Flying into Frictioned Futures

Development of Canada's Northernmost Runways

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Abstract: In Nunavut, Canada's largest, youngest, and northernmost territory, gravel, asphalt, and concrete determine much of daily life. Airport runways' materialities dictate the types of aircraft that can land in each of the 25 fly-in communities and with them the cargo-carrying capacity, passenger mobility, and frequency of intercommunity connections. The last jet capable of landing on gravel was recently phased out of commercial service in Nunavut, a move that further limits access to communities and works counter to desires voiced by residents to increase jet access. Temporality, an immaterial concept, becomes intimately articulated through the physical realities of transport infrastructure in Nunavut. I examine the interplay of residents' imagined futures for their communities and the on-the-ground reality of developing, operating, and maintaining gravel and paved runways in Nunavut as points of friction, following Anna Tsing. I argue that the divergent development of communities can be partially attributed to the accessibility of transport infrastructure in each location. In conclusion, I question the idea of infrastructure as a promise of a "future perfect" (Hetherington 2016) and attempt to refocus the processes of Nunavut's transport infrastructure development onto Nunavummi-centred solutions.

Keywords: Canadian Arctic; transport infrastructure; materiality; friction; future; Nunavut; aviation

Résumé : Au Nunavut, le territoire le plus vaste, le plus jeune et le plus septentrional du Canada, le gravier, l'asphalte et le béton déterminent en grande partie la vie quotidienne. Les matériaux utilisés pour les pistes d'aéroport définissent les types d'avions pouvant atterrir dans chacune des 25 communautés desservies par avion, ainsi que la capacité de transport de marchandises, la mobilité des passagers et la fréquence des liaisons

intercommunautaires. Le dernier avion à réaction capable d'atterrir sur du gravier a récemment été retiré du service commercial au Nunavut, une décision qui limite encore davantage l'accès aux communautés et va à l'encontre des souhaits exprimés par les résidents qui souhaitent augmenter l'accès aux avions à réaction. La temporalité, un concept immatériel, s'articule intimement avec les réalités physiques des infrastructures de transport au Nunavut. J'examine l'interaction entre l'avenir imaginé par les résidents pour leurs communautés et les réalités concrètes du développement, de l'exploitation et de l'entretien des pistes en gravier et en asphalte au Nunavut comme sujets de discorde, à la suite d'Anna Tsing. Je soutiens que le développement divergent des communautés peut être partiellement attribué à l'accessibilité des infrastructures de transport dans chaque endroit. En conclusion, je remets en question l'idée que les infrastructures sont la promesse d'un « futur parfait » (Hetherington 2016) et tente de recentrer les processus de développement des infrastructures de transport du Nunavut sur des solutions centrées sur les Nunavummiut.

Mots clés : Arctique ; infrastructure de transport ; matérialité ; friction ; avenir ; Nunavut ; aviation

Introduction

There are fifteen of us at the gate, a tucked-away area with two rows of seats and a small glass door leading out to the airport apron in Iqaluit, Nunavut. We have grown accustomed to each other over the past four days. I am the only Qallunaaq, or non-Inuit person. Everyone else is from Kimmirut: young families who were travelling for medical care, two young men who were visiting relatives, and a university student visiting home from Ottawa. Everyone is eager to make it this time. At this point, Kimmirut has not had a grocery delivery in six days. Milk and other staples ran out. Medication sits, boxed and cooled, waiting to be delivered in the next possible window. Today we have blue skies and low winds, a promising end to a turbulent week. In Nunavut, flying from one community to another is not simply a matter of booking and catching the flight. In this territory of the Canadian Arctic, aviation is the reason many of these communities exist, and it is one of the reasons people decide not to stay.

Kimmirut, formerly Lake Harbour, is one of Baffin Island's oldest settlements. As was common in the fur trade era, Kimmirut was established as a trading post for the Hudson's Bay Company in 1911, the first in the region. Today, according to Statistics Canada (2023), the community hosts a population hovering around 430, with many residents moving to the nearby territorial

capital, Iqaluit. Iqaluit was originally the site of a popular Inuit summer fish camp and is now a city of around 7,500 inhabitants, largely due to military aviation infrastructure investments (Statistics Canada 2022). As I will argue, the divergent development of these two communities is not uncommon in Nunavut and can be attributed to the accessibility of transport infrastructure in each location.

In this article, I examine how the materiality of transport infrastructure influences not only the present lives of residents in Nunavut communities, but also their desires for the future. I give a short introduction to the importance and transformation of transportation in Nunavut before delving into the specificities of materiality, infrastructure, friction, and temporality for the purposes of this article. To better understand the context of my work, I provide a brief description of my methods and field sites before moving to a discussion of first gravel, then paved runways in Nunavut. In the second half of this article, I zoom out from the material makeup of runways to consider the importance of these airstrips for Nunavut residents in the future development of their communities. In conclusion, I question the idea of infrastructure as a promise of a "future perfect" (Hetherington 2016) and attempt to refocus the processes of Nunavut's transport infrastructure development onto Nunavummi-centred solutions.

