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Cover Photograph

Installation of a permafrost ground temperature station in the Tuyeta Protected Area west of Fort Good Hope with the K'ahsho Got'ine Guardians in September 2023. (CIMP233)
Ashley Rudy

Compiled by M. Seabrook

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NWT Cumulative Impact Monitoring Program (NWT CIMP)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/1%20-%20Brekke%20-%20CIMP%20overview%20-%20results%20workshop%20-%20NWT%20wide%20-%20jan%202025.pdf

NWT CIMP is a monitoring and research program administered by the Government of the Northwest Territories, Department of Environment and Climate Change.

The program supports environmental decision-making by generating baseline, cumulative impact and environmental trend information. Many other agencies share responsibilities for environmental monitoring in the NWT. It is NWT CIMP's role to fill information gaps to better understand cumulative impacts for effective decision-making.

The NWT CIMP Steering Committee made up of regional Indigenous, territorial and federal governments guide the program. The Mackenzie Valley Land and Water Board and the Mackenzie Valley Environmental Impact Review Board provide advice to this committee as observers.

NWT CIMP has three key activity areas related to monitoring and research:

1. NWT CIMP works with key decision-makers, the Steering Committee and other partners to determine monitoring priorities;
2. NWT CIMP conducts, coordinates and funds monitoring, research and analysis.
3. NWT CIMP communicates results to decision-makers and communities.

The program currently focuses on three priority valued components: **caribou**, **water** and **fish**.

This presentation introduces NWT CIMP, the type of information generated, how this information can be used and where to find it.

Project results of NWT CIMP-funded projects are available on the NWT Discovery Portal www.nwtdiscoveryportal.enr.gov.nt.ca, the Inventory of Landscape Change, the Mackenzie Datastream, our website, www.nwtcimp.ca, or by contacting nwtcimp@gov.nt.ca.

Unravelling the Cumulative Effects of Climate Change and Permafrost Thaw on Streamflow in the Southern Taiga Plains (CIMP226)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/2-CIMP%20Final%20Results%20Workshop_Wright_2025_V2.pdf

Over the last 50 years streamflow has increased across catchments in Taiga Plains, but these changes vary across ecoregions. For example, La Martre River has increased more than any other gauged catchment in the Northwest Territories, while the Trout River has shown only moderate increases. These catchments are similar in size, contain large lakes, and have similar ground covers, but their underlying geology and permafrost coverage are different. We think different rates and patterns of permafrost thaw are changing how water moves across the land and how much groundwater contributes to streamflow, leading to the different responses to climate warming. However, there has not been enough monitoring in these catchments to confirm if this is true, which limits our ability to predict changes in the future. In response to community concerns about changing water levels in the Taiga Plains, this project collected surface water and groundwater data from the Scotty Creek Research Station located near the Trout River, and established a new groundwater and surface water monitoring program in the La Martre River catchment for comparison.

Working alongside Dehcho Guardians and community members, we collected water chemistry (major ions and isotopes) from Scotty Creek, in wetlands, and from permafrost, and compared it to data collected over 20 years ago. Results indicate that groundwater contributes up to 80% of streamflow during low-flow periods in winter and summer. Groundwater contributions have also increased by 10-25% since 2001. The amount of minerals dissolved in groundwater (indicated by electrical conductivity) has also increased, with greater increases after low precipitation summers. The increase in groundwater contributions to surface water is likely driven by permafrost thaw and more interaction between high permeability organic soils and deeper mineralized groundwater. In 2022, the catchment was burned by wildfire. Continued monitoring will allow the effects of wildfire on streamflow to be better understood.

