of *Daphnia schodleri* of 6.4 µg/L (Arzate-Cardenas and Martinez-Jeronimo 2012), and predicted chromium concentrations are also higher than this value. However, other daphnid species were less sensitive to chromium with effect concentrations ranging from 50 µg/L for *Daphnia magna* to 71 µg/L for *Daphnia carinata* (Hickey 1989) and predicted concentrations in Whale Tail Lake are below these effect concentrations. Therefore, although effects to highly sensitive aquatic invertebrate species are possible under predicted conditions, effects to a broader range of species, including fish are not expected to occur. ▪ The assumptions used in the water quality model are highly conservative and as such, the predicted concentrations of chromium have likely been overestimated (for a summary of the conservative assumptions used in the water quality model refer to Volume 6, Section 6.4.3).

[a] Magnitude for aquatic life risk is as follows: Low = 1< HQ ≤10; Moderate = 10 < HQ ≤ 100; High = HQ > 100.

HQ = hazard quotient; Cr^{6+} and Cr(VI) = hexavalent chromium; Cr^{3+} and Cr(III) = trivalent chromium; MATC = maximum acceptable toxicant concentration; d = day; IC_x = inhibitory concentration (concentration at which x% impairment occurs in a response variable (e.g., reproduction)).

3.B-7 CUMULATIVE EFFECTS ASSESSMENT

Cumulative effects to air quality and surface water quality (Volume 4 and 6, respectively) are expected to be negligible. Therefore, the subsequent effects to human health, wildlife and aquatic life are also expected to be negligible.

3.B-8 UNCERTAINTY

Table 3-B-38: Uncertainties in the Human Health and Ecological Risk Assessment

Source of Uncertainty	Overestimate/ Underestimate/ Neutral?
Baseline Data	
The maximum concentrations of measured data from air, soil, vegetation, water, and fish tissue were used to represent baseline in the HHERA. For screening purposes, the maximum concentrations plus 10% were used when determining whether predictions were expected to be measurably greater than baseline. This is considered to be a reasonable approach by neither over- nor underestimating the potential range of baseline concentrations.	Neutral
Model Predictions	
The concentrations of COPCs in air considered in the HHERA were the predicted maximum concentrations from the 5-year modelling dataset. It was conservatively assumed that the maximum emissions would occur throughout each phase of the Project	Overestimate
The concentrations of COPCs in water considered in the HHERA were the maximum monthly predictions out of one year of modelled data considering the maximum emissions from each phase of the Project. It was conservatively assumed that the maximum concentration could occur throughout each phase of the Project.	Overestimate
HHERA Assumptions	
Time spent at grave sites in the LSA is expected to be minimal. In general terms, visiting grave sites out on the land is not typically done, but people may stop and say a prayer or otherwise pay their respects if they happen across a grave site during their travels. However, the terrain in this area makes travel very difficult, such that even access by all-terrain vehicle in the summer is difficult, so the most likely access would be during the winter via skidoo. The presence of the haul road may make travel easier to this area, provided it is in the direction that people want to go. While it is possible that people may pass through this area on their way to the Back River, which is a good fishing spot, gas is expensive and the fisher would have to bring enough with them to get to Back River and back (as there is no way to get gas at Back River), and they will likely be going as quickly as possible to conserve gas and will not stop at grave sites (P. Burt, 2016, pers. comm.). Considering the above, time spent at Grave Sites 4 and 30 was considered to be 1.5 hours per day, which is a default time spent outdoors (Health Canada 2012), for 10 days per year. This would assume that a person may stop at a grave site both on their way to Back River and during their travel back, assuming they make the trip to Back River five times per year. This is considered to be an overestimation of time spent at a grave site in the LSA.	Overestimate
Although some caribou hunting could occur in the area, the areas identified in the TK report specifically identified two locations for muskox hunting, which is typically hunted when caribou are not available, and then can only be hunted in limited amounts based upon restrictions in the area (Golder 2015). It was considered that muskox hunting might occur for up to 14 days per year (i.e., a two-week trip or up to seven weekend trips). Exposure was considered to occur for 24 hours per day each day, as people would be spending most time outdoors and camping on the land.	Overestimate
The site-specific water-to-fish BCFs derived in the HHERA relied upon measured baseline surface water quality data from Whale Tail Lake and Mammoth Lake. For the BCFs relied upon in the assessment of risks to human health, BCFs were derived considering tissue residue data for trout, while those for wildlife were derived using tissue residue data for forage fish. These BCFs may be biased high given that tissue residues that were less than their respective laboratory method detection limit were	Overestimate

Table 3-B-38: Uncertainties in the Human Health and Ecological Risk Assessment (continued)

Source of Uncertainty	Overestimate/ Underestimate/ Neutral?
considered to be detections at the detection limit (i.e., a tissue residue of <0.010 mg/kg wet weight was considered to be equal to 0.010 mg/kg wet weight). Site-specific BCFs were not derived for substances for which all samples were less than method detection limits in either water, fish, or both. In these cases, BCFs from the literature were used.	
The toxicity reference values used in the HHERA for human health and wildlife were selected from reputable sources including Health Canada and the U.S. EPA. The TRVs used in this RA are generally based on the most sensitive endpoints, with the application of safety factors to protect sensitive subpopulations. The uncertainty associated with TRVs is highly dependent on the number of studies available, and whether the key study was based on humans (low uncertainty) or small mammals (high uncertainty) in the case of the human health effects assessment, or the key study was based on species similar to those observed on-site (low uncertainty) or dissimilar (high uncertainty) in the case of the wildlife and aquatic effects assessments. When few studies are available, several types of safety factors must be applied to account for this uncertainty (e.g., factors for inter- and intraspecies sensitivity).	Neutral-Overestimate
The toxicity benchmarks for COPCs do not account for all of the factors known to modify exposure and toxicity to aquatic life.	Overestimate
Individual survival, growth, reproduction, development and population changes were used as endpoints for aquatic life but these do not necessarily translate to population-level effects which are considered ecologically relevant.	Overestimate
The potential for additive effects between COPCs was not considered for aquatic life.	Neutral-Underestimate
Acclimation and adaptation were not considered for aquatic life although natural populations chronically exposed to metals often exhibit increased tolerance to exposure relative to unexposed or naïve populations such as those used in laboratory studies upon which the toxicity benchmarks are based.	Overestimate
Other uncertainties noted in Table 3-B-36 and Table 3-B-37.	Overestimate

BCF = bioconcentration factors; COPC = chemicals of potential concern; TRV = toxicity reference value

3.B-9 MONITORING AND FOLLOW-UP

Monitoring and follow-up as described by other disciplines in the FEIS are applicable. No additional monitoring or follow-up measures were identified in the HHERA.

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ATTACHMENT A

INTRODUCTION

To evaluate the potential for adverse health effects to terrestrial life associated with changes in environmental quality due to chemical releases from the Project, the existing (or baseline) conditions of the environment must first be understood. This attachment provides baseline conditions for soil and vegetation.

METHODS

A field program was carried out to characterize the existing (or baseline) conditions of soil and vegetation quality. The program included the collection of soil and vegetation samples, and analysis of the samples for concentrations of metals. These baseline concentrations in soil and vegetation were used to provide context to the predicted changes to environmental quality as a result of the Project.

The soil and vegetation sampling program was designed to include the collection of vegetation samples of interest (i.e., berries, sedges [graminoids], and lichens) and co-located soil samples, while taking spatial distribution into account. Vegetation types selected for sampling were identified based on their importance as food for human consumption (e.g., berries) and primary forage type for wildlife considered in the assessment of human and ecological health risk (e.g., sedges [graminoids], and lichens). Soil and vegetation were sampled at 10 locations at the Whale Tail site (Figure 1). Sample collection took place from August 9 to August 16, 2015 and was completed by David Brown of Golder Associates Ltd.

Vegetation samples were collected in 10 sites around the proposed mine area (AER-01 to AER-10) areas where sufficient plant material of a given species was available. One duplicate sample (for soil, lichen, graminoid and berry) was collected at AER-08 and five replicates were taken at the replicate site at the north end of the road (AER-REP). Upon arriving at a suitable sampling site, Universal Transverse Mercator (UTM) coordinates were marked with a Garmin GPSMAP62s Global Positioning System device and photographs were taken in the four cardinal directions. The species of plant was identified and general notes regarding the plant's health and vigour were recorded. Unhealthy plants were only collected when there was insufficient healthy plant material available. Plant material that was dropped during collection was not included in the sample.

Berries were hand-picked and care was taken to avoid removing dust from their surface. They were collected from a minimum of three plants. Effort was made to pick ripe berries that someone would consider edible. Graminoids were collected by cutting the base of the aboveground growth with clean, titanium blade, non-stick coated scissors and folding the stems gently. Reindeer lichen (*Cladina* sp.) was lifted from the ground surface.

At least 10 g of each vegetation type was collected and placed in a plastic sample bag. Once the sample was collected, the air was squeezed out of the bag and the bag was sealed closed. Sample bags were labelled with the date, location, time, and sample identification, and then placed inside a second plastic bag. The second bag was labelled with the same information as the first bag and sealed closed.

Disposable nitrile gloves were worn to collect samples and gloves were changed between each sample to avoid cross contamination. Scissors were cleaned with phosphate-free dish detergent and rinsed with distilled water between each sample.

LEGEND

- RISK SAMPLING SITE

WHALE TAIL

- BORROW SOURCE
- INFRASTRUCTURE
- PROPOSED HAUL ROAD
- WATERCOURSE
- WATERBODY

REFERENCE

1. WHALE TAIL INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED ON DECEMBER 21, 2015.
2. MEADOWBANK INFRASTRUCTURE OBTAINED FROM AGNICO EAGLE MINES LIMITED ON NOVEMBER 12, 2015.
3. WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. INSET MAP DATA OBTAINED FROM ESRI

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

800 0 800
METRES

PROJECT

AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

RISK SAMPLING SITES

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	PY	24 Feb. 2016	SCALE AS SHOWN	REV. 0
GIS	MH	10 Mar. 2016	FIGURE 1	
CHECK	AA	17 Jun. 2016		
REVIEW	RJ	17 Jun. 2016		

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\3500_HHERA\Report\1541520_FIG_1_SAMPLING_LOCATIONS.mxd

Soil samples were collected at each location where berries, graminoids, or lichen samples were collected. Before collecting the samples, leaves and debris were cleared from the ground or water surface. A clean plastic hand trowel was used to collect a sample from the rooting zone or top 15 cm which was placed into a plastic Ziploc bag. All bags of soil were sealed and labelled with the location, date and sample identification. The sample bags were refrigerated until they were delivered to the laboratory for analysis. All samples were recorded on a chain-of-custody form, which was also placed in the coolers prior to delivery to the analytical laboratory. Laboratory analyses on vegetation and soil samples were performed by ALS Laboratories in Winnipeg, Manitoba. Samples were analyzed for the following suite of parameters:

- moisture content (plant tissue only);
- pH (soil only); and
- total metals (plant tissue and soil unless otherwise indicated): aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, cesium (plant tissue only), chromium (total), cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, rubidium (plant tissue only), selenium, silver (soil only),sodium, strontium, tellurium (plant tissue only), thallium, tin, titanium (soil only), uranium, vanadium, and zinc.

Mercury in vegetation was analyzed using cold vapour atomic absorption. Total metals in soil and vegetation were analyzed using inductively coupled plasma atomic emission spectroscopy and inductively coupled plasma mass spectrometry, respectively. The laboratory certificates of analyses are provided in Annex A-1.

A summary of soil and vegetation samples collected during the 2015 field program is presented in Table 39.

Table 39: Soil and Vegetation Sampled During the 2015 Field Program

Media	Number of Moisture Content Samples[a]	Number of Metals Samples[a]
Soil	-	16 (1)
Total Soil	**0**	**16 (1)**
Lichen	16 (1)	16 (1)
Grass/sedges	16 (1)	16 (1)
Berries	16 (1)	16 (1)
Total Vegetation	**48 (3)**	**48 (3)**

[a] Totals include field duplicate samples. Values in parentheses represent the number of duplicates.

Quality Assurance and Quality Control

Sample duplicates were collected for Quality Assurance and Quality Control (QA/QC) purposes. Duplicates provide an indication of natural sample variation and the reproducibility of the laboratory test methods. Duplicate samples were collected with 10% frequency, excluding the five replicates at AER-REP.

To obtain duplicate vegetation samples, two samples were collected from the sample location following the sampling methods described in above. Twice as much plant material was collected and the plant material was mixed thoroughly before dividing it into two bags. To obtain duplicate soil samples, two samples were collected from the sample location following the methods described above, but twice as much sample was collected. The sample was mixed thoroughly in a large plastic bag before dividing it into plastic bags. Each duplicate sample was submitted to the laboratory for analyses via the methods and for the parameters identified above.

The results of the duplicate pair were expressed as a Relative Percent Difference (RPD). The RPD is an indicator of laboratory precision and sample heterogeneity. Lower RPD numbers indicate better precision in laboratory analysis and sample homogeneity. The formula for computing the RPD is given in the equation below:

$$RPD = \frac{|Sample - Duplicate|}{Mean} \times 100$$

Where:

RPD = relative percent difference (%);

Sample = concentration in original sample (µg/g);

Duplicate = concentration in duplicate sample (µg/g); and

Mean = average of the original sample and the duplicate sample (µg/g).

Relative percent differences were not calculated if concentrations were not detected in one or both of the duplicate samples. The calculated RPDs were compared to criteria established by the OMOE (2011). The QA/QC RPD criterion is 30% for all metals in soil (OMOE 2011). A criterion of 30% was used for vegetation, consistent with industry standard.

SOIL AND VEGETATION RESULTS

The results of the soil and sediment sampling program are presented in Annex A-2.

Soil collected around vegetation had concentrations of antimony, boron, selenium, silver and tin less than detection limits in all samples collected (Annex A-2, Table 1). The minimum and maximum concentrations for all metals in all samples were within an order of magnitude of each other, with the exception of chromium (i.e., 140 mg/kg in AER-SOIL-01 and 14.1 mg/kg in AER-SOIL-05), demonstrating there was little variability overall in metal concentrations between soil samples. Soil pH ranged from 4.59 to 5.69.

The results of the lichen sampling program are presented in Annex A-2, Table 2. Most metals were detected in lichen tissue. Only concentrations of tellurium were less than detection limits in all samples collected; lithium was not detected in all but one sample (AER-LI-10) and tin was not detected in all but two samples (AER-LI-07 and AER-LI-10). Some variability was observed in the metal concentrations between samples. The difference between the minimum and maximum concentrations were more than one order of magnitude for the following metals: aluminum, beryllium, bismuth, cesium, cobalt, iron, lead, manganese, mercury, nickel, rubidium, selenium, sodium, strontium, thallium, uranium, vanadium, and zirconium. Moisture content also varied widely, ranging from 10.1 to 81.0%.

The results of the graminoid sampling program are presented in Annex A-2, Table 3. As in lichen tissue, most metals were detected in graminoid tissue. Only concentrations of lithium were less than detection limits in all samples collected; tin was not detected in all but one sample (AER-GR-10) and tellurium was not detected in all but two samples (AER-GR-06 and AER-GR-10). Some variability was observed in the metal concentrations between samples. The difference between the minimum and maximum concentrations were more than one order of magnitude for the following metals: antimony, lead, molybdenum, rubidium, thallium, and uranium. Moisture content ranged from 36.1 to 62.0%.

The results of the berry sampling program are presented in Annex A-2, Table 4. Concentrations of metals were less than detection limits in all samples collected for the following metals: antimony, arsenic, beryllium, bismuth, chromium, lead, lithium, mercury, selenium, sodium, tellurium, thallium, uranium, vanadium, and zirconium. Cesium and molybdenum were detected in one sample (AER-BER-04). Variability was observed in the metal concentrations between samples. The maximum concentration was over an order of magnitude greater than the minimum concentration for the following metals: aluminum, iron, and manganese. Moisture content ranged from 75.5 to 88.1%.

Quality Assurance and Quality Control

One duplicate sample of each vegetation type (berry, graminoid, and lichen) and co-located soil was collected during the 2015 sampling program at location AER-08 and analyzed for metals.

The RPDs for duplicates for metal concentrations in soil are presented in Annex A-2, Table 5. The RPDs for the soil duplicates were within the 30% criterion for all metals with the exception of mercury (95%) and zirconium (56%). These results suggest that the soils in the vicinity of the vegetation have a low degree of heterogeneity.

The RPDs for duplicates for metal concentrations in vegetation are presented in Annex A-2, Table 6. The RPDs for the lichen and graminoid duplicates were above the 30% criterion for 26 and 19 metal parameters, respectively. These results suggest that the metals concentrations in lichen and graminoid vegetation have some degree of heterogeneity. The RPD for the berry duplicates did not exceed the 30% criterion for any of the metal parameters, indicating that metals concentrations in berries are relatively homogenous.

Duplicate samples that have larger variation indicate high sample variability, which can be attributed to laboratory analysis, sampling technique or natural sample heterogeneity. Specific procedures were followed in the field during the collection of duplicate soil samples (i.e., sample homogenization) to reduce the effect of sampling techniques on variability. In addition, the results of the laboratory QA/QC analyses performed by ALS on both soil and vegetation fell within acceptable control limits for most samples, suggesting laboratory analyses would not be a large source of variability for either of these media.

For soils, the majority of the variability observed is likely attributed to the natural heterogeneity of soils. Almost all natural soils are highly variable and rarely homogeneous. Soil heterogeneity can be classified into two main categories. The first is lithological heterogeneity, which can be manifested in the form of different lithology within a more uniform soil mass. The second source of heterogeneity can be attributed to inherent spatial soil variability, which is the variation of soil properties from one point to another in space due to different deposition conditions.

REFERENCES

OMOE (Ontario Ministry of the Environment). 2011. Rationale for the Development of Soil and Groundwater Standards for use at Contaminated Sites in Ontario. PIBs #7386e01. OMOE, Standards Development Branch. Ottawa, ON.

ANNEX A-1

AGNICO-EAGLE MINES LTD.
ATTN: RYAN VANENGEN
Meadowbank Division
Environment Department
Baker Lake Nunavut X0C 0A0

Date Received: 21-AUG-15
Report Date: 30-SEP-15 15:00 (MT)
Version: FINAL

Client Phone: 775-651-2974

Certificate of Analysis

Lab Work Order #: L1661327

Project P.O. #: NOT SUBMITTED
Job Reference: MEADOWBANK SLRA
C of C Numbers:
Legal Site Desc:

Ariel Tang, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L1661327-1	L1661327-5	L1661327-9	L1661327-13	L1661327-17
	Sample ID	L1661327-1	L1661327-5	L1661327-9	L1661327-13	L1661327-17
	Description	Soil	Soil	Soil	Soil	Soil
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time					
	Client ID	AER-SOIL-01	AER-SOIL-02	AER-SOIL-03	AER-SOIL-REP2	AER-SOIL-REP3
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	5.17	4.92	5.41	5.37	5.67
Metals	Aluminum (Al) (mg/kg)	9150	6270	6030	6200	9960
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	8.23	3.39	2.87	4.41	5.66
	Barium (Ba) (mg/kg)	14.1	21.9	19.5	21.6	46.5
	Beryllium (Be) (mg/kg)	0.22	0.29	0.28	0.33	0.54
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	0.27
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.061	0.047	0.026	0.036	0.047
	Calcium (Ca) (mg/kg)	1550	1970	2680	2650	3110
	Chromium (Cr) (mg/kg)	140	27.2	44.3	23.3	38.7
	Cobalt (Co) (mg/kg)	11.6	4.49	4.20	5.49	7.96
	Copper (Cu) (mg/kg)	5.50	4.34	4.99	4.76	8.02
	Iron (Fe) (mg/kg)	21200	14800	13600	17800	21500
	Lead (Pb) (mg/kg)	5.16	5.86	5.10	5.71	7.46
	Lithium (Li) (mg/kg)	11.3	6.4	7.5	7.4	11.7
	Magnesium (Mg) (mg/kg)	8810	3210	3640	3520	5210
	Manganese (Mn) (mg/kg)	450	185	147	206	310
	Mercury (Hg) (mg/kg)	0.0119	0.0184	<0.0050	<0.0050	0.0107
	Molybdenum (Mo) (mg/kg)	0.43	0.47	0.25	0.32	0.51
	Nickel (Ni) (mg/kg)	62.9	14.3	17.7	14.9	24.5
	Phosphorus (P) (mg/kg)	328	325	487	615	479
	Potassium (K) (mg/kg)	630	670	650	740	1230
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	<50	75	<50	52	66
	Strontium (Sr) (mg/kg)	19.1	21.3	26.0	24.5	32.4
	Thallium (Tl) (mg/kg)	<0.050	0.060	0.052	0.056	0.102
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	374	535	583	491	754
	Uranium (U) (mg/kg)	0.900	1.99	1.80	2.17	2.77
	Vanadium (V) (mg/kg)	24.0	12.4	13.0	12.2	17.6
	Zinc (Zn) (mg/kg)	36.5	25.5	23.4	28.9	41.4
	Zirconium (Zr) (mg/kg)	<1.0	1.6	7.0	6.9	4.7

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L1661327-21	L1661327-25	L1661327-29	L1661327-33	L1661327-37
	Description	Soil	Soil	Soil	Soil	Soil
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time					
	Client ID	AER-SOIL-REP4	AER-SOIL-REP5	AER-SOIL-04	AER-SOIL-05	AER-SOIL-06
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	5.47	5.64	5.62	5.05	5.25
Metals	Aluminum (Al) (mg/kg)	6140	8860	7190	6300	7310
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	3.26	4.14	2.45	2.04	2.72
	Barium (Ba) (mg/kg)	22.3	32.9	39.7	28.2	32.8
	Beryllium (Be) (mg/kg)	0.28	0.44	0.40	0.36	0.43
	Bismuth (Bi) (mg/kg)	<0.20	0.22	0.20	0.21	0.30
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.031	0.043	0.032	0.037	0.035
	Calcium (Ca) (mg/kg)	2670	3440	3070	2020	3170
	Chromium (Cr) (mg/kg)	23.5	32.7	14.9	14.1	19.8
	Cobalt (Co) (mg/kg)	4.82	7.25	4.98	4.08	4.74
	Copper (Cu) (mg/kg)	4.73	6.03	4.44	3.45	10.1
	Iron (Fe) (mg/kg)	14000	19300	16900	15100	16600
	Lead (Pb) (mg/kg)	5.19	6.78	4.95	5.70	7.92
	Lithium (Li) (mg/kg)	6.7	10.1	8.2	7.2	8.1
	Magnesium (Mg) (mg/kg)	3300	4650	3550	2920	3440
	Manganese (Mn) (mg/kg)	168	279	242	202	199
	Mercury (Hg) (mg/kg)	<0.0050	0.0078	0.0057	0.0131	0.0069
	Molybdenum (Mo) (mg/kg)	0.31	0.41	0.27	0.26	0.32
	Nickel (Ni) (mg/kg)	15.8	19.9	9.05	7.87	10.6
	Phosphorus (P) (mg/kg)	455	507	520	361	551
	Potassium (K) (mg/kg)	730	1060	710	690	830
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	<50	63	74	68	70
	Strontium (Sr) (mg/kg)	29.3	37.8	31.8	21.7	36.7
	Thallium (Tl) (mg/kg)	0.052	0.081	<0.050	0.053	0.063
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	600	740	698	590	694
	Uranium (U) (mg/kg)	1.75	2.43	1.47	1.26	1.92
	Vanadium (V) (mg/kg)	11.8	16.7	17.4	13.3	15.2
	Zinc (Zn) (mg/kg)	25.5	36.2	29.2	27.7	31.7
	Zirconium (Zr) (mg/kg)	5.9	4.7	7.1	1.9	7.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-41	L1661327-45	L1661327-49	L1661327-53	L1661327-57
	Description	Soil	Soil	Soil	Soil	Soil
	Sampled Date	14-AUG-15	15-AUG-15	15-AUG-15	15-AUG-15	15-AUG-15
	Sampled Time					
	Client ID	AER-SOIL-07	AER-SOIL-08	AER-SOIL-08-DUP	AER-SOIL-09	AER-SOIL-10
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	4.98	5.26	5.62	5.69	4.59
Metals	Aluminum (Al) (mg/kg)	6390	7190	8370	9360	8450
	Antimony (Sb) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Arsenic (As) (mg/kg)	3.48	12.2	12.9	8.00	4.94
	Barium (Ba) (mg/kg)	21.2	73.9	86.8	48.4	14.3
	Beryllium (Be) (mg/kg)	0.31	0.36	0.40	0.35	0.26
	Bismuth (Bi) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B) (mg/kg)	<5.0	<5.0	<5.0	<5.0	<5.0
	Cadmium (Cd) (mg/kg)	0.045	0.041	0.042	0.038	0.031
	Calcium (Ca) (mg/kg)	1540	3150	3620	3280	1130
	Chromium (Cr) (mg/kg)	29.2	45.9	55.1	94.1	70.0
	Cobalt (Co) (mg/kg)	4.27	7.34	8.07	9.10	6.34
	Copper (Cu) (mg/kg)	3.47	6.55	7.91	9.71	2.94
	Iron (Fe) (mg/kg)	15800	16300	18300	20900	19400
	Lead (Pb) (mg/kg)	6.77	6.11	6.86	4.72	4.60
	Lithium (Li) (mg/kg)	7.7	8.7	10.4	10.7	9.3
	Magnesium (Mg) (mg/kg)	3250	4930	5850	6710	5870
	Manganese (Mn) (mg/kg)	169	264	280	246	196
	Mercury (Hg) (mg/kg)	0.0160	0.0249	0.0089	0.0055	0.0061
	Molybdenum (Mo) (mg/kg)	0.28	0.32	0.33	0.29	0.33
	Nickel (Ni) (mg/kg)	11.0	23.5	27.3	38.7	33.1
	Phosphorus (P) (mg/kg)	358	735	859	755	232
	Potassium (K) (mg/kg)	710	1480	1890	1540	580
	Selenium (Se) (mg/kg)	<0.20	<0.20	<0.20	<0.20	<0.20
	Silver (Ag) (mg/kg)	<0.10	<0.10	<0.10	<0.10	<0.10
	Sodium (Na) (mg/kg)	53	66	85	55	<50
	Strontium (Sr) (mg/kg)	12.7	36.6	42.6	30.0	21.1
	Thallium (Tl) (mg/kg)	0.053	0.093	0.114	0.087	<0.050
	Tin (Sn) (mg/kg)	<2.0	<2.0	<2.0	<2.0	<2.0
	Titanium (Ti) (mg/kg)	572	683	798	716	304
	Uranium (U) (mg/kg)	0.962	1.36	1.56	1.30	0.977
	Vanadium (V) (mg/kg)	17.0	20.1	23.0	25.0	18.8
	Zinc (Zn) (mg/kg)	25.4	27.6	31.5	30.1	27.8
	Zirconium (Zr) (mg/kg)	1.8	2.6	4.6	6.9	1.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-61				
	Description	Soil				
	Sampled Date	14-AUG-15				
	Sampled Time					
	Client ID	AER-SOIL-REP1				
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	5.68				
Metals	Aluminum (Al) (mg/kg)	9350				
	Antimony (Sb) (mg/kg)	<0.10				
	Arsenic (As) (mg/kg)	5.13				
	Barium (Ba) (mg/kg)	39.2				
	Beryllium (Be) (mg/kg)	0.53				
	Bismuth (Bi) (mg/kg)	0.25				
	Boron (B) (mg/kg)	<5.0				
	Cadmium (Cd) (mg/kg)	0.037				
	Calcium (Ca) (mg/kg)	3430				
	Chromium (Cr) (mg/kg)	36.7				
	Cobalt (Co) (mg/kg)	9.01				
	Copper (Cu) (mg/kg)	7.39				
	Iron (Fe) (mg/kg)	21200				
	Lead (Pb) (mg/kg)	7.37				
	Lithium (Li) (mg/kg)	10.7				
	Magnesium (Mg) (mg/kg)	4990				
	Manganese (Mn) (mg/kg)	421				
	Mercury (Hg) (mg/kg)	0.0084				
	Molybdenum (Mo) (mg/kg)	0.44				
	Nickel (Ni) (mg/kg)	23.6				
	Phosphorus (P) (mg/kg)	436				
	Potassium (K) (mg/kg)	1110				
	Selenium (Se) (mg/kg)	<0.20				
	Silver (Ag) (mg/kg)	<0.10				
	Sodium (Na) (mg/kg)	113				
	Strontium (Sr) (mg/kg)	37.6				
	Thallium (Tl) (mg/kg)	0.091				
	Tin (Sn) (mg/kg)	<2.0				
	Titanium (Ti) (mg/kg)	816				
	Uranium (U) (mg/kg)	3.08				
	Vanadium (V) (mg/kg)	17.4				
	Zinc (Zn) (mg/kg)	36.8				
	Zirconium (Zr) (mg/kg)	4.7				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-2	L1661327-3	L1661327-4	L1661327-6	L1661327-7
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time					
	Client ID	AER-LI-01	AER-GR-01	AER-BER-01	AER-LI-02	AER-GR-02
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	15.0	55.4	81.9	12.5	50.1
Metals	Aluminum (Al)-Total (mg/kg wwt)	55.1	12.5	7.78	33.1	27.5
	Antimony (Sb)-Total (mg/kg wwt)	0.0021	<0.0020	<0.0020	0.0022	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0636	0.0129	<0.0040	0.0454	0.0191
	Barium (Ba)-Total (mg/kg wwt)	5.43	10.9	0.150	7.87	11.2
	Beryllium (Be)-Total (mg/kg wwt)	0.0037	<0.0020	<0.0020	0.0065	0.0154
	Bismuth (Bi)-Total (mg/kg wwt)	0.0030	0.0058	<0.0020	0.0026	<0.0020
	Boron (B)-Total (mg/kg wwt)	0.25	2.34	0.27	0.31	1.44
	Cadmium (Cd)-Total (mg/kg wwt)	0.0387	0.0110	<0.0010	0.0398	0.0363
	Calcium (Ca)-Total (mg/kg wwt)	770	925	18.0	1030	1070
	Cesium (Cs)-Total (mg/kg wwt)	0.0122	0.0066	<0.0010	0.0169	0.0149
	Chromium (Cr)-Total (mg/kg wwt)	0.470	0.109	<0.010	0.180	0.144
	Cobalt (Co)-Total (mg/kg wwt)	0.180	0.0498	0.0041	0.0808	0.215
	Copper (Cu)-Total (mg/kg wwt)	0.807	1.61	0.062	0.639	1.69
	Iron (Fe)-Total (mg/kg wwt)	80.6	29.7	8.14	46.4	57.8
	Lead (Pb)-Total (mg/kg wwt)	0.220	0.0292	<0.0040	0.292	0.104
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	362	704	21.7	217	553
	Manganese (Mn)-Total (mg/kg wwt)	74.8	155	0.333	71.3	325
	Mercury (Hg)-Total (mg/kg wwt)	0.0443	0.0053	<0.0010	0.0714	0.0083
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0149	0.157	<0.0040	0.0157	0.197
	Nickel (Ni)-Total (mg/kg wwt)	0.725	2.53	0.135	0.314	1.86
	Phosphorus (P)-Total (mg/kg wwt)	289	481	35.1	209	365
	Potassium (K)-Total (mg/kg wwt)	860	3940	255	860	5080
	Rubidium (Rb)-Total (mg/kg wwt)	0.962	1.74	0.124	1.93	6.10
	Selenium (Se)-Total (mg/kg wwt)	0.031	<0.010	<0.010	0.045	<0.010
	Sodium (Na)-Total (mg/kg wwt)	11.2	7.2	<4.0	16.0	9.5
	Strontium (Sr)-Total (mg/kg wwt)	2.15	3.57	0.050	3.12	4.99
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00184	0.00354	<0.00040	0.00384	0.00109
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00701	0.00112	<0.00040	0.00761	0.0164
	Vanadium (V)-Total (mg/kg wwt)	0.102	0.023	<0.020	0.057	0.034
	Zinc (Zn)-Total (mg/kg wwt)	11.4	14.6	0.41	10.8	16.9
	Zirconium (Zr)-Total (mg/kg wwt)	0.069	<0.040	<0.040	0.051	0.042

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1661327-8 Tissue 14-AUG-15 AER-BER-02	L1661327-10 Tissue 14-AUG-15 AER-LI-03	L1661327-11 Tissue 14-AUG-15 AER-GR-03	L1661327-12 Tissue 14-AUG-15 AER-BER-03	L1661327-14 Tissue 14-AUG-15 AER-LI-REP2
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	86.8	11.3	40.1	81.4	25.5
Metals	Aluminum (Al)-Total (mg/kg wwt)	<0.40	89.6	26.1	<0.40	23.4
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0045	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0923	0.0312	<0.0040	0.0444
	Barium (Ba)-Total (mg/kg wwt)	0.263	12.6	16.5	0.266	3.61
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0123	0.0051	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	0.0044	<0.0020	<0.0020	0.0032
	Boron (B)-Total (mg/kg wwt)	<0.20	0.66	1.58	<0.20	0.25
	Cadmium (Cd)-Total (mg/kg wwt)	0.0011	0.0555	0.0135	<0.0010	0.0358
	Calcium (Ca)-Total (mg/kg wwt)	25.7	2330	1380	35.6	745
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0249	0.0104	<0.0010	0.0076
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	0.715	0.348	<0.010	0.187
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	0.287	0.127	<0.0040	0.0216
	Copper (Cu)-Total (mg/kg wwt)	0.084	1.12	1.33	0.213	0.637
	Iron (Fe)-Total (mg/kg wwt)	<0.60	145	61.3	<0.60	36.4
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.304	0.0883	<0.0040	0.205
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	11.4	580	479	21.8	166
	Manganese (Mn)-Total (mg/kg wwt)	1.01	277	500	5.49	65.7
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	0.0499	0.0095	<0.0010	0.0730
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	0.0673	0.181	<0.0040	0.0137
	Nickel (Ni)-Total (mg/kg wwt)	0.041	1.26	1.74	0.067	0.259
	Phosphorus (P)-Total (mg/kg wwt)	25.5	376	359	42.3	182
	Potassium (K)-Total (mg/kg wwt)	138	1320	3400	289	648
	Rubidium (Rb)-Total (mg/kg wwt)	0.357	2.11	3.00	0.458	0.466
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.049	0.012	<0.010	0.044
	Sodium (Na)-Total (mg/kg wwt)	<4.0	160	9.8	<4.0	13.0
	Strontium (Sr)-Total (mg/kg wwt)	0.112	8.98	6.38	0.063	2.43
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00442	0.00541	<0.00040	0.00137
	Tin (Sn)-Total (mg/kg wwt)	0.033	<0.020	<0.020	0.032	<0.020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.0488	0.00698	<0.00040	0.00496
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.149	0.050	<0.020	0.048
	Zinc (Zn)-Total (mg/kg wwt)	0.33	21.4	21.4	0.42	7.53
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	0.167	<0.040	<0.040	0.044