Importance and Transformation of Transportation in Nunavut

> K: Would you consider sea ice a type of infrastructure?
>
> S: Only seasonally, only in winter, where we use it for our highway. Actually, in winter, we're more mobile on the land, even inland, because we can skidoo anywhere. Where during the summer, we're pretty much confined to the coast. A lot of us can't go inland because there's no infrastructure to go inland. Nor do we have the vehicles to be able to go inland. Even four-wheelers, you can only go so far because of the rivers, all the rivers and lakes. Four-wheelers can't go through that. And often it's very rough, that's not feasible either. … But in winter, anywhere there's ice or there's snow, you can pretty much go anywhere. So, we have more freedom in winter. It's our highway in wintertime. (Simeonie Akpalialuk, Iqaluit, February 2023)

Movement, dynamism, transformation, nomadism, mobility, and transportation are all at the core of successful life in the Arctic (Inuit Circumpolar Council - Canada 2008). Today, the majority of Nunavut residents

live a sedentary lifestyle in one of 25 communities in their territory. Over the last sixty years, the territory has undergone a rapid transition from igloos, dog teams and nomadic hunting to apartments, airplanes and wage labour (Damas 2002). Nunavut itself was established through a land claims agreement (NLCA) in 1993, overseen by what is now known as Nunavut Tunngavik Incorporated (NTI), the Inuit-led non-profit corporation responsible for administering the NLCA. Today, the territory has its own legislature and territorial government, the Government of Nunavut (GN). While modes and reasons for travel have shifted over these decades, mobility and transportation remain at the heart of life in Nunavut. Today, hunters and harvesters are reliant on their ability to travel in search of animals; students and trainees rely on their ability to access necessary educational institutions via airplane. Mothers fly to Iqaluit or Ottawa to give birth, while family members visit their elderly in care facilities down South. Social networks that were once maintained throughout Inuit Nunangat (the Inuit homeland) are now facing challenges due to the cost and availability of transportation.

Nunavut is not connected to the North American highway network; there are no roads between communities or to Nunavut. Instead, travel and transport to and from the territory runs via aviation or maritime routes, the former affected by extreme weather and fuel cost, the latter by sea ice coverage. At the same time, thanks to infrastructural developments, a greater variety of products can be circulated throughout the territory via sea lift, air freight, or snowmobile. Airplanes initially landed on ice runways or on sandbars near communities, but upgrades, increased use, and the now fickle Arctic climate solidified today's predominantly gravel airstrips. Distances that used to be crossed on foot, by dog team, or kayak can now be covered in a shorter amount of time, benefiting local economies, tourism, and medical services, as well as increasing the accessibility of higher-level education opportunities. Despite these beneficial effects of colonial infrastructure, the discourse around transport infrastructure in Nunavut has only recently brought concerns of proposed development projects' local use and value to the forefront of decision-making, alongside the possible economic and politically strategic opportunities.

Materialities and Temporal Imaginaries

According to Daniel Miller (2005, 2), the current focus on materiality has centred our relationships with the material world as a "driving force behind humanity's attempts to transform the world in order to make it accord with beliefs as to how the world should be." Materiality is discussed as transformative, affective,

"vibrant" (J. Bennett 2010), and an act of resistance when materiality is denied or altered in its realization (Kinder 2023). Throughout life, we constantly navigate changes in materiality around us and influence those changes ourselves. In this relational process, materiality is formed to create objects, structures and spaces we might identify as the built environment. Infrastructure is one expression of the built environment, one expression of materiality.

One of the most important materials for travel and transportation in the Arctic is sea ice. As Simeonie describes in the previous section, the sea ice is "our highway." While his words are undeniably true, this is not the type of infrastructure I have chosen to concentrate on here. Instead of following infrastructure carved into or onto naturally occurring, elemental landscapes, I am interested in anthropogenic infrastructure made of conglomerate materialities: a mess of materials that together create something unnatural, new and altered in the landscape. Due to the central importance of aviation in the North, I have chosen to concentrate my discussion on airport runways, or airstrips in this article. Following Brian Larkin, infrastructure is a network facilitating flows of matter, information or ideas over space (2013). Anne Spice writes of the colonial process behind the development of oil and gas pipeline infrastructure on Indigenous lands (2018), an infrastructure not present in Nunavut, yet Spice's critique of "infrastructure" is valid in the northern context, too. As a middle-aged Inuk[1] woman told me in Iqaluit,

> "You would never think that we have such a great background of great travels. But the system put it so that we no longer travel. That we are now dependent on this fuel, fueled airplanes. Whereas before everything existed, they walked. Dog teamed. Travelled by boat. Not one mechanical thing and they travelled throughout the North."

Her reference to "the system" illuminates the connection between locally lived transformations and global processes such as capitalist expansion, fossil fuel dependency, and the use of infrastructure as markers of nationhood and sovereignty. Today, Nunavut's airports are considered a lifeline, delivering people, medical services, food, water, goods, and building supplies. The territory's airports function like the legs of a table: each one must stand alone to uphold the entirety, and without one, the whole system shifts and may collapse. The instability of Nunavut's transport infrastructure is also an instability in Nunavummiut's[2] access to daily necessities. As a lifeline, the ways aviation functions in Nunavut help determine the opportunities and restrictions of daily life. The materiality of the airport, the runway, and the airplane influence how

aviation is organized and connected in Nunavut, consequently shaping the ways life can be lived now and in the future. While aviation infrastructure was built with a colonial agenda, and Nunavummi livelihoods have been irreversibly altered by their development, aviation is now integral to northern life, albeit not completely accommodated to northern realities.