In the La Martre River catchment, we hosted a 2-day workshop in Whatì and learned of the concerns related to changing lake levels, water quality, drying of nearby ponds, and the effects of a major fire in 2014. This information informed our permafrost and groundwater monitoring to

include burned and unburned areas. Local Environmental Monitors were hired and trained to install shallow wells, sample groundwater, sample surface water, measure permafrost and deploy geophysics equipment. Results showed that permafrost thaw has led to more groundwater flowing toward streams year-round, with wildfire accelerating this process. Unlike the Dehcho region, precipitation is likely increasing in the Tlicho region over the last 50 years, which has led to even greater increases in streamflow in the La Martre River. Data collected so far suggests that increasing precipitation, permafrost thaw, and wildfire cumulatively increase streamflow. We are currently building a hydrologic model of the La Martre River catchment using field data to understand which factors are most important to driving this change. The model aims to make projections of streamflow into the future to support responsible use of surface water and groundwater, and for habitat management and protection.

Fish Mercury in Dehcho Lakes (CIMP154)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/3-CIMP154_Jan%202025_ML_HKS.pdf

In 2012, leaders from several First Nations in the Dehcho region approached George Low, who was the Dehcho AAROM (Aboriginal Aquatic Resources and Oceans Management) Coordinator at the time, and asked for studies to be conducted on fish mercury levels in the region. Mercury is a natural element, like copper or iron, but both human activities – like burning coal – as well as natural processes – like volcanoes – can move mercury into the atmosphere. Once in the atmosphere, mercury can travel long distances and end up on northern lands and in northern lakes, where it can build up in food chains and fish. After a series of "Return to Country Food" workshop were held in the early 2010s, harvesters and community members wanted to know why fish mercury levels were high in some lakes and fish types but low in others, how climate change would affect fish mercury levels, and if there was a risk to people. A series of projects were developed in response, including this project (CIMP 154).

Since 2013, we have worked with 6 First Nations in the Dehcho region to intensively sample 18 lakes. Each year (except 2020), University researchers, Guardians, harvesters, and community members have worked together in on-the-land fish camps to collect fish, water, bugs, and sediment from lakes. Harvested fish are also prepared (when they are of good quality) for

distribution in communities – dry fish and fillets are made alongside sampling. Meetings are held each winter with communities, harvester committees, and /or leadership to discuss results, decide which lakes are priorities for sampling, and make sure that research questions and approaches are evolving and adapting to community questions. We began sampling all lakes for water and sediment each year to make sure that we capture changes over time; this started in 2018. In 2022, we added sampling of algae in response to community observations. We share our fish mercury results with public health researchers and GNWT HSS, and our water quality and fisheries results are shared with community-based and government agencies, including Fisheries and Oceans Canada and the Edézhíe Management Board.

Our results show that there are safe, healthy sources of fish in every lake we have sampled in the Dehcho region. Lake Whitefish tend to have low mercury levels in all lakes, because they feed low in the food chain. Northern Pike have higher levels of mercury than Lake Whitefish, but are lowest in lakes where the Pike grow quickly - and this tends to be in lakes that are larger, with clearer water, less land around them, and less forest in the land around them (more shurbs and grasses). The size of the lake relative to the size of the land that drains into the lake is a very good predictor of fish mercury levels, which is helpful in making decisions on which lakes to sample and monitor most frequently, and in predicting which lakes might be most vulnerable to increases in mercury in the future due to climate change.

Traditional Knowledge All My Relations – A First Nations Framework for Monitoring Changes in Water Quality (CIMP230)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/4-CIMP%20Report%20Back%20Jan%202025%20Is%20Our%20Water%20Good%20to%20Drink%20USB.pdf

Climate change impacts on water threaten spiritual, ceremonial, and nutritional health. This is certainly true for the Dene of northern Canada who want to be able to include their values of water and impacts on their traditional ways of life into water-related assessments. While Akaitcho communities recognize modern science standards for drinking water quality, potability as a concept is not sufficient to address the Indigenous concepts of “good” or “bad” in relation to

water. To develop an approach which prioritizes Dene local and Traditional Knowledge of water and what makes water good or bad to drink, the Aquatic Monitoring Program of the Akaitcho Territory Government partnered with colleagues from the Global Institute for Water Security at the University of Saskatchewan. A project was co-developed to identify all my relations (indicators) to be used in addition to standard water quality testing. These will be used alongside water quality data to provide a more relevant assessment of water resources that can be used for long term resource allocation and climate adaptation.