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L1661327-15	L1661327-16	L1661327-18	L1661327-19	L1661327-20
	Sample ID	L1661327-15	L1661327-16	L1661327-18	L1661327-19	L1661327-20
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time					
	Client ID	AER-GR-REP2	AER-BER-REP2	AER-LI-REP3	AER-GR-REP3	AER-BER-REP3
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	55.7	83.6	32.1	56.4	81.0
Metals	Aluminum (Al)-Total (mg/kg wwt)	12.2	<0.40	27.9	16.7	<0.40
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0187	<0.0040	0.0505	0.0250	<0.0040
	Barium (Ba)-Total (mg/kg wwt)	13.6	0.259	3.23	22.1	0.289
	Beryllium (Be)-Total (mg/kg wwt)	0.0052	<0.0020	<0.0020	0.0081	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0029	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	1.75	0.24	0.35	2.09	0.24
	Cadmium (Cd)-Total (mg/kg wwt)	0.0120	0.0018	0.0456	0.0092	<0.0010
	Calcium (Ca)-Total (mg/kg wwt)	1100	33.4	1260	1380	35.2
	Cesium (Cs)-Total (mg/kg wwt)	0.0062	<0.0010	0.0071	0.0071	<0.0010
	Chromium (Cr)-Total (mg/kg wwt)	0.083	<0.010	0.241	0.076	<0.010
	Cobalt (Co)-Total (mg/kg wwt)	0.0435	<0.0040	0.0248	0.0431	<0.0040
	Copper (Cu)-Total (mg/kg wwt)	1.41	0.159	0.769	1.37	0.188
	Iron (Fe)-Total (mg/kg wwt)	40.2	<0.60	36.1	41.8	<0.60
	Lead (Pb)-Total (mg/kg wwt)	0.0387	<0.0040	0.236	0.0269	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	475	18.1	213	605	21.8
	Manganese (Mn)-Total (mg/kg wwt)	328	6.16	89.7	227	4.84
	Mercury (Hg)-Total (mg/kg wwt)	0.0047	<0.0010	0.0587	0.0042	<0.0010
	Molybdenum (Mo)-Total (mg/kg wwt)	0.162	<0.0040	0.0167	0.264	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	1.38	0.069	0.459	1.80	0.066
	Phosphorus (P)-Total (mg/kg wwt)	388	36.6	235	302	43.2
	Potassium (K)-Total (mg/kg wwt)	3030	239	770	3040	303
	Rubidium (Rb)-Total (mg/kg wwt)	1.88	0.233	0.503	1.66	0.311
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.042	<0.010	<0.010
	Sodium (Na)-Total (mg/kg wwt)	23.0	<4.0	17.7	16.5	<4.0
	Strontium (Sr)-Total (mg/kg wwt)	6.61	0.099	3.28	9.50	0.087
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	<0.00040	0.00063	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg wwt)	<0.020	0.024	<0.020	<0.020	0.023
	Uranium (U)-Total (mg/kg wwt)	0.0121	<0.00040	0.00549	0.0174	<0.00040
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.020	0.056	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	13.5	0.42	9.30	8.47	0.37
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.042	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1661327-22 Tissue 14-AUG-15 AER-LI-REP4	L1661327-23 Tissue 14-AUG-15 AER-GR-REP4	L1661327-24 Tissue 14-AUG-15 AER-BER-REP4	L1661327-26 Tissue 14-AUG-15 AER-LI-REP5	L1661327-27 Tissue 14-AUG-15 AER-GR-REP5
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	42.0	62.0	84.3	33.2	57.2
Metals	Aluminum (Al)-Total (mg/kg wwt)	29.6	25.2	<0.40	39.1	8.95
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0401	0.0264	<0.0040	0.0651	0.0194
	Barium (Ba)-Total (mg/kg wwt)	3.11	7.08	0.251	5.51	14.7
	Beryllium (Be)-Total (mg/kg wwt)	0.0029	0.0035	<0.0020	0.0098	0.0026
	Bismuth (Bi)-Total (mg/kg wwt)	0.0057	<0.0020	<0.0020	0.0029	<0.0020
	Boron (B)-Total (mg/kg wwt)	0.27	1.10	0.20	0.24	2.06
	Cadmium (Cd)-Total (mg/kg wwt)	0.0675	0.0156	0.0017	0.0586	0.0123
	Calcium (Ca)-Total (mg/kg wwt)	1980	754	31.0	2010	1190
	Cesium (Cs)-Total (mg/kg wwt)	0.0109	0.0038	<0.0010	0.0094	0.0045
	Chromium (Cr)-Total (mg/kg wwt)	0.168	0.164	<0.010	0.251	0.126
	Cobalt (Co)-Total (mg/kg wwt)	0.0456	0.0560	<0.0040	0.0652	0.0291
	Copper (Cu)-Total (mg/kg wwt)	0.626	1.17	0.155	0.612	1.23
	Iron (Fe)-Total (mg/kg wwt)	42.5	53.1	0.69	55.8	37.3
	Lead (Pb)-Total (mg/kg wwt)	0.250	0.0452	<0.0040	0.304	0.0308
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	204	346	18.2	264	535
	Manganese (Mn)-Total (mg/kg wwt)	68.7	257	5.97	44.4	387
	Mercury (Hg)-Total (mg/kg wwt)	0.0489	0.0058	<0.0010	0.0681	0.0045
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0319	0.205	<0.0040	0.0225	0.150
	Nickel (Ni)-Total (mg/kg wwt)	1.13	1.24	0.070	0.685	1.05
	Phosphorus (P)-Total (mg/kg wwt)	293	351	37.9	238	346
	Potassium (K)-Total (mg/kg wwt)	785	2160	227	676	3130
	Rubidium (Rb)-Total (mg/kg wwt)	0.737	0.861	0.226	0.685	1.60
	Selenium (Se)-Total (mg/kg wwt)	0.035	0.011	<0.010	0.042	<0.010
	Sodium (Na)-Total (mg/kg wwt)	39.1	30.1	<4.0	18.9	20.4
	Strontium (Sr)-Total (mg/kg wwt)	5.95	4.62	0.099	8.59	6.79
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00096	0.00056	<0.00040	0.00086	<0.00040
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.0179	0.0175	<0.00040	0.0367	0.00267
	Vanadium (V)-Total (mg/kg wwt)	0.050	0.039	<0.020	0.059	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	9.01	13.8	0.40	8.85	14.6
	Zirconium (Zr)-Total (mg/kg wwt)	0.064	<0.040	<0.040	0.068	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-28	L1661327-30	L1661327-31	L1661327-32	L1661327-34
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time					
	Client ID	AER-BER-REP5	AER-LI-04	AER-GR-04	AER-BER-04	AER-LI-05
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	88.1	10.3	43.3	78.3	11.1
Metals	Aluminum (Al)-Total (mg/kg wwt)	<0.40	23.4	31.4	1.07	36.7
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.0521	0.0153	<0.0040	0.0490
	Barium (Ba)-Total (mg/kg wwt)	0.223	3.85	16.5	0.451	18.0
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0052	0.0067	<0.0020	0.0177
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	0.0036	<0.0020	<0.0020	0.0041
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	1.10	0.30	0.34
	Cadmium (Cd)-Total (mg/kg wwt)	0.0022	0.0385	0.0099	<0.0010	0.0854
	Calcium (Ca)-Total (mg/kg wwt)	23.8	621	848	57.1	3290
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0159	0.0151	0.0011	0.0106
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	0.143	0.184	<0.010	0.187
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	0.0469	0.0628	<0.0040	0.120
	Copper (Cu)-Total (mg/kg wwt)	0.089	0.615	0.862	0.236	0.634
	Iron (Fe)-Total (mg/kg wwt)	<0.60	35.4	46.2	0.79	63.6
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.343	0.0912	<0.0040	0.518
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	11.7	125	239	28.2	280
	Manganese (Mn)-Total (mg/kg wwt)	4.64	28.7	96.8	8.95	62.3
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	0.0651	0.0108	<0.0010	0.0772
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	0.0139	0.163	0.0055	0.0179
	Nickel (Ni)-Total (mg/kg wwt)	0.055	0.141	1.07	<0.040	0.335
	Phosphorus (P)-Total (mg/kg wwt)	25.8	173	382	43.0	287
	Potassium (K)-Total (mg/kg wwt)	129	763	2490	317	1010
	Rubidium (Rb)-Total (mg/kg wwt)	0.122	1.94	3.83	0.694	1.64
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.049	0.014	<0.010	0.050
	Sodium (Na)-Total (mg/kg wwt)	<4.0	14.3	13.0	<4.0	19.9
	Strontium (Sr)-Total (mg/kg wwt)	0.069	1.96	3.91	0.090	12.0
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00203	0.00131	<0.00040	0.00346
	Tin (Sn)-Total (mg/kg wwt)	0.024	<0.020	<0.020	0.033	<0.020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00560	0.00305	<0.00040	0.0120
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.046	0.041	<0.020	0.059
	Zinc (Zn)-Total (mg/kg wwt)	0.36	8.36	9.79	0.45	15.6
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.111	<0.040	0.060

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-35	L1661327-36	L1661327-38	L1661327-39	L1661327-40
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time					
	Client ID	AER-GR-05	AER-BER-05	AER-LI-06	AER-GR-06	AER-BER-06
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	47.5	86.1	10.1	45.6	85.0
Metals	Aluminum (Al)-Total (mg/kg wwt)	47.3	0.81	39.7	17.4	<0.40
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0278	<0.0040	0.0708	0.0161	<0.0040
	Barium (Ba)-Total (mg/kg wwt)	16.9	0.258	8.32	62.1	0.304
	Beryllium (Be)-Total (mg/kg wwt)	0.0088	<0.0020	0.0053	0.0146	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0036	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	0.89	<0.20	0.21	2.11	0.23
	Cadmium (Cd)-Total (mg/kg wwt)	0.0119	0.0015	0.0409	0.0098	0.0021
	Calcium (Ca)-Total (mg/kg wwt)	860	30.4	909	1860	34.6
	Cesium (Cs)-Total (mg/kg wwt)	0.0145	<0.0010	0.0201	0.0086	<0.0010
	Chromium (Cr)-Total (mg/kg wwt)	0.313	<0.010	0.375	0.124	<0.010
	Cobalt (Co)-Total (mg/kg wwt)	0.0721	<0.0040	0.0820	0.0681	<0.0040
	Copper (Cu)-Total (mg/kg wwt)	0.809	0.061	0.624	2.11	0.117
	Iron (Fe)-Total (mg/kg wwt)	81.5	0.99	69.5	95.5	<0.60
	Lead (Pb)-Total (mg/kg wwt)	0.141	<0.0040	0.316	0.0614	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	263	14.3	220	453	17.4
	Manganese (Mn)-Total (mg/kg wwt)	99.9	0.743	90.3	388	7.48
	Mercury (Hg)-Total (mg/kg wwt)	0.0123	<0.0010	0.0673	0.0068	<0.0010
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0720	<0.0040	0.0247	2.99	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	0.631	<0.040	0.282	1.67	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	341	23.6	226	700	31.5
	Potassium (K)-Total (mg/kg wwt)	1980	162	857	3860	190
	Rubidium (Rb)-Total (mg/kg wwt)	3.26	0.320	1.40	3.00	0.269
	Selenium (Se)-Total (mg/kg wwt)	0.016	<0.010	0.042	0.011	<0.010
	Sodium (Na)-Total (mg/kg wwt)	10.7	<4.0	24.4	12.6	<4.0
	Strontium (Sr)-Total (mg/kg wwt)	5.13	0.082	4.57	17.6	0.078
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0081	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00124	<0.00040	0.00271	<0.00040	<0.00040
	Tin (Sn)-Total (mg/kg wwt)	<0.020	0.040	<0.020	<0.020	0.038
	Uranium (U)-Total (mg/kg wwt)	0.00687	<0.00040	0.00670	0.00200	<0.00040
	Vanadium (V)-Total (mg/kg wwt)	0.072	<0.020	0.080	0.025	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	12.6	0.35	11.6	15.4	0.45
	Zirconium (Zr)-Total (mg/kg wwt)	0.053	<0.040	0.050	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-42	L1661327-43	L1661327-44	L1661327-46	L1661327-47
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15	15-AUG-15	15-AUG-15
	Sampled Time					
	Client ID	AER-LI-07	AER-GR-07	AER-BER-07	AER-LI-08	AER-GR-08
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	10.6	46.1	87.3	15.7	36.5
Metals	Aluminum (Al)-Total (mg/kg wwt)	228	22.6	0.84	31.6	72.2
	Antimony (Sb)-Total (mg/kg wwt)	0.0055	<0.0020	<0.0020	<0.0020	0.0026
	Arsenic (As)-Total (mg/kg wwt)	0.149	0.0196	<0.0040	0.0832	0.0757
	Barium (Ba)-Total (mg/kg wwt)	15.7	15.9	0.236	3.42	29.8
	Beryllium (Be)-Total (mg/kg wwt)	0.0170	0.0045	<0.0020	0.0023	0.0067
	Bismuth (Bi)-Total (mg/kg wwt)	0.0130	0.0020	<0.0020	0.0055	0.0024
	Boron (B)-Total (mg/kg wwt)	0.42	1.20	<0.20	0.24	1.88
	Cadmium (Cd)-Total (mg/kg wwt)	0.0697	0.0070	0.0019	0.0477	0.0168
	Calcium (Ca)-Total (mg/kg wwt)	780	860	24.9	460	1430
	Cesium (Cs)-Total (mg/kg wwt)	0.0383	0.0226	<0.0010	0.0155	0.0128
	Chromium (Cr)-Total (mg/kg wwt)	0.659	0.191	<0.010	0.214	0.366
	Cobalt (Co)-Total (mg/kg wwt)	0.251	0.0534	<0.0040	0.0350	0.131
	Copper (Cu)-Total (mg/kg wwt)	1.14	0.906	0.053	0.613	1.20
	Iron (Fe)-Total (mg/kg wwt)	367	44.6	0.91	46.1	117
	Lead (Pb)-Total (mg/kg wwt)	1.17	0.0709	<0.0040	0.383	0.196
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	261	308	9.56	135	415
	Manganese (Mn)-Total (mg/kg wwt)	48.4	54.0	0.962	53.6	214
	Mercury (Hg)-Total (mg/kg wwt)	0.139	0.0083	<0.0010	0.0914	0.0164
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0237	0.146	<0.0040	0.0149	0.321
	Nickel (Ni)-Total (mg/kg wwt)	0.696	1.23	<0.040	0.234	1.44
	Phosphorus (P)-Total (mg/kg wwt)	249	344	20.2	173	449
	Potassium (K)-Total (mg/kg wwt)	739	2700	140	603	3210
	Rubidium (Rb)-Total (mg/kg wwt)	1.86	4.55	0.466	1.61	3.73
	Selenium (Se)-Total (mg/kg wwt)	0.072	0.010	<0.010	0.052	0.021
	Sodium (Na)-Total (mg/kg wwt)	16.7	10.4	<4.0	10.4	17.1
	Strontium (Sr)-Total (mg/kg wwt)	3.83	3.81	0.075	1.24	6.76
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00620	0.00706	<0.00040	0.00322	0.00348
	Tin (Sn)-Total (mg/kg wwt)	0.021	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.0758	0.00242	<0.00040	0.00696	0.0128
	Vanadium (V)-Total (mg/kg wwt)	0.323	0.036	<0.020	0.073	0.128
	Zinc (Zn)-Total (mg/kg wwt)	11.9	10.9	0.26	6.08	23.8
	Zirconium (Zr)-Total (mg/kg wwt)	0.202	<0.040	<0.040	0.064	0.079

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L1661327-48	L1661327-50	L1661327-51	L1661327-52	L1661327-54
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	15-AUG-15	15-AUG-15	15-AUG-15	15-AUG-15	15-AUG-15
	Sampled Time					
	Client ID	AER-BER-08	AER-LI-08-DUP	AER-GR-08-DUP	AER-BER-08-DUP	AER-LI-09
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	79.8	15.2	46.5	81.8	13.9
Metals	Aluminum (Al)-Total (mg/kg wwt)	<0.40	147	26.8	<0.40	35.8
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0064	0.0054	<0.0020	0.0078
	Arsenic (As)-Total (mg/kg wwt)	<0.0040	0.173	0.0430	<0.0040	0.0609
	Barium (Ba)-Total (mg/kg wwt)	0.309	9.26	23.6	0.295	8.74
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	0.0065	0.0049	<0.0020	0.0052
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	0.0120	0.0044	<0.0020	0.0062
	Boron (B)-Total (mg/kg wwt)	0.28	0.31	1.04	0.27	0.53
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0010	0.0482	0.0102	<0.0010	0.0324
	Calcium (Ca)-Total (mg/kg wwt)	32.4	407	760	31.6	508
	Cesium (Cs)-Total (mg/kg wwt)	<0.0010	0.0337	0.0075	<0.0010	0.0268
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	0.560	0.171	<0.010	0.188
	Cobalt (Co)-Total (mg/kg wwt)	<0.0040	0.113	0.0708	<0.0040	0.0440
	Copper (Cu)-Total (mg/kg wwt)	0.194	0.782	0.848	0.182	0.822
	Iron (Fe)-Total (mg/kg wwt)	<0.60	233	43.9	<0.60	45.2
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	1.32	0.0835	<0.0040	0.241
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	20.6	167	265	19.4	185
	Manganese (Mn)-Total (mg/kg wwt)	3.08	34.4	87.9	2.93	57.6
	Mercury (Hg)-Total (mg/kg wwt)	<0.0010	0.149	0.0103	<0.0010	0.128
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	0.0214	0.211	<0.0040	0.0162
	Nickel (Ni)-Total (mg/kg wwt)	0.042	1.07	1.07	0.041	0.555
	Phosphorus (P)-Total (mg/kg wwt)	41.6	169	266	38.5	313
	Potassium (K)-Total (mg/kg wwt)	311	596	2310	290	872
	Rubidium (Rb)-Total (mg/kg wwt)	0.578	2.12	2.98	0.544	2.62
	Selenium (Se)-Total (mg/kg wwt)	<0.010	0.075	0.014	<0.010	0.066
	Sodium (Na)-Total (mg/kg wwt)	<4.0	25.3	12.3	<4.0	14.9
	Strontium (Sr)-Total (mg/kg wwt)	0.077	1.54	4.79	0.076	1.34
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	<0.00040	0.00748	0.00423	<0.00040	0.00288
	Tin (Sn)-Total (mg/kg wwt)	0.022	0.021	<0.020	0.021	<0.020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.0184	0.00275	<0.00040	0.00524
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.306	0.038	<0.020	0.065
	Zinc (Zn)-Total (mg/kg wwt)	0.30	8.02	11.0	0.28	9.71
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	0.133	<0.040	<0.040	0.051

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-55	L1661327-56	L1661327-58	L1661327-59	L1661327-60
	Description	Tissue	Tissue	Tissue	Tissue	Tissue
	Sampled Date	15-AUG-15	15-AUG-15	15-AUG-15	15-AUG-15	15-AUG-15
	Sampled Time					
	Client ID	AER-GR-09	AER-BER-09	AER-LI-10	AER-GR-10	AER-BER-10
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	44.5	75.5	11.2	36.1	83.8
Metals	Aluminum (Al)-Total (mg/kg wwt)	13.3	1.47	353	51.1	<0.40
	Antimony (Sb)-Total (mg/kg wwt)	0.0039	<0.0020	0.0118	0.0460	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0220	<0.0040	0.178	0.0981	<0.0040
	Barium (Ba)-Total (mg/kg wwt)	45.0	0.637	18.4	17.2	0.228
	Beryllium (Be)-Total (mg/kg wwt)	0.0038	<0.0020	0.0307	0.0109	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0250	0.0552	<0.0020
	Boron (B)-Total (mg/kg wwt)	3.10	0.44	0.66	2.00	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0111	<0.0010	0.154	0.0283	<0.0010
	Calcium (Ca)-Total (mg/kg wwt)	1010	58.2	2760	1360	27.4
	Cesium (Cs)-Total (mg/kg wwt)	0.0260	<0.0010	0.0553	0.0300	<0.0010
	Chromium (Cr)-Total (mg/kg wwt)	0.080	<0.010	0.811	0.466	<0.010
	Cobalt (Co)-Total (mg/kg wwt)	0.0877	<0.0040	0.180	0.0883	<0.0040
	Copper (Cu)-Total (mg/kg wwt)	1.80	0.275	1.75	1.98	0.147
	Iron (Fe)-Total (mg/kg wwt)	30.7	1.66	492	110	<0.60
	Lead (Pb)-Total (mg/kg wwt)	0.0437	<0.0040	3.15	0.432	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	601	34.1	240	357	14.9
	Manganese (Mn)-Total (mg/kg wwt)	136	8.19	42.8	69.7	4.17
	Mercury (Hg)-Total (mg/kg wwt)	0.0106	<0.0010	0.120	0.0180	<0.0010
	Molybdenum (Mo)-Total (mg/kg wwt)	0.433	<0.0040	0.0837	0.414	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	3.40	0.059	1.28	1.23	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	595	61.9	329	379	27.2
	Potassium (K)-Total (mg/kg wwt)	3480	428	904	3210	230
	Rubidium (Rb)-Total (mg/kg wwt)	5.71	0.684	3.58	8.34	0.498
	Selenium (Se)-Total (mg/kg wwt)	<0.010	<0.010	0.118	0.069	<0.010
	Sodium (Na)-Total (mg/kg wwt)	20.2	<4.0	26.8	14.6	<4.0
	Strontium (Sr)-Total (mg/kg wwt)	9.77	0.133	6.12	4.19	0.037
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	0.0060	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00135	<0.00040	0.00995	0.0531	<0.00040
	Tin (Sn)-Total (mg/kg wwt)	<0.020	0.025	0.040	0.025	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00134	<0.00040	0.633	0.00967	<0.00040
	Vanadium (V)-Total (mg/kg wwt)	0.020	<0.020	0.474	0.112	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	17.0	0.49	18.8	14.7	0.28
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.405	0.053	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1661327-62	L1661327-63	L1661327-64
	Description	Tissue	Tissue	Tissue
	Sampled Date	14-AUG-15	14-AUG-15	14-AUG-15
	Sampled Time			
	Client ID	AER-LI-REP1	AER-GR-REP1	AER-BER-REP1
Grouping	**Analyte**			
TISSUE				
Physical Tests	% Moisture (%)	81.0	57.1	81.4
Metals	Aluminum (Al)-Total (mg/kg wwt)	72.1	8.66	<0.40
	Antimony (Sb)-Total (mg/kg wwt)	0.0056	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0353	0.0262	<0.0040
	Barium (Ba)-Total (mg/kg wwt)	9.55	15.3	0.250
	Beryllium (Be)-Total (mg/kg wwt)	0.0254	0.0032	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	0.0022	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	0.35	1.54	0.25
	Cadmium (Cd)-Total (mg/kg wwt)	0.0260	0.0093	0.0013
	Calcium (Ca)-Total (mg/kg wwt)	1080	948	39.0
	Cesium (Cs)-Total (mg/kg wwt)	0.0041	0.0076	<0.0010
	Chromium (Cr)-Total (mg/kg wwt)	0.216	0.097	<0.010
	Cobalt (Co)-Total (mg/kg wwt)	0.0559	0.0360	<0.0040
	Copper (Cu)-Total (mg/kg wwt)	0.741	1.33	0.234
	Iron (Fe)-Total (mg/kg wwt)	86.3	39.5	0.85
	Lead (Pb)-Total (mg/kg wwt)	0.0680	0.0290	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	387	598	24.3
	Manganese (Mn)-Total (mg/kg wwt)	36.5	221	6.10
	Mercury (Hg)-Total (mg/kg wwt)	0.0114	0.0051	<0.0010
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0195	0.209	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	2.44	1.47	0.066
	Phosphorus (P)-Total (mg/kg wwt)	96.2	541	56.6
	Potassium (K)-Total (mg/kg wwt)	359	4800	301
	Rubidium (Rb)-Total (mg/kg wwt)	0.290	2.97	0.328
	Selenium (Se)-Total (mg/kg wwt)	0.012	<0.010	<0.010
	Sodium (Na)-Total (mg/kg wwt)	15.0	17.8	<4.0
	Strontium (Sr)-Total (mg/kg wwt)	8.83	6.47	0.127
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00081	0.00057	<0.00040
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	0.026
	Uranium (U)-Total (mg/kg wwt)	0.126	0.00893	<0.00040
	Vanadium (V)-Total (mg/kg wwt)	0.081	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	5.56	11.5	0.59
	Zirconium (Zr)-Total (mg/kg wwt)	0.080	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Aluminum (Al)-Total	DUP-H	L1661327-12, -16, -20, -24, -28, -32, -36, -4, -40, -44, -48, -50, -51, -52, -54, -55, -56, -58, -59, -60, -62, -63, -64, -8
Duplicate	Iron (Fe)-Total	DUP-H	L1661327-12, -16, -20, -24, -28, -32, -36, -4, -40, -44, -48, -50, -51, -52, -54, -55, -56, -58, -59, -60, -62, -63, -64, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

HG-WET-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CRC ICPMS.

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. This method does not dissolve all silicate materials and may result in a partial extraction. depending on the sample matrix, for some metals, including, but not limited to Al, Ba, Be, Cr, Sr, Ti, Tl, and V.

MET-WET-CCMS-N-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

L1661327-COFC

COC # ____

Report To	
Company:	Agnico Eagle Mines Ltd.-Meadowbank Division
Contact:	Ryan VanEngen
Address:	Baker Lake NU X0C 0A0
Phone:	819 651 2974 Fax:
Invoice To	Same as Report ? ☑ Yes ☐ No
Hardcopy of Invoice with Report?	☐ Yes ☑ No
Company:	
Contact:	
Address:	
Phone:	Fax:
Lab Work Order # (lab use only)	

Report Format / Distribution: ☐ ... Other; ☑ PDF ☑ Excel ☐ Digital ☐ Fax

Email 1: ryan.vanengen@agnicoeagle.com
Email 2: andrea_amendola@golder.com
Email 3: leilan.baxter@agnicoeagle.com

Client / Project Information
Job #: Meadowbank SLRA
PO / AFE:
LSD:
Quote #: 52390
ALS Contact: Ariel Tang
Sampler: David Brown

Service Requested (Rush for routine analysis subject to availability)
- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request
Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Met+Hg+pH (MET-CCME+FUL	Metals (MET-WET-CCMS-N-VA	Moisture (MOISTURE-TISS-VA	Mercury (HG-WET-CVAFS-N-V	Number of Containers
1	AER-SOIL-01	Aug 14/15	—	Soil	X				1
2	lichen- AER-LI-01	↓	—	Tissue		X	X	X	1
3	sedge AER-GR-01	↓	—	Tissue		X	X	X	1
4	berries AER-BER-01	↓	—	Tissue		X	X	X	1
5	AER-SOIL-02	↓	—	Soil	X				1
6	AER-LI-02	↓	—	Tissue		X	X	X	1
7	AER-GR-02	↓	—	Tissue		X	X	X	1
8	AER-BER-02	↓	—	Tissue		X	X	X	1
9	AER-SOIL-03	↓	—	Soil	X				1
10	AER-LI-03	↓	—	Tissue		X	X	X	1
11	AER-GR-03	↓	—	Tissue		X	X	X	1
12	AER-BER-03	↓	—	Tissue		X	X	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please see back side of 1st sheet for more sample ID's & analysis → Contact David Brown djbrown@golder.com if questions arise

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by: CC	Date: 21Aug15	Time: 12:05	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

GENF 20.00 Front

	SAMPLE ID	DATE	SAMPLE TYPE	ANALYSIS
13	AER-SOIL-REP2	Aug 14/15	SOIL	
14	AER-LI-REP2	↓	TISSUE	See other side of CoC.
15	AER-GR-REP2		TISSUE	
16	AER-BER-REP2		TISSUE	
17	AER-SOIL-REP3		SOIL	
18	AER-LI-REP3		TISSUE	
19	AER-GR-REP3		TISSUE	
20	AER-BER-REP3		TISSUE	
21	AER-SOIL-REP4		SOIL	
22	AER-LI-REP4		TISSUE	
23	AER-GR-REP4		TISSUE	
24	AER-BER-REP4		TISSUE	
25	AER-SOIL-REP5		SOIL	
26	AER-LI-REP5		TISSUE	
27	AER-GR-REP5		TISSUE	
28	AER-BER-REP5	↓	TISSUE	

L1661327-COFC

ALS Environmental

L1661327-COFC

COC # ______

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Report To		Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company:	Agnico Eagle Mines Ltd.-Meadowbank Division	☐ Standard ☑ Other		◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Ryan VanEngen	☑ PDF ☑ Excel ☐ Digital ☐ Fax		○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	Baker Lake NU X0C 0A0	Email 1:	ryan.vanengen@agnicoeagle.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
		Email 2:	andrea_amendola@golder.com	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	819 651 2974 Fax:	Email 3:	leilan.baxter@agnicoeagle.com	Analysis Request
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information		Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #:	Meadowbank SLRA	
Company:		PO / AFE:		
Contact:		LSD:		
Address:				
Phone:	Fax:	Quote #:	52390	
Lab Work Order # (lab use only)		ALS Contact:	Ariel Tang — Sampler: David Brown	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Met+Hg+pH (MET-CCME+FUL	Metals (MET-WET-CCMS-N-VA	Moisture (MOISTURE-TISS-VA	Mercury (HG-WET-CVAFS-N-V									Number of Containers
29	— AER-SOIL-04	Aug 14/15	—	Soil	X												1
30	— ~~lichen~~ AER-LI-04	↓	—	Tissue		X	X	X									1
31	— ~~sedge~~ AER-GR-04		—	Tissue		X	X	X									1
32	— ~~berries~~ AER-BER-04		—	Tissue		X	X	X									1
33	AER-SOIL-05		—	Soil	X												1
34	AER-LI-05		—	Tissue		X	X	X									1
35	AER-GR-05		—	Tissue		X	X	X									1
36	AER-BER-05		—	Tissue		X	X	X									1
37	AER-SOIL-06		—	Soil	X												1
38	AER-LI-06		—	Tissue		X	X	X									1
39	AER-GR-06		—	Tissue		X	X	X									1
40	AER-BER-06	↓	—	Tissue		X	X	X									1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

ALS Environmental

L1661327-COFC

COC #

Report To	
Company:	Agnico Eagle Mines Ltd.-Meadowbank Division
Contact:	Ryan VanEngen
Address:	Baker Lake NU X0C 0A0
Phone:	819 651 2974 Fax:
Invoice To	Same as Report ? ☑ Yes ☐ No
Hardcopy of Invoice with Report?	☐ Yes ☑ No
Company:	
Contact:	
Address:	
Phone:	Fax:
Lab Work Order # (lab use only)	

☐ Standard ☑ Other

☑ PDF ☑ Excel ☐ Digital ☐ Fax

Email 1: ryan.vanengen@agnicoeagle.com

Email 2: andrea_amendola@golder.com

Email 3: leilan.baxter@agnicoeagle.com

Client / Project Information

Job #: Meadowbank SLRA

PO / AFE:

LSD:

Quote #: 52390

ALS Contact: Ariel Tang **Sampler:** David Brown

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Met+Hg+pH (MET-CCME+FUL	Metals (MET-WET-CCMS-N-VA	Moisture (MOISTURE-TISS-VA	Mercury (HG-WET-CVAFS-N-V	Number of Containers
41	AER-SOIL-07	AUG 14/15	—	Soil	X				1
42	~~lichen~~ AER-LI-07	↓	—	Tissue		X	X	X	1
43	~~sedge~~ AER-GR-07	↓	—	Tissue		X	X	X	1
44	~~berries~~ AER-BER-07	↓	—	Tissue		X	X	X	1
45	AER-SOIL-08	Aug 15/15	—	Soil	X				1
46	AER-LI-08	↓	—	Tissue		X	X	X	1
47	AER-GR-08	↓	—	Tissue		X	X	X	1
48	AER-BER-08	↓	—	Tissue		X	X	X	1
49	AER-SOIL-08-DUP	↓	—	Soil	X				1
50	AER-LI-08-DUP	↓	—	Tissue		X	X	X	1
51	AER-GR-08-DUP	↓	—	Tissue		X	X	X	1
52	AER-BER-08-DUP	↓	—	Tissue		X	X	X	1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

ALS Environmental

L1661327-COFC

rm

COC #

Page 4 of

Report To	
Company:	Agnico Eagle Mines Ltd.-Meadowbank Division
Contact:	Ryan VanEngen
Address:	Baker Lake NU X0C 0A0
Phone:	819 651 2974 Fax:

☑ PDF ☑ Excel ☐ Digital ☐ Fax

Email 1: ryan.vanengen@agnicoeagle.com
Email 2: andrea_amendola@golder.com
Email 3: leilan.baxter@agnicoeagle.com

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Invoice To	
Same as Report ?	☑ Yes ☐ No
Hardcopy of Invoice with Report?	☐ Yes ☑ No
Company:	
Contact:	
Address:	
Phone:	Fax:

Client / Project Information

Job #: Meadowbank SLRA
PO / AFE:
LSD:
Quote #: 52390

Lab Work Order # (lab use only)

ALS Contact: Ariel Tang Sampler: David Brown

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Met+Hg+pH (MET-CCME+FUL	Metals (MET-WET-CCMS-N-VA	Moisture (MOISTURE-TISS-VA	Mercury (HG-WET-CVAFS-N-V									Number of Containers
53	AER-SOIL-09	Aug 15/15	—	Soil	X												1
54	~~lichen~~ AER-LI-09	↓	—	Tissue		X	X	X									1
55	~~sedge~~ AER-GR-09	↓	—	Tissue		X	X	X									1
56	~~berries~~ AER-BER-09	↓	—	Tissue		X	X	X									1
57	AER-SOIL-10	↓	—	Soil	X												1
58	AER-LI-10	↓	—	Tissue		X	X	X									1
59	AER-GR-10	↓	—	Tissue		X	X	X									1
60	AER-BER-10	↓	—	Tissue		X	X	X									1
61	AER-SOIL-REP1	Aug 14/15	—	Soil	X												1
62	AER-LI-REP1	↓	—	Tissue		X	X	X									1
63	AER-GR-REP1	↓	—	Tissue		X	X	X									1
64	AER-BER-REP1	↓	—	Tissue		X	X	X									1

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature: °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

ANNEX A-2

Table 1. Baseline Soil Analytical Results

	Sample Location	AER-01	AER-02	AER-03	AER-04	AER-05	AER-06	AER-07	AER-08		AER-09	AER-10	AER-REP						
	Sample Name	AER-SOIL-01	AER-SOIL-02	AER-SOIL-03	AER-SOIL-04	AER-SOIL-05	AER-SOIL-06	AER-SOIL-07	AER-SOIL-08	AER-SOIL-08-DUP	AER-SOIL-09	AER-SOIL-10	AER-SOIL-REP1	AER-SOIL-REP2	AER-SOIL-REP3	AER-SOIL-REP4	AER-SOIL-REP5		
	Sampling Date	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	MIN	MAX
Parameter	**Units**																		
pH (1:2 soil:water)		5.17	4.92	5.41	5.62	5.05	5.25	4.98	5.26	5.62	5.69	4.59	5.68	5.37	5.67	5.47	5.64	4.59	5.69
Aluminum (Al)	mg/kg	9150	6270	6030	7190	6300	7310	6390	7190	8370	9360	8450	9350	6200	9960	6140	8860	6030	9960
Antimony (Sb)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	8.23	3.39	2.87	2.45	2.04	2.72	3.48	12.2	12.9	8	4.94	5.13	4.41	5.66	3.26	4.14	2.04	12.9
Barium (Ba)	mg/kg	14.1	21.9	19.5	39.7	28.2	32.8	21.2	73.9	86.8	48.4	14.3	39.2	21.6	46.5	22.3	32.9	14.1	86.8
Beryllium (Be)	mg/kg	0.22	0.29	0.28	0.4	0.36	0.43	0.31	0.36	0.4	0.35	0.26	0.53	0.33	0.54	0.28	0.44	0.22	0.54
Bismuth (Bi)	mg/kg	<0.20	<0.20	<0.20	0.2	0.21	0.3	<0.20	<0.20	<0.20	<0.20	<0.20	0.25	<0.20	0.27	<0.20	0.22	0.2	0.3
Boron (B)	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	mg/kg	0.061	0.047	0.026	0.032	0.037	0.035	0.045	0.041	0.042	0.038	0.031	0.037	0.036	0.047	0.031	0.043	0.026	0.061
Calcium (Ca)	mg/kg	1550	1970	2680	3070	2020	3170	1540	3150	3620	3280	1130	3430	2650	3110	2670	3440	1130	3620
Chromium (Cr)	mg/kg	140	27.2	44.3	14.9	14.1	19.8	29.2	45.9	55.1	94.1	70	36.7	23.3	38.7	23.5	32.7	14.1	140
Cobalt (Co)	mg/kg	11.6	4.49	4.2	4.98	4.08	4.74	4.27	7.34	8.07	9.1	6.34	9.01	5.49	7.96	4.82	7.25	4.08	11.6
Copper (Cu)	mg/kg	5.5	4.34	4.99	4.44	3.45	10.1	3.47	6.55	7.91	9.71	2.94	7.39	4.76	8.02	4.73	6.03	2.94	10.1
Iron (Fe)	mg/kg	21200	14800	13600	16900	15100	16600	15800	16300	18300	20900	19400	21200	17800	21500	14000	19300	13600	21500
Lead (Pb)	mg/kg	5.16	5.86	5.1	4.95	5.7	7.92	6.77	6.11	6.86	4.72	4.6	7.37	5.71	7.46	5.19	6.78	4.6	7.92
Lithium (Li)	mg/kg	11.3	6.4	7.5	8.2	7.2	8.1	7.7	8.7	10.4	10.7	9.3	10.7	7.4	11.7	6.7	10.1	6.4	11.7
Magnesium (Mg)	mg/kg	8810	3210	3640	3550	2920	3440	3250	4930	5850	6710	5870	4990	3520	5210	3300	4650	2920	8810
Manganese (Mn)	mg/kg	450	185	147	242	202	199	169	264	280	246	196	421	206	310	168	279	147	450
Mercury (Hg)	mg/kg	0.0119	0.0184	<0.0050	0.0057	0.0131	0.0069	0.016	0.0249	0.0089	0.0055	0.0061	0.0084	<0.0050	0.0107	<0.0050	0.0078	0.0055	0.0249
Molybdenum (Mo)	mg/kg	0.43	0.47	0.25	0.27	0.26	0.32	0.28	0.32	0.33	0.29	0.33	0.44	0.32	0.51	0.31	0.41	0.25	0.51
Nickel (Ni)	mg/kg	62.9	14.3	17.7	9.05	7.87	10.6	11	23.5	27.3	38.7	33.1	23.6	14.9	24.5	15.8	19.9	7.87	62.9
Phosphorus (P)	mg/kg	328	325	487	520	361	551	358	735	859	755	232	436	615	479	455	507	232	859
Potassium (K)	mg/kg	630	670	650	710	690	830	710	1480	1890	1540	580	1110	740	1230	730	1060	580	1890
Selenium (Se)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	<50	75	<50	74	68	70	53	66	85	55	<50	113	52	66	<50	63	52	113
Strontium (Sr)	mg/kg	19.1	21.3	26	31.8	21.7	36.7	12.7	36.6	42.6	30	21.1	37.6	24.5	32.4	29.3	37.8	12.7	42.6
Thallium (Tl)	mg/kg	<0.050	0.06	0.052	<0.050	0.053	0.063	0.053	0.093	0.114	0.087	<0.050	0.091	0.056	0.102	0.052	0.081	0.052	0.114
Tin (Sn)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	374	535	583	698	590	694	572	683	798	716	304	816	491	754	600	740	304	816
Uranium (U)	mg/kg	0.9	1.99	1.8	1.47	1.26	1.92	0.962	1.36	1.56	1.3	0.977	3.08	2.17	2.77	1.75	2.43	0.9	3.08
Vanadium (V)	mg/kg	24	12.4	13	17.4	13.3	15.2	17	20.1	23	25	18.8	17.4	12.2	17.6	11.8	16.7	11.8	25
Zinc (Zn)	mg/kg	36.5	25.5	23.4	29.2	27.7	31.7	25.4	27.6	31.5	30.1	27.8	36.8	28.9	41.4	25.5	36.2	23.4	41.4
Zirconium (Zr)	mg/kg	<1.0	1.6	7	7.1	1.9	7.3	1.8	2.6	4.6	6.9	1.2	4.7	6.9	4.7	5.9	4.7	1.2	7.3

mg/kg = milligram per kilogram; < = less than laboratory method detection limit

Table 2. Baseline Lichen Analytical Results

	Sample Location	AER-01	AER-02	AER-03	AER-04	AER-05	AER-06	AER-07	AER-08		AER-09	AER-10	AER-REP						
	Sample Name	AER-LI-01	AER-LI-02	AER-LI-03	AER-LI-04	AER-LI-05	AER-LI-06	AER-LI-07	AER-LI-08	AER-LI-08-DUP	AER-LI-09	AER-LI-10	AER-LI-REP1	AER-LI-REP2	AER-LI-REP3	AER-LI-REP4	AER-LI-REP5		
	Sampling Date	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15		
Parameter	**Units**																	**MIN**	**MAX**
% Moisture	%	15	12.5	11.3	10.3	11.1	10.1	10.6	15.7	15.2	13.9	11.2	81	25.5	32.1	42	33.2	10.1	81
Aluminum (Al)-Total	mg/kg wwt	55.1	33.1	89.6	23.4	36.7	39.7	228	31.6	147	35.8	353	72.1	23.4	27.9	29.6	39.1	23.4	353
Antimony (Sb)-Total	mg/kg wwt	0.0021	0.0022	0.0045	<0.0020	<0.0020	<0.0020	0.0055	<0.0020	0.0064	0.0078	0.0118	0.0056	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	0.0118
Arsenic (As)-Total	mg/kg wwt	0.0636	0.0454	0.0923	0.0521	0.049	0.0708	0.149	0.0832	0.173	0.0609	0.178	0.0353	0.0444	0.0505	0.0401	0.0651	0.0353	0.178
Barium (Ba)-Total	mg/kg wwt	5.43	7.87	12.6	3.85	18	8.32	15.7	3.42	9.26	8.74	18.4	9.55	3.61	3.23	3.11	5.51	3.11	18.4
Beryllium (Be)-Total	mg/kg wwt	0.0037	0.0065	0.0123	0.0052	0.0177	0.0053	0.017	0.0023	0.0065	0.0052	0.0307	0.0254	<0.0020	<0.0020	0.0029	0.0098	0.0023	0.0307
Bismuth (Bi)-Total	mg/kg wwt	0.003	0.0026	0.0044	0.0036	0.0041	0.0036	0.013	0.0055	0.012	0.0062	0.025	0.0022	0.0032	0.0029	0.0057	0.0029	0.0022	0.025
Boron (B)-Total	mg/kg wwt	0.25	0.31	0.66	<0.20	0.34	0.21	0.42	0.24	0.31	0.53	0.66	0.35	0.25	0.35	0.27	0.24	0.21	0.66
Cadmium (Cd)-Total	mg/kg wwt	0.0387	0.0398	0.0555	0.0385	0.0854	0.0409	0.0697	0.0477	0.0482	0.0324	0.154	0.026	0.0358	0.0456	0.0675	0.0586	0.026	0.154
Calcium (Ca)-Total	mg/kg wwt	770	1030	2330	621	3290	909	780	460	407	508	2760	1080	745	1260	1980	2010	407	3290
Cesium (Cs)-Total	mg/kg wwt	0.0122	0.0169	0.0249	0.0159	0.0106	0.0201	0.0383	0.0155	0.0337	0.0268	0.0553	0.0041	0.0076	0.0071	0.0109	0.0094	0.0041	0.0553
Chromium (Cr)-Total	mg/kg wwt	0.47	0.18	0.715	0.143	0.187	0.375	0.659	0.214	0.56	0.188	0.811	0.216	0.187	0.241	0.168	0.251	0.143	0.811
Cobalt (Co)-Total	mg/kg wwt	0.18	0.0808	0.287	0.0469	0.12	0.082	0.251	0.035	0.113	0.044	0.18	0.0559	0.0216	0.0248	0.0456	0.0652	0.0216	0.287
Copper (Cu)-Total	mg/kg wwt	0.807	0.639	1.12	0.615	0.634	0.624	1.14	0.613	0.782	0.822	1.75	0.741	0.637	0.769	0.626	0.612	0.612	1.75
Iron (Fe)-Total	mg/kg wwt	80.6	46.4	145	35.4	63.6	69.5	367	46.1	233	45.2	492	86.3	36.4	36.1	42.5	55.8	35.4	492
Lead (Pb)-Total	mg/kg wwt	0.22	0.292	0.304	0.343	0.518	0.316	1.17	0.383	1.32	0.241	3.15	0.068	0.205	0.236	0.25	0.304	0.068	3.15
Lithium (Li)-Total	mg/kg wwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	0.1	0.1
Magnesium (Mg)-Total	mg/kg wwt	362	217	580	125	280	220	261	135	167	185	240	387	166	213	204	264	125	580
Manganese (Mn)-Total	mg/kg wwt	74.8	71.3	277	28.7	62.3	90.3	48.4	53.6	34.4	57.6	42.8	36.5	65.7	89.7	68.7	44.4	28.7	277
Mercury (Hg)-Total	mg/kg wwt	0.0443	0.0714	0.0499	0.0651	0.0772	0.0673	0.139	0.0914	0.149	0.128	0.12	0.0114	0.073	0.0587	0.0489	0.0681	0.0114	0.149
Molybdenum (Mo)-Total	mg/kg wwt	0.0149	0.0157	0.0673	0.0139	0.0179	0.0247	0.0237	0.0149	0.0214	0.0162	0.0837	0.0195	0.0137	0.0167	0.0319	0.0225	0.0137	0.0837
Nickel (Ni)-Total	mg/kg wwt	0.725	0.314	1.26	0.141	0.335	0.282	0.696	0.234	1.07	0.555	1.28	2.44	0.259	0.459	1.13	0.685	0.141	2.44
Phosphorus (P)-Total	mg/kg wwt	289	209	376	173	287	226	249	173	169	313	329	96.2	182	235	293	238	96.2	376
Potassium (K)-Total	mg/kg wwt	860	860	1320	763	1010	857	739	603	596	872	904	359	648	770	785	676	359	1320
Rubidium (Rb)-Total	mg/kg wwt	0.962	1.93	2.11	1.94	1.64	1.4	1.86	1.61	2.12	2.62	3.58	0.29	0.466	0.503	0.737	0.685	0.29	3.58
Selenium (Se)-Total	mg/kg wwt	0.031	0.045	0.049	0.049	0.05	0.042	0.072	0.052	0.075	0.066	0.118	0.012	0.044	0.042	0.035	0.042	0.012	0.118
Sodium (Na)-Total	mg/kg wwt	11.2	16	160	14.3	19.9	24.4	16.7	10.4	25.3	14.9	26.8	15	13	17.7	39.1	18.9	10.4	160
Strontium (Sr)-Total	mg/kg wwt	2.15	3.12	8.98	1.96	12	4.57	3.83	1.24	1.54	1.34	6.12	8.83	2.43	3.28	5.95	8.59	1.24	12
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg wwt	0.00184	0.00384	0.00442	0.00203	0.00346	0.00271	0.0062	0.00322	0.00748	0.00288	0.00995	0.00081	0.00137	0.00063	0.00096	0.00086	0.00063	0.00995
Tin (Sn)-Total	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	0.021	<0.020	0.04	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	0.04
Uranium (U)-Total	mg/kg wwt	0.00701	0.00761	0.0488	0.0056	0.012	0.0067	0.0758	0.00696	0.0184	0.00524	0.633	0.126	0.00496	0.00549	0.0179	0.0367	0.00496	0.633
Vanadium (V)-Total	mg/kg wwt	0.102	0.057	0.149	0.046	0.059	0.08	0.323	0.073	0.306	0.065	0.474	0.081	0.048	0.056	0.05	0.059	0.046	0.474
Zinc (Zn)-Total	mg/kg wwt	11.4	10.8	21.4	8.36	15.6	11.6	11.9	6.08	8.02	9.71	18.8	5.56	7.53	9.3	9.01	8.85	5.56	21.4
Zirconium (Zr)-Total	mg/kg wwt	0.069	0.051	0.167	<0.040	0.06	0.05	0.202	0.064	0.133	0.051	0.405	0.08	0.044	0.042	0.064	0.068	0.042	0.405

mg/kg wwt = milligram per kilogram wet weight; < = less than laboratory method detection limit

