

An aerial photograph of a wide river in winter. The water is a deep blue, and the surface is covered with numerous ice floes of various sizes. The river flows from the foreground towards the horizon. On the right side, there is a sandy and snow-covered bank with a dense line of evergreen trees. The sky is a clear, pale blue with a few wispy clouds near the horizon.

NORMAN WELLS

Understanding riverbank erosion and its
impact on local infrastructure

By Sophie Guilbault

Source: Town of Norman Wells

THE SCIENCE

The way Canadian communities are affected by climate change varies greatly depending on location, with northern communities facing unique challenges. Climate change is happening more rapidly at higher latitudes than in other parts of the country, leaving northern communities with constantly evolving adaptation needs. Current and future climate patterns in the North are most visible through changes in sea ice, seasonal snow cover, glaciers and ice caps, permafrost, and river and lake ice. Changing climate conditions in Canada's North are threatening the integrity of community infrastructure, including foundations, roads, water and wastewater facilities, pipelines, and traditional travel routes.

THE TRIGGER

The Town of Norman Wells is located in the Northwest Territories, on the shores of the Mackenzie River, approximately 680 km northwest of Yellowknife. Over time, local authorities started noticing increased erosion on the riverbank, threatening the stability of local roads and other infrastructure. Concerned with this situation worsening under our changing climate, the Town decided to request funding through the Climate Change in the North Program of Crown Indigenous Relations and Northern Affairs Canada in order to conduct a geotechnical investigation of the riverbank. The study conducted by a consulting firm allowed local leaders in Norman Wells to better understand the consequences of the erosion of the riverbank and the associated risk to local infrastructure moving forward. In addition to providing a vulnerability and risk assessment of the area, the report also looked at remediation alternatives to protect the existing riverbanks against future erosion and impacts from climate change.

THE APPROACH

The Town of Norman Wells hired Stantec Consulting to conduct the geotechnical field investigation with four main objectives in mind: evaluate the historic performance of the riverbank, review stratigraphic and permafrost information along the riverbank, estimate future potential permafrost degradation from climate change and its expected impact to the riverbank stability and adjacent infrastructure, and finally evaluate the riverbank stability impacts and improvement options.

The consulting firm responsible for the study identified various processes affecting the riverbanks. Firstly, the study reported that thaw settlement of roadways as a result of permafrost degradation could impact road infrastructure, more specifically as it relates to grades for land drainage ditches and culverts. Second, when looking at slope stability of the riverbank, the study identified key areas of concern that were also faced with greater erosion. Finally, the report noted that surface runoff erosion and gully formation was observed at several locations along the studied area caused by inadequate surface runoff management.

Beyond these observations, the study offered recommendations to implement climate change adaptation actions that would reduce the impact of these risks on



Figure 4: *Current and future climate patterns in the North are most visible through changes in sea ice, seasonal snow cover, glaciers and ice caps, permafrost, and river and lake ice. (Source: Town of Norman Wells)*

the Town of Norman Wells' infrastructure. For instance, the consulting engineers recommended placing additional granular fill to fill areas of settlement and conduct regular topographic surveys to quantify levels of settlement. In terms of slope stability, the recommendations included the construction of stabilizing measures such as rockfill buttress to provide lateral support and increase soil strength along the riverbanks. Providing additional support in areas that are more significantly affected by slope stability would simultaneously help with the impact of erosion, given that the areas where riverbank erosion is of greatest concern generally coincide with areas identified at higher risk for slope stability. It is interesting to note that given challenges associated with accessing construction materials in northern and remote communities, it was suggested to the Town of Norman Wells to consider using meshed tires from the town's landfill to help fill the areas of concern along the riverbanks.

The study also highlighted the need for the Town to pay close attention to municipal drainage as a strategy to reduce erosion and flooding risk. More specifically, the report specifies that the construction of armoured channels at the culvert outlets to direct water down the riverbank slope would be an effective way to mitigate erosion caused by surface runoff.

THE OUTCOME

The report that came out of the geotechnical investigation of the riverbank was well received by the Town's Council. Since it was shared with the community in April 2020, Council supported the development and implementation of a comprehensive drainage plan to reduce erosion and flooding risk along 7 km of the Mackenzie River. In addition to the drainage work that was completed, several considerations were incorporated within Norman Wells' community plan, including the restriction of any development that may adversely affect water quality and natural patterns, ground coverage, melting permafrost, and potential for erosion.

The study conducted by Stantec also allowed the community to better understand the risks faced by Mackenzie Drive, the road bordering the river, and remediation actions that needed to be taken to ensure its longevity. Given challenges around construction planning and access to materials in northern communities, Mr. Frank Pope, Mayor of the Town of Norman Wells, emphasized the importance of understanding risk faced by specific infrastructure and planning their rehabilitation to ensure they function over long periods of time. "In order to prolong the life of our roads and protect our coastline, it's important to understand what adaptation actions need to be implemented. Proper understanding and planning can give you an additional 10 to 15 years on your roads when things are done properly," said Mayor Pope.

A WORD FROM NORMAN WELLS

When asked what advice she would give to other northern communities interested in better understanding some of the climate risks facing their infrastructure, Cathy Clark, Senior Administrative Officer for the Town of Norman Wells, emphasized the need to push for a cultural shift in the North. "As northern communities are increasingly facing the impact of climate change, it is instrumental to not only inform but to educate community members on the risks faced by local infrastructure and the need to implement adaptation actions," said Ms. Clark. Mayor Pope added that, while communication with community members was key to the implementation of successful adaptation initiatives, it is equally important to make sure the information communicated is delivered in a way that is easily understandable and avoids scientific engineering terms that might confuse people who do not work in the field.