Akhil Gupta suggests examining infrastructure through the lens of "infrastructural time," a time that is dynamic, as though following the lifetime of a living being through its processes (2018). Just as with living beings, infrastructure is never at any point "complete;" it is simply at the stage it is at in that given moment. The temporalities of infrastructures differ drastically depending on their materiality, intensity of use, and ecosystem suitability. Infrastructures' temporalities, their "relationship[s] to time" (Bryant and Knight 2019, 9), are largely determined by people who design and use them. Notably, transport infrastructures partially reciprocate this determination, as they determine many of the paces of our daily lives, enabling and restricting our movement. Furthermore, infrastructure is commonly discussed as a material development of possible futures, and as a consequence, the material limitation of futures (for example Anand, Gupta, and Appel 2018; Buier 2022; Hetherington 2016). By building one future, other futures remain imagined.

How then, do certain futures come into being while others do not? I use temporality and materiality to think through Nunavut's airport runways as sites of friction both metaphorically and analytically in the sense of the physical force and in the sense evoked by Anna Tsing in her study of global interconnections, which she situates in the "sticky materiality of practical encounters" (2005, 1). Her conceptualization of global encounters describes a dynamic wherein, at any point in time, there are forces that strive for continuity and forces that strive for change: together, these forces interplay at points of friction (Tsing 2005). Friction creates movement, motion: physically, for example, as airplane wheels spin on gravel, snow, or pavement, and metaphorically in the creation of ideas, policies, or agendas.

Throughout Nunavut's history, desires for continuity and change have gone hand in hand: Inuit leaders mobilized frictions to create the NLCA and ensure continued representation of Inuit knowledge, rights and ways of life. Historically, Inuit involvement in the trade system created both the necessity and a desire for foreign goods such as firearms and bullets, which in turn supported harvesting activities and families. During the colonially induced creation of federally administered communities in Nunavut, imposed mandatory schooling

created a desire among many Inuit to live in these communities, close to their children, to continue their role of mentoring younger generations in Inuit Qaujimajatuqangit (IQ)[3]. Today, long-distance mobility is largely restricted to aviation dependent on fuel, aircraft and runway infrastructure, but necessary for travel to other communities or outside of the territory. The social mobility of many Inuit, combined with the centralized development of administrative and medical services in Iqaluit and Ottawa, means Nunavummiut have needs and expectations towards aviation that do not always align with the current services. Within this context, I examine Nunavut residents' desires for the future to ask: If infrastructure is seen as a material development of possible futures, how can these points of friction be utilized to create aviation infrastructure more attuned to Nunavummi needs?

Methods and Fieldsites

I conducted ethnographic fieldwork in five communities of Nunavut's Qikiqtani region from August 2022 to December 2023. My first visit to the territory was in May and June 2022 to discuss my project idea with local stakeholders in an effort to align our interests. The research for this article was conducted as a subtheme of my overall dissertation topic on the role of transport infrastructure in Nunavut's food sovereignty, which is embedded in the ERC Advanced Grant project "InfraNorth." My focus on food sovereignty emerged through discussions during my preliminary fieldwork. My lens on runways derives from my personal experience travelling between communities and realizing the drastic differences between local infrastructures and their effects on everyday community life. This research is licensed by the Nunavut Research Institute, whose employees guided me throughout my fieldwork.

Over a period of around one year, I spent most of my time in Iqaluit and made two trips each to Kimmirut, Pond Inlet, Resolute Bay and Grise Fiord, all of which are fly-in communities. Iqaluit, established during World War II, is the largest settlement in Nunavut. The communities as they exist today were created through colonial involvement, for example, through trade, residential schools, resource prospecting, or military interests, as was the case for Grise Fiord and Resolute Bay during the forced High Arctic relocation. While they vary in size and topographic accessibility, all airstrips in the Qikiqtani region, excluding the Iqaluit runway, are made of gravel. Residents connect through Iqaluit to leave the territory, cementing the capital's role as a political, social, medical, and travel hub.

Figure 1. Field sites in Nunavut. (Map by Alexis Sancho-Reinoso)

During my fieldwork, I joined interlocutors on hunting trips, grocery runs, work meetings, and meals, at concerts, their homes, or the airport, among many other places. My decision to conduct research in five communities allowed me to conduct autoethnography while flying within, as well as to and from, Nunavut. I engaged in participant observation at the airport gates, on flights, awaiting baggage and passenger pickup, and following airport employees around airside or in their offices. I visited each community during both frozen and dirt runway months to experience the seasonality of the materials. Following methods of qualitative data collection, I conducted semi-structured and open interviews, hosted focus groups, wrote ethnographic fieldnotes, and took photos and videos in each community. I conducted interviews and hosted a series of workshops in which we discussed future scenarios for the community, ending with each participant coming up with their own desired scenario. The data described and analyzed in this article derives from these interactions, collected over months of participant observation and literature review, as well as many informal conversations with interlocutors.

My position as a young, at the time single, woman of European descent with funding from a European organization placed me among the wealthy from the perspective of many interlocutors. This was in many cases true, in comparison to local financial situations, yet also caused frustrations on both sides when residents expected me to be able to provide funding for local projects and infrastructures. At times, the fact that I was a single woman

restricted the situations and people I could interact with in order to avoid inflicting jealousy on others. I took care, for example, to meet young men in public places. Nonetheless, I was able to speak with men and women ranging in age from their early 20s to their 70s and with various backgrounds. My interactions focused primarily on young adult community members[4], many of whom are hunters, young parents, or government employees. This demographic was especially interested in sharing their ideas, hopes and demands of what Nunavut should become in the future. I also spoke with elderly community members, who shared historical perspectives through their own experiences and offered suggestions for the coming decades. The majority of research participants identify as Inuk; however, this research was not restricted to the Inuit population of Nunavut.