Table 3. Baseline Graminoid Analytical Results

	Sample Location	AER-01	AER-02	AER-03	AER-04	AER-05	AER-06	AER-07	AER-08		AER-09	AER-10	AER-REP						
	Sample Name	AER-GR-01	AER-GR-02	AER-GR-03	AER-GR-04	AER-GR-05	AER-GR-06	AER-GR-07	AER-GR-08	AER-GR-08-DUP	AER-GR-09	AER-GR-10	AER-GR-REP1	AER-GR-REP2	AER-GR-REP3	AER-GR-REP4	AER-GR-REP5		
	Sampling Date	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15		
Parameter	**Units**																	**MIN**	**MAX**
% Moisture	%	55.4	50.1	40.1	43.3	47.5	45.6	46.1	36.5	46.5	44.5	36.1	57.1	55.7	56.4	62	57.2	36.1	62
Aluminum (Al)-Total	mg/kg wwt	12.5	27.5	26.1	31.4	47.3	17.4	22.6	72.2	26.8	13.3	51.1	8.66	12.2	16.7	25.2	8.95	8.66	72.2
Antimony (Sb)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0026	0.0054	0.0039	0.046	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0026	0.046
Arsenic (As)-Total	mg/kg wwt	0.0129	0.0191	0.0312	0.0153	0.0278	0.0161	0.0196	0.0757	0.043	0.022	0.0981	0.0262	0.0187	0.025	0.0264	0.0194	0.0129	0.0981
Barium (Ba)-Total	mg/kg wwt	10.9	11.2	16.5	16.5	16.9	62.1	15.9	29.8	23.6	45	17.2	15.3	13.6	22.1	7.08	14.7	7.08	62.1
Beryllium (Be)-Total	mg/kg wwt	<0.0020	0.0154	0.0051	0.0067	0.0088	0.0146	0.0045	0.0067	0.0049	0.0038	0.0109	0.0032	0.0052	0.0081	0.0035	0.0026	0.0026	0.0154
Bismuth (Bi)-Total	mg/kg wwt	0.0058	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002	0.0024	0.0044	<0.0020	0.0552	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002	0.0552
Boron (B)-Total	mg/kg wwt	2.34	1.44	1.58	1.1	0.89	2.11	1.2	1.88	1.04	3.1	2	1.54	1.75	2.09	1.1	2.06	0.89	3.1
Cadmium (Cd)-Total	mg/kg wwt	0.011	0.0363	0.0135	0.0099	0.0119	0.0098	0.007	0.0168	0.0102	0.0111	0.0283	0.0093	0.012	0.0092	0.0156	0.0123	0.007	0.0363
Calcium (Ca)-Total	mg/kg wwt	925	1070	1380	848	860	1860	860	1430	760	1010	1360	948	1100	1380	754	1190	754	1860
Cesium (Cs)-Total	mg/kg wwt	0.0066	0.0149	0.0104	0.0151	0.0145	0.0086	0.0226	0.0128	0.0075	0.026	0.03	0.0076	0.0062	0.0071	0.0038	0.0045	0.0038	0.03
Chromium (Cr)-Total	mg/kg wwt	0.109	0.144	0.348	0.184	0.313	0.124	0.191	0.366	0.171	0.08	0.466	0.097	0.083	0.076	0.164	0.126	0.076	0.466
Cobalt (Co)-Total	mg/kg wwt	0.0498	0.215	0.127	0.0628	0.0721	0.0681	0.0534	0.131	0.0708	0.0877	0.0883	0.036	0.0435	0.0431	0.056	0.0291	0.0291	0.215
Copper (Cu)-Total	mg/kg wwt	1.61	1.69	1.33	0.862	0.809	2.11	0.906	1.2	0.848	1.8	1.98	1.33	1.41	1.37	1.17	1.23	0.809	2.11
Iron (Fe)-Total	mg/kg wwt	29.7	57.8	61.3	46.2	81.5	95.5	44.6	117	43.9	30.7	110	39.5	40.2	41.8	53.1	37.3	29.7	117
Lead (Pb)-Total	mg/kg wwt	0.0292	0.104	0.0883	0.0912	0.141	0.0614	0.0709	0.196	0.0835	0.0437	0.432	0.029	0.0387	0.0269	0.0452	0.0308	0.0269	0.432
Lithium (Li)-Total	mg/kg wwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	mg/kg wwt	704	553	479	239	263	453	308	415	265	601	357	598	475	605	346	535	239	704
Manganese (Mn)-Total	mg/kg wwt	155	325	500	96.8	99.9	388	54	214	87.9	136	69.7	221	328	227	257	387	54	500
Mercury (Hg)-Total	mg/kg wwt	0.0053	0.0083	0.0095	0.0108	0.0123	0.0068	0.0083	0.0164	0.0103	0.0106	0.018	0.0051	0.0047	0.0042	0.0058	0.0045	0.0042	0.018
Molybdenum (Mo)-Total	mg/kg wwt	0.157	0.197	0.181	0.163	0.072	2.99	0.146	0.321	0.211	0.433	0.414	0.209	0.162	0.264	0.205	0.15	0.072	2.99
Nickel (Ni)-Total	mg/kg wwt	2.53	1.86	1.74	1.07	0.631	1.67	1.23	1.44	1.07	3.4	1.23	1.47	1.38	1.8	1.24	1.05	0.631	3.4
Phosphorus (P)-Total	mg/kg wwt	481	365	359	382	341	700	344	449	266	595	379	541	388	302	351	346	266	700
Potassium (K)-Total	mg/kg wwt	3940	5080	3400	2490	1980	3860	2700	3210	2310	3480	3210	4800	3030	3040	2160	3130	1980	5080
Rubidium (Rb)-Total	mg/kg wwt	1.74	6.1	3	3.83	3.26	3	4.55	3.73	2.98	5.71	8.34	2.97	1.88	1.66	0.861	1.6	0.861	8.34
Selenium (Se)-Total	mg/kg wwt	<0.010	<0.010	0.012	0.014	0.016	0.011	0.01	0.021	0.014	<0.010	0.069	<0.010	<0.010	<0.010	0.011	<0.010	0.01	0.069
Sodium (Na)-Total	mg/kg wwt	7.2	9.5	9.8	13	10.7	12.6	10.4	17.1	12.3	20.2	14.6	17.8	23	16.5	30.1	20.4	7.2	30.1
Strontium (Sr)-Total	mg/kg wwt	3.57	4.99	6.38	3.91	5.13	17.6	3.81	6.76	4.79	9.77	4.19	6.47	6.61	9.5	4.62	6.79	3.57	17.6
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0081	<0.0040	<0.0040	<0.0040	<0.0040	0.006	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.006	0.0081
Thallium (Tl)-Total	mg/kg wwt	0.00354	0.00109	0.00541	0.00131	0.00124	<0.00040	0.00706	0.00348	0.00423	0.00135	0.0531	0.00057	<0.00040	<0.00040	0.00056	<0.00040	0.00056	0.0531
Tin (Sn)-Total	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.025	<0.020	<0.020	<0.020	<0.020	<0.020	0.025	0.025
Uranium (U)-Total	mg/kg wwt	0.00112	0.0164	0.00698	0.00305	0.00687	0.002	0.00242	0.0128	0.00275	0.00134	0.00967	0.00893	0.0121	0.0174	0.0175	0.00267	0.00112	0.0175
Vanadium (V)-Total	mg/kg wwt	0.023	0.034	0.05	0.041	0.072	0.025	0.036	0.128	0.038	0.02	0.112	<0.020	<0.020	<0.020	0.039	<0.020	0.02	0.128
Zinc (Zn)-Total	mg/kg wwt	14.6	16.9	21.4	9.79	12.6	15.4	10.9	23.8	11	17	14.7	11.5	13.5	8.47	13.8	14.6	8.47	23.8
Zirconium (Zr)-Total	mg/kg wwt	<0.040	0.042	<0.040	0.111	0.053	<0.040	<0.040	0.079	<0.040	<0.040	0.053	<0.040	<0.040	<0.040	<0.040	<0.040	0.042	0.111

mg/kg wwt = milligram per kilogram wet weight; < = less than laboratory method detection limit

Table 4. Baseline Berry Analytical Results

	Sample Location	AER-01	AER-02	AER-03	AER-04	AER-05	AER-06	AER-07	AER-08		AER-09	AER-10	AER-REP						
	Sample Name	AER-BER-01	AER-BER-02	AER-BER-03	AER-BER-04	AER-BER-05	AER-BER-06	AER-BER-07	AER-BER-08	AER-BER-08-DUP	AER-BER-09	AER-BER-10	AER-BER-REP1	AER-BER-REP2	AER-BER-REP3	AER-BER-REP4	AER-BER-REP5		
	Sampling Date	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	15-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15	14-Aug-15		
Parameter	**Units**																	**MIN**	**MAX**
% Moisture	%	81.9	86.8	81.4	78.3	86.1	85	87.3	79.8	81.8	75.5	83.8	81.4	83.6	81	84.3	88.1	75.5	88.1
Aluminum (Al)-Total	mg/kg wwt	7.78	<0.40	<0.40	1.07	0.81	<0.40	0.84	<0.40	<0.40	1.47	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.81	7.78
Antimony (Sb)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic (As)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Barium (Ba)-Total	mg/kg wwt	0.15	0.263	0.266	0.451	0.258	0.304	0.236	0.309	0.295	0.637	0.228	0.25	0.259	0.289	0.251	0.223	0.15	0.637
Beryllium (Be)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth (Bi)-Total	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron (B)-Total	mg/kg wwt	0.27	<0.20	<0.20	0.3	<0.20	0.23	<0.20	0.28	0.27	0.44	<0.20	0.25	0.24	0.24	0.2	<0.20	0.2	0.44
Cadmium (Cd)-Total	mg/kg wwt	<0.0010	0.0011	<0.0010	<0.0010	0.0015	0.0021	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	0.0018	<0.0010	0.0017	0.0022	0.0011	0.0022
Calcium (Ca)-Total	mg/kg wwt	18	25.7	35.6	57.1	30.4	34.6	24.9	32.4	31.6	58.2	27.4	39	33.4	35.2	31	23.8	18	58.2
Cesium (Cs)-Total	mg/kg wwt	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.0011
Chromium (Cr)-Total	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt (Co)-Total	mg/kg wwt	0.0041	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0041	0.0041
Copper (Cu)-Total	mg/kg wwt	0.062	0.084	0.213	0.236	0.061	0.117	0.053	0.194	0.182	0.275	0.147	0.234	0.159	0.188	0.155	0.089	0.053	0.275
Iron (Fe)-Total	mg/kg wwt	8.14	<0.60	<0.60	0.79	0.99	<0.60	0.91	<0.60	<0.60	1.66	<0.60	0.85	<0.60	<0.60	0.69	<0.60	0.69	8.14
Lead (Pb)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Lithium (Li)-Total	mg/kg wwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	mg/kg wwt	21.7	11.4	21.8	28.2	14.3	17.4	9.56	20.6	19.4	34.1	14.9	24.3	18.1	21.8	18.2	11.7	9.56	34.1
Manganese (Mn)-Total	mg/kg wwt	0.333	1.01	5.49	8.95	0.743	7.48	0.962	3.08	2.93	8.19	4.17	6.1	6.16	4.84	5.97	4.64	0.333	8.95
Mercury (Hg)-Total	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Molybdenum (Mo)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	0.0055	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0055	0.0055
Nickel (Ni)-Total	mg/kg wwt	0.135	0.041	0.067	<0.040	<0.040	<0.040	<0.040	0.042	0.041	0.059	<0.040	0.066	0.069	0.066	0.07	0.055	0.041	0.135
Phosphorus (P)-Total	mg/kg wwt	35.1	25.5	42.3	43	23.6	31.5	20.2	41.6	38.5	61.9	27.2	56.6	36.6	43.2	37.9	25.8	20.2	61.9
Potassium (K)-Total	mg/kg wwt	255	138	289	317	162	190	140	311	290	428	230	301	239	303	227	129	129	428
Rubidium (Rb)-Total	mg/kg wwt	0.124	0.357	0.458	0.694	0.32	0.269	0.466	0.578	0.544	0.684	0.498	0.328	0.233	0.311	0.226	0.122	0.122	0.694
Selenium (Se)-Total	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium (Na)-Total	mg/kg wwt	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Strontium (Sr)-Total	mg/kg wwt	0.05	0.112	0.063	0.09	0.082	0.078	0.075	0.077	0.076	0.133	0.037	0.127	0.099	0.087	0.099	0.069	0.037	0.133
Tellurium (Te)-Total	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium (Tl)-Total	mg/kg wwt	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Tin (Sn)-Total	mg/kg wwt	<0.020	0.033	0.032	0.033	0.04	0.038	<0.020	0.022	0.021	0.025	<0.020	0.026	0.024	0.023	<0.020	0.024	0.021	0.04
Uranium (U)-Total	mg/kg wwt	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium (V)-Total	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc (Zn)-Total	mg/kg wwt	0.41	0.33	0.42	0.45	0.35	0.45	0.26	0.3	0.28	0.49	0.28	0.59	0.42	0.37	0.4	0.36	0.26	0.59
Zirconium (Zr)-Total	mg/kg wwt	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040

mg/kg wwt = milligram per kilogram wet weight; < = less than laboratory method detection limit

Table 5. Relative Percent Differences - Soils

Sample Name	AER-SOIL-08	AER-SOIL-08-DUP	
Sample Date	15-Aug-15	15-Aug-15	
Parameter			RPD (%)
Aluminum (Al)	7190	8370	15.2
Antimony (Sb)	<0.10	<0.10	-
Arsenic (As)	12.2	12.9	5.6
Barium (Ba)	73.9	86.8	16.1
Beryllium (Be)	0.36	0.4	10.5
Bismuth (Bi)	<0.20	<0.20	-
Boron (B)	<5.0	<5.0	-
Cadmium (Cd)	0.041	0.042	2.4
Calcium (Ca)	3150	3620	13.9
Chromium (Cr)	45.9	55.1	18.2
Cobalt (Co)	7.34	8.07	9.5
Copper (Cu)	6.55	7.91	18.8
Iron (Fe)	16300	18300	11.6
Lead (Pb)	6.11	6.86	11.6
Lithium (Li)	8.7	10.4	17.8
Magnesium (Mg)	4930	5850	17.1
Manganese (Mn)	264	280	5.9
Mercury (Hg)	0.0249	0.0089	**94.7**
Molybdenum (Mo)	0.32	0.33	3.1
Nickel (Ni)	23.5	27.3	15.0
Phosphorus (P)	735	859	15.6
Potassium (K)	1480	1890	24.3
Selenium (Se)	<0.20	<0.20	-
Silver (Ag)	<0.10	<0.10	-
Sodium (Na)	66	85	25.2
Strontium (Sr)	36.6	42.6	15.2
Thallium (Tl)	0.093	0.114	20.3
Tin (Sn)	<2.0	<2.0	-
Titanium (Ti)	683	798	15.5
Uranium (U)	1.36	1.56	13.7
Vanadium (V)	20.1	23	13.5
Zinc (Zn)	27.6	31.5	13.2
Zirconium (Zr)	2.6	4.6	**55.6**

Notes:
All concentrations in milligrams per kilogram (mg/kg)
< = less than laboratory method detection limit
- = not calculated because one or both concentrations were below the laboratory method detection limit
RPD = relative percent difference
50 RPD is greater than the 30% criterion for metals in soil.

Table 6. Relative Percent Differences - Vegetation

Sample Name	AER-LI-08	AER-LI-08-DUP		AER-GR-08	AER-GR-08-DUP		AER-BER-08	AER-BER-08-DUP	
Sample Date	15-Aug-15	15-Aug-15		15-Aug-15	15-Aug-15		15-Aug-15	15-Aug-15	
Parameter			RPD (%)			RPD (%)			RPD (%)
Aluminum (Al)-Total	31.6	147	**129**	72.2	26.8	**92**	<0.40	<0.40	-
Antimony (Sb)-Total	<0.0020	0.0064	-	0.0026	0.0054	**70**	<0.0020	<0.0020	-
Arsenic (As)-Total	0.0832	0.173	**70**	0.0757	0.043	**55**	<0.0040	<0.0040	-
Barium (Ba)-Total	3.42	9.26	**92**	29.8	23.6	23	0.309	0.295	5
Beryllium (Be)-Total	0.0023	0.0065	**95**	0.0067	0.0049	**31**	<0.0020	<0.0020	-
Bismuth (Bi)-Total	0.0055	0.012	**74**	0.0024	0.0044	**59**	<0.0020	<0.0020	
Boron (B)-Total	0.24	0.31	25	1.88	1.04	**58**	0.28	0.27	-
Cadmium (Cd)-Total	0.0477	0.0482	1	0.0168	0.0102	**49**	<0.0010	<0.0010	-
Calcium (Ca)-Total	460	407	12	1430	760	**61**	32.4	31.6	2
Cesium (Cs)-Total	0.0155	0.0337	**74**	0.0128	0.0075	**52**	<0.0010	<0.0010	-
Chromium (Cr)-Total	0.214	0.56	**89**	0.366	0.171	**73**	<0.010	<0.010	-
Cobalt (Co)-Total	0.035	0.113	**105**	0.131	0.0708	**60**	<0.0040	<0.0040	-
Copper (Cu)-Total	0.613	0.782	24	1.2	0.848	**34**	0.194	0.182	6
Iron (Fe)-Total	46.1	233	**134**	117	43.9	**91**	<0.60	<0.60	-
Lead (Pb)-Total	0.383	1.32	**110**	0.196	0.0835	**81**	<0.0040	<0.0040	-
Lithium (Li)-Total	<0.10	<0.10	-	<0.10	<0.10	-	<0.10	<0.10	-
Magnesium (Mg)-Total	135	167	21	415	265	**44**	20.6	19.4	6
Manganese (Mn)-Total	53.6	34.4	**44**	214	87.9	**84**	3.08	2.93	5
Mercury (Hg)-Total	0.0914	0.149	**48**	0.0164	0.0103	**46**	<0.0010	<0.0010	-
Molybdenum (Mo)-Total	0.0149	0.0214	**36**	0.321	0.211	**41**	<0.0040	<0.0040	-
Nickel (Ni)-Total	0.234	1.07	**128**	1.44	1.07	29	0.042	0.041	2
Phosphorus (P)-Total	173	169	2	449	266	**51**	41.6	38.5	8
Potassium (K)-Total	603	596	1	3210	2310	**33**	311	290	7
Rubidium (Rb)-Total	1.61	2.12	27	3.73	2.98	22	0.578	0.544	6
Selenium (Se)-Total	0.052	0.075	**36**	0.021	0.014	**40**	<0.010	<0.010	-
Sodium (Na)-Total	10.4	25.3	**83**	17.1	12.3	**33**	<4.0	<4.0	-
Strontium (Sr)-Total	1.24	1.54	22	6.76	4.79	**34**	0.077	0.076	1
Tellurium (Te)-Total	<0.0040	<0.0040	-	<0.0040	<0.0040	-	<0.0040	<0.0040	-
Thallium (Tl)-Total	0.00322	0.00748	**80**	0.00348	0.00423	19	<0.00040	<0.00040	-
Tin (Sn)-Total	<0.020	0.021	-	<0.020	<0.020	-	0.022	0.021	5
Uranium (U)-Total	0.00696	0.0184	**90**	0.0128	0.00275	**129**	<0.00040	<0.00040	-
Vanadium (V)-Total	0.073	0.306	**123**	0.128	0.038	**108**	<0.020	<0.020	-
Zinc (Zn)-Total	6.08	8.02	28	23.8	11	**74**	0.3	0.28	7
Zirconium (Zr)-Total	0.064	0.133	**70**	0.079	<0.040	-	<0.040	<0.040	-

Notes:
All concentrations in milligram per kilogram wet weight (mg/kg wwt)
< = less than laboratory method detection limit
- = not calculated because one or both concentrations were below the laboratory method detection limit
RPD = relative percent difference
50 RPD is greater than the 30% criterion for metals in vegetation.

APPENDIX 3-C

Pathway Analysis and Linkage Matrix Tables

Table 3-C-1: Potential Pathway for Atmospheric Environment

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	General construction, operations, and decommissioning activities associated with the Whale Tail Pit and the haul road.	Construction, Operations, Closure	Climate	Greenhouse gas emissions from the Project can contribute to climate change.	Agnico Eagle will comply with regulatory emission requirements for GHG's (e.g., reporting GHG emissions to the Federal Greenhouse Gas Reporting Program if they exceed 50,000 tonnes CO2e/yr). The following environmental design and mitigation features will lessen the effects of Project operations on GHG emissions: • All vehicles will adhere to the 50 km/h speed limit. • Regular maintenance will be implemented for equipment and vehicles.	No Linkage	There is no defined linkage that is considered valid between the Project emissions of GHG's and regional climate. As described by the federal government *"…the contribution of an individual project to climate change cannot be measured"* (FTPCCCEA, 2003). The GHG emissions from the Project will be estimated, but are too small to have any measureable effect on regional climate.
2	Mining of the Whale Tail Pit	Operations	Climate	Additional 3 years of processing and use of supporting infrastructure at the Meadowbank mine site and the existing AWAR for delivery of materials and contributions for the Whale Tail Project itself can produce greenhouse gas emissions that contribute to climate change.	Agnico Eagle will comply with regulatory emission requirements for GHG's (e.g., reporting GHG emissions to the Federal Greenhouse Gas Reporting Program if they exceed 50,000 tonnes CO_2e/yr). The following environmental design and mitigation features will lessen the effects of Project operations on GHG emissions: • All vehicles will adhere to the 50 km/h speed limit. • Regular maintenance will be implemented for equipment and vehicles.	Primary	See Section 4.2.3.1
3	Upgrading of the haul road from the Whale Tail Pit to the Meadowbank Mine	Construction, Closure	Air	Vehicle emissions and fugitive dust from construction and decommissioning of the haul road can affect air quality.	The following environmental design and mitigation features will reduce the effects of haul road upgrading on air quality: • Implement dust control measures, if needed on mine roads • Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase. • Regular maintenance will be implemented for equipment and vehicles. • Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the TEMP).	Secondary	Combustion emissions and fugitive dust emissions generated during upgrading of the haul road will be small compared to emissions during haul road operations. Air dispersion modelling of the operations case will provide a conservative estimate of the worst case scenario eliminating the need to model construction-phase or decommissioning-phase emissions separately.
4	Traffic on the haul road from the Whale Tail Pit to the Meadowbank Mine	Operations	Air	Vehicle emissions and fugitive dust from traffic on the haul road can affect air quality.	The following environmental design and mitigation features will lessen the effects of haul road traffic on air quality: • Watering of roads and enforcing speed limits to suppress dust production. • Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase • Regular maintenance will be implemented for equipment and vehicles • Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the TEMP).	Primary	See Section 4.3.3.

Table 3-C-1: Potential Pathway for Atmospheric Environment

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
5	Construction of the Whale Tail Pit	Construction	Air	Blasting, stationary and mobile combustion sources, and fugitive dust emissions during construction of the Whale Tail Pit can affect air quality.	The following environmental design and mitigation features will reduce the effects of Whale Tail Pit construction on air quality: • Best Management practices for controlling fugitive dust from construction activities • Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase • Regular maintenance will be implemented for equipment and vehicles	Secondary	Combustion emissions and fugitive dust emissions generated during the construction of the Whale Tail Pit will be small compared to emissions during mining operations. Air dispersion modelling of the operations case will provide a conservative estimate of the worst case scenario, thereby eliminating the need to model construction-phase emissions separately.
6	Mining of the Whale Tail Pit	Operations	Air	Blasting, stationary and mobile combustion sources, and fugitive dust from mining activities in the Whale Tail Pit can affect air quality.	The following environmental design and mitigation features will lessen the effects of mining activities on air quality: • Watering of pit roads and enforcing speed limits to suppress dust production. • Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase. • Regular maintenance will be implemented for equipment and vehicles. • Enclosures are used to reduce fugitive emissions at the processing facility.	Primary	Results of the air quality model (e.g., dust deposition) will be passed to other valued components with assessment endpoints that are affected by air quality and/or atmospheric deposition (e.g., water quality).
7	Mining of the Whale Tail Pit	Operations	Air	Additional 3 years of processing and use of supporting infrastructure at the Meadowbank mine site and the existing AWAR for delivery of materials can continue to affect air quality	• Adherence to the Air Quality Monitoring Plan. • Enclosures are used to reduce fugitive emissions at the processing facility. • Adherence to the Incinerator Waste Management Plan •Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the TEMP).	Primary	See Section 4.3.3.3 and 4.3.3.3
8	Decommissioning of the Whale Tail Pit	Closure	Air	Stationary and mobile combustion sources, and fugitive dust from decommissioning activities can affect air quality.	The following environmental design and mitigation features will reduce the effects of Whale Tail Pit construction on air quality: • Best Management practices for controlling fugitive dust from decommissioning activities • Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase • Regular maintenance will be implemented for equipment and vehicles	Secondary	Combustion emissions and fugitive dust emissions generated during the decommissioning of the Whale Tail Pit will be small compared to emissions during mining operations. Air dispersion modelling of the operations case will provide a conservative estimate of the worst case scenario, thereby eliminating the need to model decommissioning-phase emissions separately.
9	Upgrading of the haul road from the Whale Tail Pit to the Meadowbank Mine	Construction	Noise and Vibration	Noise emissions from construction equipment can increase ambient noise levels. Blasting can result in ground vibration and increase ambient noise levels.	The following environmental design and mitigation features will reduce the effects of haul road construction on noise and vibration: • Best Management practices for controlling equipment noise emissions, including use of silencers on all engines. • Regular maintenance will be implemented for equipment and vehicles.	Primary	See Section 4.4.3

Table 3-C-1: Potential Pathway for Atmospheric Environment

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
10	Traffic on the haul road from the Whale Tail Pit to the Meadowbank Mine	Operations	Noise	Noise emissions from vehicles on the haul road can increase ambient noise levels.	The following environmental design and mitigation features will reduce the effects of haul road operations on noise: • Best Management practices for controlling equipment noise emissions, including use of silencers on all trucks. • Enforcing speed limits. • Regular maintenance will be implemented for equipment and vehicles.	Primary	See Section 4.4.3
11	Construction of the Whale Tail Pit	Construction	Noise and Vibration	Noise emissions from construction equipment can increase ambient noise levels. Blasting can result in ground vibration and increase ambient noise levels.	The following environmental design and mitigation features will reduce the effects of pit construction on noise and vibration: • Best Management practices for controlling equipment noise emissions, including use of silencers on all engines • Regular maintenance will be implemented for equipment and vehicles. • Adherence to the Noise Monitoring and Abatement Plan (Agnico Eagle 2014)	Secondary	Noise emissions and blasting activities during pit construction are expected to be comparable or less than similar emissions and activities during pit operations. Modelling of the operations case will provide a conservative estimate of the maximum emissions/blasting scenario, thereby eliminating the need to model pit construction.
12	Mining of the Whale Tail Pit	Operations	Noise and Vibration	Noise emissions from mining equipment can increase ambient noise levels. Blasting can result in ground vibration and increase ambient noise levels.	The following environmental design and mitigation features will reduce the effects of pit operations on noise and vibration: • Best Management practices for controlling equipment noise emissions, including use of silencers on all trucks. • Periodic far-field noise monitoring to validate modelling and confirm adherence with applicable limits. • Regular maintenance will be implemented for equipment and vehicles. • Adherence to the Noise Monitoring and Abatement Plan (Agnico Eagle 2014)	Primary	See Section 4.4.3
13	Additional 3 years of processing and use of supporting infrastructure at the Meadowbank mine site and the existing AWAR for delivery of materials.	Operations	Noise	Noise emissions from equipment and activities at the Meadowbank mine site can increase ambient noise levels.	A detailed Noise Monitoring and Abatement Plan was developed for the Meadowbank mine site in 2009 (Agnico Eagle 2009) and refined in 2014 (Agnico Eagle 2014). The most recent version of the Meadowbank Noise Monitoring and Abatement Plan describes a large number of specific noise mitigation measures that are incorporated in the design and operation of the Meadowbank mine (e.g., avoid nighttime trucking, where possible; avoid prolonged idling; keep equipment in good condition; place crushers in sheltered/enclosed locations, where possible) and commits to regular noise monitoring twice each year to ensure that noise conforms to appropriate target levels.	Secondary	Noise emissions from the Meadowbank mine site will not change as a result of the Whale Tail Pit - they will be extended for 3 additional years. Noise effects associated with the Meadowbank mine have been well-characterized as part of an earlier regulatory process (Cumberland 2005a; Cumberland 2005b) and regular noise monitoring has confirmed that representative noise from Meadowbank mine operations conforms to acceptable target levels (e.g., Agnico Eagle 2014; Agnico Eagle 2015). Given the noise level and temporal extent of the impact, this pathway was considered minor. The wildlife impact assessment has considered the temporal extension of noise from existing facilities and roads.

Table 3-C-1: Potential Pathway for Atmospheric Environment

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
14	Decommissioning the haul road from the Whale Tail Pit to the Meadowbank Mine	Closure	Noise	Noise emissions from equipment involved in decommissioning can increase ambient noise levels.	The following environmental design and mitigation features will reduce the effects of haul road decommissioning on noise: • Best Management practices for controlling equipment noise emissions, including use of silencers on all engines. • Regular maintenance will be implemented for equipment and vehicles.	Secondary	Noise emissions during haul road decommissioning are expected to be comparable or less than similar emissions during haul road construction. Modelling of the construction case should provide a conservative estimate of the maximum emissions scenario, thereby eliminating the need to model haul road decommissioning.
15	Decommissioning of the Whale Tale Pit	Closure	Noise	Noise emissions from equipment involved in decommissioning can increase ambient noise levels.	The following environmental design and mitigation features will reduce the effects of pit decommissioning on noise: • Best Management practices for controlling equipment noise emissions, including use of silencers on all engines. • Regular maintenance will be implemented for equipment and vehicles.	Secondary	Noise emissions during pit decommissioning are expected to be comparable or less than similar emissions during pit operations. Modelling of the operations case should provide a conservative estimate of the maximum emissions scenario, thereby eliminating the need to model pit decommissioning.

Table 3-C-2: Potential Pathway for Terrain, Permafrost, Soils, and Vegetation

	Project Activity	Project Phase	Valued Components: Terrain	Valued Components: Permafrost	Valued Components: Soils	Valued Components: Vegetation	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	Mine Infrastructure Footprint (e.g. open pits, site roads, access roads)	Construction, Operations and Closure	X		X	X	Physical loss or alteration of terrain and soil from the Project footprint , impacting vegetation and available wildlife habitat.	Compact infrastructure arrangement is designed to reduce the overall Project footprint. Minimizing proposed haul road width and length by designing roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. For example, minimum haul road widths are defined under the Mine *Health and Safety Act*. Limit the use high value habitats to only what is required (e.g., esker, shorelines). Locating borrow sites as close to the proposed haul road as practical. Minimizing borrow areas by using suitable waste rock (e.g., Vault Pit waste rock) to the greatest extent practicable. Restoring contours and reclaiming habitat after closure. Avoid new disturbances by using existing ones where possible.	Primary	See Section 5.3.3.1 for terrain and soils and Section 5.4.3.1 for vegetation
2	Mine Infrastructure Footprint (e.g. open pits, site roads, access roads)	Construction, Operations and Closure		X	X	X	Mine infrastructure footprint: Loss or alteration of local flows, drainage patterns (distribution), and drainage areas from the Project footprint and haul road can cause changes to soils, and vegetation.	Use of design features (i.e., dams, drainages, dykes, and diversions) that reduce changes to local flows, drainage patterns, and drainage areas. Implement slope stability criteria to manage erosion. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed.	Secondary (Permafrost and Soils); Primary (Vegetation)	Flooding of terrestrial vegetation is expected to reach a maximum of 165.9 ha in July 2020 and continue to May 2022 (Golder 2016), affecting soil moisture. At post-closure, it is expected that hydrology conditions would return to baseline (Volume 6, Section 6.3). Due to the short nature and the limited area with expected flooding effects to permafrost and soil are expected to be minor. There is limited erosion potential because slope stability criteria will be implemented. See Section 5.4.3.1.2 for assessment of effect to vegetation.
3	Mine Infrastructure Footprint (e.g. open pits, site roads,	Construction		X		X	Physical loss or alteration of permafrost from the Project footprint can lead to changes in vegetation ecosystem structure and composition	Compact infrastructure arrangement is designed to reduce the overall Project footprint. Mine site infrastructure (buildings) foundations will be built on bedrock or pillars to minimize Project induced thawing of permafrost. Short construction period for mine infrastructure. Design roads as narrow as possible, while maintaining safe construction and operation practices and meeting legislated requirements. For example, minimum haul road widths are defined under the *Mine Health and Safety Act*. Design and construct roads using thaw-stable construction fills to minimize frost effects.	Secondary	Environmental Design and Mitigation Features are expected to minimize permafrost loss due to the Project footprint during construction, given the short duration. Changes in water regimes and soil moisture associated with loss of permafrost can strongly influence plant species composition, and vegetation community structure. Measures will be taken to mitigate changes in hydrological characteristics through project design (e.g., minimizing project footprint) and though the reclamation of a stable closure landscape. With the minimal loss of permafrost during construction, it is expected that there will be minimal effect on vegetation.
4	Earthworks: Drilling, blasting, grading, trenching, excavation and backfilling, crushing activities, and dike construction	Construction	X	X	X		Physical changes, including degradation to the permafrost, terrain and soils in the area of the mine site footprint and supporting infrastructure (i.e., haul roads)	Minimize footprint areas for stripping and removal of material. Use appropriately designed structural fill and thickness to maintain and promote permafrost conditions. Where possible, stockpiling of rock and fill from quarries and borrow sites will be placed such that surface water is not diverted through the piles. Maximum quarry depths of 3 m are currently planned. Minimum setback distance of 31 m from the ordinary high water mark of waterbodies. Drainage from quarries or borrow sources will not flow directly into any waterbodies or watercourses.	Primary (Terrain and Soils)	Effects from earthworks in considered minor due to the implementation of environmental design and mitigation features. The construction and operation of the open pit, water management infrastructure is covered in separate pathways. See Section 5.3.3.1 under heading." and "Physical loss or permanent alteration of terrain and soils within the Project footprint…." Effects for vegetation are covered under the permanent lost of the Project footprint (see line 1 of this table).
								The road alignment has been chosen to avoid areas that are ice-rich and, therefore, more susceptible to disturbance. Thaw-stable construction fills will be used to construct the haul road. Fill thickness is designed to preserve the permafrost and promote permafrost growth into the thaw-stable road fills. Road fill material will be placed directly over the existing soil layer without cutting, stripping, or grubbing to avoid disturbing the subgrade materials. Placement of much of the road construction materials during winter will minimize disturbance to the permafrost. Thick drifted snow greater than 1 m thick will be removed before the road fills are placed. Minimize depth of excavations to limit impact on active layer. Monitoring of the Whale Tail Dike will be undertaken to understand the hydraulic and thermal behaviour of the dike during filling Whale Tail (South Basin)	Primary (Terrain and Soils)	Effects from earthworks in considered minor due to the implementation of environmental design and mitigation features. The construction and operation of the open pit, water management infrastructure is covered in separate pathways. See Section 5.3.3.1 under heading." and "Physical loss or permanent alteration of terrain and soils within the Project footprint…." Effects for vegetation are covered under the permanent lost of the Project footprint (see line 1 of this table).