Understanding the Cumulative Impacts of Beaver Activity on Stream health in the Inuvialuit Settlement Region (CIMP231)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/5-Musetta-Lambert%20CIMP%20Results%20Forum%20Jan%2014_25.pdf

Tundra ecosystems have been experiencing climate-driven changes ranging from increasing shrub cover, longer ice-free seasons, and decreasing ice thickness. These changes provide opportunities for the northward range expansion of southern species. The North American Beaver (*Castor canadensis*) is one such example of a northward range expanding species that is becoming more common in tundra ecosystems of northern Canada and America. In the Inuvialuit Settlement Region (ISR), community members and scientists have observed increasing presence of this "ecosystem engineer" and, subsequently, rapid changes in freshwater ecosystems. Inuvialuit community members and environmental monitors have communicated serious concerns over the impacts of beavers in freshwater ecosystems on fish habitat, water quality and presence of contaminants, food sovereignty, and hydrology backed by observations on the land.

This project proposed a multi-faceted approach to monitor and understand the cumulative impacts of beaver activity in freshwater ecosystems of the ISR, specifically in the corridor between Inuvik and Tuktoyaktuk. Our main objectives included studying the effects of beaver impoundments (i.e., dams) on freshwater biota, water chemistry, and contaminant concentrations. In addition, we evaluated and developed methods for documenting beaver presence and describing the extent of activity (e.g., dam or lodge formation).

A focused assessment was conducted in Year 1 and 2 to investigate the impacts of beaver dams in tundra streams on benthic macroinvertebrate communities and water quality using standardized Canadian Aquatic Biomonitoring Network protocols (CABIN) in collaboration with CABIN-certified Imaryuk Monitors. In addition, we collected samples from across the freshwater food web (including fish, insects, vegetation and algae) to describe food web structure around areas impacted by beavers and to provide input on pathways for potential contaminant uptake. In Year 3, we completed an extensive water and sediment sampling campaign across streams and lakes to understand the novel impacts of beaver impoundments on dissolved organic matter, and total and methyl mercury concentrations. Mercury can be a complex contaminant in freshwater ecosystems that can bioaccumulate and biomagnify in food webs with potential risks to human and wildlife health. Therefore, it is important to understand if beaver activity can increase mercury bioavailability in food webs that support healthy fish populations. Lastly, we refined and advanced methods of quantifying beaver occupancy using accessible tools. The Epicollect application was used to develop a platform for recording beaver sightings and evidence of beaver activity to begin collecting occupancy data from community members and researchers on the land. A test run was completed by graduate students and community-led monitors in Year 2 and 3.

While results and analysis of this project are ongoing, we have successfully produced a comprehensive dataset as a team of community-led monitors, researchers, and students to investigate how biotic communities and contaminants are influenced by the presence of beavers in tundra freshwater ecosystems. In addition, we were able to evaluate and refine methods to collect occupancy data to quantify beaver activity. Together, these methods provide critical initial information for decision makers to direct management priorities and conserve ecosystem services provided by tundra freshwater ecosystems.

Understanding Cumulative Impacts on Dene Ts'įlį and Relationships to Fish through Knowledge Mapping in Délįnę (CIMP229)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/6-CIMP%20Presentation.pdf

The Délįnę Renewable Resource Board alongside the FISHES (Fostering Indigenous Small-Scale Fisheries for Health, Economy and Food Security) team from Carleton University, the Délįnę Got'įnę Government, and the greater community of Délįnę are keen to understand how the cumulative impacts of climate change and human activities surrounding Sahtú affect Dene Ts'įlį and Sahtúgot'įnę relationships to fish. Through a collaborative research process grounded in knowledge co-evolution, the DRRC, community members and the Carleton team documented the related cumulative impacts through interviews, focus groups, mapping workshops, and open

houses. Following this documentation of knowledge, the same methods were applied to identify possible solutions and mitigation strategies that uphold Dene Ts'įlį, relationships to fish, and food security.