Materiality's Frictions

Imagine you are sitting in an airplane, about to embark from Toronto International Airport. You look out the window onto the runway, a smooth, paved strip with guidelines painted on its surface, connected to other paved areas and marked by lighting. You likely entered the plane via a jet bridge, or by bus and stairs. Airside vehicles of all shapes and sizes drive by. The airport is teeming with employees, all working together to ensure your safe and timely travel.

The average runway in Canada is 8,000 to 13,000 feet (2,438 to 3,962 m) in length and paved (Dargie 2016). In Nunavut, all but two runways in the territory are made of gravel. Iqaluit's paved runway is the longest at 8,605 ft (2,622 m), at the low end of the national average. The remaining communities have airstrips around 3,500 to 4,000 ft (1,066 to 1,219 m) long, with the exceptions of Kimmirut and Grise Fiord, whose runways are both under 1,700 ft (518 m), and Resolute Bay's 6,504-foot (1,982 m) gravel runway, which acts as a forwarding base for the Canadian military (Government of Nunavut 2023). This almost complete reliance on gravel runways is somewhat unusual compared to other Arctic regions, such as Norway and Finland, where most communities have paved runways, or Greenland and Russia, which combine airplanes with helicopters for passenger transportation (Meyer, Adams, and Elixhauser forthcoming). While Nunavut looks to Greenland for infrastructural inspiration, East Greenland looks to Iceland, and other Nordic countries seem comparatively successful in developing regionally appropriate networks (*ibid.,* and Elixhauser 2023). The majority of Nunavut's runways are substandard and do not conform to national regulations, with insufficient lighting, surface material, border

fencing or length (Government of Nunavut 2014), but they continue to operate, and as lines for the transportation of goods and people, it is vital that they do. In the following section, I discuss the differences between gravel and paved runways in Nunavut and their materialities' impact on daily life.

Gravel, Ice and Snow

Gravel is considered predictable and reliable in the Arctic, where the land is made of shifting permafrost tundra and rock (Krause 2022). Gravel is a geologic resource necessary for infrastructure in the north. However, it is not legally recognized as a resource, as described in the NLCA (Indian and Northern Affairs Canada and Tungavik 1993). Instead, gravel is catalogued under "specified substances," which Inuit and Nunavummiut have the right to access and use, even on non-Inuit-owned lands (*ibid.*, art. 1.1.1. and 21.6.1.). This is noteworthy because, as Mia Bennett points out, in the North, gravel is a resource and material of power: the power of building tomorrow (2023). Unfortunately, gravel is in "short supply" in North America (Bennett 2023, 1189), and regardless of the size of gravel-suitable deposits, the granular material is not easy to acquire or work with under Arctic conditions.

The gravel runway is built using a stockpile of crushed rock, which takes about two ice-free seasons, or two years, to make. The "crusher" machine is sent up from one of Canada's southern ports and delivered via sealift during the summer. Once rock is crushed to an adequate size, an "overlay" made of 15 cm of gravel is distributed on the already compacted airstrip foundation (Government of Nunavut 2014). This lasts for about seven years, with daily maintenance including hole filling, flattening, and snow clearing. After this period, another overlay is necessary, which holds another seven years, after which major maintenance work must be conducted. As such, the average lifecycle of an Arctic gravel runway is around 15 years. (Government of Nunavut 2014; Nunavut Tunngavik Incorporated 2020). This is within the globally-anticipated lifecycle of a gravel runway, between 10 and 20 years (for example, Midwest Industrial Supply, Inc. 2024).

However, as Adam Martin, the owner of a consulting company for aero engineering with a long history of working in Nunavut, described to me, crushing, moving, and then storing rock carries significant cost, which is a struggle for some communities "to maintain and be able to prepare their runways and keep them in operational condition." The precarity limited gravel places on communities is further illuminated in an entry written by the hamlet of Grise Fiord in the 2023–2024 logbook for community and government

Figure 2. Gravel runway in Kimmirut, Nunavut, September 2022 (Photo by author)