Table 3-C-2: Potential Pathway for Terrain, Permafrost, Soils, and Vegetation

	Project Activity	Project Phase	Valued Components				Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
			Terrain	Permafrost	Soils	Vegetation				
5	Earthworks: Drilling, blasting, grading, trenching, excavation and backfilling, crushing activities, and dike construction	Construction		X			Physical changes to permafrost and active layer by quarry or borrow source excavation. Degradation of rock and soil slopes in proposed borrow sites due to annual freeze-thaw processes.	Minimize depth of quarrying to limit impact on active layer. Maximum quarry depths of 3 m are currently planned. Appropriate design of quarry walls to promote stability, and to minimize annual slope degradation. Quarries will be shallow excavations and will be closed on completion using current industry standards and practices. Appropriate design of quarries to manage water and minimize ponding of water within the quarries which would result in a deeper active layer.	Secondary	Effects are expected to be minor because the active layer and permafrost table will equilibrate to final quarry/borrow source shape and profile.
6	Earthworks: Drilling, blasting, grading, trenching, excavation and backfilling, crushing activities, and dike construction	Construction			X	X	Soil disturbance, stockpiling and transport can change physical, biological, and chemical properties of soils. Site clearing, contouring, excavation and decommissioning can cause admixing, compaction, and soil erosion and change soil quality.	The roads will be as narrow as possible, while maintaining safe construction and operation practices. Compact infrastructure arrangement is designed to reduce the overall Project footprint. Most of the overburden will be placed in the Waste Rock Storage Facility, except for a small amount used in operations, which will only be temporarily stockpiled. Overburden will be piled at the base of the Whale Tail WRSF and surrounded with waste rock to stabilize the material and then all the overburden stockpiled in the Whale Tail WRSF will be eventually covered with Erosion control practices on steep slopes to limit wind and water erosion.	Primary (Soil); Secondary (Vegetation)	See Section 5.3.3.1 for soil assessment. Secondary for vegetation because soil disturbance and stockpiling can change physical, biological or chemical properties of soil, increase erosion potential and affect vegetation quantity and quality. However, mitigation measures will be implemented to minimize Project footprint, and keep vehicles off areas not designated for vehicles, and erosion control practices on steep slopes will limit wind and water erosion.
7	Earthworks: Drilling, blasting, grading, trenching, excavation and backfilling, crushing activities, and dike construction	Construction	X	X	X		Loss or alteration of local flows, drainage patterns (distribution), and drainage areas from quarries, borrows or haul road footprint can cause changes to terrain, permafrost and soils	Use of culverts and bridges that reduce changes to local flows, drainage patterns and drainage areas. Where possible, stockpiling of rock and fill from quarries and borrow sites will be placed such that surface water is not diverted through the piles with runoff to surface waterbodies. Minimum setback distance of 31 m from the ordinary high water mark of waterbodies. Drainage from quarries will not flow directly into any waterbodies or watercourses Borrow areas will be will be closed on completion using best management practices. Road design includes the use of localized drainage culverts to control and manage drainage adjacent to and under the road.	No Linkage	Through the implementation of the Mine Site Surface Water Management Plan and Environmental Design Features and Mitigations outlined here, there is expected to be negligible alteration of drainage paths that would impact soils, terrain or permafrost
8	Mine Site Facilities Construction	Construction		X			Physical changes to permafrost due to temporary building footprint area and height	Minimize footprint area and limit exposure time.	No Linkage	Buildings will be removed once construction of the permanent buildings are complete and the construction period is expected to be less than two years.
9	Mine Site Facilities Construction	Construction, Operations	X	X			Physical gain of terrain and permafrost within the structural fills used to construct site facilities and infrastructure.	Minimize footprint areas of facilities and infrastructure while maintaining safe construction and operation practices. Use of thaw-stable materials in structural fills to support site facilities and infrastructure. Minimize footprint of roads while maintaining safe construction and operation practices. Use appropriate engineering design and construction practices for permafrost environments, including elevated structures where required to minimize Submission of all design drawings to the Nunavut Water Board for approval, prior to construction.	No Linkage	Thaw-stable structural fills will promote the development of permafrost within the fill materials and reduce the potential for permafrost degradation of thaw-unstable materials but changes will be negligible.
10	Mine Site Facilities Construction	Construction	X		X	X	Use of potential acid generating materials for road building materials and other supporting infrastructure can affect terrain and soil quality and subsequently vegetation.	Use of non-acid generating material for road construction.	No Linkage	Acid generating materials will not be used for road construction; therefore there is no link to valued components.
11	Mine Site Facilities Construction	Construction		X			Placement of fill materials during the summer could insulate warm temperatures in subgrade soils leading to permafrost degradation. Use of structural fill pads for facilities; construction of site roads.	Where possible, use thaw-stable road fills for construction. Fill thickness is designed to preserve the permafrost and promote permafrost growth into the thaw-stable road fills. Road fill material will be placed directly over the existing soil layer without cutting, stripping, or grubbing to avoid disturbing the subgrade soils. Placement of the road construction materials during winter will minimize disturbance to the permafrost. Thick drifted snow greater than 1 m thick will be removed before the road fills are placed.	No Linkage	To the greatest extent possible, Project components will be constructed in winter when the subgrade soils are frozen to prevent insulation of the thawed active layer therefore there is no link to the valued components.

Table 3-C-2: Potential Pathway for Terrain, Permafrost, Soils, and Vegetation

	Project Activity	Project Phase	Valued Components: Terrain	Permafrost	Soils	Vegetation	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
12	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Operations		X			Snow clearing and stockpiling may result in the insulation of the active layer, incomplete freezing of the active layer, and subsequent thaw settlement.	Stockpile snow on thaw-stable materials, or in areas that are insensitive to thaw settlement. Use appropriate drainage and water diversion structures to minimize water ponding during thaw. Stock pile snow on thaw-stable materials. Use snow fencing where appropriate to minimize snow clearing requirements.	Secondary	Thaw consolidation or settlement may result in a measurable but minor environmental change to permafrost, with no link to other valued components.
13	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Operations		X			Use of heavy equipment, vehicle circulation, and helicopter use may cause degradation of permafrost due to traffic frequency, vehicle weight.	Use of appropriate structural fills and thickness for site roads, lay-down areas, and pads.	No Linkage	Use of appropriate structural fills and thickness for site roads, lay-down areas, and pads will negate changes to permafrost.
14	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Operations		X			Road use and maintenance activities: Permafrost degradation and thaw settlement along existing and haul road edges due to snow drifting and snow accumulation in lee of road; snow accumulation along toe of road shoulders from winter plowing; and pooling of water and ice lens growth.	Use of culverts and bridges that reduce changes to local flows, drainage patterns and drainage areas. Where possible, construct road along exposed ridge lines to reduce potential snow accumulation. Where possible, use thaw-stable road fills for construction. Annual road maintenance as required.	Secondary	Subgrade soil near the toe of site roads and the haul road may experience deeper thaw penetration during each subsequent spring/summer season, which may lead to thaw consolidation. Thaw consolidation in ice rich soil at the toe of an embankment will result in the formation of tension cracks and small grabens inside the shoulder area. Thaw consolidation may result in a measureable, but minor environmental change, and is therefore considered a secondary pathway.
15	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Construction, Operations			X	X	Air emissions, dust deposition, or chemical contamination on terrain, soils, and vegetation can potentially change the quality and/or chemical properties of soil and effecting vegetation.	Implement dust control measures on mine roads, when required. Road surfaces will be maintained through grading and the addition of granular material. Equipment and vehicles will comply with relevant non-road emission criteria at that time of purchase. Regular maintenance of equipment and vehicles will be conducted to meet emission standards. Use of non-acid generating materials for road bed and fills. Enforcing speed limits will assist in reducing dust emissions. Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the Terrestrial Ecosystem Management Plan) Implement the spill plan for potential chemical spills, including hydrocarbons. Complete a Wildlife Screening Level Risk Assessment every 3 years	Secondary (Soil); Primary (Vegetation)	Environmental design features and mitigation have been incorporated into the Project to reduce potential effects from dust deposition. Air quality modelling results indicate maximum deposition rates of 0.38 kiloequivalent per hectare per year (keq/ha/y) within the Project Lease Boundary. While the 0.38 keq/ha/y maximum potential acid input (PAI) is predicted to be above the critical load of 0.25 keq/ha/y for sensitive soils (CASA 1996), it is expected that sensitive soils would likely not be affected by acid deposition relative to baseline conditions due to the short duration of emission (7 years). Therefore, metal emissions and PAI effects to soil are expected to be negligible to minor. Air missions generated during construction, operations and closure of the Whale Tail mine will be relatively small; therefore metal emissions and PAI effects to vegetation are expected to be negligible. Dust deposition is anticipated to affect vegetation quantity and quality within 100 m of the haul road, this is assessed in Section 5.4. The 2015 Air Quality and Dustfall Monitoring Report for the Meadowbank mine (Agnico Eagle 2015x) has shown a continual decline in dustfall exceedances on an annual basis with only 1 exceedance out of 48 in 2015. In addition, there have been no observed changes in soil/plant metal concentrations from the Wildlife Screening Level Risk Assessment (Agnico Eagle 2015x).
16	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Construction				X	Dust deposition may cover vegetation and lead to physical and/or physiological damage	Roads are designed as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. Minimum haul road widths are defined under the Mine's Act. Refer to Item 15 for additional mitigation measures	Primary	Dust deposition is anticipated to affect vegetation quantity and quality within 100 m of the haul road, this is assessed in Section 5.4.
17	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Operations	X	X			Physical alteration of terrain and permafrost within and beneath the tailings storage facility.	Use of existing facility at the Meadowbank Mine and maintain the same approved footprint. Continue to use appropriate facilities management methods to reduce the amount of ice trapped within the facility. Use appropriate deposition planning (i.e., tailings placed in layers to promote freezing).	No Linkage	Existing tailings facility at Meadowbank Mine will be used and raised. This is anticipated to have no additional effect on permafrost. Current conditions of the permafrost and current predictions of permafrost condition at Meadowbank Mine are expected to be maintained.

Table 3-C-2: Potential Pathway for Terrain, Permafrost, Soils, and Vegetation

	Project Activity	Project Phase	Valued Components: Terrain	Permafrost	Soils	Vegetation	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
18	Mine Site Operations and Maintenance, including use of existing facilities and AWAR				X	X	Surface water runoff from the mine facilities area can affect surface water quality, soil, and vegetation	Water Management Plan is approved and adhered to at existing facilities and Water Management Plan specific to the Whale Tail Pit areas has been developed and these plans have considered the containment and management of contact site water. Seepage and runoff from the waste rock storage facility will be managed via the Whale Tail Waste Rock Storage Facility Pond where the contact water will then be pumped to the Whale Tail Attenuation Pond for further treatment. Surface runoff seeping into the open pits will be collected in in-pit sumps. The collected water will be managed as contact water (collected, contained, monitored and treated if required to meet water license discharge standards before release). Natural construction materials will be tested before they are used to confirm that they are not potential acid draining or potential sources of metal leaching.	Secondary (Soil and Vegetation)	Suspended solids in surface water runoff from the mine footprint can contain chemicals, which can change soil quality. Weathering of waste rock (e.g., waste rock spoils, coal stockpiles) may also cause changes to soil quality. However with the application of Water Management Plan and monitoring of sediment chemistry, dust, effects are expected to be minor. Water chemistry will also be monitored to mitigate effects to the receiving aquatic environment. Surface water runoff and seepage will be intercepted in diversion ditches and treated before release into the environment and water releases will be within the limits dictated by the water licence. The effects of sedimentation from surface runoff on soils from active mine areas may be similar to the effects of dust deposition on soil quality (i.e. minor). Any effects to the receiving environment will be confined to the area surrounding or downstream of the Project. Subsequently the effect to soils and vegetation while potentially measurable is expected to be minor with the implementation of mitigation measures.
19	Mine Site Operations and Maintenance, including use of existing facilities and AWAR					X	Introduction of non-native plant species can affect native vegetation	Inspection of newly shipped equipment/vehicles and clean as required. Enforce DOE guidelines regarding non-native plant species and incorporate protocols for monitoring non-native plant species.	No Linkage	No Linkage for vegetation with the implementation of best practices. Currently no evidence at the Meadowbank Mine that non-native plants are of concern.
20	Mine Site Operations and Maintenance, including use of existing facilities and AWAR	Construction, Operations,				X	Off-road vehicle access: Vehicles accidentally or purposefully leaving proposed exploration access road during and after construction ATV, and snowmobile use in landscape surrounding the proposed road	Restricting construction to designated roads. Designating and clearly delineating temporary workspaces during construction. Clearly marking road edges. Limiting vehicle access to road.	No Linkage	Off-road vehicle use during construction, operations, or closure may directly affect vegetation quantity. Restricting access to designated roads, and workspaces, and clearly marking road edges will mitigate impacts to vegetation. Off-road vehicle use on the existing AWAR is not expected to change from current practices and no additional effects are expected.
21	Waste Rock Storage Areas and Stockpiles	Operations	X	X			Physical alteration of terrain and permafrost within and beneath the waste rock piles.	Seepage and runoff from the waste rock storage facility will be managed via the Whale Tail Waste Rock Storage Facility Pond where the contact water will then be pumped to the Whale Tail Attenuation Pond for further treatment. This will minimize ponding around the facility. Where possible begin construction during winter months, when active layer is frozen. Place waste rock in lifts to promote freezing of pile.	Secondary	Foundations of waste rock storage facilities currently frozen and will remain frozen as waste rock is placed. Waste rock piles will also freeze with time resulting in improved stability. The 2014 Meadowbank Annual Report states that below approximately 5.6 m from the surface the temperature at the Meadowbank Waste Rock Storage Facility remains below $0^{\circ}C$ all year long. Therefore minor changes only are expected to permafrost and terrain.
22	Waste Rock Storage Areas and Stockpiles	Operations			X	X	Leaching of dissolved metals from waste rock in the waste rock/overburden storage facilities may cause changes to water quality and soils, which may affect vegetation	Waste rock management procedures developed for potentially problematic waste rock/overburden material. Implement the Mine Waste Rock and Tailings Management Plan. Use of non-acid generating material at any watercourse crossings. Testing will verify lack of acid rock drainage and metal leaching potential. Any potentially acid generating (PAG) or high metal leaching waste rock will be segregated at source and placed into designated areas within the waste rock storage facility. Runoff and lateral seepage from the waste rock/overburden facilities will not be released directly to the environment during pre-production or operations. Use of climate control strategies for the development of the waste rock storage facility to act as a natural control to reduce the production of acid mine drainage and metal leachate. Over time potential PAG and high metal leaching rock will become permanently frozen with an active cover layer of non-PAG rock.	Secondary	Changes to ground and surface water quality associated with leaching of constituents from waste rock and mining areas (e.g., road surfaces and stockpiles) could affect soil quality and vegetation quantity and quality. Changes to water quality are expected to be minor (Table 3-C-6). Waste rock storage facilities are located above permafrost Techniques to design the waste rock spoil to minimize the potential for the leaching of chemicals from waste rock and other mining areas will be implemented, including the diversion of clean runoff around mining areas, and treatment to remove suspended solids, which will result in negligible to minor changes to soil and vegetation.
23	Water Management Infrastructure	Construction, Operations		X			Ponding of water, or high volume flow during freshet may result in permafrost degradation due to thickening of the active layer. Water diversion and discharge may result in soil erosion.	Minimize ponding of water adjacent to roads, infrastructure, and facilities by promoting drainage and installing appropriate water diversion structures. Use appropriate water management methods to avoid water ponding and to control high volume potentially erosive flows. Manage snow accumulation locally	Secondary	Snow acts as an insulating layer to the active layer and can restrict the deep penetration of the freezing front through the active layer during winter. Over time this may result in deepening of the active layer at the toe of slopes but changes will be negligible.
24	Water Management Infrastructure	Operations	X	X	X		Freezing and plugging of culverts in the winter may result in: inadequate drainage during spring thaw and freshet, over-topping and erosion of road surface releasing silt onto terrain and soils; pooling of water adjacent to road flanks; potential instability and thaw settlement of road shoulders; thaw settlement beneath and adjacent to culverts; and ice lens growth.	Use appropriate culvert design based on the site specific hydraulics. Where deemed appropriate, use of staggered culvert configuration to promote drainage during spring thaw and freshet. Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or drains to alleviate the risk.	No Linkage	The use Environmental Design Features and Mitigation remove the linkage between freezing and plugging of culverts and impacts to permafrost, terrain and soils.

Table 3-C-2: Potential Pathway for Terrain, Permafrost, Soils, and Vegetation

	Project Activity	Project Phase	Valued Components: Terrain	Permafrost	Soils	Vegetation	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
25	Water Management Infrastructure			X	X	X	Dewatering of lakes and diversion of water may change downstream flows and water levels, affecting permafrost, soils, vegetation, and wildlife habitat.	Pumped discharge to receiving lake will only occur while water quality discharge criteria are met. Pumped discharge will be directed to the lake environment, and not directly to outlets, to attenuate flow changes. Shoreline areas susceptible to extensive erosion will be addressed by appropriate erosion protection measures, mitigation measures based on adaptive management, or a combination of both, to reduce erosion and associated re-suspension of fine sediment. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms	Primary (Vegetation); Secondary (Soils, Permafrost)	Vegetation is assessed in Section 5.4 because changes in soil moisture regime may result in changes to species abundance and diversity. Due to the short nature and the limited area with expected flooding effects to permafrost and soil are expected to be minor.
26	Water Management Infrastructure				X X	X	Cross-drainage structures for the mine site roads, may alter stream hydraulics and geomorphology, and can alter soils, vegetation, and wildlife habitat	Pumped discharge will be directed to the lake environment, and not directly to outlets, to attenuate flow changes. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms Cross-drainage structures will be designed for a 1:10 year precipitation event or to meet DFO requirements for fish passage. Use of staggered culvert configuration, and removal of snow at the culvert inlet and outlet prior to the freshet to promote drainage during spring thaw and freshet. Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts to alleviate the risk.	Secondary	Changes in drainage flows and surface water levels can strongly influence plant species composition, and vegetation community structure. Measures will be taken to mitigate changes in hydrological characteristics through project design (minimizing project footprint) and though the reclamation of a stable closure landscape subsequently changes to soils and vegetation are considered minor.
27	Open Pits	Operations	X	X			Open Pit mining result in physical loss or permanent alteration of terrain, soils, and permafrost within the mined out areas. Permafrost degradation and retreat due to excavation of open pits and potential groundwater inflows to the open pit during operations if depth extends below the base of permafrost.	Appropriate design of open pit walls to promote stability, and to minimize annual slope degradation. Water inflows to the pit will require sumps and be pumped to the Attenuation Pond. Use appropriate back filling methods for the placement of fill material. Initial permafrost retreat that may occur during the placement of backfill may be replaced by permafrost re-establishing within the backfilled areas.	Primary	See Section 5.3.3.1
28	Open Pits	Construction, Operations	X	X			Dike construction, dewatering and open pit mining may result in terrain instability within the open pit mine due to exposure of sediments during dewatering and excavation of slopes during operation. Permafrost degradation may cause unstable slopes.	Appropriate design of open pit walls to promote stability, and to minimize annual slope degradation. Use of appropriate currently accepted permafrost engineering practices as part of dike construction and drawdown for open pit mine.	Secondary	The Environmental Design Features and Mitigation will minimize the likelihood and extent of changes to terrain or permafrost. Therefore effects are expected to be negligible.
29	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction, Operations		X			Use of petroleum products, and maintenance of vehicles may result in hydrocarbon spills infiltrating the active layer.	Appropriate operations and maintenance procedures in place for the operation of the fuel tank farm. Appropriate re-fueling areas and procedures to minimize and capture spills. Implement the spill plan for potential chemical spills, including hydrocarbons.	Secondary	Environmental Design Features and Mitigation minimize the link between the active layer and spills.
30	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction, Operations		X			Physical alteration of permafrost from latent heat of petroleum and fuel oil stored in tank farm.	Appropriate design and construction of fuel tank farm foundations using thaw-stable materials and to thickness' to promote permafrost growth and stability. Appropriate site maintenance buildings will be constructed.	No Linkage	Environmental Design Features and Mitigation negate the link to permafrost.
31	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction,	X	X	X		Permanent alteration of terrain, soils, and permafrost beneath the structural fills used to construct fuel tanks farm.	Appropriate design and construction of fuel tank farm foundations using thaw-stable materials and to thickness to limit permafrost degradation. Implement the spill plan for potential chemical spills, including hydrocarbons.	No Linkage	Environmental Design Features and Mitigation negate the link to permafrost, terrain, and soils.

Table 3-C-2: Potential Pathway for Terrain, Permafrost, Soils, and Vegetation

	Project Activity	Project Phase	Valued Components				Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
			Terrain	Permafrost	Soils	Vegetation				
32	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction, Operations, Closure			X	X	Spills on the mine site or along the roads can affect surface water quality, soils, and vegetation	Equipment will be re-fueled, serviced, and washed away from stream crossings and on impermeable pads wherever possible. There will be a wash bay in the maintenance shop. Implement emergency response and spill contingency plans. Vehicles properly loaded and loads appropriately covered where necessary. Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers Individuals working on site and handling hazardous materials will be trained to do so (e.g., WHMIS) Soils and rock contaminated by light hydrocarbons and from petroleum spills will be excavated and backhauled to the Meadowbank Mine. Soils contaminated with heavy hydrocarbons will be segregated, packaged and shipped to the south from the mine site for proper treatment and disposal. Fuel storage tanks will be situated in a lined and bermed containment area capable of containing 110 per cent of the contents of the largest tank. The storage tanks and fuel-dispensing systems will be constructed in accordance with current regulatory requirements and fire regulations. Fuel will be transported year-round by double-walled tanker trucks to the Whale Tail tank farm. Construction and mining equipment, machinery, and vehicles will be regularly maintained. Ready access to an emergency spill clean-up kit for cleaning-up any spills.	No Linkage	Chemical or hazardous material spills (e.g., petroleum products, reagents, explosives) on the mine site or haul road can affect vegetation quantity and quality. The Hazardous Materials and Waste Management Plan will be implemented to limit the frequency and extent of spills that result from Project activities.
33	Waste Management: Landfill, Landfarm, Sewage Treatment	Operation	X	X			Sewage Treatment and disposal: Physical alteration of terrain, soils, and permafrost due to earthworks, facilities construction, and ground disturbance.	Appropriately designed facility to contain and manage sewage. Minimize ground disturbance. Use appropriate engineering design and construction practices for permafrost environments.	Secondary	Environmental Design Features and Mitigation negate the link to permafrost and terrain. See Effect pathway for impacts from the loss of the project footprint.
34	Waste Management: Landfill, Landfarm, Sewage Treatment	Operation		X			Management of the landfill may degrade permafrost.	Use appropriate waste management methods to operate the facilities within the proposed waste rock piles, to promote permafrost growth. Operate the landfill in an area of the waste rock pile that will not result in permafrost degradation.	No Linkage	Landfill will be managed and operated within the waste rock storage facility. Permafrost will aggrade into the waste rock facility over time.
35	Mine Site Decommissioning	Closure		X			Flooding of pit at closure has the potential to increase the size of the existing talik below Whale Tail Pit. The talik may be closed, or it may be open, depending on the depth of the pit and the size of the pit lake that is formed.	Monitor pit lake water chemistry and temperature.	Primary	See Section 5.3.3.1
36	Mine Site Decommissioning	Closure	X	X			Demolition and removal of mine infrastructure: Physical gain of terrain and permafrost within the structural fills used to construct project components.	Following an approved Closure and Reclamation Plan, use appropriate demolition methods to remove mine site facilities and to render infrastructure impassible.	No Linkage	Building components (concrete, steel) will be dismantled once mining ceases.
37	Mine Site Decommissioning	Closure		X			Ponding of water adjacent to facilities and infrastructure may degrade permafrost.	Water management and appropriate drainage and diversion around facilities; infrastructure graded to promote site drainage. Adherence to an approved closure and reclamation plan at the time of closure.	No Linkage	Covered by Environmental Design Features and Mitigation
38	Mine Site Decommissioning	Closure		X	X		Ponding of water adjacent to site roads may degrade permafrost. Sediment and contaminant releases during removal of culverts can affect downstream soil and permafrost	Roads will be scarified, and water barred to promote drainage of water and limit ponding. Where possible, in-stream work will be limited to when watercourses are not flowing for ephemeral watercourses or when watercourses are frozen.	No Linkage	Site roads and the main haul road will be decommissioned
39	Mine Site Decommissioning	Closure		X	X		Ripping of road surface and slopes can result in dust emissions and affect down-wind soil and terrain.	Minimize activity using appropriate equipment and re-establish drainage paths and promote permafrost re-equilibration within the decommissioned road bed. Make road surfaces impassable by vehicular traffic.	No Linkage	Environmental Design Features and Mitigation negate the link to permafrost and soils.
41	Mine Site Decommissioning	Closure		X	X	X	Residual ground disturbance can cause permanent loss and alteration of permafrost and soil	Limited Project footprint size. Implement a Closure and Reclamation Plan.	Primary	See Section 5.3.3.1 and 5.4
42	Mine Site Decommissioning	Closure			X	X	Long-term seepage from the facilities can change groundwater and surface water quality, which can affect soils and vegetation	Water quality will be monitored on site until it meets approved criteria for release. Landfill will be covered with waste rock pile and the waste rock pile will be monitored and water will be treated until it meets approved criteria for release to the natural environment. Implement an approved Closure and Reclamation Plan.	Secondary	Changes to ground water quality associated with long-term seepage from facilities could affect soil and vegetation quantity and quality. Techniques to minimize the potential seepage will be implemented, including maintaining activity at the sewage treatment plant for an initial period during decommissioning, capping the landfill with waste rock, and the implementation of the Closure and Reclamation Plan.

Table 3-C-3: Potential Pathway for Terrestrial Wildlife and Birds

Project Phase	Valued Components							Effects Pathways	Environmental Design Features and Mitigation	Rational
	caribou	muskox	predatory mammals	raptors	water birds	upland birds	small mammals			
Construction, Operations	P	S	S	S	S	P	S	Direct loss and fragmentation of wildlife habitat from the Project footprint	Compact arrangement of Project infrastructure to reduce the overall project footprint. Where possible, clearing of vegetation would take place outside the migratory bird breeding season Design roads as low and narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. See the Whale Tail Haul Road Management Plan for additional details Surveys of proposed granular sources for dens and nests will take place prior to construction. Detailed mitigation and monitoring is provided in the TEMP.	Primary for caribou and upland birds and assessed in Section 5.5.7. This pathway is secondary for muskox, predatory mammals, raptors, water birds, and small mammals because their low population density and low percentage of habitat lost compared to the available habitat.
Construction, Operations	P	S	S	N	N	N	S	Barriers to migration, which may affect population connectivity and distribution	Wildlife will have the right-of-way and vehicle traffic will be minimized according to the TEMP. Maximum speed limits of 50 km/hr will be enforced. Wildlife log will be maintained. Roads will have low profiles to avoid barriers. Detailed mitigation is provided in the Whale Tail Haul Road Management Plan. Both mitigation and monitoring are provided in the TEMP.	Primary for caribou and assessed in Section 5.5.7. This pathway does not have linkage to birds, as their movement is not restricted by roads, or small mammals as they will experience habitat loss but not barriers to movement. This is assessed as a secondary pathway for muskox as they are non-migratory and are in low abundance, predatory mammals who have large seasonal movements but low abundance and their use of the existing AWAR as a travel corridor has led to few mortalities (Gebauer et al. 2015).
Construction, Operations, Closure, Post-closure	S	S	S	N	N	N	S	Physical hazards, causing injury or mortality to individual animals, can affect population sizes	Wildlife will have the right-of way. Traffic speeds will be enforced (maximum of 50 km/h on the haul road). When caribou are observed near the road or mine speed limits will be reduced to 30km/hr in that area. All employees will be provided with wildlife environmental awareness training. Drivers will be alerted when caribou are observed near the haul road. The presence of wildlife will be monitored and communicated to site personnel. Report all mine related injuries and mortalities. Detailed mitigation is included in the Whale Tail Haul Road Management Plan, and TEMP. Littering and feeding of wildlife will be prohibited Removal of physical hazards at closure and post-closure will be consistent with Meadowbank Mine and a new Interim Closure Plan for Whale Tail will be developed.	Pathway is assessed as no linkage for birds and secondary for caribou and muskox, predatory and small mammals because a few mortalities have occurred at Meadowbank Mine . No caribou or muskox have been killed at the Meadowbank Mine as a result of mining activity and none are expected at the Whale Tail Pit. Caribou have been killed on the AWAR but adaptive management has reduced the hazard from vehicle collisions by closing the AWAR during peak migrations. The same approach will be applied to the haul road. Wolverine and wolf have been killed at the Meadowbank Mine but no clear pattern has emerged. Each incident is investigated, reported and adaptive management has been applied to reduce these incidents. Continued monitoring of wildlife activity on site and adaptive management of issues as they arise will continue to mitigate any effect to wildlife survival and reproduction.

Table 3-C-3: Potential Pathway for Terrestrial Wildlife and Birds

Project Phase	Valued Components							Effects Pathways	Environmental Design Features and Mitigation	Rational
	caribou	muskox	predatory mammals	raptors	water birds	upland birds	small mammals			
Construction, Operations	N	N	N	N	S	N	N	Fish-out may lead to diving water bird mortality in fish nets	Based on Agnico Eagle experience at Meadowbank Mine fish-out water bird mortalities have not occurred and will continue to use same consistent practices	Water bird mortalities that result from the fish-out will be reported to Environment Canada (EC). While some mortalities are likely, they will be limited to the fish-out lakes. Thus, there may be local effects to water bird survival and reproduction due to drowning in fish nets and removal of the fish resource.
Construction, Operations	N	N	N	N	P	P	N	Destruction of nests and flooding from construction activities including increased flows or water levels can increase risk of mortality to individual birds, which can affect population sizes	Land will be cleared outside the breeding season (June 1 to August 1) Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms. Mitigation to reduce impacts to nesting birds will be discussed with Environment Canada. Detailed mitigation is included in the TEMP and Water Quality Monitoring and Management Plan for Dike Construction Dewatering.	Primary for water birds and upland birds and assessed in Section 5.5.7. No linkage for other VCs that don't nest on ground. Volume 6, Appendix 6-F provides the anticipated flooding area and schedule during the Whale Tail Lake (South Basin) and Northeast diversions. Results are also presented for the migratory bird nesting season (May 17 to August 15). Volume 6, Table 6-F-1 provides the total flooded and flooded terrestrial areas for bird nesting months of May, June, July, and August, during the diversion, at the start of each month.
Construction, Operations, Closure, Post-closure	S	S	N	N	S	S	S	Dust deposition may cover vegetation, change the amount of different quality habitats, and alter movement and behaviour	The following environmental design and mitigation features will lessen the effects of haul road traffic on air quality: • Watering of roads and enforcing speed limits to suppress dust production. • Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase. • Regular maintenance will be implemented for equipment and vehicles. • Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the TEMP). • Enforcing speed limits and limiting access to haul road to public (less traffic) will assist in reducing dust. • Scheduling of construction work in winter where possible. • Detailed mitigation is provided in the Whale Tail Haul Road Management Plan and TEMP.	While IQ suggests that behaviour of caribou has changed. Anticipated effects to vegetation from dust are assessed in Section 5.4.3. Pathway is assessed as no linkage for herbivores and carnivores. Dust levels are expected to be similar to levels at Meadowbank Mine. Herbivores are still present next to Meadowbank Mine. Changes to vegetation quality is anticipated to be minimal. , there have been no observed changes in soil/plant metal concentrations from the Wildlife Screening Level Risk Assessment that examined impacts of dust, therefore changes to wildlife are expected to be minimal.

Table 3-C-3: Potential Pathway for Terrestrial Wildlife and Birds

Project Phase	Valued Components: caribou	muskox	predatory mammals	raptors	water birds	upland birds	small mammals	Effects Pathways	Environmental Design Features and Mitigation	Rational
Construction, Operations, Closure	S	S	N	N	S	S	S	Use of fuels, oils and chemicals can lead to spills which can affect surface water quality, soils, vegetation, wildlife through exposure to toxins	All spills will be immediately reported, cleaned up and/or isolated from the receiving environment. Ready access to emergency spill kits. Regular maintenance of equipment to reduce oil leakage. Training in refueling procedures for site staff. Hazardous materials and fuel will be stored according to regulatory requirements. Detailed mitigation is provided in the Emergency Response Plan, Hazardous Materials Management Plan, Whale Tail Haul Road Management Plan and Spill Contingency Plan.	Assessed as a secondary to herbivores, as they ingest plants and soil and no linkage to carnivores. Adherence to management plans is expected to result in a low frequency and severity of spills, as has occurred at the Meadowbank Mine. Spills of fuel and oil have occurred at Meadowbank, but response has been quick and clean-up has occurred with negligible to minor, reversible short-term environmental impact, requiring minor remediation. There has never been a spill at Meadowbank resulting in moderate to serious environmental impact (Agnico Eagle 2011a).
Construction, Operations, Closure	P	S	S	S	S	P	S	Sensory disturbance from Project activities can change the amount of different quality habitats, and alter wildlife movement, migration and behaviour	When caribou are observed near the road or mine speed limits will be reduced to 30km/hr in that area All employees will be provided with wildlife environmental awareness training. Traffic speeds will be enforced (i.e., maximum of 50 km/h on the haul road). Employees will be notified when caribou, muskox and predatory mammals are observed in the local study area. Wildlife provided the right-of-way Detailed mitigation is provided in the Noise Monitoring and Abatement Plan, Whale Tail Haul Road Management Plan and TEMP.	Primary for caribou and muskox and upland birds and assessed in Section 5.5.7. Noise and vibration from the Project will be similar to Meadowbank Mine and confined to the RSA. Noise levels and vibrations from the Project will decay to background levels within 8 km. Small mammals and raptors readily habituate to mine-related activities while water birds occur in low densities on the landscape that measureable impacts are not anticipated. Monitoring at Meadowbank Mine indicates that predatory mammals do not avoid the Mine and will habituate to it when attractants are present. With mitigation of attractants, very few predatory mammals will be attracted to the Project.
Construction, Operations, Closure, Post-closure	S	S	S	S	S	S	S	Improved access for harvesting wildlife can affect population sizes	Enforce no hunting, trapping, harvesting or fishing policy for employees and contractors. Hunter harvest survey, consistent with the Meadowbank Mine will continue. Access to the Project will be controlled (gated at Meadowbank); Restricting public vehicle access beyond km 85 of Meadowbank All-weather Access Road. All efforts will be made to enforce a no shooting zone for the public along the road and around the Project site. All roads will be decommissioned and scarified during closure Detailed mitigation is provided in the Whale Tail Haul Road Management Plan, Interim Closure Plan and Reclamation Plan and TEMP.	No caribou calving grounds are found within the Project RSA but caribou are seasonally present. Muskox harvest numbers in the Baker Lake area are limited by a quota (Agnico Eagle 2014), but muskox seem to have a general aversion to the Meadowbank AWAR (Agnico Eagle 2013); therefore, the presence of the haul road is thought to have little effect on muskox hunting patterns. Grizzly bears are often hunted because of a perceived or real threat to security, while wolves and Arctic foxes have been hunted for their fur (Agnico Eagle 2014). Restricted access to the haul road, the overland distance from the AWAR and the northern cost of fuel, is likely to make hunting difficult in this area and generally cost prohibitive. Residents of Baker Lake already have good access to RSA across land by snowmobile and ATV.

Table 3-C-3: Potential Pathway for Terrestrial Wildlife and Birds

Project Phase	Valued Components							Effects Pathways	Environmental Design Features and Mitigation	Rational
	caribou	muskox	predatory mammals	raptors	water birds	upland birds	small mammals			
Construction, Operations, Closure, Post-closure	N	N	S	N	S	N	N	Attractants may increase human-carnivore interactions and removal of individual animals which can affect wildlife population sizes	Littering and feeding of wildlife will be prohibited. Education and reinforcement of proper waste management practices to all workers and visitors to the site. Education on the risk associated with feeding wildlife and careless disposal of food wastes and liquids such as coffee and juices. Inspection of waste streams to ensure no attractants to predatory mammals. Food-related waste will be incinerated on a daily basis and general waste will be sent to the landfill and buried. All buildings will be skirted to the ground to limit opportunities for shelter. Detailed mitigation and monitoring is described in the TEMP.	Secondary for predatory mammals and upland birds. Learnings from Meadowbank Mine, and continual improvement through the mitigation and adaptive management processes described in the TEMP, and Wildlife Protection and Response Plan, should limit availability of attractants at the Project.
Construction, Operation, Closure	N	N	N	S	S	S	N	Attraction of birds to Project facilities and infrastructure for roosting and nesting sites can affect mortality and productivity	Monitoring for bird nesting activity, including inspection of pit walls for Peregrine Falcon nests. Discharge raptors from establishing nests on artificial structures, pit walls, or other facilities. Detailed mitigation is described in the TEMP.	Mines tend to create nesting habitat in quarries and pits for raptors (Gebauer et al. 2015; ERM 2015). Nesting on pit walls has become so common at Ekati that a monitoring program has been implemented. Monitoring of infrastructure and Project facilities for bird pre-nesting behaviour and the implementation of deterrents or limiting activities around nests that are deemed to be in a safe location are likely to limit effects on bird survival or productivity. When an established nest is found, the location is communicated to employees and a nest-specific management plan is developed.
Operations, Closure, Post-closure	N	N	N	N	S	N	N	Use of water management facilities may increase bird mortality through exposure to contaminants and impact water bird health	Attenuation Pond will be monitored for use by water birds as part of the TEMP. Deterrents will be used if required. Attenuation Ponds will be monitored for water quality. Detailed mitigation is described in the Water Management Plan and TEMP.	Monitoring of infrastructure and Project facilities for water bird pre-nesting behaviour and the implementation of deterrents or limiting activities around nests that are deemed to be in a safe location are likely to limit effects on water bird survival or productivity. When an established nest is found, the location is communicated to employees and a nest-specific management plan is developed. A screening-level wildlife risk assessment was completed to investigate the risk to wildlife of dietary ingestion of contaminants present in the environment and released by Meadowbank Mine. The screening found that overall the Mine does not appear to be contributing excess risk to wildlife via the uptake of chemicals (AEM 2015b). Similar results are expected for the Project.