Based on the data from the interviews and workshops conducted, the project has developed a Community Atlas; a platform that documents community knowledge on fish populations, fishing locations and other important geographic sites, as well as placenames, and locations of sport fishing activities. This atlas contains 7 modules: Fish Module, Family Routes and Settlements Module, Community Sampling Module (DFO Sampling Program), Subsistence Harvesting Data Module, Sport Fishing Module, Land and Water Zoning Module, and Ice Module. These modules were designed in partnership with the community and expanded from initial drafts that focused solely on fishing locations and documenting of sportfishing impacts. Based on feedback from the community, we worked with the Department of Fisheries and Oceans to include the fish sampling data from their sponsored program into the atlas as well as focus on the sharing of stories.

The atlas is interactive, located on a secured server and user friendly. As we conclude our work, the Carleton Geomatics and Cartographic Research Center is assisting the FISHES team with training community members on how to input and edit data. We are also working with the local high school to include the atlas into the science and social science classes as a learning tool with the goal being intergenerational knowledge transfer between the elders and knowledge holders who provided the information in the atlas and the youth in school. Based on community interest, the projects seeks to develop modules on contaminates while continuing to document the cumulative impacts from sport fishing and climate change in order to inform decision-making processes at multiple levels and fisheries management on Sahtú.

Recovery of the Mining-Impacted Landscape in the Yellowknife Region (CIMP227)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/7-Jamieson_CIMP227%20presentation_Jan2025.pdf

The objective of our research is to determine what natural processes control the recovery of the landscape near Yellowknife that was polluted by stack emissions from the Giant Mine roaster, and how this recovery will be affected by climate change and unusual or severe weather events.

One focus is on how climatic events, especially sudden rainfall or snowmelt, affects how arsenic is transported from the soil through runoff into lakes. Another focus is on how arsenic in the soils changes over time, and whether those changes in mineral host results in increased mobilization of arsenic from soil to surface water, or enhanced storage of arsenic in the soil.

The processing of gold ore from mines in the Yellowknife area released large amounts arsenic trioxide that settled on the nearby landscape. More than 20,000 tonnes of arsenic were released from roaster stacks from Con and Giant mines between 1948-1999, most of it from Giant mine.

Although the contamination is not visible on the landscape, our previous research has shown that arsenic concentration in soil and small lakes is very high near the Giant mine and decreases with distance from the former roaster. We have also used a scanning electron microscope to show that the main form of arsenic in the near-surface samples taken within 15 km of the former roaster is arsenic trioxide which is a “fingerprint” for roaster stack emissions, since it would not form naturally in this environment.

For this project, our research was focused on three areas near the Ingraham Trail, located approximately 1 to 4 km from the former ore roaster. Soil was sampled in 2021, 2022 and 2024 by digging pits in various areas and collecting samples at different depths. These samples were analyzed for total arsenic and the mineral form of arsenic. Some soil samples that were taken near the surface were mixed with water and shaken for 24 hours to simulate interaction of precipitation and soil. Water samples were taken during the snowmelt period in late April and early May in 2023 from three different landscape types. Those samples were analyzed for total arsenic and aqueous arsenic species.

The results that we have so far indicate that the arsenic concentrations are much higher in the soil samples taken within the top few cm compared to those at depth, confirming contamination from the air. The total arsenic is as high as 2400 mg/kg, much higher than the Canadian soil quality guideline of 12 mg/kg. The shake flask tests indicate that arsenic is easily released from the near-surface soil to water. The relatively high concentrations of arsenic in snowmelt and runoff indicate that soil is still an ongoing source of arsenic to lakes. Other results are still being analyzed and are expected to help us understand how climate change is going to affect the way arsenic moves within soil and from soil to lakes. This will provide information to residents of Yellowknife, Ndilo and Dettah about the health of their environment and how this may change over time.