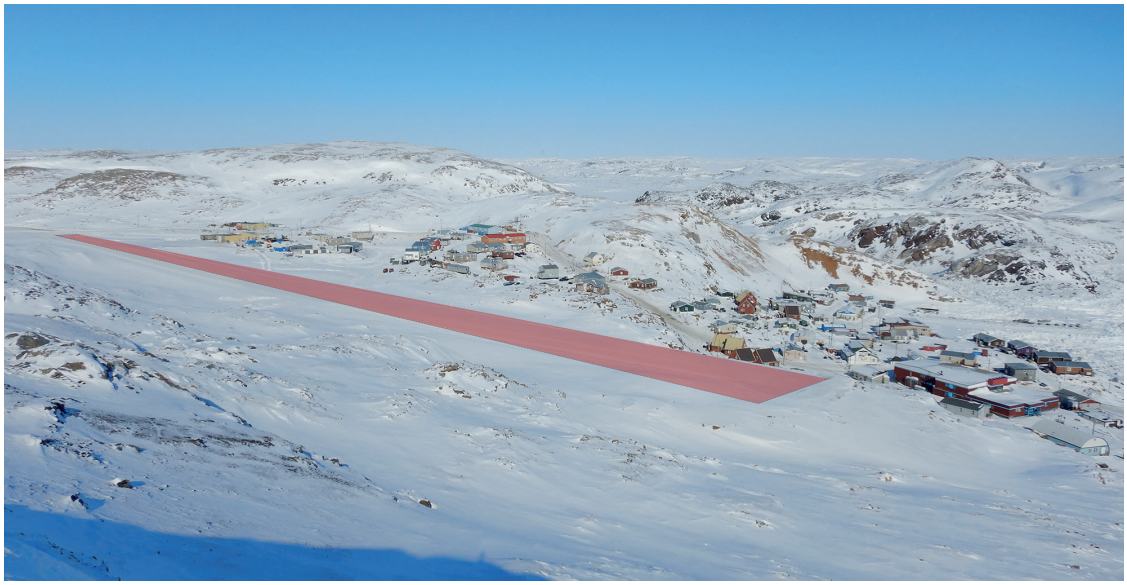

Figure 3. Kimmirut runway, marked in red, covered in ice and snow, March 2023. (Photo and red arrow by author)

services: "The runway needs gravel, since the surface is mainly skeleton and large rocks have started to surface. The frequent heavy winds have taken a toll on the surface." (Government of Nunavut 2024).

For most of the year, gravel runways do not look like the one in Figure 2. Instead, they are covered by snow and ice (see Figure 3). The altered material composition of the runway surface influences the friction produced by the airplane wheels during takeoff and landing, as the wheels' traction varies depending on the contact surface.

Regular maintenance is required on the runway to ensure the surface is flat and snow and mud are removed and compacted. Nathan Qaunaq, who works at the airport in Grise Fiord, describes how maintenance is dependent on season and weather:

K: Do you take care of the runway every day there's a plane landing?

N: Just if it snows. And in the summertime, we'll go in there every two days to compact it.

K: Every two days?

N: Something like that.

K: Do you have to do it more often in the winter or the summer?

N: It depends on the conditions. In the winter, if it snows a lot, we'll go in way more.

K: Isn't there a time in spring when it's super mucky?

N: There's about an inch of snow, an inch or less, so it'll melt out pretty quick. And then it's fine with the gravel because you can compact it and the runoff is good enough.

Gravel is not only important as a material providing friction, but also as a foundation suitable for Arctic conditions, where the ground is heavily waterlogged during the spring and summer months. The temporality of the runway's foundation, permafrost, and its winter surface, compacted ice and snow, is shifting as the climate warms rapidly. Precipitation and extreme weather events are increasing, changing levels of snowfall and ground saturation (Clark et al. 2022). The depth of the gravel pad for the runway will need to increase as permafrost thaw advances. This is costly not only in monetary terms but also on a broader scale of infrastructure development. With a limited source of gravel available and aviation as a lifeline for northern communities, runways will be prioritized while other projects addressing basic needs, such as housing foundations, may face challenges in procuring enough gravel to build foundations suitable for the Arctic ecosystems (Bennett 2023). These material constraints impact daily life in the communities.

Here is an example: We are flying to Kimmirut. In March, it took us three attempts over a span of four days to reach the hamlet. The plane was packed with people. Every seat was taken, and the seats on the right side, the wider seats, were filled by two people per seat, and they are small. Tight quarters and

no cargo in the front. A strong contrast to my last flight in a DHC Twin Otter after the Kimmirut Trail in September, when we each had a seat to ourselves, the front was full with our backpacks, and I could stretch my legs out. This time, we sat thigh to thigh, in our parkas, hats, and mitts, with carry-on luggage between our legs. The windows were frozen over. We took off and were soon in mostly white, low-visibility conditions. This, combined with the frosty windows, made it nearly impossible to see anything below us. After about half an hour (the time it takes to Kimmirut flying south) we dropped a bit and could see more of the rolling mountainous landscape. Dropping…dropping….and then the cockpit got busy again, pilot and co-pilot smoothly shifting the handle that seems to control the acceleration. We started ascending again. Ascending and turning. My seat neighbour looked at me and asked, "Going back?" I shrugged, it seems so. Once we'd stabilized at the desired altitude, the pilot, Scott, turned around and spoke into his microphone, "Can you guys hear me?" The intercoms on the ceiling of the plane transmitted his voice. I nodded. "Just as we were reaching Kimmirut they updated the winds, and they are way too high, so we are going back to Iqaluit, and they'll try to put you all on another flight."

For context, Kimmirut's runway is the second shortest and most challenging runway to land on in Nunavut. This has several reasons: The de Havilland Canada-6 Twin Otter, which is a Canadian Short Takeoff and Landing commuter plane, is built for these conditions, but even so, landing on a short, inclined, gravel runway has its challenges in any weather, not to mention extreme weather events common in the Arctic. Secondly, the useful carrying capacity of a Twin Otter is limited by the amount of fuel it has to carry and the weight it is allowed to have on descent and landing. In Nunavut, the average load is between 3,300 and 2,600 pounds, depending on fuel availability at the destination community and the distance between communities. For the Kimmirut route, the Twin Otter carries a maximum of 15 passengers, depending on cargo weight; more often than not, it is only able to transport eight people per flight.