Table 3-C-3: Potential Pathway for Terrestrial Wildlife and Birds

Project Phase	Valued Components							Effects Pathways	Environmental Design Features and Mitigation	Rational
	caribou	muskox	predatory mammals	raptors	water birds	upland birds	small mammals			
Operations, Closure, Post-closure	S	S	N	N	S	S	S	Uptake of metals by wildlife through ingestion of tailings, dust or leachate can affect health of individual animals, which can affect wildlife population sizes and wildlife health	If deemed necessary through monitoring, dust from roads will be managed through use of dust suppressants and enforcing speed limits and through other dust mitigation measures described above. Processing of ore will be done at Meadowbank Mine. Hazardous materials will be transported back to Meadowbank Mine for proper disposal. Any PAG or high metal leaching waste rock will be segregated at source and placed into designated areas within waste rock storage facilities to control acid generating reactions and the migration of contaminants. Leachate from the waste rock piles will be monitored and controlled and not released to the natural environment. Detailed mitigation is provided in the Operational ARD-ML Sampling and Testing Plan, Landfarm Design and Management Plan, Landfill Design and Management Plan, and Mine Waste Rock and Tailings Management Plan, Air Quality and Dustfall Monitoring Plan, Whale Tail Haul Road Management Plan, Water Management Plan, AEMP, CREMP and the TEMP.	Secondary for VCs that may ingest vegetation or soil. No linkage to carnivores. A screening-level wildlife risk assessment was completed to investigate the risk to wildlife of dietary ingestion of contaminants present in the environment and released by the mine. The screening found that overall the Mine does not appear to be contributing excess risk to wildlife via the uptake of chemicals (AEM 2015b). There will be no tailings generated at the Project as all ore will be processed at the Meadowbank Mine.
Construction, Operation, Closure, Post closure	S	S	N	N	S	S	S	Cross-drainage structures for the mine site roads, and access road may alter stream hydraulics and geomorphology, and can alter wildlife habitat	Regular inspection of the road to identify any areas where ponding of water along the road represents a risk. Cross-drainage structures will be designed for a 1:10 year precipitation event or to meet DFO requirements for fish passage to avoid creating hydraulic barriers. Where deemed appropriate, use of staggered culvert configuration, and removal of snow at the culvert inlet and outlet prior to the freshet to promote drainage during spring thaw and freshet. Roads will be scarified and cross drainage structures will be removed at closure. Detailed mitigation is provided in the Water Quality and Flow Monitoring Plan, TEMP and Water Management Plan.	Secondary for VCs that may ingest vegetation or soil. No linkage to carnivores. The implementation of appropriate cross-drainage structures is expected to result in minor changes to stream flow velocity in the vicinity of the structures relative to baseline conditions and have negligible residual effects on soil, vegetation and wildlife habitat. The cross-drainage structures will be removed at closure and natural flows will be re-established. Thus, the effects on soil, vegetation and wildlife habitat from the alteration of stream flow are expected to have a negligible effect on wildlife habitat quantity or quality.

Table 3-C-3: Potential Pathway for Terrestrial Wildlife and Birds

Project Phase	Valued Components							Effects Pathways	Environmental Design Features and Mitigation	Rational
	caribou	muskox	predatory mammals	raptors	water birds	upland birds	small mammals			
Construction, Operations, Closure	S	S	N	N	S	S	S	Surface water runoff, seepage from the core mine facilities area and effluent can affect surface water quality, soil, vegetation, wildlife habitat	The Type A Water Licence will dictate the water quality requirements prior to release to the environment. Contact water will be managed on-site in accordance with the Water Management Plan. This water will be monitored for quality and if necessary transferred to the mine attenuation pond before discharge. Water collected from the open pit will be pumped to the attenuation pond where it will be treated prior to release. Granular materials will be tested before they are used to confirm that they are not potential acid draining or potential sources of metal leaching. Detailed mitigation is described in the Water Quality and Flow Monitoring Plan, AEMP, CREMP, TEMP, Operational ARD-ML Sampling and Testing Plan, and Water Management Plan for additional mitigation.	Secondary for VCs that may ingest vegetation or soil. No linkage to carnivores. Monitoring of sediment chemistry, limnology, dust, water chemistry, phytoplankton and benthic invertebrates to mitigate effects to the receiving aquatic environment. Further, surface runoff and seepage will be intercepted in diversion ditches and treated prior to release to the environment, and water releases will be within the limits dictated by the water licence. Any effects to the receiving environment will be confined to the area surrounding or downstream of the Project.

N = no linkage; S = secondary; P = primary

Table 3-C-4: Potential Pathway for Hydrogeology and Groundwater

	Project Activity	Project Phase	Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	Lake	Construction, Operations and Closure	Groundwater quantity	Groundwater flow from un-dewatered lakes may be increased because of higher gradients towards dewatered lakes. May lower water levels in un-dewatered lakes	None	Secondary	Groundwater quantity is assessed and discussed in Volume 6, Section 6.2. Surface water quantity is assessed and discussed in Volume 6, Section 6.3. Potential changes in groundwater regimes in lakes in local watersheds are expected to be negligible compared to surface water discharge regimes, resulting in negligible effects to surface water levels.
2	Lake	Construction, Operations and Closure	Groundwater quantity	Groundwater flow from dewatered lakes may be reduced thereby reducing the flow to nearby un-dewatered lakes, thereby lowering water levels in those nearby lakes	None	Secondary	Groundwater quantity is assessed and discussed in Volume 6, Section 6.2. Surface water quantity is assessed and discussed in Volume 6, Section 6.3. Potential changes in groundwater regimes in lakes in local watersheds are expected to be negligible compared to surface water discharge regimes, resulting in negligible effects to surface water levels.
3	Open Pit	Closure	Groundwater quantity	Open pit may alter thermal regime and may produce an open talik below the pit were none existed. The presence of an open talik may alter the regional groundwater flow directions.	None	Secondary	Static water levels will develop following closure that will reproduce the current regional groundwater flow conditions.
4		Closure	Groundwater quality	Groundwater quality in pit lake may migrate through groundwater to downstream lakes if the gradient allows it. If the flow is high relative to the turn over rate of the receiving Lake, it could alter surface water chemistry	None	Secondary	Groundwater flow from Whale Tail pit lake is predicted to take over 1000 years to reach DS1 (groundwater discharge zone for pit lake). This pathway is considered to have a minor linkage to hydrogeology.
5	Mine Site Operations and Maintenance	Construction, Operation, Closure	Groundwater quality	Potential impacts on groundwater quality in relation to site waste management activities other than waste rock, including: handling and landfilling of waste; handling of contaminated ice, snow and/or soil; the management of historical contaminated material (e.g., previous spills, mishaps, releases, etc.), and sewage effluent	A Water Management Plan has been developed and describes the containment and management of contact water on-site designed to prevent impacts to site water quality. Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds where water quality will be monitored and treated if necessary prior to discharge.	No Linkage	All contact water will be managed on site and will not be released into the natural environment unless it meets Type A Water Licence criteria. It is not anticipated that the contact water on site would interact with groundwater.
6	Site Water Management along the road (seepage and runoff)	Construction, Operation	Groundwater quality		Roads constructed on permafrost, which provides a barrier to downward flow of poor quality water to the deep groundwater regime. Use of non-acid generating material at any watercourse crossings. Testing will verify low potential for acid rock drainage and metal leaching. Testing will continue on new sources identified for road building. Current testing practices at Meadowbank Mine are effective at identifying non PAG rock for construction. Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation and will limit disturbance of lakes from activities. In-stream works will be constructed in winter, when possible, to avoid increased TSS and turbidity, and changes to water and sediment quality. Regular road inspections to check for ponding. Proposed roads will be as narrow as possible, while maintaining safe construction and operating practices.	Secondary	To minimize disturbance to watercourses, construction and decommissioning activities at the watercourse crossings will mostly occur during winter when the streams are frozen or are not flowing. If construction or decommissioning activities are required during open water season, then the Fisheries and Oceans Canada (DFO) timing windows for in-water work will be followed. Any equipment used in the stream will be clean and inspected for leaks. These procedures will minimize the potential for erosion, sediment releases, and introduction of contaminants into the receiving streams. Standard erosion and sediment control measures (e.g., erosion mats, silt curtains) will be used. Roads and most of the infrastructure will be constructed on top of permafrost that will act as a barrier to downward migration of water to the deep groundwater regime.
7	Waste Rock Storage Areas and Stockpiles	Operations, Closure	Groundwater quality	Seepage from waste rock storage facilities could result in changes to groundwater quality, which flow to surface water.	Waste rock storage facility is located above permafrost or lakes with closed taliks (i.e., unfrozen ground does not extend to groundwater regime beneath permafrost). A Water Management Plan has been developed and describes the containment and management of contact water on-site. Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds (and treated if required) prior to release to Mammoth Lake. Potential acid generating rock and metal leaching waste rock will be placed into designated areas within waste rock storage facility.	Secondary	Waste rock storage facilities are located above permafrost or lakes with closed taliks (unfrozen ground does not extend to groundwater regime beneath permafrost). During operations seepage will be collected and tre ated , if necessary. At some point during closure, it is predicted that water treatment will no longer be required, at which time, all components of the water treatment facilities will be decommissioned. Groundwater inflow to the southern portion of Whale Tail Lake will occur from Lake A60 to the southeast. Hydraulic gradients following closure were used to estimate groundwater travel times from the Whale Tail Lake and the open pit to DS1. Based on the shortest travel time, water from Whale Tail Lake or the open pit was predicted to take over 1,000 years to reach Lake DS1. Consequently negligible effects to groundwater are predicted.

Table 3-C-4: Potential Pathway for Hydrogeology and Groundwater

	Project Activity	Project Phase	Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
8	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction, Operation, Closure	Water Quality	Spills and leaks during equipment operation may affect groundwater quality, which may affect surface water quality.	Permafrost will provide a barrier for downward flow of poor quality water to the deep groundwater regime.	No Linkage	Based on Agnico Eagle's experience at Meadowbank, accidental spills (e.g., fuel) have occurred but most of the spill volumes have been small and clean-up has occurred with only minor effects to the environment (Agnico Eagle 2015). Between 2011 and 2015 , 63 reportable spills were reported to the GN spill hot line. In 2015 there were 4 spills greater than 900 L at Meadowbank. In 2015 spill training was provided to employees. All spills are managed appropriately on site in accordance with Agnico Eagle's Spill Contingency Plan and there was no off site impact to any watercourses as a result of spills in 2015. In NIRB's 2011 annual report (NIRB 2011), it was noted that Meadowbank was kept in an impressively clean state with no apparent spills on location. It is anticipated the Meadowbank will continue to manage spills in the same manner and only minor and/or temporary impact are predicted to surface water. In addition, most of the equipment will be operated on top of continuous permafrost that will inhibit the downward movement of spills and leaks. Spills will be isolated to the active layer and direct spills to open taliks are not expected to occur. Therefore, impacts are not predicted to groundwater quality.
					The Emergency Response and Spill Contingency Plan will be implemented, including ready access to an emergency spill clean-up kit for cleaning up any spills.		
					Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Materials and Waste Management Plan).		
					Storage tanks (e.g., fuel, engine oil, hydraulic oil, and waste oil and coolant) will be double walled, or located in lined and bermed containment areas.		
					Hazardous wastes will be temporarily stored at the Whale Tail Pit site and transported to the Meadowbank Mine in appropriate containers to prevent exposure until they are shipped off site to an approved facility.		
					Individuals working on site and handling hazardous materials will be given appropriate training (e.g. WHMIS).		
					Soils from petroleum spill areas will be deposited at the Meadowbank Mine.		
					Equipment will be re-fueled, serviced, or washed away from the watercourse crossings.		
					Fuel, lubricants, hydraulic fluids, and other chemicals will be stored at least 31 m away from the high water mark of any waterbody, and in areas where any spillage can be contained.		
					Construction equipment will be regularly maintained.		
					As deemed feasible, construction of the roads will occur in the winter, so there would be opportunity to clean up any spills prior to spring thaw.		
					Drivers will be appropriately qualified and cautioned.		
					Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred.		
					Enforced speed limits.		

Table 3-C-5: Potential Pathway for Surface Water Quantity

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	Mine Infrastructure Footprint (e.g. open pits, site roads, access roads)	Construction, Operations, Closure	Project footprint, which will physically alter watershed areas and drainage patterns, may change downstream discharge, water levels, and channel/bank stability in streams, and affect water quality, fish habitat, and fish	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Access roads will be as narrow as possible, while maintaining safe construction and operation practices. Best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management), where needed.	Primary	Section 6.3.3.1
2	Site Water Management: Dewatering of Project Footprint Lakes to Downstream Receiving Lakes	Construction, Operations	Dewatering of lakes may change discharges, water levels, and channel/bank stability in receiving and downstream waterbodies, and affect water quality, fish and fish habitat	Pumped discharge will be directed to the lake environment, and not directly to outlets, to attenuate flow changes.	Primary	Section 6.3.3.1
			Dewatering of lakes may result in ice damming and alter flow pathways	If feasible, pumped discharge to the receiving environment will cease during the winter.	Secondary	Project lakes do not flow during the winter and the dewatering schedule was developed to mitigate potential effects. See Water Management Plan Section 4.4.2.
3	Site Water Management: Watershed Modification by Diversion of Water	Construction, Operations	Alteration of watershed flow paths may change flows, water levels, and channel/bank stability in diverted and receiving waterbodies, and affect water quantity, water quality, fish and fish habitat	Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.	Primary	Section 6.3.3.1
4	General construction and operation of the proposed exploration access road	Construction, Operations	Cross-drainage structures for the roads may alter stream hydraulics and geomorphology	Cross-drainage structures will be designed for a 1:10 year precipitation event or to meet DFO requirements for fish passage to avoid creating hydraulic barriers. Rock aprons at culvert inlets and outlets will provide erosion protection and prevent localized erosion from concentrated high velocity flows above the peak 1:10 year rainfall event.	Secondary	Cross-drainage structures provide a design conveyance for the 1:10 year event without overtopping the roadway, which will result in minor changes in stream velocity (preventing channel aggradation, degradation, erosion, or changes in bankfull width or depth). The implementation of appropriate cross-drainage structures is expected to result in minor changes to stream flow velocity in the vicinity of the structures relative to baseline conditions and have negligible residual effects on water quantity. Cross-drainage structures will be implemented to provide sufficiently low flow velocity such that spawning Arctic grayling, which may use watercourses crossed by the exploration access road for spawning or as a migration corridor, can navigate the structure under a specified design flow condition (i.e., 3-day delay; 1:10 year return flood condition). See Section 6.5.3 for an assessment of impacts to Artic Grayling.

Table 3-C-5: Potential Pathway for Surface Water Quantity

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
5		Construction, Operations	Freezing and plugging of culverts in the winter may result in over-topping and erosion of road surface releasing silt onto terrain and soils; ponding of water adjacent to road flanks; potential instability and thaw settlement of road shoulders; thaw settlement beneath and adjacent to culverts; inadequate drainage during spring thaw and freshet, and ice lens growth.	Where deemed appropriate, use of staggered culvert configuration, and removal of snow at the culvert inlet and outlet prior to the freshet to promote drainage during spring thaw and freshet. Inspection prior to spring melt period to identify build-up of snow or ice, and take remedial action. Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or drains to alleviate the risk.	Secondary	The use of a staggered culvert configuration and regular inspection of the road will alleviate the risk of freezing and plugging of culverts.
6		Construction, Operations	Cross-drainage structures for the roads may prevent navigability	Although none of the crossings along the haul road are considered navigable by TC, cross-drainage structures will be designed to allow navigation (i.e., bridge) for future crossings that may be deemed navigable waters by TC. Regular inspections will be completed	Secondary	Cross-drainage structures for crossings with navigable waters will be designed in accordance to Transportation Association of Canada (TAC 2004) with a minimum freeboard of 1.0 m over the peak flow elevation and will not impede navigability. Traditional travel routes identified in Volume 7 Appendix 7-A will not be impacted.
7	Existing Meadowbank Infrastructure	Operations, Closure	Additional 3 years of processing and use of supporting infrastructure at the Meadowbank mine site and the existing AWAR for delivery of materials	No discharge at the Meadowbank Mine to the freshwater environment from processing. No additional footprint required Adherence to the water quality and flow monitoring plan. Adherence to the existing Water Management Plan	No Linkage	There is no discharge to the outside environment. All process water will pumped to existing open pits at the Meadowbank Mine Site. Subsequently there are no changes expected to the hydrology around the Meadowbank site or road.
8	Open Pits	Operations, Closure	Removal of bedrock and ore material during the active mining of pits may change shallow groundwater quantity in local watersheds, and the water level in small waterbodies in local watersheds	Mined-out pit flooding will be augmented by active fresh water diversion active flooding will reduce the period required to flood the pits, and the period of time with increased hydraulic gradients between waterbodies.	Secondary	Groundwater quantity is assessed and discussed in Volume 6, Section 6.2. Potential changes in groundwater regimes in lakes in local watersheds are expected to be negligible compared to surface water discharge regimes, resulting in negligible effects to water levels.

Table 3-C-6: Potential Pathway for Surface Water Quality

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	Whale Tail Pit Infrastructure Footprint (e.g. open pits, site roads, access roads)	Operations, Closure	Water quality	Project footprint, which will physically alter watershed areas and drainage patterns, rates and quantities of diverted non-contact water to new watersheds, change downstream flows through flooding and dewatering, water levels, channel/bank stability in streams, and disturb lakes and may affect water quality and sediment quality	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation and will limit disturbance of lakes from activities. Access roads will be as narrow as possible, while maintaining safe construction and operation practices. Minimum haul road widths will follow that defined under the *Mine Health and Safety Act's* Erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed. Minimum setback distance of 31 m from the ordinary high water mark of waterbodies. Regular road inspections to check for ponding. To reduce the potential for erosion in channels due to higher than normal water flows and levels, natural drainage courses have been surveyed to evaluate capacity. Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms. A water management plan has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas. Monitoring during activities and use of adaptive management where necessary. Pumped water from the dewatered waterbodies will be directed through properly designed structures to the lake environment, and not to lake outlets, to prevent erosion in the receiving waterbodies and to attenuate flows. During dewatering activities, TSS will be monitored, and if necessary, treated before release downstream.	Primary	See Section 6.4.3.2
2	Site Water Management (drainage and diversions)		Water Quality	Water management activities (dams, drainage, diversion, discharge, and dewatering) that will alter natural drainage paths and create a reservoir may cause a change in mercury cycling and bioaccumulation	A Water Management Plan has been developed and describes designs to reduce changes to local flows, drainage patterns, and drainage areas. Water that does not meet discharge criteria will be treated prior to discharge into Mammoth Lake. Use of turbidity curtains during dike construction to limit disturbance to lakes and waterbodies Monitoring during activities and use of adaptive management where necessary. Use of the Dewatering Dikes, Operations, Maintenance and Surveillance Manual developed by Agnico Eagle.	Primary	See Section 6.4.3.2
3	Earthworks: Drilling, blasting and excavation (includes Quarry/Borrow Pit) and Crushing activities for the haul road and Whale Tail Pit development	Construction, Operation	Water quality	Surface water drainage through quarries and transport of blasting residuals and metals directly into watercourses can disturb lakes and affect surface water and sediment quality	Where possible, stockpiling of rock and fill from quarries and borrow sites will be placed such that surface water is not diverted through the piles with runoff to surface waterbodies; drainage from quarries will not flow directly into any waterbodies or watercourses. When there is seepage from a quarry that could enter a waterbody, a water quality sample will be collected and analyzed. Quarries will be inspected on a regular basis to monitor water ponding, particularly at spring melt. Best management practices for erosion and sediment control.	Secondary	Using environmental design features and best practices, water from the quarries, which would be located at least 31 m from the high water mark for any waterbody, should not drain directly to waterbodies and thus there should be negligible effects to water quality and limit disturbance to lakes. Disturbance of lakes was specifically identified as a concern through IQ. Quarries will be inspected on a regular basis to identify any areas of water ponding, particularly during spring freshet. Management of the water in quarries will be managed according to the Whale Tail Haul Road Management Plan (Volume 8 Appendix 8-C.1). If there is noticeable flow from a quarry that could enter a waterbody, a water quality sample will be collected. Samples and results will be reported in the annual NWB report.
4	Site Water Management along the road (seepage and runoff)	Construction, Operation	Water quality	Release of potentially acid generating materials from road building materials at the watercourse crossings can alter water and sediment quality	Use of non-acid generating material at any watercourse crossings. Testing will verify lack of acid rock drainage and metal leaching potential. Testing will continue on new sources identified for road building. Current testing practices at Meadowbank Mine are effective at identifying non PAG rock for construction. Road contact water will be monitored during construction.	Secondary	All esker samples tested from potential borrow sources show no potential to generate ARD and all release low concentrations of chemicals (within one order of magnitude of the CCME aquatic life criteria). The current waste rock monitoring program being followed by Agnico Eagle is effective at identifying non PAG waste rock mined at currently operating pits. Details are provided in the Evaluation of the Geochemical Properties of Waste Rock, Ore, Tailing, Overburden and Sediment from the Whale Tail Pit and Road Aggregate Materials (Volume 5, Appendix 5-E). Road and construction materials that are non PAG and non metal leaching should not cause a change in downstream water and sediment quality, and as such the residual effects on surface water and sediment quality are considered to be negligible.

Table 3-C-6: Potential Pathway for Surface Water Quality

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
5	Mining and supporting infrastructure for the Whale Tail Pit and haul road	Construction, Operation	Water quality	Activities from construction activities and mining operations (e.g., equipment, vehicles, buildings, open-pit mining, blasting) can create fugitive dust emissions and subsequent dust deposition may cause a change in water quality	Implement dust control measures, if needed on mine roads. Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase Enforcing speed limits (maximum speed 50 km/h) to suppress dust production. Design road as narrow as possible while maintaining safe construction practices; passing turnouts will be placed to accommodate multi-directional traffic. If deemed necessary through monitoring, dust from roads will be managed through use of dust suppressant. The running surface of the road will be maintained thereby reducing the generation of dust. Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the Terrestrial Ecosystem Management Plan) Most personnel arriving at or leaving the site will be transported by bus, thereby reducing the amount of traffic (and dust).	Primary	See Section 6.4.3.1
6	Mining and supporting infrastructure for the Whale Tail Pit and haul road	Construction, Operation	Water quality	Activities from construction activities and mining operations (e.g., equipment, vehicles, buildings, open-pit mining, blasting) can alter air and dust emissions (including Sulphur dioxide, nitrogen oxides, and particulate matter) and subsequent deposition may cause a change in water quality	Construction equipment and trucks will be equipped with industry-standard emission control systems. Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. SO_2 emissions from non-road vehicles and stationary equipment will be reduced through the use of low emission diesel fuel. Adherence to existing air quality monitoring plan to detect changes in air quality Adherence to water quality monitoring and adaptive management in the CREMP to detect changes in water quality	Primary	See Section 6.4.3.1
7	Dike Construction	Construction, Closure	Water Quality	Release of sediment during construction of the dike in Whale Tail Lake may cause changes in water quality, affecting fish and other aquatic life"	Erosion and sediment control measures will be implemented during dike construction, where appropriate (e.g., installation of silt curtains for turbidity control)" The dike will be constructed using non-potentially acid-generating rock or low potential for metal leaching material Adherence to the Water Quality Monitoring and Management Plan for Dike Construction and Dewatering, including installation of turbidity curtains and monitoring.	Secondary	Erosion and sediment control measures will be implemented (e.g., installation of silt curtains) for turbidity control. During summer construction, turbidity curtains will be installed near the portion of the alignment where dike construction will occur, which is an approach demonstrated at other northern mining projects and according to the Water Quality Monitoring and Management Plan for Dike Construction and Dewatering (Volume 8 Appendix 8-A.2). Enhanced TSS settlement is anticipated under-ice in the areas in close proximity to dike construction. Turbidity monitoring will be conducted at designated locations, consistent with the monitoring conducted at the Meadowbank Mine and presented in the Plan. Non-potentially acid generating, chemically inert material will be used to construct the dike to prevent leaching of metals into water. A closure plan will be developed, which will include management of dike breaching and removal activities to limit the potential for effects to water quality and fish and fish habitat. At closure, breaching and removal of sections of the dike will only occur when water quality within the diked area meets specifications in the Type A Water Licence. Through the described mitigation, the release of sediment from dike construction and breaching of the dike is expected to result in short-term, localized, and minor changes to water quality in the adjacent environment of the dike.
8	Development of Supporting Infrastructure for Whale Tail Pit and the haul road	Construction, Operation, Closure	Water quality	Sediment releases from infrastructure (including watercourse crossings), road construction, and decommissioning of the road can affect quality of nearby surface waters and sediments.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation and will limit disturbance of lakes from activities. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks), where needed to limit disturbance to lakes. In-stream works will be constructed in winter, when possible, to avoid increased TSS and turbidity, and changes to water and sediment quality. Where applicable, construction runoff will be captured and managed to minimize suspended solids. Regular road inspections to check for ponding. Proposed roads will be as narrow as possible, while maintaining safe construction and operating practices.	Secondary	To minimize disturbance to watercourses, as deemed feasible, construction and decommissioning activities at the watercourse crossings will mostly occur during winter when the streams are frozen or are not flowing. If construction or decommissioning activities are required during open water season, then the Fisheries and Oceans Canada (DFO) timing windows for in-water work will be followed. Any equipment used in the stream will be clean and inspected for leaks. These procedures will minimize the potential for erosion, sediment releases, and introduction of contamination. All construction and decommissioning activities will be subject to an erosion and sediment control plan, and best management practices will be used that include standard erosion and sediment control measures (e.g., erosion mats, silt curtains). Through the use of best management practices and monitoring, effects to water and sediment quality are expected to be minor; however, a water quality monitoring will be conducted to observe conditions.

Table 3-C-6: Potential Pathway for Surface Water Quality

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
9	Mine Site Operations and Maintenance, including the use of existing infrastructure at Meadowbank Mine and the haul road	Operation and Closure	Water quality	Runoff from mine site infrastructure and roads can affect surface water and sediment quality	Road cross fill (surface slope from road centre line to edge of road) and side slope designed to encourage drainage. Best management practices for erosion and sediment control (e.g., silt curtains, runoff management) will be implemented, as needed to limit disturbance to lakes. No changes to the existing footprint of the AWAR or the Meadowbank Mine. Water Management Plan is approved and adhered to at existing facilities and Water Management Plan specific to the Whale Tail Pit areas has been developed and these plans have considered the containment and management of contact site water Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds (and treated if required), prior to release. Water quality in attenuation ponds will be monitored and managed such that the discharge meets discharge limits. Any potentially acid generating (PAG) or high metal leaching waste rock will be segregated at source and placed into designated areas within the waste rock storage facility. Adherence to the Operational ARD/ML Testing and Sampling Plan and the Mine Waste Rock and Tailings Management Plan.	Secondary	Given the risk posed by contact water to change receiving environment water quality, and to disturb lakes, several environmental design features have been included to prevent release of untreated contact water into receiving waterbodies. A key environmental design feature during construction will be to adhere to the Operational ARD/ML Testing and Sampling Plan. (PAG) and NAG material should any PAG waste rock be found in continuing studies. Runoff and lateral seepage from the waste rock/overburden facilities will not be released directly to the environment during pre-production or operations. During the pre-production and operation phases, all surface water runoff from the areas of the mine facilities or that has been in contact with any mine facilities or processes will be captured through a series of collection ditches and sumps. Contact water from open pits will be pumped to the Attenuation Pond, along with surface water from the other facilities. Water collected at Attenuation Pond will either be used for pir road dust suppression or will be discharged as an effluent into Mammoth Lake through a diffuser. Any discharge will meet Type A Water Licence limits. During the closure phase, contact water will be treated to discharge limits and at some point during closure, treatment will no longer be required, and the water treatment facilities will be decommissioned, but all runoff will be required to meet discharge limits. Subsequently, changes to water quality from runoff are expected to be minor.
10	Construction and operation of roads	Construction, Operation	Water quality	Cross-drainage structures for the mine site roads may alter stream hydraulics and geomorphology, and alter water and sediment quality	Rock aprons at culvert inlets and outlets will provide erosion protection and prevent localized erosion from concentrated high velocity flows. Regular road inspections to check for ponding. Removal of snow at the culvert inlet prior to freshet.	Secondary	In most cases, cross-drainage structures provide a design conveyance for the 1:10 year event without overtopping the roadway, which will result in minor changes in stream velocity, preventing channel aggradation, degradation, erosion, or changes in bankfull width or depth. The implementation of appropriate cross-drainage structures is expected to result in minor changes to stream flow velocity in the vicinity of the structures relative to baseline conditions and have negligible residual effects on water quantity. To protect water and sediment quality, best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management) will be used, subsequently minor changes only are expected to water and sediment quality.
11	Development of Supporting Infrastructure for Whale Tail Pit and the haul road	Construction and operation of roads	Water quality	Freezing and plugging of culverts in the winter may result in over-topping and erosion of road surface releasing silt into watercourses during freshet and affect water and sediment quality	Where deemed appropriate, use of staggered culvert configuration to promote drainage during spring thaw and freshet. Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts to alleviate the risk.	Secondary	Overall, drainage from the road is a small component of total drainage in the area, and any contribution from the road and effects on water and sediment quality should be negligible. Where deemed approriate, the use of staggered culvert configuration and regular inspection of the road during operation will alleviate the risk of freezing and plugging of culverts, which could result in ponding and overflow, which in turn could increase erosion and input of sediment into watercourses. Removal of snow at the culvert inlet and outlet prior to the freshet will promote drainage during spring thaw and freshet.
12	Site Water management: Seepage and Runoff	Operation and Closure	Water quality	Vertical and lateral seepage from the waste rock storage facility may enter nearby waterbodies and change water and sediment quality (i.e., metal concentrations).	A Water Management Plan has been developed and describes the containment and management of contact water on-site. Seepage will be captured at sumps and diverted to the Attenuation Pond. All ponds collecting seepage will be designed to prevent release into the surrounding aquatic environment. Facility discharge water will be monitored for water quality, and treated as required, prior to discharge.	Secondary	Waste rock storage facilities are located above permafrost or lakes with closed taliks (unfrozen ground does not extend to groundwater regime beneath permafrost). During operations seepage will be collected and treated. At some point during closure, it is predicted that treatment will no longer be required, and, therefore, all components of the water treatment facilities will be decommissioned. Groundwater inflow to the southern portion of Whale Tail Lake will occur from Lake A60 to the southeast. Hydraulic gradients following closure were used to estimate groundwater travel times from the Whale Tail Lake and the open pit to DS1. Based on the shortest travel time, water from Whale Tail Lake or the open pit was predicted to take over 1,000 years to reach Lake DS1. Environmental design features and mitigations reduce the potential risk of contaminants entering surface water, subsequently effects to surface water quality and sediment quality are expected to be minor.

Table 3-C-6: Potential Pathway for Surface Water Quality

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
13	Site Water management: Seepage and Runoff	Operation	Water quality	Seepage of pore water though, or underneath, incompletely frozen dikes to adjacent watersheds may change water and sediment quality in local watersheds.	A Water Management Plan has been developed and describes containment and management of contact water on-site. The dikes will be designed and constructed to control seepage. Performance of the dikes will be monitored and appropriate remediation applied, if required.	Secondary	Waste rock that meets the requirements for building material will be crushed, screened, and used for the construction of dikes, foundations, laydown pads, and roads. There is potential for arsenic as well as other parameters (i.e., chloride, fluoride, cadmium, lead, and selenium) to be present in the waste rock leachate. Waste rock used for construction will be analyzed and segerated according to the OPertaional ARD/ML Testing and Sampling Plan. Runoff will be monitored and remediation at closure will be employed, if required. Therefore, changes to water and sediment quality are expected to be minor.
14	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction , Operation, Closure	Water quality	Spills and leaks from equipment or accidents can affect surface water and sediment quality	The Spill Contingency Plan will be implemented, including ready access to an emergency spill clean-up kit for cleaning up any spills. Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers and will be stored at the Meadowbank Mine. Storage tanks (e.g., fuel, engine oil, hydraulic oil, and waste oil and coolant) will be double walled, or located in lined and bermed containment areas. Hazardous wastes will be temporarily stored at Whale Tail Pit and then transported to the Meadowbank Mine in appropriate containers to prevent exposure until they are shipped off site to an approved facility. Individuals working on site and handling hazardous materials will have appropriate training (e.g. WHMIS) Soils from petroleum spill areas will be deposited at the Meadowbank Mine Landfarm Equipment will be re-fueled, serviced, or washed away from the watercourse crossings. Fuel, lubricants, hydraulic fluids, and other chemicals will be stored at least 31 m away from the high water mark of any waterbody. Construction equipment will be regularly maintained. Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred. Enforced speed limits.	Secondary	Based on Agnico Eagle's experience with the Meadowbank, accidental spills (e.g., fuel) have occurred, but most of the spill volumes have been small, and clean-up has occurred with only minor effects to the environment (Agnico Eagle 2015). Between 2011 and 2015 , 63 reportable spills were reported to the GN spill hot line. In 2015 there were 4 spills greater than 900 L at Meadowbank. In 2015 spill training was provided to employees. All spills are managed appropriately on site in accordance with Agnico Eagle's Spill Contingency Plan and there was no off site impact to any watercourses as a result of spills in 2015. In NIRB's 2011 annual report (NIRB 2011), it was noted that Meadowbank was kept in an impressively clean state with no apparent spills on location. It is anticipated the Meadowbank will continue to manage spills in the same manner and only minor impacts are predicted.
15	Mining Activities and Water Management	Construction, Operation, Closure	Water quality	Release of treated mine effluent (including sources from sewage, WRSF pond, and attenuation pond contact) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations) in Mammoth Lake in operations and closure.	A Water Management Plan has been developed and describes containment of contact water through the use of diversions, attenuation ponds, and treatment facilities during construction, operations, and closure. Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds. Treated sewage will be piped to the attenuation pond Water quality in attenuation ponds will be monitored and managed such that the discharge entering Mammoth Lake meets Type A Water Licence discharge limits. If water quality does not meet discharge limits, it will be circulated and re-treated. Other applicable design features and mitigation, as outlined in the Interim Closure and Reclamation Plan.	Primary	See Section 6.4.3
16	Water Management Infrastructure, including existing infrastructure that will be used the Meadowbank Mine site, the haul road, and the Whale Tail Pit	Construction, Operation, Closure	Water quality	Process and potable water use resulting in reduced water levels can affect water quality in Whale Tail Lake and Nemo Lake.	Manage pumping rates so total annual discharge from Whale Tail and Nemo Lake does not drop below the 10-year dry condition. Water withdrawal rate(s) will be controlled to avoid effects on the source water lake(s). Capture and reuse site water to reduce fresh water requirements.	Secondary	At Whale Tail Pit, the source of freshwater during a portion of construction and operations will be Nemo Lake, and the source of water for during closure and for pit flooding, will be Whale Tail Lake. Freshwater requirements for freshwater during operations is $241m^3$/day and approximately $48m^3$/day during construction and closure (Volume 1, Project Description). Where possible, process water will be reused to reduce the need for freshwater. The water demand relative to available source water makes potential effects to water and sediment quality in Nemo and Whale Tail Lake as a minor pathway, with negligible residual effects expected on water and sediment quality.

