CLIMATE CHANGE AND IMPLICATIONS FOR THE PROPOSED CANADIAN NORTHERN CORRIDOR

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SUMMARY

The Canadian Northern Corridor (CNC) has been proposed as a potential solution to the challenges presented by limited transportation infrastructure in Northern Canada (Sulzenko and Fellows 2016). Building, operating and maintaining infrastructure in a northern corridor would be inherently challenging due to issues of remoteness and climate change. This paper reviews scientific evidence about the documented and potential impacts of climate change in Northern Canada and examines what the implications are for future CNC development.

Between 1948 and 2016, the annual average temperature across Northern Canada increased approximately 2.3 C, including a 4.3 C increase during winter months (Vincent et al. 2018). There is "virtual certainty" that this trend will continue, with the magnitude of increase dependent on future atmospheric greenhouse gas emissions (Zhang et al. 2019). Over a similar period, Canada experienced a 20-percent increase in precipitation, with Northern Canada experiencing the largest proportional increase (Vincent et al. 2018). Precipitation increases are expected to continue and be more concentrated at northern latitudes. This is expected to result in more snowfall in northern regions, turning into more rainfall and extreme precipitation throughout the century (Zhang et al. 2019).

As temperature and precipitation patterns have changed, the cryosphere has been impacted. Sea-ice extent and thickness have decreased in Northern Canada (Derksen et al. 2018). Under all emissions scenarios, reductions to sea-ice cover is expected to continue (Mudryk et al. 2018). Snow cover and accumulation, particularly in the fall and spring, have decreased across Canada, particularly in Northern Canada, and this trend is "virtually certain" to continue (Derksen et al. 2018). Permafrost temperatures have increased as well, resulting in permafrost thaw in some areas (Romanovsky et al. 2017). Under all emissions scenarios, air temperatures over permafrost areas are expected to increase, which is expected to result in the continued warming of permafrost across Northern Canada and the thawing of large areas by mid-century (Derksen et al. 2018). Glaciers and ice caps are losing mass at an accelerating rate, which is expected to continue and, along with reduced snow accumulation, begin to impact streamflow and water resources in some northern areas (Clarke et al. 2015).

Changes to meltwater and precipitation have shifted streamflow towards earlier peaks and higher flows in the winter and spring (Bonsal et al. 2019). Streamflow is projected to continue towards earlier onset of freshet and peaks in the winter and spring (Burn and Whitfield 2016; Burn et al. 2016). River and lake-ice-cover duration has also declined, a trend that is expected to continue (Cooley and Pavelsky 2016).

Coastal areas in Northern Canada are particularly vulnerable to climate change. Wave height and energy have increased, and the loss of sea-ice has exposed coastal areas and infrastructure to wave impacts (Greenan et al. 2018). This has increased erosion in some locations, especially those that have experienced permafrost thaw. These changes and impacts are compounded by warmer ocean water temperatures that promote further permafrost thaw and thermal erosion (Derksen et al. 2018). Projected relative sea-level change at coastal locations and the progression of these conditions are expected to adversely affect coastal areas and infrastructure in the future (Greenan et al. 2018).

Climate change is also impacting the occurrence of extreme events and ecosystems. Changing climate conditions can increase the probability or intensity of extreme events, such as forest fires or floods (Zhang et al. 2019). Across Canada, shifts in the distribution of species and range expansion and contraction have also been documented and attributed to climate change (Nantel et al. 2014).

These documented and projected future climate change impacts threaten the construction, maintenance and operation of infrastructure within the corridor. Climate change impacts are likely to affect the feasibility and costs of some infrastructure and create ongoing challenges to operations. Climate change impacts are highly localized, and a disturbance at one chokepoint in the corridor could compromise the operation of the whole corridor. More research is needed to examine climate change impacts at local scales to understand the characteristics of the physical environment and how it is changing, as well as how existing human activities overlap with the proposed corridor. Efforts are needed to engage relevant local communities and Indigenous Peoples early in corridor discussions to identify if a corridor is desirable and relevant to them and, if so, whether it can be developed in a manner that sustains livelihoods, culture, health and well-being.

Canada's commitment to reducing greenhouse gas emissions (e.g., the Paris agreement), the responses of the global economy to climate change, and the existence (or lack thereof) of a social licence for the development of infrastructure that contributes to greenhouse gas emissions all need to be considered in the visioning of the corridor. Will a Canadian Northern Corridor be relevant in an economy that is moving away from fossil fuel dependency and towards renewable energy? If so, will building, operating and maintaining the infrastructure within a corridor be feasible under changing climatic conditions, such as those outlined in this report?