Restrictions in cargo and passenger capacity have direct negative effects on medical services and food security, creating a desire among many Nunavummiut to have their community serviced by larger aircraft. In fact, a gravel runway does not automatically mean smaller aircraft: Resolute Bay's gravel airstrip is accessed by turboprop ATRs, Twin Otters, and the occasional C-17 Globemaster belonging to the United States Air Force, among others. Baffinland's Mary River iron ore mine has a gravel air strip serviced by a Nolinor 737-200 combi, the only

remaining jet aircraft capable of landing on gravel. Gravel is not the limiting factor here; it is the aircraft. Resolute and Baffinland's runways allow for high traffic and several sizes of aircraft; however, all of these must be classified for gravel. Therein lies the challenge.

Adam Martin of HM Aero explained to me that since Boeing and Airbus are no longer making gravel-suitable jets, the available airplanes are limited in number, and they are getting old and expensive to maintain. This affects passenger safety and fuel efficiency, which, in turn, affects cost and carbon footprint. He continued, "As time goes on, these airplanes are becoming more and more obsolete, and we're not really seeing any of these large airplane manufacturers coming up with any alternatives for that." In May 2023, Michael Rodyniuk, the then CEO of Canadian North, the sole commercial operator in the territory, hosted an open house in Iqaluit where he further underlined the challenges associated with serving Nunavut communities:

> We're still running on gravel runways and specialized equipment. Even the modern ATR turboprops that we operate, we have to invest heavily in those aircraft for them to be able to fly into the North because they need special skins on the belly of the aircraft. They have to have special deflection panels around the wheels, and they have to have unique piloting skills and training to land in the North because there's gravel. And gravel isn't kind when it comes to aircraft. (Transcript of public event, Iqaluit, 24 May 2023)

In the discussion of aviation's service to communities with gravel airstrips, frictions occur between the ecosystem suitability of the gravel runway and the discontinuation of gravel-approved aircraft. While 737-200 combis are still being used to service Nunavut's biggest mine, Canadian North discontinued its jet service to Cambridge Bay's gravel airstrip, switching instead to the smaller ATR in late 2022 (Kennedy 2022). Even so, the dream of jet service and paved runways is very much alive in Canada's northeast.

Paved Tundra Takeoffs

"If President Biden wanted to visit Kimmirut, I think that's the only way Kimmirut would get a bigger runway. That's how Iqaluit got a runway, is by the military." (Rosie Akavak, Kimmirut, March 2023)

Iqaluit and Rankin Inlet are the only communities in Nunavut with paved runways, both of which were paved by the military. Iqaluit's runway and adjacent infrastructure were built and financed by the United States as the Crystal Two

air base, later bought by the Canadian government in 1944 (Clark 2022). Rankin Inlet's runway was extended and paved in 1994 by the Canadian Department of National Defense and now functions as a forward operating station for the Canadian air force. Although their runways are a rarity in Nunavut, the stories of these two communities are not unique. Indeed, they speak to a reality of infrastructure development in the territory that continues to this day, where predominantly outside interests direct what gets built, when, where, and by and for whom.

The idea of a paved runway is enticing for many Nunavummiut who wish to see their communities grow in size and prominence. With a paved runway, jet service may follow, and with jet service, other amenities may be built. A resident of Pond Inlet explained to me, "Our community is thinking to become a High Arctic community hub. … And if we become a hub, if we have health centres and if we have jet service, those communities that I mentioned would go to Pond, hop on a jet, go to Iqaluit, and then go further South." However, the GN does not have any immediate intentions of converting further runways. Here is an excerpt of a conversation with John Hawkins, Assistant Deputy Minister, Transportation at GN and Paul Crenson, Airport Operations Manager at Iqaluit International Airport for the GN:

> J: Paved runways are *hard* to maintain compared to-, it seems like a gravel runway would be hard, difficult to maintain, but they're actually less challenging to maintain.
>
> P: Even more so up here in the Arctic, where your geological conditions - there's a lot, much more movement in the ground with the thaw … Just in general, the life cycle of something paved is going to be a lot shorter because of the geological conditions that exist in the permafrost.
>
> J: Extremely hard to put a rigid structure on top of permafrost. These two runways that we have, that are paved, both have severe challenges.

Although a paved runway may seem to be more complete, more static, in its presence than a gravel runway, the lifespan of paved runways averages around 15 years, similar to a gravel runway. The airstrip is built and then requires minor maintenance, like pulling weeds or filling in cracks, for 10 to 15 years (Bouchard 2020). However, getting the material to make a paved runway up to a community in Nunavut takes a lot of planning, at least one sealift season and the practical know-how of paving. With permafrost thaw and changing weather patterns, freeze-thaw events cause the frozen ground to shift more often, allowing seeping

Figure 4. Cracks on the runway at Rankin Inlet airport. Satellite image taken 14 June 2023 (Google Earth 2023)

water to collect in indentations. The water freezes and cracks the tundra apart, forming ice wedge polygons. In an attempt to slow such thaw effects, both of Nunavut's paved runways were built with an insulating layer of high-grade Styrofoam[5]. However, instead of halting the cracking, the insulating layer has only changed the location of the cracks, which now develop at the edges of the Styrofoam slabs (see Figure 4, Google Earth 2023). As a result, the lifetime of paved runways in the Arctic is shorter than in non-permafrost areas further south. The repairs necessary on Nunavut's paved runways are expensive and time-consuming, requiring the runway to be partially blocked off when cracks jut across the entire strip, impeding regular service. One interlocutor suggested to me that Rankin Inlet's runway is in such poor condition, "They should just rip up the pavement and go back to gravel—but that's never going to happen."