Table 3-C-6: Potential Pathway for Surface Water Quality

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
17		Construction, Operation	Water quality	Dewatering of waterbodies may change flows, water levels, channel/bank stability, and water quality (e.g., suspended sediments, nutrients, metals) in receiving and downstream waterbodies.	During dewatering activities, TSS will be monitored, and if necessary, treated before release downstream. Pumped water from the dewatered waterbodies will be directed through properly designed structures to the lake environment, and not to lake outlets, to prevent erosion in the receiving waterbodies and to attenuate flows. Erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed.	Primary	See Section 6.4.3.2
18	Open Pits	Operation	Water quality and Sediment quality	Release of pit water inflows to local watersheds may affect water and sediment quality in local watersheds.	Groundwater inflow to the pits or other dewatered areas will not be directly released to local watersheds. All pit water will be pumped to the Attenuation Pond for management and treated prior to release.	Minor	Minimal water is expected in the Whale Tail open pit because it is above the permafrost, which will reduce the inflows of groundwater. Groundwater inflows are provided in Volume 6, Section 6.2.3.1. The short mine of life of the open pit will also reduce the opportunity for groundwater inflow. However, any water that is present in the open pits will be pumped to the attenuation pond for re-use or treated and discharged to the receiving environment therefore impacts to water and sediment quality in local watersheds is expected to be minimal.
19		Operation	Water quality	Removal of bedrock and ore material may change or alter existing faults and change contaminant transport processes in subsurface and surface water quality	Mined-out pit flooding will be augmented by fresh water diversion.	No Linkage	Based on the hydrogeological model, the groundwater flow from Whale Tail pit lake is predicted to take over 1000 years to reach DS1 (groundwater discharge zone for pit lake). Volume 6, Section 6.2.3 1, provides supporting evidence. This pathway is considered to have a minor linkage to hydrogeology and thus it is expected to have no linkage to surface water.
20	Mine Site Decommissioning			Removal of project infrastructure (e.g., roads, dikes, etc.) may change flows and cause of release sediment and contaminants and can affect water and sediment quality	A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. All bridges and culverts will be removed and original drainage patterns restored. Stream crossings will be rehabilitated and instream work will be limited to the extent possible and will follow DFO operational guidance and timing windows. Dikes will be breached to allow for fish passage; removal of dikes will be timed to minimize release of sediments. Remove chemicals from the mine site. Roads will be scarified, allowing native plants to re-establish, and slopes will be stabilized against erosion.	Secondary	Through the use of best management practices and monitoring during construction, operation, and decommissioning, effects to water and sediment quality are expected to be negligible; however, a water quality monitoring and reporting plan will be conducted to observe conditions. The present reclamation and closure plan for the Meadowbank Mine and for the Whale Tail Pit includes the roads and will feature erosion and sedimentation protection during the decommissioning phase. Thus the residual effects on surface water and sediment quality are considered to be negligible.
21	ımissioning (e.g., roads, bui	Closure	Water quality	Activities required for covering and reclaiming the waste rock storage facilities may cause release of contaminants and can affect water and sediment quality.	A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. The waste rock storage facilities have been designed for long-term stability. The waste rock storage facilities will have a 2 to 4 m cover. Adherence to the Operational ARD/ML Testing and Sampling Plan and the Mine Waste Rock and Tailings Management Plan. The surface of the waste rock storage facilities will be graded to blend into the existing topography and to shed water from the surface.	Secondary	During operations the water quality in the waste rock storage facility pond are expected to meet the Type A effluent limits for all parameters except arsenic, TDS and mercury. Based on modelling, post-closure, at the waste rock storage pond, some parameters exhibit, average predicted concentrations that are above the CEQG-AL, including: arsenic, cadmium, copper, fluoride, lead, mercury, selenium, and uranium. All average concentrations are within the same order of magnitude as the CEQG-AL guidelines, with the exception of arsenic, fluoride and cadmium. While closure activities are occurring, contact water off the waste rock will be monitored, collected and treated, if necessary prior to discharge to the receiving environment. The Mine Site and Downstream Receiving Water Quality Prediction Report provide details of expected water quality. Section 6.4.3 discusses the primary impact to water quality from all facilities in closure and post-closure, including the waste rock storage facilities.
22	Pits (reconnection to downstream environment)	Closure	Water quality	Water quality in flooded open pit may be higher than objectives and reconnection of drainages may affect downstream water and sediment quality.	A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pits are designed to have stable slopes during mining and post-closure. The pits will be progressively reclaimed as excavation is completed. Water quality in the pits will be monitoring continuously during the flooding process. The open pit will be kept disconnected form the surrounding waterbodies until the pit water meets Type A conditions for breaching. Water will be treated from the waste rock storage pond if it is unacceptable for discharge.	Primary	See Section 6.4.3.3

Table 3-C-6: Potential Pathway for Surface Water Quality

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
23	Pits (flooding)	Closure	Water quality	Pumping of water from Whale Tail Lake (South Basin) to fill the pit at closure and increase the elevation in Whale Tail Lake (North Basin) can affect water quality in Whale Tail Lake .	A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pit is designed to have stable slopes during mining and post-closure The pits will be flooded, with water from Whale Tail Lake, over following completion of pit operations. Water quality in the pits will be monitoring continuously during the flooding process. All diversion dikes will be kept intact as a barrier between open pits and surrounding waterbodies until the pit water meets acceptable concentrations for release to the environment. Water will be treated if it is unacceptable for discharge.	Primary	See Section 6.4.3.2
24	Waste Rock Storage Areas and Stockpiles	Closure	Water quality	Runoff and leaching from the waste rock storage facilities and mine footprint may change surface water and sediment quality (i.e., metal concentrations).	A Water Management Plan has been developed and describes the containment and management of contact water on-site. Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds (and treated if required) prior to release to Mammoth Lake. Any potentially acid generating (PAG) or high metal leaching waste rock will be segregated at source and placed into designated areas within the waste rock storage facility.	Primary	Section 6.4.3.2

Table 3-C-7: Potential Pathways for Fish and Fish Habitat Valued Components (Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish Fishery)

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	Mine Infrastructure Footprint (e.g. open pits, site roads, access roads)	Construction, Operations, Closure	The construction of the Northeast, Whale Tail, and Mammoth dikes, and Whale Tail Pit, and the dewatering of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) will result in the direct loss or alteration of fish habitat.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. Best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management), where needed. Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms. A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. The dikes are temporary structures, to be removed during the closure phase, as per the Water Management Plan	Primary (A1 assessment area) No linkage (C1, C38 and A69 assessment areas)	The primary pathway for Arctic Char, Lake Trout, and Round Whitefish in the A1 assessment area was addressed in detail in Section 6.5.3.2.1. This pathway has no linkage to VC fish species in other assessment areas of the RSA because of the compact layout of the mine effects are\ restricted to headwater lakes and streams in the A1 assessment area.
2	Mine Infrastructure Footprint (e.g. open pits, site roads, access roads)	Construction, Operations, Closure	The construction of the Haul Road may result in the direct loss or alteration of fish habitat.	Roads aligned to cross streams of low quality habitat to the extent possible. Where possible, in-stream works will be constructed in winter when watercourses are frozen. In-stream works will be conducted according to DFO timing windows to avoid critical periods for fish. Clear span bridges at crossings km 16.0, km 23.9, km 32.3, and km 44.8 will maintain fish passage or will be used to minimize blockages to fish movement. Design roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. For example, minimum haul road widths are defined under the *Mine Health and Safety Act*, NWT (Nu). A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. All bridges and culverts will be removed and original drainage patterns restored. Stream crossings will be rehabilitated and instream work will be limited to the extent possible and will follow DFO operational guidance and timing windows.	Secondary (Haul road and A1 assessment areas) No linkage (C1, C38 and A69 assessment areas)	Measureable residual effects to VC fish species are not expected from the construction of the Haul Road. The implementation of proven engineering designs and best management practices and polices during construction and operation of the Haul Road are expected to minimize, if not eliminate, any effects to VC fish species, as described in similar environmental assessments in Nunavut (Agnico Eagle 2014). Agnico Eagle will follow recommendations set out in DFO letter of advice for the exploration access road, dated March 14, 2016.
3	Mine Infrastructure Footprint (e.g. open pits, site roads, access roads)	Construction, Operations, Closure	The construction of the North-East, Whale Tail, and Mammoth dikes will alter access to tributary streams and lakes (i.e., habitat connectivity) in the LSA, and may result in habitat loss for Lake Trout, Arctic Char, and Round Whitefish.	Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation. The dikes are temporary structures, to be removed during the closure phase, as per the Water Management Plan	Primary (A1 assessment area) No linkage (A69, C1, and C38 assessment areas)	The primary pathway for Arctic Char, Lake Trout, and Round Whitefish in the A1 assessment area was addressed in detail in Section 6.5.3.2.1. This pathway has no linkage to VC fish species in other assessment areas of the RSA because of the compact layout of the mine effects are\ restricted to headwater lakes and streams in the A1 assessment area.
4	Haul Road Operation	Construction, Operations, Closure	Potential overexploitation of fish stocks due to improved road access can lead to changes in the abundance and distribution of fish	Mining staff will not be allowed to hunt or fish while on their work rotation; Agnico Eagle will develop and enforce "no hunting, trapping, harvesting or fishing policy" for employees and contractors, which will be consistent with the Meadowbank Mine. All roads will be decommissioned during closure. Detailed mitigation is provided in the Whale Tail Pit Haul Road Management Plan, the TEMP and is condition of the NIRB PC No 4 that will continue to be enforced.	Secondary	Restricted use of the haul road is likely to make fishing access difficult in the area; residents of Baker Lake already have good access to the RSA across land by snowmobile and ATV (also see Table 3-C-3).
5	Site Water Management - Road Infrastructure	Construction, Operations, Closure	Crossing structures may alter stream hydraulics and geomorphology affecting passage for migratory fish (e.g., blocking or delaying fish movements on streams)	Clear span bridges at crossings km 3.4, 10.7, 16.0, 20.0, 23.9, 26.1, 32.3, 43.5, 44.8 and embedded culvert at crossing 11.1 will maintain fish passage or will be used to minimize blockages to fish movement. Watercourses will be inspected upstream and downstream of the crossings for, erosion, scour, and flow blockages. Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or drains to alleviate risk, where required. Rock aprons at culvert inlets and outlets will provide erosion protection and prevent localized erosion from concentrated high velocity flows above the peak 1:10 year rainfall event. Cross-drainage structures will be designed and constructed such that structures will not create a hydraulic barrier to fish passage and will convey peak flows corresponding to 1:10 year rainfall event. Use of staggered culvert configuration, and removal of snow at the culvert inlet and outlet prior to the freshet to promote drainage and increased conveyance of flow during spring thaw and freshet. All bridges and culverts will be removed and original drainage patterns restored. Stream crossings will be rehabilitated and instream work will be limited to the extent possible and will follow DFO operational guidance and timing windows.	Secondary (Haul Road and A1 assessment areas) No linkage (A69, C1, and C38 assessment areas)	Using environmental design features and best practices (also see Table 3-C-5), there should be no effects from the watercourse crossing structures on fish passage and thus there should be negligible effects to the fishery.

Table 3-C-7: Potential Pathways for Fish and Fish Habitat Valued Components (Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish Fishery)

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
6	Earthworks: Drilling, blasting and excavation (includes Quarry/Borrow Pit) and Crushing activities	Construction, Operations, Closure	Introduction of blasting residue (nitrogen compounds) to surface water can alter water and sediment quality, affecting fish habitat quality and fish health	Only the required amount of explosive will be used as necessary for the amount of rock or borrow material to be blasted. Where possible, stockpiling of rock and fill from quarries and borrow sites will be placed such that surface water is not diverted through the piles with runoff to surface waterbodies; drainage from quarries will not flow directly into any waterbodies or watercourses. Borrow and rock quarry activity will be at least 31 m from the high water mark of any waterbody. Borrow pits and quarry will be excavated and sloped for positive drainage. Quarries will be inspected on a regular basis to monitor water ponding, particularly at spring melt. Drainage from borrow pits and quarry will not flow directly into any waterbodies or watercourses. When there is ponded water in the rock quarry or borrow pits that could enter a waterbody or watercourse, a water quality sample will be collected and analyzed, and the results used to determine appropriate mitigation measures (e.g., prevent runoff from entering waterbody or watercourse). To avoid and mitigate Serious Harm to Fish, Agnico Eagle will continue to adhere to blasting requirements and will continue to use practices consistent with those used at the Meadowbank Mine. Agnico Eagle will engage with DFO, when required.	No Linkage	The use of environmental design features and best practices (also see Table 3-C-6) will any eliminate effects from blasting residues on fish health and habitat quality. Water from the quarries, which would be located at least 31 m from the high water mark for any waterbody, should not drain directly to waterbodies and thus there should be negligible effects to water quality and limit disturbance to lakes. Disturbance of lakes was specifically identified as a concern through IQ. Quarries will be inspected on a regular basis to identify any areas of water ponding, particularly during spring freshet. However, if there is noticeable flow from a quarry that could enter a waterbody, a water quality sample will be collected. Samples will be analyzed for physical parameters, nutrients (i.e., phosphorus and nitrogen), and trace metals.
7	Earthworks: Drilling, blasting and excavation (includes Quarry/Borrow Pit) and Crushing activities	Construction, Operations, Closure	Blasting near fish-bearing waterbodies may result in pressure changes and vibrations, and affect fish mortality and reproduction	Applicable guidelines for set-back distances and quantities of explosives will be followed. To avoid and mitigate Serious Harm to Fish, Agnico Eagle will continue to adhere to blasting requirements and will continue to use practices consistent with those used at the Meadowbank Mine. Agnico Eagle will engage with DFO, when required. Lessons learned from the Meadowbank Mine will be applied.	Secondary (Haul road and A1 assessment area) No linkage (A69, C1, and C38 assessment areas)	Agnico Eagle will follow best practices and applicable guidelines provided by DFO such that there will be no measurable residual effects from blasting on fish health.
8	Earthworks: Drilling, blasting and excavation (includes Quarry/Borrow Pit) and Crushing activities	Construction, Operations, Closure	Release of potential acid generating materials from quarry locations and from road building materials at the watercourse crossings can alter water and sediment quality, affecting fish habitat quality and fish health	Use of non-acid generating material at watercourse crossings; testing will verify lack of acid rock drainage and metal leaching potential. The rock quarry and borrow pits will be located and constructed in a manner where runoff will not be released directly into a watercourse or waterbody. Any PAG or high metal leaching waste rock will be segregated at source and placed into designated areas within the waste rock storage facilities.	No Linkage	All esker samples tested from potential borrow sources show no potential to generate ARD and all release low concentrations of chemicals (within one order of magnitude of the CCME aquatic life criteria). The current waste rock monitoring program being followed by Agnico Eagle is effective at identifying non PAG waste rock mined at currently operating pits. Details are provided in the Evaluation of the Geochemical Properties of Waste Rock, Ore, Tailing, Overburden and Sediment from the Whale Tail Pit and Road Aggregate Materials. Road and construction materials that are non PAG and non metal leaching should not cause a change in downstream water and sediment quality, and as such the residual effects on surface water and sediment quality are considered to be negligible (for more information, see Table 3-C-6).
9	General Construction / Decommissioning Activities	Construction, Operations, Closure	Sediment releases from infrastructure and road construction / decommissioning can affect quality of nearby surface waters and fish habitat quality.	Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks), where needed to limit disturbance to lakes and streams. In-stream works will be in winter, when possible, to avoid increased TSS and turbidity, and changes to water quality. Proposed roads will be as narrow as possible, while maintaining safe construction and operating practices. Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation and will limit disturbance of lakes from activities. Where applicable, runoff from construction / decommissioning activities will be captured and managed to minimize suspended solids (e.g., discharged into an attenuation pond to settle out suspended sediments) Road alignment will avoid direct drainage into surface waterbodies. Road cross fill (surface slope from road centre line to edge of road) and side slope designed to encourage drainage. Where possible, in-stream works will be constructed in winter when watercourses are frozen. In-stream works will be conducted according to DFO timing windows to avoid critical periods for fish. Bridge abutment installation will span majority of the active channel (i.e., outside of the high-water mark), <u>and if feasible</u>, construction will occur in winter. Disturbed areas along the streambanks will be stabilized and allowed to revegetated upon completion of work. At closure, drainage patterns will be re-established as close to pre-construction conditions as possible, select non-contact water diversion ditches will be retained to promote surface water drainage.	Secondary (Haul Road and A1 assessment areas) No linkage (A69, C1, and C38 assessment areas)	To minimize disturbance to watercourses, construction and decommissioning activities at the watercourse crossings will mostly occur during winter when the streams are frozen or are not flowing. If construction or decommissioning activities are required during open water season, then the Fisheries and Oceans Canada (DFO) timing windows for in-water work will be followed. Any equipment used in the stream will be clean and inspected for leaks. These procedures will minimize the potential for erosion, sediment releases, and introduction of contamination (also see Table 3-C-6). All construction and decommissioning activities will be subject to an erosion and sediment control plan, and best management practices will be used that include standard erosion and sediment control measures (e.g., erosion mats, silt curtains). Through the use of best management practices and monitoring, effects to water quality, and subsequently the fishery, are expected to be negligible.
10	Site Water Management	Construction	During the construction of the Whale Tail, Mammoth, and WRSF dikes, water diversions will result in a reduction of water levels in Lake A16 (Mammoth Lake) and downstream locations, affecting fish and fish habitat.	A Surface Water Management Plan will be implemented.	Primary (A1 assessment area) Secondary (A69 assessment area) No linkage (Haul Road, C1 and C38 assessment areas)	This pathway was evaluated in detail in Fish and Fish Habitat Section 6.5.3.3. Effects to flows and water levels are expected to diminish at downstream locations, including the A69 assessment area (see Surface Water Hydrology Section 6.3.3.1.2).

Table 3-C-7: Potential Pathways for Fish and Fish Habitat Valued Components (Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish Fishery)

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
11	Dike Construction / Decommissioning	Construction, Closure	Release of sediment from dike construction/removal activities may cause changes in water quality, affecting fish and fish habitat in in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake)	Use of the Dewatering Dikes, Operations, Maintenance and Surveillance Manual developed by Agnico Eagle. During summer construction, turbidity curtains will be installed near the portion of the alignment where dike construction will occur, which is an approach demonstrated at other northern mining projects. Non- potentially acid generating, chemically inert material (i.e., granite) will be used to construct the dike to prevent leaching of metals into water. Turbidity monitoring will be conducted at designated locations throughout open-water and under-ice conditions, within and outside of the zone of the turbidity curtains. In the event that TSS concentrations approach monitoring thresholds, a review of local conditions and activities will be conducted. A closure plan will be developed which will include management of dike breaching and removal activities to limit the potential for effects to water quality and fish and fish habitat.	Secondary (A1 assessment area) No linkage (A69, C1, and C38 assessment areas)	Through the described mitigation, the release of sediment from dike construction and breaching of the dike is expected to result in short-term, localized, and minor changes to water quality in the adjacent environment of the dikes, resulting in negligible effects to fish habitat and the health of VC fish species
12	General mining activities and use of vehicles	Construction, Operations, Closure	Activities from construction activities and mining operations (e.g., equipment, vehicles, buildings, open-pit mining, blasting) can create fugitive dust emissions and subsequent dust deposition may cause a change in water quality, affecting fish habitat and fish health.	Implement dust control measures, if needed on mine roads. Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase Enforcing speed limits (maximum speed 50 km/h) to suppress dust production. Design road as narrow as possible while maintaining safe construction practices; passing turnouts will be placed to accommodate multi-directional traffic. If deemed necessary through monitoring, dust from roads will be managed through use of dust suppressant. The running surface of the road will be maintained thereby reducing the generation of dust. Adherence to the AWAR and the Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the Terrestrial Ecosystem Management Plan) Most personnel arriving at or leaving the site will be transported by bus, thereby reducing the amount of traffic (and dust).	Secondary (Haul Road and A1 assessment areas) No linkage (A69, C1, and C38 assessment areas)	This pathway was assessed in Surface Water Quality Section 6.4.3.1. The effects of dust are predicted to have a negligible effect on water quality, and fish and fish habitat
13	General mining activities and use of vehicles	Construction, Operations, Closure	Activities from construction activities and mining operations (e.g., equipment, vehicles,) can alter air emissions (including Sulphur dioxide and nitrogen oxides) and subsequent deposition may cause a change in water quality, affecting fish habitat and fish health.	Adherence to water quality monitoring and adaptive management in the CREMP to detect changes in water quality Construction equipment and trucks will be equipped with industry-standard emission control systems. Compliance with regulatory emission requirements will be met. Exhaust emissions from non-road vehicles will be managed through regular and routine maintenance of vehicles. SO_2 emissions from non-road vehicles and stationary equipment will be reduced through the use of low emission diesel fuel. Adherence to the Air Quality Monitoring Plan to detect changes in air quality	Secondary (Haul Road and A1 assessment areas) No linkage (A69, C1, and C38 assessment areas)	This pathway was assessed in Surface Water Quality Section 6.4.3.1. The effects of air emissions are predicted to have a negligible effect on habitat quality.
14	Site Water Management	Construction	During the construction of the Whale Tail, Mammoth, and WRSF dikes, water diversions will result in a reduction of water levels in Lake A16 (Mammoth Lake) and downstream locations, affecting fish and fish habitat.	A Surface Water Management Plan will be implemented.	Primary (A1 assessment area) Secondary (A69 assessment area) No linkage (Haul Road, C1 and C38 assessment areas)	This pathway was evaluated in detail in Fish and Fish Habitat Section 6.5.3.3. Effects to flows and water levels are expected to diminish at downstream locations, including the A69 assessment area (see Surface Water Hydrology Section 6.3.3.1.2).
15	Waste Rock Storage Areas and Stockpiles	Construction, Operation, Closure	Leachate, and seepage from the waste rock storage facility may change water and sediment quality (i.e., metal concentrations) in nearby waterbodies, affecting fish habitat quality and fish health.	A Water Management Plan has been developed and describes the containment and management of contact water on-site. Contact water will be monitored and managed through the Attenuation Ponds. Seepage will be captured at sumps and diverted to the Attenuation Pond. All ponds collecting seepage will be designed to prevent release into the surrounding aquatic environment. Facility discharge water will be monitored for water quality, and treated as required, prior to discharge. Performance of the dikes will be monitored throughout their construction and operating life.	Secondary (A1 assessment area) No linkage (Haul Road, A69, C1, and C38 assessment areas)	Waste rock that meets the requirements for building material will be crushed, screened, and used for the construction of dikes, foundations, laydown pads, and roads. Use of the waste rock in construction will take into account that leachate draining from the waste rock may contain trace metals in concentrations that exceed CCME freshwater aquatic life guidelines. There is potential for arsenic as well as other parameters (i.e., chloride, fluoride, cadmium, lead, and selenium) to be present in the leachate. Waste rock used for construction will be monitored and remediation will be employed, if required. Changes to water quality, and therefore, fish, are expected to be minor. This pathway was also addressed in Table 3-C-6.
16	Site Water Management	Construction, Operation, Closure	Runoff from mine site infrastructure and roads can affect surface water and sediment quality, affecting fish habitat quality and fish health	Road cross fill (surface slope from road centre line to edge of road) and side slope designed to encourage drainage. Best management practices for erosion and sediment control (e.g., silt curtains, runoff management) will be implemented, as needed to limit disturbance to lakes. No changes to the existing footprint of the AWAR or the Meadowbank Mine site Water Management Plan is approved and adhered to at existing facilities and Water Management Plan specific to the Whale Tail Pit areas has been developed and these plans have considered the containment and management of contact site water Runoff and seepage from the Project site will be diverted to sumps and the attenuation pond (and treated if required) prior to release. Water quality in attenuation ponds will be monitored and managed such that the discharge meets discharge limits. Potential acid generating rock and metal leaching waste rock will be segregated at source and placed into designated areas within waste rock locations	Secondary (Haul Road and A1 assessment areas) No linkage (A69, C1, and C38 assessment areas)	Given the risk posed by contact water to the receiving environment water quality, environmental design features have been included to prevent release of untreated contact water into receiving waterbodies (also see Table 3-C-6). A key environmental design feature during construction will be the use of separate waste management procedures for the potentially acid generating (PAG) rock and adherence to the Operational ARD/ML Testing and Sampling Plan. Also, the Whale Tail deposit mineralization sulphur content is relatively low and is generally contained within the rocks that form the ore. Thus, the majority of waste rock is non-acid generating (non PAG) based on the low sulphur content and presence of excess carbonate buffering capacity. Approximately 25% of samples are characterized as PAG, mostly associated with waste rock from the central greywacke and chert lithologies. Runoff and lateral seepage from the waste rock/overburden facilities will not be released directly to the environment during operations. All surface water runoff from the areas of the mine facilities or that has been in contact with any mine facilities will be captured through collection ditches and sumps. Contact water from open pits will be pumped to the Attenuation Pond, along with surface water from the other facilities. Water collected at Attenuation Pond will either be used to supplement fresh water from Nemo Lake or be discharged as an effluent into Mammoth Lake through a diffuser outfall. Any discharge will meet Portage limits discharge criteria, or water license discharge criteria, whichever is lower. During closure, contact water will be treated to discharge limits and at some point treatment will no longer be required, and the water treatment facilities will be decommissioned. All runoff will be required to meet discharge limits

Table 3-C-7: Potential Pathways for Fish and Fish Habitat Valued Components (Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish Fishery)

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
				Adherence to the Operational ARD/ML Testing and Sampling Plan and the Mine Waste Rock and Tailings Management Plan.		water treatment facilities will be decommissioned. All runoff will be required to meet discharge limits. Changes to water quality (and fish habitat quality) from runoff are expected to be negligible.
17	Site Water Management	Construction, Operation, Closure	Process and potable water use resulting in reduced water levels can affect fish habitat quantity and quality in Lake A17 (Whale Tail) and Lake C38 (Nemo).	Manage pumping rates so total annual discharge from Whale Tail and Nemo Lake does not drop below the 10-year dry condition. Water withdrawal rate(s) will be controlled to avoid effects on the source water lake(s). Capture and reuse site water to reduce fresh water requirements.	Secondary (A1 and C38 assessment areas) No linkage (Haul Road, A69 and C1 assessment areas)	At Whale Tail Pit, the source of process and potable water during construction and operations will be Nemo Lake, and the source of water for closure will be Whale Tail Lake. Freshwater requirements for process and potable water during operations is 241 m^3/day and approximately 48 m^3/day during construction and closure (Volume 1, Project Description). Where possible, process water will be reused to reduce the need for freshwater. The water demand relative to available source water makes potential effects to water and sediment quality in Nemo and Whale Tail Lake as a minor pathway, with negligible residual effects expected on water quality, and therefore fish. This pathway was also evaluated in Table 3-C-6.
18	Site Water Management	Operation	Alteration of watershed flow paths may increase downstream flows and water levels, and affect channel/bank stability in diverted and receiving waterbodies, affecting fish and fish habitat	A Surface Water Management Plan will be implemented. Pumped water from the dewatered lakes will be directed through properly designed structures to prevent erosion in the receiving waterbodies. Pumped discharge will be directed to the lake environment, and not directly to outlets, to attenuate flow changes. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed. Where practical, natural drainage patterns will be used to reduce the use of ditches or diversion berms.	Secondary (A1, A69, C1, and C38 assessment areas) No linkage (haul road assessment area)	This pathway was assessed in Surface Water Hydrology Section 6.3.3.1. It is expected that an increase in flows and water levels will result in an overall increase of available fish habitat.
19	Site Water Management	Construction, Operation	Water diversions for the Whale Tail and Northeast dikes during construction and operations will flood tributary lakes and streams, and will result in the alteration of	A Surface Water Management Plan will be implemented. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed.	Primary (A1 assessment area) No linkage (Haul	This pathway was assessed in Fish and Fish Habitat Section 6.5.3.2.
20	Site Water Management - Dewatering	Construction, Operation	The dewatering of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) will result in the removal and subsequent mortality of fish from the area during the proposed fish-out	A fish-out of the diked area of Whale Tail and Mammoth lakes will be conducted before and during dewatering phase; the fish-out plan will be designed and implemented in consultation with DFO and local Inuit communities, and will consider recommendations in Tyson et al. (2011).	Primary (A1 assessment area) No linkage (haul road, A69, C1, and C38 assessment areas)	This pathway was assessed in Fish and Fish Habitat Section 6.5.3.2.
21	Site Water Management - Dewatering	Construction, Operation	Impingement and entrainment of fish in intake pumps during dewatering may cause injury and mortality to fish, affecting abundance and distributions	Appropriately sized fish screens, which meet DFO guidelines, will be fitted to pumps to limit fish access and to limit fish entrained to the smaller species and life stages	Secondary (A1 Assessment area) No linkage (haul road, C1, C38 and A69 assessment areas)	Using environmental design features and best practices, the effects to the fishery from impingement and entrainment during dewatering should be minor.
22	Fuel Storage and use (includes Chemical and Hazardous material Storage and Explosives Storage Area)	Construction, Operation, Closure	Spills and leaks can affect water and sediment quality of nearby surface waters, affecting habitat quality and fish health	The Spill Contingency Plan will be implemented, including ready access to an emergency spill clean-up kit for cleaning up any spills. Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers and will be stored at the Meadowbank Mine. Storage tanks (e.g., fuel, engine oil, hydraulic oil, and waste oil and coolant) will be double walled, or located in lined and bermed containment areas. Hazardous wastes will be temporarily stored at Whale Tail Pit site and then transported to the Meadowbank Mine in appropriate containers to prevent exposure until they are shipped off site to an approved facility. Individuals working on site and handling hazardous materials will have appropriate training (e.g. WHMIS) Soils from petroleum spill areas will be deposited at the Meadowbank Mine Landfarm Equipment will be re-fueled, serviced, or washed away from the watercourse crossings. Fuel, lubricants, hydraulic fluids, and other chemicals will be stored at least 31 m away from the high water mark of any waterbody. Construction equipment will be regularly maintained. Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred. Enforced speed limits.	No Linkage	Based on Agnico Eagle's experience with the Meadowbank, accidental spills (e.g., fuel) have occurred, but most of the spill volumes have been small, and clean-up has occurred with only minor effects to the environment (Agnico Eagle 2015). Between 2011 and 2015 , 63 reportable spills were reported to the GN spill hot line. In 2015 there were 4 spills greater than 900 L at Meadowbank. In 2015 spill training was provided to employees. All spills are managed appropriately on site in accordance with Agnico Eagle's Spill Contingency Plan and there was no off site impact to any watercourses as a result of spills in 2015. In NIRB's 2011 annual report (NIRB 2011), it was noted that Meadowbank was kept in an impressively clean state with no apparent spills on location. It is anticipated that Meadowbank will continue to manage spills in the same manner and only minor impacts are predicted to surface water quality and therefore fish. This pathway was also evaluated in Table 3-C-6.
23	Mining Activities and Water Management	Construction, Operations, Closure	Release of treated mine effluent (including sources from sewage, WRSF pond, and attenuation pond contact) may cause changes to surface water quality and sediment quality (i.e., nutrient and metal concentrations) in Mammoth Lake in operations and closure.	A Water Management Plan has been developed and describes containment of contact water through the use of diversions, attenuation ponds, and treatment facilities during construction, operations, and closure. Runoff and seepage from the Project site will be diverted to sumps and the attenuation pond. Treated sewage will be piped to the attenuation pond Water quality in attenuation ponds will be monitored and managed such that the discharge entering Mammoth Lake meets discharge limits. If water quality does not meet discharge limits, it will be circulated and re-treated. Other applicable design features and mitigation, as identified in the Interim Closure and Reclamation Plan	Primary (A1 assessment area) Secondary (A69 assessment area) No linkage (haul road, C1 and C38 assessment areas)	This pathway was evaluated in detail in Fish and Fish Habitat Section 6.5.3.3. Changes to water quality are expected to diminish at downstream locations, including the A69 assessment area (see Surface Water Quality Section 6.4.3.3).

Table 3-C-7: Potential Pathways for Fish and Fish Habitat Valued Components (Arctic Char, Arctic Grayling, Lake Trout, and Round Whitefish Fishery)

	Project Activity	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
24	Mine Site Decommissioning	Closure	Removal of project infrastructure may alter flows, and release sediment and contaminants into nearby waterbodies, affecting fish habitat quality and fish health	An Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. All bridges and culverts will be removed and original drainage patterns restored. Stream crossings will be rehabilitated and instream work will be limited to the extent possible and will follow DFO operational guidance and timing windows. Roads will be scarified, allowing native plants to re-establish, and slopes will be stabilized against erosion. The surface of the waste rock storage facilities will be graded to shed water from the surface. Drainage patterns will be re-established as close to pre-construction conditions as possible, select non-contact water diversion ditches will be retained to promote surface water drainage. Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management and rip-rap on banks), as needed.	Secondary (Haul road and A1 assessment areas) No linkage (A69, C1, and C38 assessment areas)	Through the use of best management practices and monitoring during construction, operation, and decommissioning, effects to water and sediment quality are expected to be negligible; however, a water quality monitoring and reporting plan will be conducted to observe conditions. The present reclamation and closure plan for the Meadowbank Mine and for the Whale Tail Pit includes the roads and will feature erosion and sedimentation protection during the decommissioning phase. Thus the residual effects on surface water and sediment quality are considered to be negligible. This pathway was also evaluated in Table 3-C-6.
25	Site Water Management -Refilling	Closure	Reflooding of the diked area in Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake) at closure will reduce water levels in Lake A16 (Mammoth Lake) and downstream locations, resulting in effects to fish and fish habitat.	A Surface Water Management Plan will be implemented.	Primary (A1 assessment area) Secondary (A69 assessment area) No linkage (Haul Road, C1 and C38 assessment areas)	This pathway was evaluated in detail in Fish and Fish Habitat Section 6.5.3.3. Effects to flows and water levels diminish at downstream locations, including the A69 assessment area (see Surface Water Hydrology Section 6.3.3.1.5), where effects to fish and fish habitat are expected to be negligible.
26	Water Management - Refilling	Closure	Water quality concentrations in flooded pits may exceed objectives, and if reconnected to pre-construction flow paths may affect downstream water and sediment quality, affecting fish health and habitat quality	A Interim Closure and Reclamation Plan has been developed and describes measures for permanent closure. The pits are designed to have stable slopes during mining and post-closure. The pits will be progressively reclaimed as excavation is completed. Water quality in the pits will be monitoring continuously during the flooding process. The open pit will be kept disconnected form the surrounding waterbodies until the pit water meets acceptable concentrations for release to the environment. Water will be treated if it is unacceptable for discharge.	Primary (A1 assessment area) Secondary (A69 assessment area) No linkage (C1 and C38 assessment areas)	The pathway was evaluated in Fish and Fish Habitat Section 6.5.3.3, and in Surface Water Quality Section 6.4.3.3. Any changes in surface water quality during reconnection of the diked area are expected to be localized within Lake A17 (Whale Tail Lake) and Lake A16 (Mammoth Lake), with negligible effects to fish and fish habitat at downstream locations, including the A69 assessment area.

Table 3-C-8: Potential Pathway for Heritage Sites

	Project Activity	Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
1	Mine Site Facilities and Supporting Infrastructure Construction	Construction	Heritage Sites	Construction activity leading to ground alteration that affects physical heritage resources	Complete heritage assessment for the Project footprint to identify archaeological sites present. For Additional measures refer to Item 2	Secondary	Negligible residual effects once mitigation measures applied
2	Mine Site Operations and Maintenance	Operations	Heritage Sites	Activities such as regrading embankments, shoulder stabilization or new borrow sources if required; changes in water levels; accidents or malfunction; and increased tourism to sites in project area as a result of improved access that results in site damages	Alter or adjust the location of a Project component or activity to fully avoid impacts on culturally important sites such as graves; otherwise mitigate and conduct heritage resource surveys in accordance with the GN department of Culture and Heritage. For archaeological sites that will be adversely affected by the Project, and where more passive mitigation strategies (e.g., capping, relocation) are not viable for those locations, preservation by systematic recording (i.e., excavation or documentation) is an option. Complete additional heritage baseline assessment for any changes to the Project footprint in areas considered to have potential to contain heritage resources. Agnico Eagle will mark the perimeter of heritage sites to be avoided with flagged stakes or similar, will erect “no work zone” signage, and, if in a potentially high traffic area, will erect snow fencing or similar barrier to prevent entry. Agnico Eagle will monitor condition of site barriers. Agnico Eagle will include no work areas on project drawings. Provide awareness training for Agnico Eagle and Contractors that includes general guidelines for the appropriate response to the inadvertent discovery of known or suspected archaeological materials.	Secondary	
3		Operations	Heritage Sites	Additional 3 years of processing and use of supporting infrastructure at the Meadowbank mine site and the existing AWAR for delivery of materials	The existing AWAR and Meadowbank Mine are approved and licensed and heritage resources within these footprints have been previously mitigated. Complete heritage assessment for the Meadowbank Project footprint to identify archaeological sites present was completed prior to construction of these facilities.	No Linkage	There is no change to the existing footprint. Therefore there are no heritage sites that will be impacted.
4	Mine Site Decommissioning	Closure	Heritage Sites	Closure, reclamation and post-closure activities such as scarifying roads, breaching of dikes, removal of buildings if occurring outside original footprint	Refer to Item 2	Secondary	Negligible residual effects once mitigation measures applied

Table 3-C-9: Potential Pathway for Traditional Land Use

Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
Construction, Operations, and Closure	TLU: Wildlife Harvesting	Project activities may affect continued opportunities for traditional wildlife harvesting	Compact arrangement of Project infrastructure to reduce the overall project footprint.	Primary for Traditional Land Use of Caribou and Waterfowl/Geese Secondary for Traditional Land Use of Muskox, Ptarmigan, Furbearers/Predatory Mammals	Primary pathway for harvesting of caribou and waterfowl/geese (see Section 7.3.3.2). Upland birds were not identified as a preferred species for harvesting by Baker Lake harvesters, other than ptarmigan which are harvested closer to the community. No environmentally significant effects were anticipated for the other wildlife VCs, including muskox, predatory mammals (Arctic wolf, wolverine, grizzly bear), raptors and small mammals, following the implementation of mitigation measures. Muskox and grizzly bears were not identified as preferred species for harvesting. The Project area was not identified as a preferred area for trapping activities, and furbearers will still be available for harvesting in preferred trapping locations closer to the community, and in the greater region. Subsequently, the primary pathway for continued opportunities for traditional wildlife harvesting is limited to caribou and waterfowl harvesting.
			Design roads as low and narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. See the Whale Tail Haul Road Management Plan for additional details.		
			Surveys of proposed granular sources for dens and nests will take place prior to construction.		
			Wildlife will have the right-of-way and vehicle traffic will be minimized according to the TEMP. Maximum speed limits of 50 km/hr will be enforced.		
			Roads will have low profiles to avoid barriers.		
			Traffic volumes will be managed and roads closed when large numbers of caribou are present, in consultation with the HTO, GN, and KIA according to the TEMP.		
			All employees will be provided with wildlife environmental awareness training.		
			Drivers will be alerted when caribou are observed near the haul road.		
			Littering and feeding of wildlife will be prohibited.		
			Employees will be notified when caribou, muskox and predatory mammals are observed in the local study area.		
			Detailed mitigation is provided in the TEMP.		
			Where possible, clearing of vegetation would take place outside the migratory bird breeding season.		
			Removal of physical hazards at closure and post-closure will be consistent with Meadowbank Mine and a new Interim Closure Plan for Whale Tail will be developed.		
			Land will be cleared outside the breeding season (June 1 to August 1). Mitigation to reduce impacts to nesting birds will be discussed with Environment Canada.		
			All spills will be immediately reported, cleaned up and/or isolated from the receiving environment. Ready access to emergency spill kits. Regular maintenance of equipment to reduce oil leakage. Training in refueling procedures for site staff. Hazardous materials and fuel will be stored according to regulatory requirements. Detailed mitigation is provided in the Emergency Response Plan, Hazardous Materials Management Plan, Whale Tail Haul Road Management Plan and Spill Contingency Plan.		
			Dust mitigation measures will be applied as outlined in Table 3-C-1 and 3-C-3.		
			Monitoring for bird nesting activity. Birds showing nesting activity will be discouraged from nesting and roosting on site infrastructure. Detailed mitigation is described in the TEMP.		

Table 3-C-9: Potential Pathway for Traditional Land Use

Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
			Attenuation Ponds will be monitored for use by water birds as part of the TEMP. Deterrents will be used if required. Attenuation Ponds will be monitored for water quality. Detailed mitigation is described in the TEMP.		
			Enforce no hunting, trapping, harvesting or fishing policy for employees and contractors. Hunter harvest survey, consistent with the Meadowbank Mine will continue. Access to the Project will be controlled (gated at Meadowbank); Restricting public vehicle access beyond km 85 of Meadowbank All-weather Access Road. All efforts will be made to enforce a no shooting zone for the public along the road and around the Project site. All roads will be decommissioned and scarified during closure. Detailed mitigation is provided in the Whale Tail Haul Road Management Plan, Interim Closure Plan and Reclamation Plan and TEMP.		
			Any PAG or high metal leaching waste rock will be segregated at source and placed into designated areas within waste rock storage facilities to control acid generating reactions and the migration of contaminants. Leachate from the waste rock piles will be monitored and controlled and not released to the natural environment. Detailed mitigation is provided in the Operational ARD-ML Sampling and Testing Plan, Landfarm Design and Management Plan, Landfill Design and Management Plan, and Mine Waste Rock and Tailings Management Plan, Air Quality and Dustfall Monitoring Plan, Road Management Plan, Water Management Plan, AEMP, CREMP and the TEMP.		
			Continue social management approach identified in Sections 5.4, 5.5 and 5.6 of the Socio-Economic Management and Monitoring Plan		
			Adhere to mitigation measures outlined in Table 3-C-3.		
Construction, Operations, and Closure	TLU: Fishing	Project activities may affect continued opportunities for traditional fishing	Adhere to mitigation measures outlined in Table 3-C-7.	Primary	The Project is expected to affect traditional fishing (Sections 7.3.2.1.2; 7.3.3.2), and so has been carried forward for assessment as a primary pathway.
			Compact layout of the surface facilities within local watersheds will limit the area that is disturbed by construction and operation.		
			Best management practices for erosion and sedimentation control (e.g., ground cover, silt fences and curtains, runoff management), where needed.		
			Where practical, natural drainage patterns will be used to reduce the use of ditches and diversion berms.		
			Use of design features to reduce changes to local flows, drainage patterns, and drainage areas.		
			Roads aligned to cross streams of low quality habitat to the extent possible.		
			Design roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. For example, minimum haul road widths are defined under the *Mine Health and Safety Act, NWT (Nu)* .		
			Diversion channels will be designed to provide fish habitat and conditions allowing for passage of Arctic char, lake trout, and Arctic grayling where necessary.		
			Adherence to the Water Management Plan.		