Boreal Caribou Habitat Enhancement – Lichen Restoration on Disturbed Sites (CIMP234)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/8-DKFN%20(dEntremont)%20-%20CIMP234%20Boreal%20caribou%20habitat%20enhancement%20Jan2025.pdf

The boreal caribou habitat enhancement project – lichen habitat restoration on disturbed sites – is a collaboration between the Deninu Kue First Nation (DKFN) and LGL Limited (LGL) that aims to accelerate the restoration of functioning winter range for boreal caribou in the South Slave Region and develop progressive reclamation prescriptions to allow for end land uses on disturbed lands that align with DKFN stewardship goals. The main objective of the project is to establish a terrestrial lichen transplant and monitoring program at the Pine Point mine, specifically on areas that were impacted by past mining activities. A reconnaissance survey of the old Pine Point mine was completed in the summer of 2023 where disturbed areas within the mine were examined and identified for potential lichen transplant locations. In addition, sites for the collection of lichen were also identified near the proposed transplant locations.

During this survey, members of our study team visited an experimental lichen seeding project near Kakisa, NT, being completed by Wilfred Laurier University (i.e., Dr. Jennifer Baltzer's lab). We met with researchers who were quantifying the environmental conditions and associated vegetative community structures best suited to support early lichen re-establishment, which helped to solidify the study design for our project. The intention was to return to the Pine Point area in August 2023 to complete the collection and transplant of lichen; however, field plans were postponed due to the community evacuations resulting from the forest fire events in the South Slave region.

Our study team returned to Pine Point in June 2024 and established 18 lichen transplant sites. Each site consisted of two 30 m transects. Along each transect were eight 1m by 1m quadrats where a paired design and different treatment types were used, including full, partial, and minimal enhancement, plus control quadrats. We placed the same quantity of lichen (3 L) in each quadrat and affixed lichen fragments to the substrate to reduce loses potentially caused by wind. We primarily collected the three most common species of native reindeer lichen: *Cladonia mitis*, *C. rangiferina*, and *C. stellaris*. Healthy lichens were collected by hand from areas near Pine Point where it was abundant, and no more than 20% of lichen cover was removed from these areas. Lichens were collected under moist conditions, stored in industrial garbage bags and transported to the transplant sites on the same day, when possible, to minimize handling and transport.

The speed of habitat recovery will be measured by monitoring the persistence and growth of transplanted lichen over a 10 year period, with monitoring planned 1, 3, 6, and 10 years post-treatment. In addition, the locations where lichen were collected will be examined during the monitoring period to document and compare the rate of natural recovery. The focus of analysis will aim to determine how fast lichen communities can regenerate by transplants versus natural re-establishment, and which treatments perform best. The integrity of the transplant sites will be protected by erecting signage in 2025. Future work associated with the project includes developing a protocol for transplanting lichen that can be applied to other sites within the boreal caribou range.

Environmental and Human Factors that Best Predict Boreal Caribou Survival and Population Trends in the NWT (CIMP247)

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/9-Boreal_caribou_survival_project_CIMP_results_workshop_presentation_Jan2025_v4.1.pdf

The boreal caribou national Recovery Strategy requires maintaining at least 65% undisturbed habitat within each caribou range to support self-sustaining populations. Under this framework, habitat disturbance is defined as the combined area of human disturbance (buffered by 500 meters) and wildfires up to 40 years old. Previous work in the NWT (CIMP202) found that boreal caribou select recent (0-10 year) burns during summer and shift to selecting unburned habitat (>60 years since fire) by late winter, suggesting that alternative ways of measuring fire disturbance may better predict caribou survival. Furthermore, annual fluctuations in adult female survival and calf recruitment rates in southern NWT monitoring areas – despite relatively stable levels of human disturbance over time – suggest that weather may be an important driver of population trends.

We used survival and calf recruitment data from seven population monitoring program areas in southern NWT to compare performance of area-based disturbance models from the national Recovery Strategy against models with alternative metrics for human and wildfire disturbance, and models with weather-related variables. Additionally, we tested a similar set of disturbance-based models to evaluate which factors best predicted individual adult-female survival. Here we present preliminary results from this work.