Why is it highly unlikely Rankin Inlet would ever do such a thing? Because paved runways are more than their materiality. Nunavut's paved runways are hubs for population, medical services, and commercial transport. In fact, they were made into hubs purposefully, with the choice of paving the runway. The only purpose of a paved runway in the Arctic is to improve access and thus enable the region to become a hub for cargo and passenger transportation.

Paved runways tend to service larger airplanes: turboprop ATRs, Boeing 737s, and jet aircraft. People and goods are flown to the hub, where they are then transported to different communities using smaller aircraft. In this way, the materiality of the runway and those who decide on the materiality simultaneously decide that the future of the community or region in question is to become a hub. Infrastructure development decisions are, therefore, socio-material decisions which have direct consequences for social lives and material realities in these areas (Elixhauser 2023; Ren 2023).

According to Akhil Gupta (2018), infrastructure is, among other things, a (bio-)political, aspirational process, a material manifestation of what the future might entail. But when there is a discrepancy in future musings, this influences infrastructural investment, which, in turn, influences what futures are possible, and for whom. Expectations of infrastructures do not always align with what works in the Arctic, or what people think the infrastructures will bring with them.

Futures, Flights and Frictions

The GN, a public government heavily reliant on transfer payments from the federal government, and NTI, financed by the land claims transfer and royalties from resource development, signed a devolution agreement with the federal government in January 2024, wherein land and resource rights are transferred to the two territorial powers (Government of Canada; Crown-Indigenous Relations and Northern Affairs Canada 2024). From April 2027 onwards, territorial rather than federal decision-makers will determine what infrastructure is built. Nunavut's political situation is better equipped today to investigate and follow the desires of Nunavummiut than it was 25 years ago. Yet frictions remain where the often conflicting GN and NTI have overlapping governance structures and financial dependencies (Rodon 2014), in a region that costs more than it produces, and political representation down South is limited by Nunavut's small population. While Nunavut receives significant federal funding for infrastructure development, funding packages and policies surrounding these infrastructures are often discussed and developed in southern boardrooms, based on limited knowledge of northern realities. Deborah Cowen writes, "Infrastructures thus highlight the issue of competing and overlapping jurisdictions – matters of both time and space." (2017).

As Tsing makes clear, frictions need not simply be points of resistance; instead, frictions can lead to sparks of something new (2005). Recalling the framing of materiality and infrastructure as transformative, it is especially important to understand Nunavummiut perceptions of infrastructure development in regard to territorial future-making. The GN has only had control over their airports since 1999, when it took over this responsibility from the Northwest Territories. Now the GN is making decisions about whether to renovate—that is, continue to do maintenance on a piece of infrastructure—or replace each runway and aerodrome. NTI explained in its report on the state of the territory's infrastructure that the path forward should not continue with the transfer of infrastructure built for southern conditions and implemented in the Arctic. Instead, infrastructure needs to be examined "within the context of Northern and Inuit-specific realities" (2020). A re-evaluation of the territory's aviation infrastructure may be an opportunity to re-examine the realities NTI is referring to. Paying heed to points of friction could present new opportunities.

In a 2015 study, Widener, Saxe, and Galloway concluded that Canada's northern runways would significantly improve air service if extended in length (2017). During the future scenario workshops I hosted in Resolute Bay and Grise Fiord, the topic of aviation was mentioned repeatedly in connection with the community's future well-being. Figure 5 shows a scenario sketched by a workshop participant in Grise Fiord in June 2023. Alongside a transition from diesel to renewable energy sources, the scenario suggests extending the current runway (lower left) and revitalizing and extending the old runway (lower centre). Such changes would create a second approach for aircraft, which could be an important option in southern Ellesmere Island's heavy wind region.

As Rebecca Bryant and Daniel Knight eloquently convey, temporalities have different depths, layers, and urgencies (2019) depending on their subjects. When it comes to building infrastructure, multiple temporalities converge: the temporality of actors planning, building and using the infrastructure, and the temporality of the materials that make up the infrastructure itself. In Nunavut, all construction materials and machines must be ordered well in advance and then shipped up from southern ports, making the temporality of construction dependent on logistics and seasonality. When access to materials is seasonally restricted, funding allocation is largely determined by outside sources, and the building season is short. Infrastructure, too, has various depths, layers, and urgencies. A longer runway could bring many potential benefits to Grise Fiord; however, securing the community's drinking water supply is at the top of the