Table 3-C-9: Potential Pathway for Traditional Land Use

Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
			Quarries will be inspected on a regular basis to monitor water ponding, particularly at spring melt; when there is flow from a quarry that could enter a waterbody, a water quality sample will be collected and analyzed.		
			The dike will be constructed using not contain potentially acid-generating rock or low potential for metal leaching material		
			In-stream works will be constructed in winter, when possible, to avoid increased TSS and turbidity, and changes to water and sediment quality.		
			Mining staff will not be allowed to hunt or fish while on their work rotation; Agnico Eagle will develop and enforce "no hunting, trapping, harvesting or fishing policy" for employees and contractors, which will be consistent with the Meadowbank Mine.		
			Runoff and seepage from the Project site will be diverted to sumps and attenuation ponds (and treated if required), prior to release.		
			Water quality in attenuation ponds will be monitored and managed such that the discharge meets discharge limits.		
			Any potentially acid generating (PAG) or high metal leaching waste rock will be segregated at source and placed into designated areas within the waste rock storage facility.		
Construction, Operations, and Closure	TLU: Plant Gathering	Project activities may affect continued opportunities for traditional plant harvesting	Adherence to the mitigation measures for vegetation outlined in Table 3-C-2.	Primary	Primary pathway for traditional plant harvesting, due to the consideration of results from the vegetation assessment, traditional land use patterns, and IQ values (Section 7.3.3.2).
			Compact infrastructure arrangement is designed to reduce the overall Project footprint.		
			Minimizing proposed haul road width and length by designing roads as narrow as possible, while maintaining safe construction and operation practices, and meeting legislated requirements. For example, minimum haul road widths are defined under the Mine *Health and Safety Act* .		
			Limit the use high value habitats to only what is required (e.g., esker, shorelines).		
			Implement a Closure and Reclamation Plan, restoring contours and reclaiming habitat after closure.		
			Implement the spill plan for potential chemical spills, including hydrocarbons.		
			Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management, armouring of banks, sloping of banks), where needed.		
			Use of design features (i.e., dams, drainages, dykes, and diversions) that reduce changes to local flows, drainage patterns, and drainage areas.		
			Design and construct roads using thaw-stable construction fills to minimize frost effects.		
			Seepage and runoff from the waste rock storage facility will be managed via the Whale Tail Waste Rock Storage Facility Pond where the contact water will then be pumped to the Whale Tail Attenuation Pond for further treatment.		
			Use of non-acid generating materials for road bed and fills.		
			Implement dust control measures on mine roads, when required.		
			Road surfaces will be maintained through grading and the addition of granular material.		
			Equipment and vehicles will comply with relevant non-road emission criteria at that time of purchase.		

Table 3-C-9: Potential Pathway for Traditional Land Use

Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
			Use of non-acid generating materials for road bed and fills.		
			Enforcing speed limits will assist in reducing dust emissions.		
			Implement the Spill Contingency Plan for potential chemical spills, including hydrocarbons.		
			Waste rock management procedures developed for potentially problematic waste rock/overburden material. Implement the Mine Waste Rock and Tailings Management Plan.		
			Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers.		
			Adherence to the AWAR and Whale Tail Pit Haul Road Dustall Monitoring Plan (Appendix B of the TEMP).		
Construction, Operations, and Closure	TLU: Culturally Important Sites	Project activities may affect continued opportunities for the use of culturally important sites	Adherence to mitigation measures outlined in Table 3-C-8 and those related to noise under Table 3-C-1.	Primary	Primary pathway for the use of culturally important sites, due to the consideration of results from the heritage resources assessment and noise assessment, traditional land use patterns, and IQ values (Section 7.3.3.2).
			Complete heritage assessment for the Project footprint to identify archaeological sites present.		
			Alter or adjust the location of a Project component or activity to fully avoid impacts on culturally important sites such as graves; otherwise mitigate and conduct heritage resource surveys in accordance with the GN department of Culture and Heritage.		
			For archaeological sites that will be adversely affected by the Project, and where more passive mitigation strategies (e.g., capping, relocation) are not viable for those locations, preservation by systematic recording (i.e., excavation or documentation) is an option.		
			Complete additional heritage baseline assessment for any changes to the Project footprint in areas considered to have potential to contain heritage resources.		
			Agnico Eagle will mark the perimeter of heritage sites to be avoided with flagged stakes or similar, will erect “no work zone” signage, and, if in a potentially high traffic area, will erect snow fencing or similar barrier to prevent entry. Agnico Eagle will monitor condition of site barriers.		
			Agnico Eagle will include no work areas on project drawings.		
			Provide awareness training for Agnico Eagle and Contractors that includes general guidelines for the appropriate response to the inadvertent discovery of known or suspected archaeological materials.		
			Provide ongoing consultation with the community of Baker Lake (specifically Elders and the HTO Members), and provide opportunities for participation in heritage resource surveys and mitigation measures.		
			The following environmental design and mitigation features will reduce the effects of haul road operations on noise: • Best Management practices for controlling equipment noise emissions, including use of silencers on all trucks • Enforcing speed limits • Regular maintenance will be implemented for equipment and vehicles		
			Implement the mitigation measures outlined in the Noise Monitoring and Abatement Plan that was developed for the Meadowbank mine site in 2009 (Agnico Eagle 2009) and refined in 2013 (Agnico Eagle 2013).		

Table 3-C-9: Potential Pathway for Traditional Land Use

Project Phase	Valued Components	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale
Construction, Operations, and Closure	TLU Access	Project activities may change access to traditional use areas	Use minimal sized footprint. The haul road will be closed to the public. Access to the Project will be controlled (gated at Meadowbank); Restricting public vehicle access beyond km 85 of Meadowbank All-weather Access Road. Enforce no hunting, trapping, harvesting or fishing policy for employees and contractors. Hunter harvest survey, consistent with the Meadowbank Mine will continue. Agnico Eagle will work with local wildlife harvesters to ensure the preferred ATV and snowmobile crossing areas are well identified for both hunters and operators on the road.	No linkage	The Project area is primarily used as a travel corridor between Baker Lake and the Back River area to access preferred TLU sites, and it continues to be used opportunistically. Use of the Project area has increased recently due to the construction of the Meadowbank all-weather road. Access is via trails used by ATVs in the summer and snowmobiles in the winter, some of which may intersect with the Project area. The Haul Road will be closed to the public and will have controlled access at the mine site, and will only be available to Agnico Eagle staff and contractors. The Haul Road does not connect with any communities in Kivalliq or beyond. Agnico Eagle will consult with land users to identify important travel routes that potentially intersect the Project footprint, and will install ATV or snowmobile crossing areas along the Haul Road and signage for vehicles. The Project is not expected to change current access to or use of the AWAR.

Table 3-C-10: Potential Pathway for Socio-economics

Valued Components	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale	Relevant EIS Sections
Economic Development	Construction / Operations	The Project will contribute to territorial economic activity via expenditures, procurement and Gross Domestic Product contributions	Not applicable	Primary	Project contribution will be large relative to territorial economy	7.4.3.2; 7.4.4
Economic Development	Construction / Operations	The Project will contribute to government revenues through the payment of taxes and royalties		Primary	Project contribution will be large relative to territorial economy	7.4.3.2; 7.4.4
		The Project will contribute to local business development through procurement and contacting		Primary	Project contribution will be large relative to business capacity	7.4.3.2; 7.4.4
Employment and Training	Construction / Operations	The Project will result in direct, indirect and induced employment opportunities	Use of existing Meadowbank Mine workforce.	Primary	Project contribution will continue a large amount of existing employment	7.4.3.3; 7.4.4
		The Project will result in direct, indirect and induced incomes	Use of existing Meadowbank Mine workforce.	Primary	Project contribution will be large relative to labour force and incomes	7.4.3.3; 7.4.4
		The Project will provide training opportunities for its workforce The Project will contribute to community education	Continue existing training initiatives for the Project's workforce.	Primary	Education and training builds long-term capacity in the labour force Taken together, the pathway is: Support for Training and Education	7.4.3.3; 7.4.4
Individual and Community Wellbeing	Construction to Post-Closure	The Project may contribute to intra- and/or inter-territorial migration and associated population and demographic change in communities	Use of existing Meadowbank Mine workforce; Housing out-of-area workers in on-site camp; Fly-in/fly-out to and from Kivalliq communities	No Linkage	Project is not expected to generate employment-driven migration	7.4.3.1
	Construction / Operations	Project incomes may enhance individual and community wellness by providing access to education, nutritious food, and recreation, and by reducing poverty	Continue social management approach identified in Sections 5.3, 5.5, 5.6, 5.7 and 8.0 of the Socio-Economic Management and Monitoring Plan (Appendix 8-E.6).	Primary	Community investment can have a long-term positive effect on life in a community, especially where outside sources are limited Taken together, the pathway is: Continued Community Investment	7.4.3.4; 7.4.4
	Construction to Closure	The Project may enhance individual and community wellness by continuing community contributions and the IIBA				
	Construction / Operations	The Project will continue existing individual and family wellness programming (e.g., EFAP)				
	Construction to Post-Closure	The Project may improve health and safety awareness amongst employees, their families, and their communities	Continue social management approach identified in Sections 5.3, 5.4 and 5.6 of the Socio-Economic Management and Monitoring Plan (Appendix 8-E.6).	Primary	Health and safety awareness can have significant, long-lasting implications	7.4.3.1
	Construction to Closure	The Project may result in accidental injury or emergencies	Continue social management approach identified in Sections 5.4 and 5.6 of the Socio-Economic Management and Monitoring Plan (Appendix 8-E.6).	Primary	A single accident can be catastrophic if it results in loss of life	7.4.3.1
	Construction to Post-Closure	Project incomes may adversely affect family and community cohesion through social ills (e.g., substance abuse, sexual misconduct, family violence, crime)	Continue social management approach identified in Sections 5.4, 5.5 and 5.6 of the Socio-Economic Management and Monitoring Plan (Appendix 8-E.6).	Primary	Social ills can linger after a Project is gone, and can have a significant adverse effect on people Taken together, the pathway is: Changes in Family and Community Cohesion	7.4.3.1
		Project incomes may exacerbate income inequality, social disparity, and, potentially, related conflict in families and crime in communities	Continue social management approach identified in Section 5.5 of the Socio-Economic Management and Monitoring Plan (Appendix 8-E.6).			
		Project rotational employment may adversely affect family and community cohesion related to extended time away from family and community	Continue social management approach identified in Sections 5.4, 5.5 and 5.6 of the Socio-Economic Management and Monitoring Plan (Appendix 8-E.6).	Primary		
	Construction to Closure	Project-related nuisance effects (noise, increased traffic, dust, visual disturbances) could affect people's quality of life	Use existing Meadowbank Mine infrastructure; Housing out-of-area workers in on-site camp; Fly-in/fly-out to and from Kivalliq communities; Implement noise and air quality mitigations including: Adherence to the • Air Quality Monitoring Plan. • Enclosures are used to reduce fugitive emissions at the processing facility. • Adherence to the Incinerator Waste Management Plan •Adherence to the AWAR and Whale Tail Pit Haul Road Dustfall Monitoring Plan (Appendix B of the TEMP). • Best Management practices for controlling equipment noise emissions, including use of silencers on all trucks • Enforcing speed limits. • Regular maintenance will be implemented for equipment and vehicle.	No Linkage	The Project will use existing mine infrastructure, and is far from communities	7.4.3.1

Table 3-C-10: Potential Pathway for Socio-economics

Valued Components	Project Phase	Effects Pathways	Environmental Design Features and Mitigation	Pathway Assessment	Rationale	Relevant EIS Sections
Infrastructure and Services	Construction to Post-Closure	Project-induced migration can increase demand for housing and associated crowding	Use of existing Meadowbank Mine workforce; Housing out-of-area workers in on-site camp; Fly-in/fly-out to and from Kivalliq communities.	No Linkage	No Project employment-driven migration or population change is anticipated	7.4.3.1
		Project-induced migration can increase demand on physical infrastructure		No Linkage		7.4.3.1
		Project-induced migration can increase demand for social and healthcare services		No Linkage		7.4.3.1
		Project-induced migration can increase demand for emergency and protective services		No Linkage		7.4.3.1
Governance	Construction to Closure	The Project could impact the operation of governments	The Project will operate in a manner compliant with all governing bodies.	No Linkage	The Project will operate in a manner compliant with all governing bodies	7.4.3.1
Non-Traditional Land Use	Construction to Closure	Project disturbances could impact commercial outfitting or fishing	The Project does not interact with commercial fishing and other tourism initiatives and it does not interact with parks or protected areas.	No Linkage	No known commercial activity is expected to interact with the Project	7.4.3.1
		Project disturbances could impact tourist canoeing on major rivers		No Linkage	The Project will not alter the navigability of the Thelon River	7.4.3.1
		Project disturbances could impact the use of parks and protected areas		No Linkage	The Project is not in close proximity to any known parks or protected areas	7.4.3.1
		Project activities could conflict with regional or municipal land use planning initiatives	The Project will comply with all relevant land use planning in its vicinity.	No Linkage	The Project will comply with all relevant land use planning in its vicinity	7.4.3.1

Table 3-C-11: Linkage Matrix for Atmospheric and Terrestrial Components

Project Components and Activities	Air Quality	Greenhouse Gases, Climate, and Climate Change	Noise and Vibration	Geology	Permafrost, Terrain and Soils	Vegetation	Wildlife	Environmental Risk Assessment
Construction								
Earth moving (excavation, drilling, grading, trenching, backfilling)	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Blasting activities	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Borrow pits and management of overburden	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Presence of temporary buildings (footprint and height)	0	0	1	1	1	1	1	1
Construction of infrastructures and facilities	1	1	1	1	1	1	1	1
Use of heavy equipment, vehicle circulation and helicopter use	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Tankfarm, use of petroleum products and maintenance of vehicles	1	0	1	1	1	1	1	1
Water management (dams, drainage, diversion, intake, discharge, and dewatering)	0	0	0	0	1,2	1,2	1,2	1
Sewage treatment and disposal	1	1	0	0	1	1	1	1
Waste management (landfill)	1	1	1	0	1	1	1	1
Snow clearing and stockpiling	1,2	1,2	1,2	0	1,2	1,2	1,2	1,2
Shipping and unloading (marine)	4	4	4	0	0	0	0	0
Investments, expenditures, taxes, and royalties	0	0	0	0	0	0	0	0
Creation, presence, and movement of workforce	1,2,3,4	1,2,3,4	1,2,3,4	0	0	0	1,2,3,4	0
Operations								
Open pit mining and waste rock management	1	1	1	1	1	1	1	1
Existing mill operation	3	3	3	0	0	0	0	3
Existing tailings storage facility	3	0	3	0	0	0	0	3
Presence of infrastructures and facilities (footprint and height)	0	0	0	1	1	1	1	0
Presence of roads and road network	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Use of heavy equipment, vehicle circulation, and helicopter use	1,2	1,2	1,2	0	1,2	1,2	1,2	1,2
Tankfarm, use of petroleum products and maintenance of vehicles	1	1	1	1	1	12	1	1

Table 3-C-11: Linkage Matrix for Atmospheric and Terrestrial Components (continued)

Project Components and Activities	Air Quality	Greenhouse Gases, Climate, and Climate Change	Noise and Vibration	Geology	Permafrost, Terrain and Soils	Vegetation	Wildlife	Environmental Risk Assessment
Water management (dams, drainage, diversion, intake, discharge, and dewatering)	0	0	0	0	1,2	1,2	1,2	1
Waste management (landfill)	1	1	1	0	1	1	1	1
Snow clearing and stockpilling	1,2	1,2	1,2	0	1,2	1,2	1,2	1,2
Shipping and unloading (marine)	4	4	4	0	0	0	0	0
Investments, expenditures, taxes and royalties	0	0	0	0	0	0	0	0
Presence and movement of workforce	1,2,3,4	1,2,3,4	1,2,3,4	0	0	0	1,2,3,4	0
Temporary, Final, and Post-closure								
Open pit management	1	1	1	1	1	1	1	1
Demolition and removal of infrastructures and facilities	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
Hydrological reconnection	1	1	1	0	1,2	1,2	1,2	1,2
Grading, reclamation, and re-vegetation	1,2	1,2	1,2	0	1,2	1,2	1,2	1,2
Waste management (landfill)	1	1	1	0	1	1	1	1
Presence and movement of workforce	1,2,3,4	1,2,3,4	1,2,3,4	0	0	0	1,2,3,4	0
Monitoring and follow-up	1,2	1,2	1,2	0	0	1,2	1,2	1,2

Legend:
0. No linkage; 1. Whale Tail Project; 2. Haul Road; 3. Use of Meadowbank Mine Permitted Infrastructure; 4. Marine Shipping

Table 3-C-12: Linkage Matrix for Freshwater Environment and Marine Environment

Project Activities	Freshwater				Marine			
	Groundwater Quantity and Quality	Surface Water Quantity	Surface Water and Sediment Quality	Fish and Fish Habitat	Marine Water Quality	Fish and Fish Habitat	Marine Birds	Marine Mammals
Construction								
Earth moving (excavation, drilling, grading, trenching, backfilling)	0	1,2	1,2	1,2	0	0	0	0
Blasting activities	0	0	1,2	1,2	0	0	0	0
Borrow pits and management of overburden	0	1	1,2	1	0	0	0	0
Presence of temporary buildings (footprint and height)	0	1	1	1	0	0	0	0
Construction of infrastructures and facilities	0	1	1	1	0	0	0	0
Use of heavy equipment, vehicle circulation and helicopter use	0	0	1,2	1,2	0	0	0	0
Tankfarm, use of petroleum products and maintenance of vehicles	1	0	1	1	0	0	0	0
Water management (dams, drainage, diversion, intake, discharge, and dewatering)	1	1,2	1,2	1,2	0	0	0	0
Sewage treatment and disposal	1	1	1	1	0	0	0	0
Waste management (landfill)	1	1	1	1	0	0	0	0
Snow clearing and stockpilling	0	1,2	1,2	1,2	0	0	0	0
Shipping and unloading (over water and land)	0	0	0	0	4	4	4	4
Purchases of goods and services	0	0	0	0	0	0	0	0
Presence and movement of workforce	0	0	0	0	0	0	0	0
Operations								
Open pit mining and waste rock management	1	1	1	1	0	0	0	0
Mill operation	0	3	3	3	0	0	0	0
Tailings storage facility	0	3	3	3	0	0	0	0
Presence of infrastructures and facilities (footprint and height)	0	1	1	1	0	0	0	0
Presence of road and road network	0	1,2	1,2	1,2	0	0	0	0
Use of heavy equipment, vehicle circulation and helicopter use	0	0	1,2	0	0	0	0	0

Table 3-C-12: Linkage Matrix for Freshwater Environment and Marine Environment (continued)

Project Activities	Freshwater				Marine			
	Groundwater Quantity and Quality	Surface Water Quantity	Surface Water and Sediment Quality	Fish and Fish Habitat	Marine Water Quality	Fish and Fish Habitat	Marine Birds	Marine Mammals
Tankfarm, use of petroleum products and maintenance of vehicles	1	0	1	1	0	0	0	0
Water management (dams, drainage, diversion, intake, discharge, and dewatering)	1	1,2	1,2	1,2	0	0	0	0
Waste management (landfill)	1	0	1	1	0	0	0	0
Snow clearing and stockpilling	0	1,2	1,2	1,2	0	0	0	0
Shipping and unloading (marine)	0	0	0	0	4	4	4	4
Purchases of goods and services	0	0	0	0	0	0	0	0
Presence and movement of workforce	0	0	0	0	0	0	0	0
Temporary, Final, and Post-closure								
Open pit management	1	1	1	1	0	0	0	0
Demolition and removal of infrastructures and facilities	1	1,2	1,2	1,2	0	0	0	0
Hydrological reconnection	1	1,2	1,2	1,2	0	0	0	0
Grading, reclamation, and re-vegetation	0	1,2	1,2	1,2	0	0	0	0
Waste management (landfill)	1	1	1	1	0	0	0	0
Creation, presence, and movement of workforce	0	0	0	0	0	0	0	0
Monitoring and follow-up	1	1,2	1,2	1,2	4	4	4	4

Legend:
0. No linkage; 1. Whale Tail Project; 2. Haul Road; 3. Use of Meadowbank Mine Permitted Infrastructure; 4. Marine Shipping

Table 3-C-13: Linkage Matrix for 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	Human Health Risk Assessment
Construction											
Earth moving (excavation, drilling, grading, trenching, backfilling)	0	1,2	0	1	0	0	0	1,2	1,2	1,2	1,2
Blasting activities	0	1,2	0	0	0	0	0	1,2	1,2	1,2	1,2
Borrow pits and management of overburden	0	1,2	0	0	0	0	0	1,2	1,2	1,2	1
Presence of temporary buildings (footprint and height)	0	1	0	0	0	0	0	1	0	1	1
Construction of infrastructures and facilities	0	1	0	1	0	0	0	1	1	1	1
Use of heavy equipment, vehicle circulation and helicopter use	0	1,2	0	1	0	0	0	1,2	1,2	1,2	1,2
Tankfarm, use of petroleum products and maintenance of vehicles	0	1	0	1	0	0	0	1	1	1	1
Water management (dams, drainage, diversion, intake, discharge, and dewatering)	0	1,2	0	0	0	0	0	1,2	0	1,2	1
Sewage treatment and disposal	0	1	0	0	0	0	0	1	0	1	1
Waste management (landfill)	0	1	0	0	0	0	0	1	0	1	1
Snow clearing and stockpilling	0	1,2	0	0	0	0	0	1,2	0	1,2	1,2
Shipping and unloading (marine)	0	4	0	0	0	0	0	4	0	4	0
Investments, expenditures, taxes and royalties	0	0	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	0	0	0	0
Creation, presence and movement of workforce	1,2,3	1,2,3	0	0	1,2,3	1,2,3	0	1,2,3	1,2,3	1,2,3	0
Employment and Income	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	0	1,2,3	1,2,3	0	0
Operations											
Open pit mining and waste rock management	0	1	0	1	0	0	0	1	1	1	1
Mill operation	0	0	0	3	0	0	0	0	3	0	1,3
Tailings storage facility	0	3	0	3	0	0	0	3	3	3	1,3
Presence of infrastructures and facilities (footprint and height)	0	1	0	0	0	0	0	1	0	1	1

Table 3-C-13: Linkage Matrix for 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	Human Health Risk Assessment
Presence of roads and road network	0	1,2	0	0	0	0	0	1,2	1,2	1,2	1,2
Use of heavy equipment, vehicle circulation and helicopter use	0	1,2	0	1	0	0	0	1,2	1,2	1,2	1,2
Tankfarm, use of petroleum products and maintenance of vehicles	0	1	0	1	0	0	0	1	1	1	1
Water management (dams, drainage, diversion, intake, discharge, and dewatering)	0	1,2	0	0	0	0	0	1,2	0	1,2	1
Waste management (landfill)	0	1	0	0	0	0	0	1	0	1	1
Snow clearing and stockpiling	0	1,2	0	0	0	0	0	1,2	0	1,2	1,2
Shipping and unloading (marine)	0	4	0	0	0	0	0	4	0	4	0
Investments, expenditures, taxes and royalties	0	0	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	0	0	0	0
Creation, presence and movement of workforce	1,2,3	1,2,3	0	0	1,2,3	1,2,3	0	1,2,3	1,2,3	1,2,3	0
Employment and Income	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	0	1,2,3	1,2,3	0	0
Temporary, Final, and Post-closure											
Open pit management	0	1	0	0	0	0	0	1	1	0	1
Demolition and removal of infrastructures and facilities	0	1	0	0	0	0	0	1	1	1	1,2
Hydrological reconnection	0	1	0	0	0	0	0	1	0	1	1,2
Grading, reclamation, and re-vegetation	0	1	0	0	0	0	0	1	0	1	1,2
Waste management (landfill)	0	1	0	0	0	0	0	1	1	1	1
Creation, presence and movement of workforce	1,2,3	1,2,3	0	0	1,2,3	1,2,3	0	1,2,3	1,2,3	1,2,3	0
Employment and Income	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	0	1,2,3,	1,2,3	0	0
Monitoring and follow-up	0	1,2	0	1,2	1	0	0	1,2	1,2	1,2	1,2

Legend:

0. No linkage; 1. Whale Tail Project; 2. Haul Road; 3. Use of Meadowbank Mine Permitted Infrastructure; 4. Marine Shipping

APPENDIX 3-D

Cumulative Effects Study Area and Reasonably Foreseeable Future Development

3.D-1 CUMULATIVE EFFECTS

The Nunavut Impact Review Board (NIRB) defines a cumulative effects assessment as the assessment of impacts on the biophysical and socio-economic environment that results from the incremental effects of a development when added to other past, present, and Reasonable Foreseeable Future Developments (RFFDs), regardless of what agency or person undertakes such other developments. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (NIRB 2007).

Using this definition, the following approach was used to assess cumulative effects:

1) Select broad cumulative effect categories to describe key components of the biophysical and socio-economic environment, and select suitable study areas for each.

2) Identify past and present developments, and determine which occur in each study area.

3) Select and describe the suitable RFFD.

4) Identify possible pathways of effect to each cumulative effects category based on the number and type of developments in each study area.

These steps are detailed in the sections below. Cumulative effects were scoped at a broad level, with the intent on focussing on particular areas of concern, if required. Pathway validity indicates a possibility for cumulative effects, rather than actual cumulative effects. For example, two projects in the same water management area may not cause cumulative effects if the effluent from the two does not overlap. Thus, this screening process indicates cumulative effects potential only.

3.D-2 CUMULATIVE EFFECTS CATEGORIES AND STUDY AREAS

Broad cumulative effects categories were identified, grouping effects that operate through similar pathways and at similar spatial scales. As the pathways and spatial scales may differ for each of the cumulative effects categories, several unique cumulative effect study areas were established (Table 3-D-1).

Table 3-D-1: Cumulative Effects Categories and Cumulative Effects Study Areas

Cumulative Effects Category	Cumulative Effect Study Areas
Effects to Caribou	Ranges of the Lorrilard, Wager Bay, and Ahiak caribou herds
Effects to Terrestrial Environment	Terrestrial Regional Study Area
Effects to Marine Wildlife	Chesterfield Inlet, Hudson Bay, and Hudson Strait
Effects to Aquatic Resources (Water and Fish)	Thelon, Quoich, and Back River water management areas, and the Baker Lake water management area crossed by the Meadowbank Mine All-weather Access Road and Whale Tail Haul Road
Effects to Traditional Land Use	Kivalliq Region
Effects to Socio-Economics	Kivalliq Region

3.D-3 PAST AND PRESENT DEVELOPMENT

3.D-3.1 Methods

To quantify past and present development, a geospatial database containing the type and location of past and present development was compiled. The following sources were reviewed for information on development and other human activity:

- NIRB permitted and licensed activities within Nunavut;
- KIA Land Management Application (KIA 2015);
- Aboriginal Affairs and Northern Development Canada: permitted and licensed activities within Northwest Territories and Nunavut;
- Aboriginal Affairs and Northern Development Canada: Nunavut Mineral Exploration, Mining and GeoScience Overview (AANDC 2013);
- Federal Contaminated Sites Inventory (Treasury Board 2015);
- Kiggavik Project Final Environmental Impact Assessment (Areva 2014);
- location of hunting camps from operator websites;
- Amaruq Baseline Traditional Knowledge Report (Agnico Eagle 2014);
- websites of companies holding land use permits; and
- knowledge of the area and Project status.

The developments included were current to 31 December 2015. The Meliadine Gold Project, located near Rankin Inlet and also owned by Agnico Eagle, was included as a current development in the analysis though it was not active as of December 2015. It was included as a current development because it is nearing the end of the permitting stage, and including it as an existing project rather than a reasonably foreseeable project is the more conservative approach offering greater certainty that cumulative effects are not under-estimated.

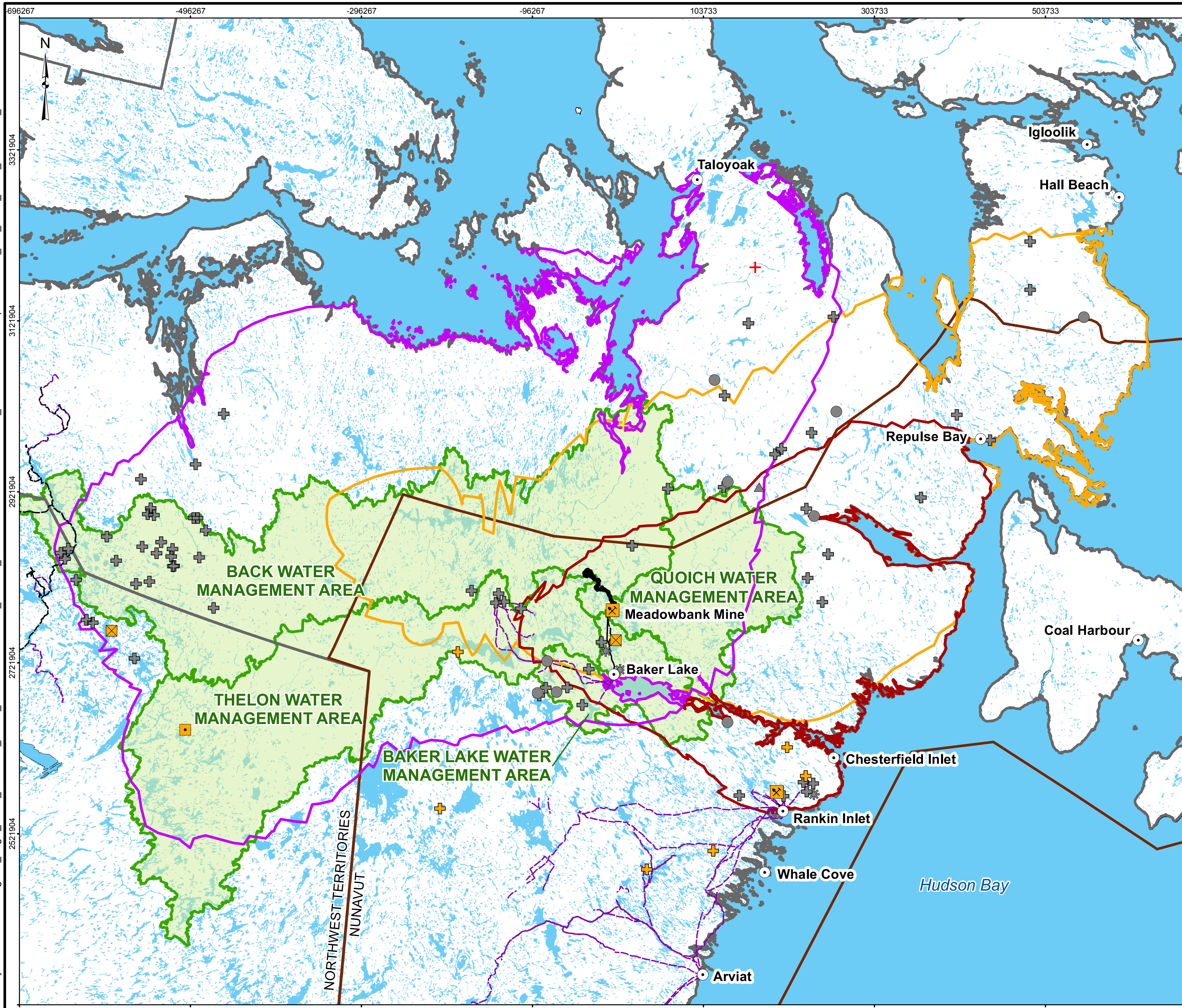
Data were divided into points and lines. The use and type of existing development was derived from land use permit applications. In cases where multiple land use permits issued for the same development, the information was merged into a single feature in the database, using the most relevant descriptions. The following limitations and assumptions guided the preparation of the database:

- 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 greater source of disturbance.
- Contaminated sites of moderate or high priority (as defined by Treasury Board 2015) were included; sites of low or unassigned priority were not included. Low priority contaminated sites are typically point-source sites considered too small to be relevant at the spatial scales for cumulative effects assessment.

- 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.
- All permitted developments and activities were assumed to be operating throughout the year, for the full duration of the land use permit. This is a conservative assumption, as many activities are seasonal and many are not active each year of the five year span of the land use permit.
- Activities that did not trigger land use permits were considered to have a negligible effect on the environment, and were not included. This included traditional outpost camps.
- Developments were described by their land use permit category, unless additional information was available. Land use permits for Research Projects and Territorial Campgrounds were not included as these likely have negligible effects on the biophysical environment. Land use permits for miscellaneous activities were included, and typically describe reclamation activities.
- Mineral exploration projects often include a camp and multiple drilling locations in the vicinity. For the purposes of this assessment, operations by a single proponent working from a single camp were consolidated into a single feature, although it may contain multiple drill camps or possibly satellite camps. Exact details of camp and drill locations are not typically recorded.

3.D-3.2 Results

Previous and existing developments in the various cumulative effect study areas include roads, communities (including airports), hunting or fishing camps, mines, mineral exploration camps, contaminated sites, fuel storage areas, and quarries (Figure 3-D-1).



LEGEND

- WHALE TAIL PIT STUDY AREA
- KIVALLIQ REGION BOUNDARY
- AHIAK CARIBOU RANGE
- LORILLARD CARIBOU RANGE
- WAGNER BAY CARIBOU RANGE
- KIVALLIQ REGION BOUNDARY
- PROVINCE / TERRITORY BOUNDARY
- WATER MANAGEMENT AREA
- WATERBODY

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINERAL EXPLORATION, ACTIVE
- MINERAL EXPLORATION, INACTIVE
- MISCELLANEOUS, INACTIVE
- QUARRYING, INACTIVE
- TOURISM/CARIBOU HUNTING & FISHING, ACTIVE
- TOURISM/FISHING, ACTIVE
- ALL-SEASON ROAD, ACTIVE
- WINTER ROAD, ACTIVE
- WINTER ROAD, INACTIVE

REFERENCE

1. CARIBOU RANGES - NAGY ET AL, 2011. OBTAINED FROM THE GOVERNMENT OF NUNAVUT AND NORTH WEST TERRITORIES .
2. PROVINCE DATA OBTAINED FROM ESRI.
3. WATERBODY AND WATERSHED DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

DATUM: NAD 83 PROJECTION: CANADA LAMBERT CONFORMAL CONIC

90 0 90
KILOMETRES

PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE
PAST AND PRESENT DEVELOPMENTS AND CUMULATIVE EFFECTS STUDY AREAS

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	EN	07 Apr. 2016	SCALE AS SHOWN	REV. 0
GIS	CDB	07 Apr. 2016		
CHECK	JR	04 MAY. 2016	FIGURE 3-D-1	
REVIEW	LY	04 MAY. 2016		

Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\5300_Socio-Economics\Report\1541520_FIG_3-D-1_PAST_PRESENT_DEVELOPMENTS.mxd

Caribou and Terrestrial Environment

Active and inactive development was identified in each of the three caribou ranges that overlap the Whale Tail Project (Table 3-D-2). Mineral exploration was the most common type of development, followed by camps and miscellaneous activities. Of these, very few are currently active. For example, no more than three active mineral exploration operations were identified in any of the caribou ranges. However, one active mine, the existing Meadowbank Mine, overlaps with the caribou ranges of all three herds. Further, it was assumed that these camps were active throughout the year, while in fact exploration camps are more often seasonal. Communities likely have the largest effect on caribou (as a source of harvesters), followed by roads providing access from communities. There are three communities within the Lorrilard caribou range, and one each within the Ahiak and Wager Bay herd ranges. While there is caribou sport hunting occurring in the Kivalliq region, it primarily originates from communities. One hunting lodge was identified. Within the Terrestrial Regional Study Area, the only other development documented within the regional study area was the Meadowbank Mine and Meadowbank all-weather access road.

Table 3-D-2: Past and Present Development in the Caribou Ranges

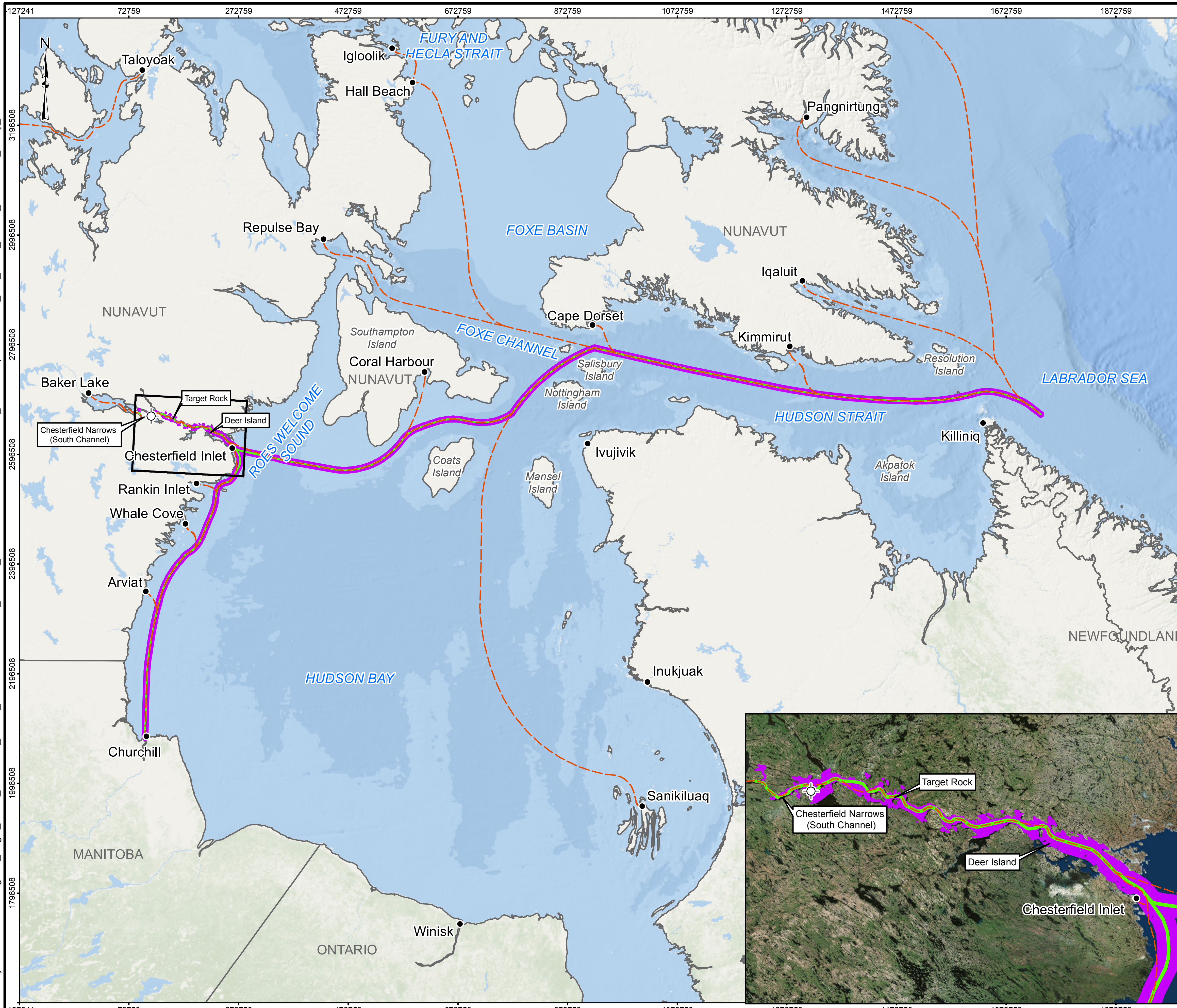
	Ahaik Caribou Range		Lorillard Caribou Range		Wager Bay Caribou Range	
Development Type	**Active**	**Inactive**	**Active**	**Inactive**	**Active**	**Inactive**
Camp		5		3		4
Community	2		3[a]		2	
Contaminated Site		1				1
Fuel Storage		1		1		1
Mine	1		2		1	
Mineral Exploration	1	47	2	14		23
Miscellaneous		2		3		2
Quarrying				1		
Research Projects	1					
Tourism/Caribou Hunting & Fishing	2		1		1	
Tourism/Fishing	1	2				

Note: There is overlap between the three caribou ranges, the number of developments within each range is not independent.

