8.0 EFFECTS OF THE ENVIRONMENT ON THE DEVELOPMENT

The MVEIRB Terms of Reference (MVEIRB 2011) requested that information be provided on potential effects of the physical environment on the Thor Lake Project. Specific issues to be considered were to include:

- Climate change including possible effects on the permafrost regime
- Extreme precipitation, seasonal flooding and melt patterns
- Seismic events and geological instability,

8.1 CLIMATE CHANGE

As previously discussed in Section 2.3, general circulation models (GCM) in combination with various population and economic growth scenarios provide simulations of climate change over the period of 2010 to 2039 for the Mackenzie Valley and by inference, the Thor Lake Project area, referenced to 1961 to 1990 climate normals (Burn 2003).

Mean annual temperature over the period of 2010 to 2039 is projected by GCMs to increase in the Upper Mackenzie Valley by between 1.0ºC and 2.1ºC over the 1961 – 1990 baseline mean temperature for the region (3.4ºC at Hay River). Mean winter temperatures are projected to increase at a slightly faster, but more variable rate in the region (between 0.6ºC and 2.5ºC). Increasing temperatures, in particular during the winter, would tend to shorten the length of the snow season in the region.

For the Upper Mackenzie Valley, the projected increase in precipitation over the next 30 years is between 0.9% and 9.6% over the 1961-1990 baseline. Over the 67 year period of record at the Yellowknife Airport weather station, annual snowfall has been increasing by an average of 1.1 cm per year. Two of the largest recorded snowfall years occurred in 2007 and 2008. The record also shows that with little change to the start of the snow season, winters are becoming shorter on average year by year.

Although climate change will affect the existing permafrost in the vicinity of the Nechalacho Mine and Flotation Plant site from both a distribution and physical/mechanical properties perspective, these changes are anticipated to have little impact on the Project infrastructure. The Project infrastructure will be designed and constructed with minimal dependence on permafrost soils as foundations. For the embankments confining the tailings and water management facilities, the shallow permafrost will be excavated and the structures will be founded directly upon competent bedrock.

Significant structures related to the plant site will also be founded on either bedrock or non thaw-susceptible materials. Roads, laydown areas and other non-critical Project components will be constructed primarily using fill in permafrost areas which will act a thermal barrier slowing the degradation of the permafrost. The thickness of the fill required will be site-specific and designed according to the existing conditions and projected effects of the Project and climate change. The removal of organics and ground disturbance will be minimized where possible.

With the application and implementation of these preventative and mitigation measures, and because of the very long term nature of climate change, no effects on Thor Lake Project infrastructure are anticipated to occur.

8.2 EXTREME PRECIPITATION

Extreme precipitation events that may occur as a result of climate change have been modeled in the water balance, including through the inclusion of a design storm for embankment sizing. The @Risk simulation program was also utilized to model both drier and wetter than normal conditions. The TMF facility will be constructed to sustain regular operation conditions, plus the design storm. Spillways will be included to route any excess water out of the facility in the event that precipitation exceeds the design storm.

With the application and implementation of these preventative and mitigation measures, no effects of extreme precipitation events on the Thor Lake Project infrastructure are anticipated to occur.

8.3 SEISMIC EVENTS

As previously discussed in Section 4.4.4, the central region of the Northwest Territories where the Thor Lake Project is located is a historically quiet earthquake zone. A seismic hazard assessment for the Thor Lake Property was completed using probabilistic calculations based on design tables from the 2005 National Building Code of Canada. The maximum acceleration for the proposed Nechalacho Mine and Flotation Plant site ranged from 0.007 g for a 1 in 100 year return period to 0.16 g for a 1 in 10,000 year return period.

A review of the tailings management facility consequence classification, following the Canadian Dam Association's 2007 Dam Safety Guideline, classified the Nechalacho Mine and Flotation Plant site's proposed tailings management facility as 'Significant'. The resulting earthquake design ground motion is a 1 in 1,000 year event, which corresponds to a maximum acceleration of 0.035 g for the Nechalacho Mine and Flotation Plant site (Knight Piésold 2010a).

The embankments constructed for the TMF will be quite low, and will be designed to be stable under a minimum 1 in 1,000 year seismic event through the use of geotechnical slope modelling. Similar design analyses will be carried out for other significant fills and any small mine waste rock dump(s) that might be developed to ensure long term stability even under seismic loading events.

With the application and implementation of these preventative and mitigation and since the Thor Lake Project is located in such a historically quiet earthquake zone, significant seismic events have a very low probability of occurrence. As a result, no effects related to seismicity on Thor Lake infrastructure are anticipated to occur. .