Among area-based models, human disturbance variables provided only marginal improvement over a null model in predicting adult female survival. Linear feature density and percent buffered human disturbance showed weak negative effects on survival. None of the fire-related variables tested were strong predictors of adult female survival. The top performing models predicting calf recruitment rates were linear feature density and percent disturbance from new fires in the year the calves were born ('0-year fires'). Both variables had significant negative relationships with calf recruitment. While fire models had less support overall, fires 1-40 yrs old or fires 11-40 yrs old were positively associated with calf recruitment. When comparing support for models with disturbance- versus weather-related variables, we found that models with the previous year's average snow depth best predicted adult female survival, with survival rates negatively related to previous year's snow depth. For calf recruitment, linear feature density and percentage of 0-year fire disturbance remained the best predictors.

At the individual scale, the amount of 1–10-year-old fire disturbance within home ranges best explained adult female survival and was positively relative to likelihood of survival. The second-best model indicated that likelihood of survival increased when fires made up a greater proportion of the total disturbance footprint in an annual home range.

Next steps include testing additional variables for weather, fire and proportion of highly selected habitat, and hopefully incorporating caribou data from adjacent ranges in Alberta and BC. We will then integrate the top predictor variables into comprehensive models to predict adult female survival and calf recruitment. These global models will help explore whether alternative disturbance management thresholds could better suit the NWT. So far, our preliminary findings suggest that, while managing landscape disturbance remains critical, we may also need to consider effects of weather when setting disturbance management thresholds.

North Slave Métis Alliance Guardianship Program: A Two-Eyed Seeing Approach to Northern Conservation

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https://nwtdiscoveryportal.enr.gov.nt.ca/geoportaldocuments/10-NWT%20CIMP%20results%20workshop%20Jan%2015%202024.pdf

Indigenous Guardians are trained experts who manage and protect Indigenous lands, waters and ice on behalf of their communities. NSMA's Guardianship Program aims to connect members to the land and gather important information about the overall health of the ecosystem in their Traditional Territory using a combination of Traditional Knowledge and Western Science.

One of the biggest obstacles to conservation in Northern Canada is capacity limitations in an extremely large area of study. In the Northwest Territories, less than 40,000 people live in a territory spanning 1.346 million km^2. Climate change, rising temperatures and loss of permafrost are having a significant impact on northern communities, peoples, biodiversity and habitats. Conservation of northern species, especially those that are culturally important to Indigenous people, is critical. The NSMA conducts biodiversity monitoring to investigate the presence and distribution of species in the North Slave region using a combination of eDNA analysis and environmental sensors. eDNA is a powerful, non-invasive tool that involves collecting water samples to identify species from fragments of DNA left behind in the environment such as skin, feces and mucus. We pair eDNA sampling with placement of game cameras (to detect mammals) and ARUs (to detect birds and frogs) with the overall goal of creating species baselines in the North Slave region to inform potential future conservation actions. Over the past five years, we have confirmed the presence of many different species of mammals, birds and amphibians, several of which are species at risk, and we are now beginning to track changes through the years.

In addition to general biodiversity monitoring, the NSMA Guardianship program runs a project dedicated specifically to monitoring caribou. Caribou hold significant cultural importance for the Métis of the North Slave region and NSMA members are extremely concerned about the decline of barren-ground caribou in the NWT, in particular, the Bathurst herd which has reduced in numbers by 98% since the 1980's. Several factors have been proposed to explain the dramatic decline of the Bathurst herd, including climate change, natural population fluctuations, and human disturbance. However, there is likely no single cause for the decline, but rather a set of combined threats that act cumulatively. Roads can create cumulative impacts for caribou in several ways. In addition to being a potential barrier to movement, roads allow vast regions of caribou habitat to become more accessible for sources of disturbance and mortality including vehicles, hunters, and predators such as wolves which use the road opportunistically. The NSMA winter road monitoring program investigates cumulative impacts of disturbances to caribou on the Tibbit to Contwoyto winter road through a combination of Guardian caribou patrols and remote sensory equipment. Data on caribou numbers, health, and disturbances are collected to evaluate the impacts of human activity on this culturally important species.

Indigenous Guardians have always been stewards of their lands, and their knowledge and presence are essential to effective conservation. The NSMA Guardianship Program exemplifies a Two-Eyed Seeing approach, blending traditional and scientific knowledge to strengthen both community and environmental resilience.