[a] The community of Rankin Inlet includes an inactive mine, considered here to be part of the community footprint.

Marine Wildlife

The study area for Marine Resources encompasses the proposed Project shipping corridor in Chesterfield Inlet, Hudson Bay, and Hudson Strait as shown in Figure 3.D-2 The proposed shipping corridor has been broken down into the following three shipping route segments: 1) eastern Hudson Strait to east entrance of Chesterfield Inlet (ocean-going vessel and/or tug-assisted barge); 2) east entrance of Chesterfield Inlet to Baker Lake (tug-assisted barge); and 3) east entrance of Chesterfield Inlet to the Port of Churchill (ocean-going vessel and/or tug-assisted barge).



Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\3600_Marine\Report\1541520_FIG_3-D-2_Marine_Resources_Study_Area.mxd

LEGEND

- POPULATED AREA
- LIGHTERING POINT (HELICOPTER ISLAND)
- SHIPPING ROUTE
- LOCAL STUDY AREA (LSA)
- REGIONAL STUDY AREA (RSA)
- PROVINCE / TERRITORY BOUNDARY

REFERENCE

1. BASE DATA ESRI, DELORME, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS
2. SHIPPING ROUTE DATA OBTAINED FROM THE DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. PROVINCE AND POPULATED AREA DATA OBTAINED FROM ESRI.

DATUM: NAD 83 PROJECTION: CANADA ALBERS EQUAL AREA CONIC

150 0 150
KILOMETRES

PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE
MARINE RESOURCES STUDY AREA

Golder Associates

PROJECT		1541520	FILE No.	
DESIGN	KA	15 OCT. 2015	SCALE AS SHOWN	REV. 0
GIS	MH	24 MAR. 2016		
CHECK	JR	04 MAY. 2016	FIGURE 3-D-2	
REVIEW	LY	04 MAY. 2016		

Approximately 13 to 16 cargo vessels and 30 to 40 fuel tankers transit through Hudson Strait annually to service Arctic communities and to support regional mining developments (P. John 2013, pers. comm.; NEAS 2012; P. Paquette, NSSI, 2016, pers. comm.; D. White, WGC, 2016, pers. comm.). An additional 12 vessel shipments occur each year in Hudson Strait for grain export to overseas markets, departing from the Port of Churchill (AREVA 2014). From three to six dry cargo ships (P. Paquette, NSSI, 2016, pers. comm.) and up to 18 fuel tankers (D. White, WGC, 2016, pers. comm.) transit through Hudson Strait annually to service the Meadowbank Mine near Baker Lake. The region has become a tourist destination and is home to many Inuit communities who use the marine environment for local transport (WWF 2015). According to WWF (2015), an average of 60 commercial vessels entered Hudson Strait annually between 2007 and 2013, of which more than half were for domestic supply, (Table 3-D-3). During the period 2007-2013, the most common vessel types in the proposed shipping corridor were bulk carriers, general cargo ships and tankers (Table 3-D-4) (WWF 2015). Between 2008 and 2014, reported annual landings at Baker Lake ranged from 17 to 45 shipments per year (Agnico Eagle 2014a; Figure 3-D-3),of which only a portion were in direct support of the Meadowbank Mine Project. This included tug-assisted barges transporting both goods and fuel, as well as shuttle tankers transporting fuel. Aside from barge and shuttle tanker traffic, vessel activities in Chesterfield Inlet are mainly restricted to small fishing vessels and pleasure crafts, given there is only one small public dock in this area (Aarluk 2011).

Table 3-D-3: Summary of Vessel Traffic in Hudson Strait by Industry Sector Between 2007 and 2013

Sector	Volume of Traffic (%)	Traffic Assessment
Domestic Supply	54	Domestic resupply/sealift operations for communities in Eastern Arctic dependent on operations for consumer, commercial, and construction needs.
Shipping	15	Bulk carrier exports of grain to foreign destinations.
Mining and Mineral Extraction	14	Supply to and export from Ragland and Nunavik mines, supply to Baker Lake.
Government Activities	9	Coast Guard icebreakers perform research activities, navigational assistance and community visits.
Tourism	5	Passenger vessels access Hudson Bay and the Canadian Arctic Archipelago.
Oil and Gas Exploration	1	Currently no development occurring in Hudson Strait. Vessels use Strait to access Hudson Bay and enter/exit Arctic Archipelago and Northwest Passage.
Fishing	1	Small numbers of fishing vessels pass through Hudson Strait in transit.
Other	1	Scientific research and ocean survey vessels perform research, tugs assist with towage.

Source: Adapted from WWF (2015).

Table 3-D-4: Vessels in Hudson Strait Between 2007 and 2013

Vessel Type	Average Annual Vessels	Average Annual Transits for All Vessels
Bulk Carrier	17	27
General Cargo	13	71
Tanker	8	34
Tug	6	14
Government Icebreaker	6	11
Passenger Vessel	5	9
Fishing Vessel	3	5
Other	2	3

Source: Adapted from WWF (2015).

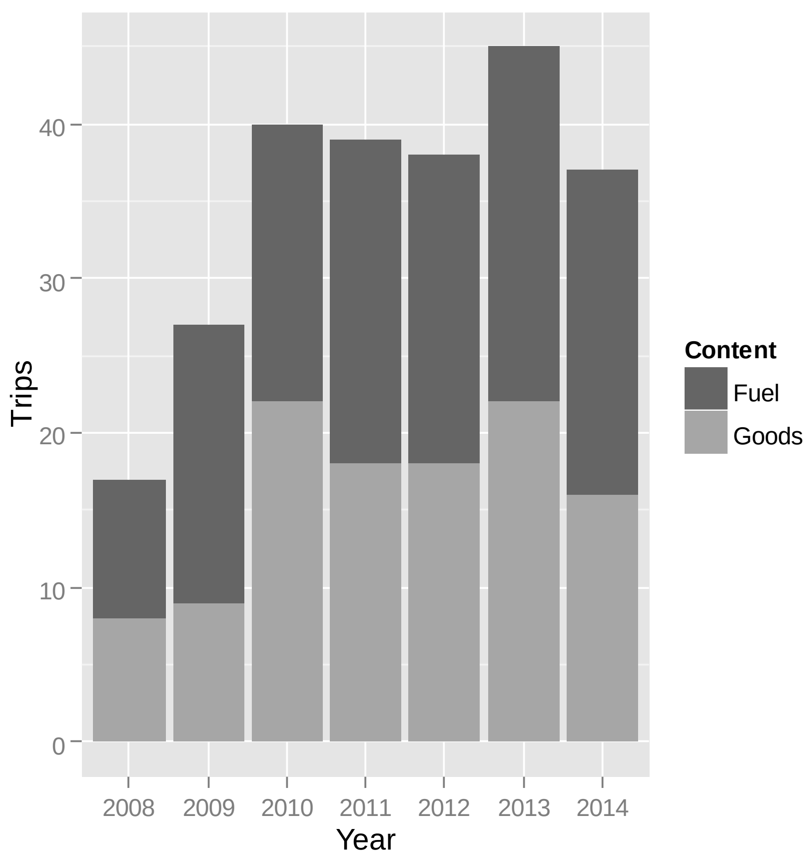


Figure 3-D-3: Barge Traffic (Number of trips/year) Arriving in Baker Lake From Chesterfield Inlet Since 2008

Source: Adapted from the Meadowbank 2014 Annual Report (Agnico Eagle 2015).

Aquatic Resources

The Whale Tail Pit Project (the Project) straddles three water management areas, the Back, Thelon, and Quioch (Figure 3-D-1). The Baker Lake water management area was also considered, as it is crossed by the Meadowbank all-weather access road. To assess potential for cumulative effects to aquatic ecosystems, active and inactive developments were identified in these water management areas (Table 3-D-5). None of the four water management areas contained more than two active developments. The active developments included the community of Baker Lake, the Meadowbank Mine, mineral exploration camps, and two outfitting lodges. The Back water management area has the highest number of historic developments at 24 mineral exploration camps (most of which are in the Kitikmeot region, Figure 3-D-1). Of these developments, communities and mines are of the greatest concern for their potential to contribute to cumulative effects, as they typically both have effluent streams triggering a Type A Water Licence. The other developments listed typically require a Type B Water Licence or do not require a water licence.

Table 3-D-5: Past and Present Development in the Water Management Areas

	Back Water Management Area		Baker Lake Water Management Area		Thelon Water Management Area		Quioch Water Management Area	
Development Type	**Active**	**Inactive**	**Active**	**Inactive**	**Active**	**Inactive**	**Active**	**Inactive**
Camp				2				
Community			1					
Contaminated Site		1						
Mine							1[a]	
Mineral Exploration		25		5	1	3		
Miscellaneous				2				
Tourism/Caribou Hunting & Fishing			1					
Tourism/Fishing		1			1			

[a] The one active mine in the Quioch Water Management Area is the Meadowbank Mine.

Traditional Land Use and Socio-Economics

Finally, to assess potential for cumulative effects to traditional land use and socio-economics, the number of past and present developments in the Kivalliq region were quantified (Table 3-D-6). According to this data, there are currently nine active and 26 inactive mineral exploration operations in the Kivalliq region, the most numerous type of development. Mineral exploration camps likely have little effect to traditional land use as they are remote and seasonal, but may affect regional socio-economics through employment and work rotations away from the community. There is only one major development, the Meadowbank Mine. All-season roads also have the potential to affect traditional land use patterns by facilitating access along their route. There is only one such road leading out of a community in the Kivalliq region, that to the Meadowbank Mine. Winter travel in the Kivalliq region is also facilitated by occasional winter roads, and there currently exists extensive travel routes in both summer and winter via boat, snowmachine, and all-terrain vehicle.

Table 3-D-6: Past and Present Development in the Kivalliq Region

Development Type	Active	Inactive
Camp		5
Community	7[a]	
Contaminated Site		1
Mine	2[b]	
Mineral Exploration	8	24
Miscellaneous		3
Quarrying		1
Tourism/Caribou Hunting & Fishing	1	

[a] The community of Rankin Inlet includes an inactive mine, considered here to be part of the community footprint.

[b] The active mines in the Kivalliq region are the Meadowbank Mine and the Meliadine Gold Project.

3.D-4 REASONABLY FORESEEABLE FUTURE DEVELOPMENTS

3.D-4.1 Methods

Reasonably foreseeable future developments are defined by the 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).

Further to the NIRB definition the following were also considered in the selection of RFFD:

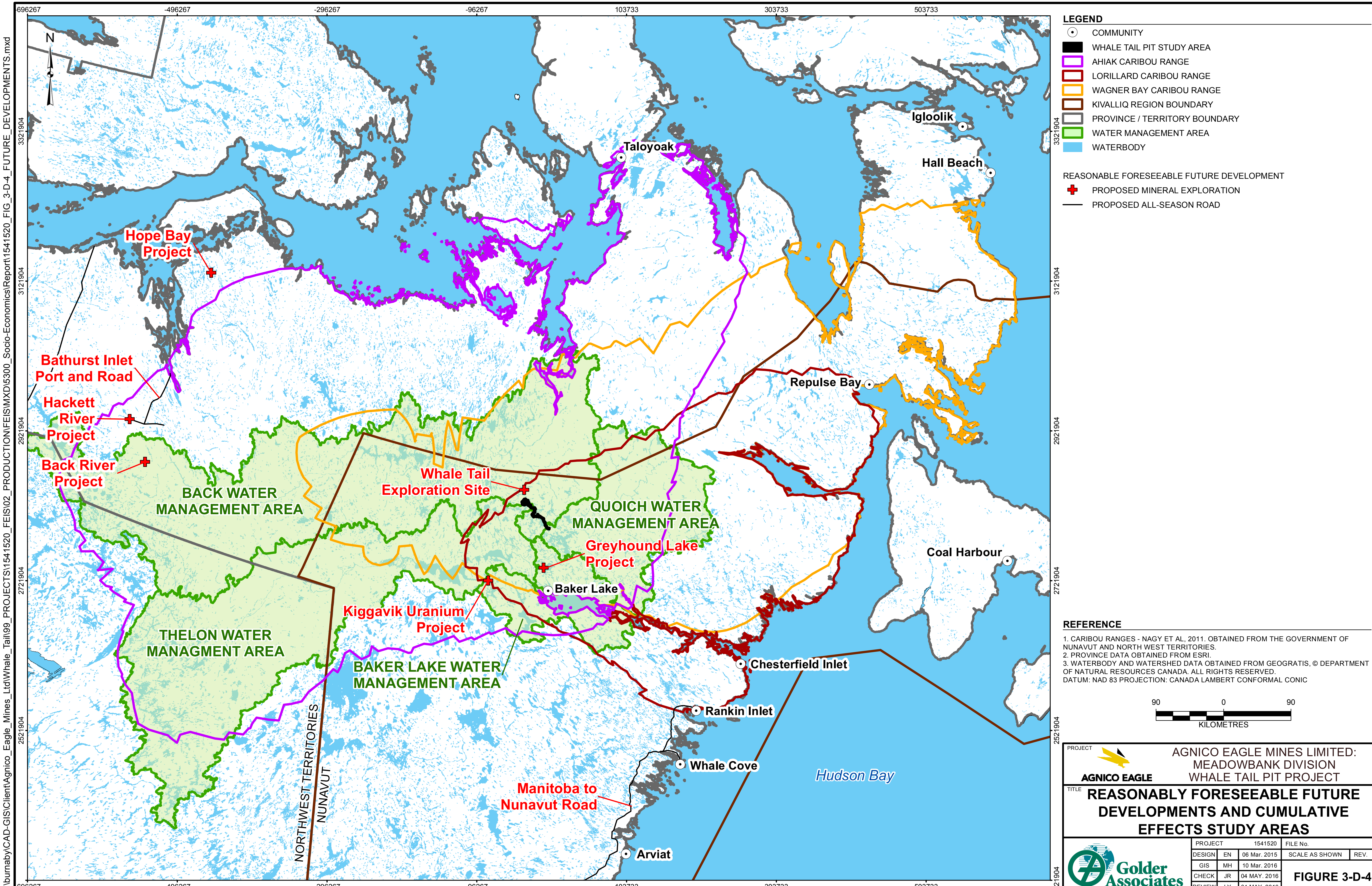
- The RFFD should have a reasonable likelihood of initiating during the life of the Project.
- The RFFD should have the potential to change the Project impact predictions.

Each of the RFFDs was considered for overlap with the Project from the perspective of the cumulative effects categories (caribou, terrestrial, aquatic resources, traditional land use, and socio-economics. The pathway was determined to be either valid or invalid depending on whether the RFFDs occurred within the relevant study area.

From the definition and considerations above, the following proposed projects were selected as a suite of major developments that may occur in the cumulative effects study areas in the foreseeable future (Figure 3-D-4):

- Manitoba to Nunavut Road;
- Greyhound Lake Project;
- Kiggavik Uranium Project;
- Hope Bay Project;
- Hackett River Project;
- Back River Project; and
- Bathurst Inlet Port and Road.

Note that not all of the above projects meet the NIRB (2007) definition of having been proposed and scoped to a reasonable level of detail, or being under regulatory review. However, they were included to provide a range of development types and to avoid under-estimating cumulative effects from RFFDs, and to avoid underestimating the future development. The Meliadine Gold Project was not included as a RFFD for this analysis because it was considered a present development. Less than 1% exploration projects monitored in Canada between 1971 and 2009 advanced to production, and the proportion is thought to be less in the north (INAC 2010). A summary of each of these projects is provided below.



LEGEND
COMMUNITY
WHALE TAIL PIT STUDY AREA
AHIAK CARIBOU RANGE
LORILLARD CARIBOU RANGE
WAGNER BAY CARIBOU RANGE
KIVALLIQ REGION BOUNDARY
PROVINCE / TERRITORY BOUNDARY
WATER MANAGEMENT AREA
WATERBODY
REASONABLE FORESEEABLE FUTURE DEVELOPMENT
PROPOSED MINERAL EXPLORATION
PROPOSED ALL-SEASON ROAD
Igloolik
Hall Beach
Taloyoak
Repulse Bay
Coal Harbour
Baker Lake
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
Hope Bay Project
Bathurst Inlet Port and Road
Hackett River Project
Back River Project
Whale Tail Exploration Site
Greyhound Lake Project
Kiggavik Uranium Project
Manitoba to Nunavut Road
BACK WATER MANAGEMENT AREA
QUOICH WATER MANAGEMENT AREA
THELON WATER MANAGMENT AREA
BAKER LAKE WATER MANAGEMENT AREA
NORTHWEST TERRITORIES
NUNAVUT
N
-696267
-496267
-296267
-96267
103733
303733
503733
3321904
3121904
2921904
2721904
2521904
REFERENCE
1. CARIBOU RANGES - NAGY ET AL, 2011. OBTAINED FROM THE GOVERNMENT OF NUNAVUT AND NORTH WEST TERRITORIES.
2. PROVINCE DATA OBTAINED FROM ESRI.
3. WATERBODY AND WATERSHED DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
DATUM: NAD 83 PROJECTION: CANADA LAMBERT CONFORMAL CONIC
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90
KILOMETRES
PROJECT
AGNICO EAGLE
AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT
TITLE
REASONABLY FORESEEABLE FUTURE DEVELOPMENTS AND CUMULATIVE EFFECTS STUDY AREAS
Golder Associates
PROJECT 1541520
FILE No.
DESIGN EN 06 Mar. 2015
SCALE AS SHOWN
REV. 0
GIS MH 10 Mar. 2016
CHECK JR 04 MAY. 2016
REVIEW LY 04 MAY. 2016
Y:\burnaby\CAD-GIS\Client\Agnico_Eagle_Mines_Ltd\Whale_Tail\99_PROJECTS\1541520_FEIS\02_PRODUCTION\FEIS\MXD\5300_Socio-Economics\Report\1541520_FIG_3-D-4_FUTURE_DEVELOPMENTS.mxd

FIGURE 3-D-4

Manitoba to Nunavut Road

The Manitoba to Nunavut Road is a proposed road route linking the community of Rankin Inlet to the Port of Churchill and the existing all-weather road transportation network in Manitoba, including the National Highway System. When or if it is built, the preferred road route would join the existing Manitoba Highway System at Sundance or Gillam, MB, with Churchill, MB, and Arviat, Whale Cove, and Rankin Inlet in Nunavut (Nunatsiaq News 2012). The development strategy for the new road is to develop a winter road, followed in time by possible construction of a single-lane, all-weather road, then finally, construction of a 2-lane, all-weather road.

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. Proponents of the road assert that the road would pass by 20-plus mineral exploration projects, the viability of which, however, has not been conclusively demonstrated (Naylor 2013). 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 water management area as the Project, none of these were considered as RFFD.

It is unclear yet what logistic arrangements will be required, but there is a possibility that some supplies for road development, including construction equipment, materials, non-perishable food and fuel will be delivered by marine transportation. It this case, shipping routes to both Churchill and Rankin Inlet would likely be used.

The Manitoba to Nunavut Road is anticipated to have large environmental, economic, and socio-economic effects to the region, relative to existing conditions. Construction of the road would take approximately 15 years after five years of preliminary planning and engineering, and cost approximately $1.2 billion (Nunatsiaq News 2012). The Manitoba to Nuanvut Road would likely also induce further exploration of mineral depostits along it's route through lower camp mobilization costs. While the road has only a small amount of overlap with the Lorrilard caribou herd, it could lead to increased caribou harvest from other herds through improved access. The Road is not within the cumulative effects study area for other cumulative effect categories.

Greyhound Project

The Greyhound Project owned by Aura Silver Resources Inc. (Aura Silver) is located 38 kilometres (km) north of Baker Lake, and about 32 km south of the Meadowbank Mine. An all-weather road to the Meadowbank Mine from Baker Lake crosses the Greyhound property. Aura Silver has undertaken surface collections, geophysical surveys, and drilling since 2006 (Aura 2014a). In 2014, Agnico Eagle conducted exploration programs including prospecting and rock assay results and an initial drill program on the property. Agnico Eagle staked additional claims enlarging the Greyhound Project area as a result of their assessment of the potential of this area. Access to the site offered by the Meadowbank road and the shared ownership agreement in the works between Aura Silver and Agnico Eagle may lead to induced development (Aura 2014b). Exploration or mining at this the Greyhould Project would likely be supported by dry-cargo ships, marine tankers or barges from outside Hudson Bay or from Churchill to Baker Lake using the existing shipping routes in Chesterfield Inlet, Hudson Bay and Hudson Starit.

Kiggavik Uranium Project

AREVA Resources Canada Inc. is proposing to construct, operate and decommission the Kiggavik Project, a uranium mine, 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 are proposed to 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 be packaged in sealed barrels and transported south by aircraft. The Kiggavik Project will be serviced by an airstrip, ship, and barge, and a winter access road from Baker Lake. An all-season road between Baker Lake and the Project is a secondary option under consideration in case the proposed winter road cannot adequately support the Kiggavik Project. The shipping requirements to support the Kiggavik mine are substantial. The annual cargo requirement to support the Kiggavik Project is estimated to include approximately 55,300 tonnes (t) of diesel fuel and 91,000 tonnes of dry cargo during peak operations. The materials and equipment needed for the construction and operation of the mine are not available in the region; therefore they will be supplied through the sea-lift, with the shipping routes in Hudson Bay between Churchill and Chesterfield Inlet, and through Hudson Bay and Hudson Strait to the extent of Nunavut Territorial waters. A dock site and cargo storage facility are proposed to be built at Baker Lake to receive supplies.

Based on existing resources, mine life is estimated at 12 to 14 years of operation, with three to four additional years for construction, and five years for decommissioning. It is expected that additional resources will be found and the Project could operate for up to 25 years. Direct job estimates for the Kiggavik Project are up to 750 and 600 workers for the construction and operations stages, respectively. Indirect and induced jobs may be as high as 400 during construction, and 1300 during operations. On 29 September 2014 AREVA submitted the Final Environmental Impact Statement for the Kiggavik Project. On 8 May 2015, NIRB released a final hearing report that recommended that the Kiggavik Project should not proceed at this time. The NIRB stated that resubmission would be reconsidered when there is greater certainty regarding the start date. In July 2015, AREVA requested that the federal government reject NIRB's decision and allow the Project to move ahead, however the Kiggavik Project currently remains under active review by NIRB. While the future of this project is uncertain, for the purposes of this cumulative assessment it is assumed that this project will continue to move ahead.

Hope Bay Project

The Hope Bay Project is a gold and mineral resources deposit located in the Kitikmeot Region, about 90 km south of Cambridge Bay. The property is currently owned by TMAC Resources Inc. (TMAC) and includes three major target areas; Doris, Madrid, and Boston. In 2012, the nearly completed mine remained inactive for more than a year and was shut down just months after the Newmont Gold Corp. (Newmont) announced an expansion. In 2013, TMAC acquired the property, with Newmont as a principal shareholder.

When the project was acquired by TMAC, Doris already had an existing project certificate issued from NIRB for a two-year mining operation. The company now wishes to extend the Doris certificate for an additional four years (a total of six years of mining). The NIRB's public hearing on the Doris extension will start 12 April 2016. The plan is to build a mine that will be "multi-generational" with a lifespan of up to 10 years (Nunatsiaq News 2014a). Access to the Hope Bay Project is by air or by ship and a proposed all-season road from Roberts Bay, including shipping that may pass through Hudson Strait. The Hope Bay Project's Pre-feasibility Study was completed in April 2015, and TMAC intends to begin production in late 2016 (TMAC 2015).

Hackett River Project

The Hackett River Base Metals Mine (Hackett River Project) is in the Kitikmeot Region, near Bathurst Inlet. The Hackett River Project was previously owned by Sabina Gold & Silver Corp. (Sabina) and is near Sabina's Back River Project. The Hackett River Project is now owned by Glencore (formerly Xstrata Zinc Canada Ltd.). Resources from the Hackett River Project are estimated at 25 million tonnes (indicated) and include silver, zinc, lead, copper, and gold (Sabina 2013). Capital costs have been estimated at $700 million, project life at 16 years, and operational employment at approximately 600 people. There is currently no road access to the Hackett River Project, but it is located 75 km south of Bathurst Inlet and 23 km from the proposed Bathurst Inlet Port site (Sabina 2008). The project may use sea-lift for supplies that may potentially be shipped through Hudson Strait. In response to a project proposal submitted in 2008, NIRB issued EIS guidelines in early 2009. If approved, Glencore had estimated a potential production date of 2018 (Xstrata 2012). Exploration in the Hackett River area continued in 2014 (Xstrata 2014). In late 2014, the submission of the Hackett River Project's Draft Environmental Impact Statement (DEIS) was delayed, and Glencore is uncertain when it will be submitted (Nunatsiaq News 2015a; Glencore 2014). Glencore has decided to put the project on hold and the future of the Hackett River Project is uncertain, it was assumed for this cumulative effects assessment that the Hackett River Project will re-open.

Back River Project

Sabina's100%-owned Back River Project is located in southwestern Nunavut, Canada, approximately 520 km northeast of Yellowknife, Northwest Territories, 50 km southeast of Glencore's Hackett River Project, and 75 km southwest of Bathurst Inlet. It consists of seven properties hosting known or observed gold mineralization in banded iron formations. Only two of these properties, Goose and George, have been the focus of exploration and resource development to date, but there are up to eight mining areas associated with the properties. Currently, Sabina only has plans to develop the Goose site (Nunatsiaq News 2015b).

A Preliminary Feasibility Study was released by Sabina in late 2013. A technical report for the Initial Project Feasibility study was released in September 2015 (Sabina 2015). The project is also in the permitting process and filed a DEIS in January of 2014 (Sabina 2014). The company filed the Back River Project FEIS to NIRB in November 2015. Final hearings on the project are expected to occur in April, 2016.

The mine is projected to operate for at least 11 years, produce 200,000 ounce of gold per year and employ up to 900 people. Sabina plans to build all season roads and a winter road from the Goose site to a marine laydown area at Bathurst Inlet (Nunatsiaq News 2015b). The project may use sea-lift for supplies that may potentially be shipped through Hudson Strait.

Bathurst Inlet Port and Road

Although there have been different owners since the proposal was first made to NIRB in 2004, the Bathurst Inlet Port and Road (BIPR) project is currently a joint venture between of Glencore and Sabina. In its current iteration, the BIPR consists of a deep water port and airstrip in Bathurst Inlet, and an 83 km all-weather road to the Back River Project and Hackett River Project properties (Phase I), with the possibility of an additional 134 km of all-season road to Contwoyto Lake (Rescan 2013). The proponent for the BIPR has recently decided to put further work on hold for an indeterminate amount of time. As of February 2015, submission of a DEIS has continued to be postponed with updates expected in December 2015 (Nunatsiaq News 2015a; Glencore and Sabina 2015). The construction of the BIPR use sea-lift for supplies that may potentially be shipped through Hudson Strait.

3.D-4.2 Results

Pathway validity was determined for each of the RFFDs by confirming which were within a cumulative effects category (Table 3-D-7). The threshold for validity was simply whether the RFFD was within the relevant study area.

Table 3-D-7: Pathway Validity to Cumulative Effects Categories from Reasonably Foreseeable Future Developments

Project	Effects to Caribou	Effects to Terrestrial Environment	Effects to Marine Wildlife	Effects to Aquatic Resources (Water and Fish)	Effects to Traditional Land Use	Effects to Socio-Economics
Study Area	Lorrilard, Wager Bay, and Ahiak caribou ranges	RSA	Chesterfield Inlet, Hudson Bay and Hudson Strait	Baker Lake, Thelon, Back River, or Quoich water management areas	Kivalliq Region	Kivalliq Region
Pathway Threshold	Valid if located within the same caribou herd range as the project	Valid if also located in the RSA	Valid if involves marine shipping or other activities in Chesterfield Inlet, Hudson Bay and Hudson Strait	Valid if also located within the Baker Lake, Thelon, Quoich, or Back water management area	Valid if there may be effects in the Kivalliq Region	Valid if there may be effects in the Kivalliq Region
Effects from the Whale Tail Project	Located within the Lorrilard, Wager Bay, and Ahiak caribou ranges	The Project will affect wildlife, vegetation, terrain, soils, and air quality in the RSA	The Project's marine shipping corridor overlaps with marine wildlife habitats	The Project will cross fish-bearing streams	Development and access may reduce traditional land use, but there will not be public access to the haul road	The Project will provide employment to the Kivalliq region
Manitoba to Nunavut Road	**Valid pathway** Located within the Lorrilard range	**Invalid pathway** Not located in the RSA	**Valid pathway** The road may use marine shipping for supplies	**Invalid pathway** Located in a different water management area	**Valid pathway** The road would improve access and change land use in the Kivalliq region	**Valid pathway** The road would change socio-economics in the Kivalliq region
Greyhound Project	**Valid pathway** Located within the Lorrilard, Wager Bay and Ahiak caribou ranges	**Valid pathway** Also located in the RSA	**Valid Pathway** Uses the same shipping corridor	**Valid pathway** Also located in the Baker Lake water management area	**Valid pathway** May lead to spur roads from the Meadowbank Road	**Valid pathway** Would affect the socio-economics of the Kivalliq region
Kiggavik Uranium Project	**Valid Pathway** Located within the range of the Lorrilard, Wager Bay and Ahiak herds	**Invalid pathway** Not located in the RSA	**Valid Pathway** Uses the same shipping corridors	**Valid pathway** Also located in the Baker Lake water management area	**Valid pathway** Would require a winter road and possibly an all-season road to Baker Lake	**Valid Pathway** Would affect the socio-economics of the Kivalliq region

Project	Effects to Caribou	Effects to Terrestrial Environment	Effects to Marine Wildlife	Effects to Aquatic Resources (Water and Fish)	Effects to Traditional Land Use	Effects to Socio-Economics
Hope Bay Project	**Invalid Pathway** Not within the range of relevant caribou herds	**Invalid pathway** Not located in the RSA	**Valid pathway** Would likely use shipping routes in Hudson Strait, not Hudson Bay or Chesterfield Inlet	**Invalid pathway** Located in a different water management area	**Invalid pathway** Would not affect land use or access in the Kivalliq region	**Invalid Pathway** Would not affect the socio-economics of the Kivalliq region
Hackett River Project	**Valid Pathway** Located within the range of the Ahiak herd	**Invalid pathway** Not located in the RSA	**Valid pathway** Would likely use shipping routes in Hudson Strait, not Hudson Bay or Chesterfield Inlet	**Invalid pathway** Located in a different water management area	**Invalid pathway** Would not affect land use or access in the Kivalliq region	**Invalid Pathway** Would not affect the socio-economics of the Kivalliq region
Back River Project	**Valid Pathway** Located within the range of the Ahiak herd	**Invalid pathway** Not located in the RSA	**Valid pathway** Would likely use shipping routes in Hudson Strait, not Hudson Bay or Chesterfield Inlet	**Invalid pathway** Located in a different water management area	**Invalid pathway** Would not affect land use or access in the Kivalliq region	**Invalid Pathway** Would not affect the socio-economics of the Kivalliq region
Bathurst Inlet Port and Road	**Valid Pathway** Located within the range of the Ahiak herd	**Invalid pathway** Not located in the RSA	**Valid pathway** Would likely use shipping routes in Hudson Strait, not Hudson Bay or Chesterfield Inlet	**Invalid pathway** Located in a different water management area	**Invalid pathway** Would not affect land use or access in the Kivalliq region	**Invalid Pathway** Would not affect the socio-economics of the Kivalliq region

RSA = regional study area.

3.D-5 CUMULATIVE EFFECTS SUMMARY

A cumulative effects assessment is the assessment of impacts on the biophysical and socio-economic environment that results from the incremental effects of a development when added to other past, present, and RFFDs. Cumulative effects can result from individually minor but collectively significant actions taking place over a given area over a period of time NIRB (2007).

Based on the summary of past, present, (Section 3.D-3), and RFFDs (Section 3.D-4) provided above, a screening of potential cumulative effects to caribou, terrestrial and marine wildlife, aquatic resources, traditional land use, and socio-economics are provided below. Cumulative effects to each Project VC were also considered as part of the residual effects assessment for each VC, provided in Volume 5.0.

3.D-5.1 Past and Present Developments

Cumulative effects from past and present development on caribou were considered within the Ahiak, Lorrilard, and Wager Bay herd ranges. Communities and hunting camps are the largest sources of direct mortality to caribou, while the other developments likely lead to negligible caribou mortality. Considering habitat loss (direct and indirect), communities, and mineral exploration camps are likely the largest sources of anthropogenic disturbance to caribou. However, the level of disturbance within the range of the three herds considered remains very low. While there may be local effects to abundance and distribution of caribou near communities and the single operating mine, anthropogenic disturbance is unlikely to be affecting the abundance and distribution of caribou at the population level.

Considering other components of the terrestrial environment (such as other wildlife, vegetation, soils, and landscape features), the Meadowbank Mine and access road was the only other development identified within the terrestrial study area. Environmental monitoring and mitigation at the Meadowbank Mine will help to reduce impacts from this development, reducing cumulative effects between the Meadowbank Mine and the Project.

The cumulative effects on marine wildlife from the past, present, and reasonably foreseeable future developments within the study are (Chesterfield Inlet, Hudson Bay, and Hudson Strait) were considered for marine wildlife. Currently, most marine shipping is for domestic supply to existing communities. Shipping specifically for mining and mineral extraction (including mines in Quebec) accounts for approximately 15% of shipping traffic, and approximately 10% of all shipping traffic is for the Meadowbank Mine. The Project will utilize existing shipping arrangements for the Meadowbank Mine and Agnico Eagle does not expect the Project to cause an increase in shipping volume within Hudson Bay and Hudson Strait or a change in shipping procedures. Considering the seasonality and low volume of shipping, the proposed mitigation and the limited impact of marine transportation to marine wildlife to date, the Project is not anticipated to led to significant cumulative effects to marine wildlife.

Cumulative effects to aquatic resources (including water and fish) were considered by estimating the number of past and present projects in the water management area crossed by the Baker Lake, Thelon, Quoich, or Back water management areas. Currently, the number of developments within these water management areas is low and the regional effect of any effluent emissions remains negligible. Few of the developments identified trigger a Type A Water Licence. A possible exception is the Baker Lake water management area, which includes the Meadowbank Mine and the community of Baker Lake. Water treatment and aquatic monitoring at the Meadowbank Mine are anticipated to prevent regional effects of the mine to the aquatic environment.

Effects to traditional land use were also considered. These were measured by the number of developments within the Kivalliq region. Very few Kivalliq residents still hunt full time or almost full time anymore but most people continue to go out on the land. Traditional land use has likely been augmented around the exiting Meadowbank Mine and road. For example, while the road facilitates caribou hunting and fishing, the area may be used less for other activities such as camping or berry picking. Considering that the level of development within the Kivalliq region remains very low, that caribou and other wildlife continue to follow traditional movements and natural population cycles, development does not significantly hinder resident's ability to use and enjoy the landscape continues in the Kivalliq region.

Effects to socio-economics were also measured by the number of developments within the Kivalliq region. Currently, there is one operating mine in the region, and a likelihood that the Meliadine Mine may soon open. Mineral exploration and tourism is also a source of employment, although seasonal. The Project is anticipated to contribute to regional employment through permanent and seasonal jobs and contracts to local business. It is expected that the Project will contribute to the local wage economy and have minimal effect on the traditional economy, although there may be social impacts of the shift work often associated with remote camps.

3.D-5.2 Future Developments

There is potential for cumulative effects from RFFD to all of the cumulative effects categories considered, as valid pathways were identified for each. However, the likelihood of significant cumulative effects from RFFD remains low, for several reasons. First, less than 1% of exploration projects in Canada advanced to production, so it is unlikely that many of the exploration camps identified will proceed to full development, or that there will be any temporal overlap in those that do (INAC 2010). Also, many of the RFFD identified are far from the Project and have limited potential for overlap (i.e., the Hope Bay Project, the Hackett River Project, the Back River Project, and the Bathurst Inlet Port and Road). Also, it is expected that each of the RFFD will undergo environmental assessment, and will implement mitigation and monitoring (subject to regulatory requirements and societal expectations) to reduce their potential effects. Finally, valid pathways do not necessarily mean that cumulative effects will occur.

Thus, cumulative effects from the RFFD may occur if most or all of the future projects proceed simultaneously. However, the likelihood of this occurring is low. This conclusion notwithstanding, there may soon be three operating mines in the Kivalliq, two of which are in the Baker Lake water management area, and environmental monitoring should be diligently continued to minimize the cumulative effects between them. Cumulative effects for each VC are also considered in the residual effects assessment for each VC, in the relevant chapters of Volumes 5, 6, and 7.

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APPENDIX 3-E

Residual Impact Classification Definitions

Table 3.E-1: Definitions of Terms Used in the Residual Impact Classification for Vegetation, Terrestrial Wildlife and Birds, Surface Water Quality, Fish and Fish Habitat

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

[a] magnitude for surface water quality is as follows: **LOW:** Measurable change in water quality but concentrations will be less than screening values, and no measureable change to aquatic health or the sustainability of the aquatic ecosystem will occur. **MEDIUM:** Measurable change in water quality such that the concentrations of some parameters will be greater than screening values; however, no effect to aquatic health or to the sustainability of the aquatic ecosystem will occur. **HIGH:** Measurable change in water quality such that concentrations may be more than screening values such that aquatic health effects are predicted and the sustainability of the aquatic ecosystem could be affected.

[c] "similar" implies an environment of the same type, region, and time period.

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Table 3.E-2: Effect Classification Parameters for Socio-economics

Direction	Magnitude	Geographic Extent	Duration
Positive Effect to measurement indicator is beneficial **Negative** Effect is adverse	**Negligible** Effect to measurement indicator that does not result in a discernible change from baseline conditions **Low** A discernible effect that represents a change from baseline conditions, but that is not expected to materially alter the socio-economic feature in question **Moderate** A discernible effect that is potentially detrimental but manageable, or potentially beneficial to the socio-economic feature in question **High** A discernible effect that is expected to substantially interfere with or enhance the socio-economic feature in question	**Local** Socio-economic Local Study Area communities **Regional** Territory of Nunavut **National (Economic Impact Assessment)** Canada	**Short-term** Effect is reversible at end of construction **Medium-term** Effect is reversible at end of operations **Long-term** Effect is reversible within a defined length of time beyond closure **Permanent** Effect not reversible