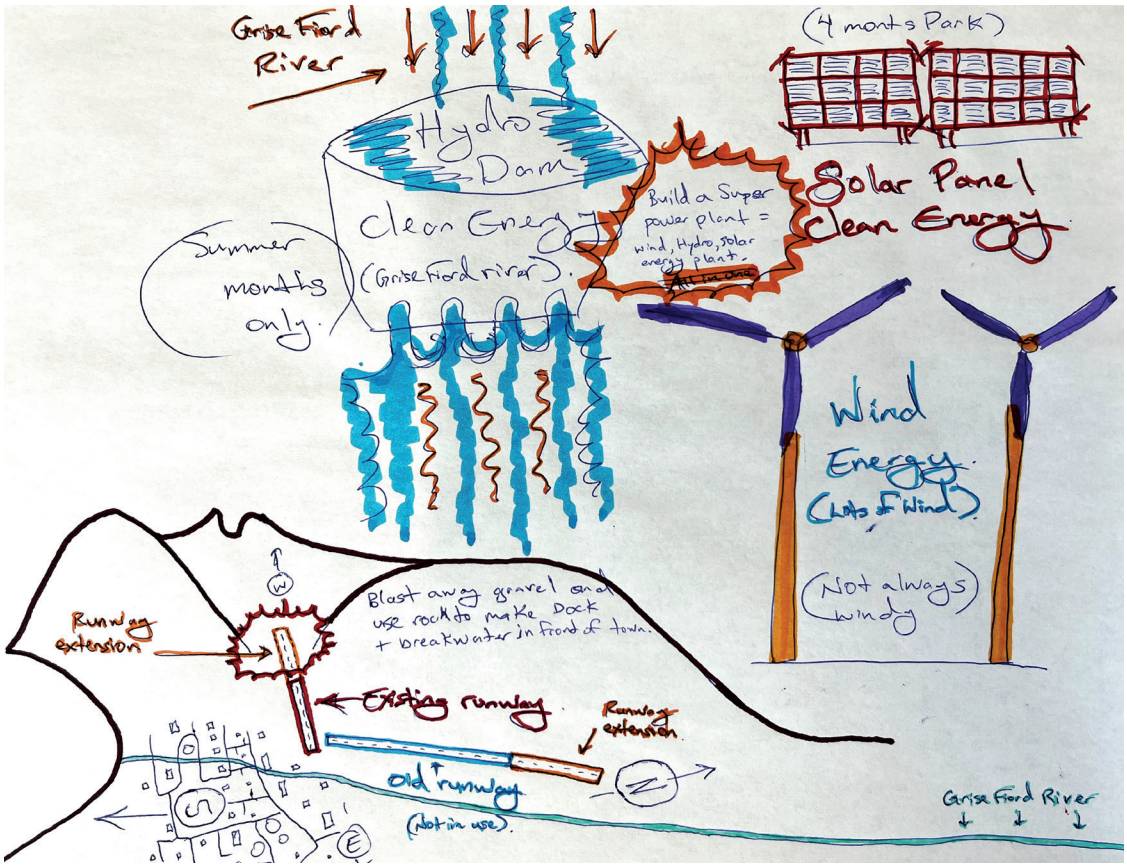

Figure 5. Workshop participant's brainstormed desires for the future of their community. (Photo by author)

hamlet's agenda. The fickleness of infrastructures supporting primary needs such as clean water waylays the desire for other future developments. The Kimmirut airport has needed an upgrade for decades, yet when asked about infrastructure priorities, residents first mention housing, government offices in town, and less dusty roads because, as Rosie Akavak explained to me in March 2023, "We don't have enough jobs, so people move. If we had more, Kimmirut would be more. It wouldn't just be a home to us. It would be more."

Decisions about infrastructure are made based on knowledge of the past and imaginations of the future. In so doing, they enable certain futures while disabling others. In its young history, Nunavut has moved from colonial administrative control to semi-autonomous territory with a predominantly Inuit government. The long-term effects of having leaders at the forefront of infrastructure development who understand the importance of IQ and know the territory's history remain to be seen, but if "the future is faced using knowledge of the past," then locating decision-makers in the territory whose future they are deciding seems to be a step in the right direction (Bryant and Knight 2019, 10).

Conclusion

> "We will want to benefit as much as everything surrounding us. They seek our support to protect it [the High Arctic region]. And yet, because we're not a hub for an airline we lose out all the time." – Resident of Grise Fiord, April 2023

Although processes of colonialism have differed across Canada, the traumatic, disruptive influence of colonialism in Nunavut is undeniable. The comparatively late year-round presence of Qallunaat (enabled by aviation infrastructure), rapid establishment of permanent settlements, and Inuit-led land claims negotiations make Nunavut's colonial transformation distinct. The influx of Qallunaat into Nunavut is part of the ongoing settler colonial movement in Canada. As Patrick Wolfe remarked, in settler colonialism, "invasion is a structure not an event" (2006, 388). Anne Spice cites Wolfe as she writes, "If settler colonialism is a structure that 'destroys to replace' (Wolfe 2006), then transportation infrastructures are themselves settler colonial technologies of invasion." (2018, 45). As this article has shown, airports and airstrips are a "lifeline," a network of critical infrastructure without which life in Nunavut would be very different. Simultaneously, aviation infrastructure's evident role in reshaping ways of life (from childbirth, education, and access to food, to name but a few) should not be ignored in an analysis of colonial influence on the territory. The fixed routes and schedules of aviation and sealift in Nunavut, combined with centralized medical, educational, transportation, and administrative services in Iqaluit, have created a dependence on invasive infrastructures in all stages of Nunavummi life. In an effort to disrupt these infrastructures' potentials to further perpetuate settler colonialism, transportation developers must think beyond the immediate, southern-style use of said infrastructures and instead sit with northern residents to plan infrastructure that does not redirect northern life and aspirations, but assists and aligns with them. The choice of runway material is a significant and consequential factor in communities' economic and social capacities, as it determines accessibility and prominence. Thinking through the specific material and temporal realities that affect transport infrastructure in Nunavut is about Inuit self-determination and capacity building. It is about disrupting imaginaries inundated with settler-colonial perspectives concentrating on the economic and technological (Abildgaard et al. 2022), and instead daring to think of Inuit-led futures by placing socio-material dimensions to infrastructural investment at the forefront of discussions (Elixhauser 2023).

In the midst of all this potential for the future, I relate to Kregg Hetherington (2016): Don't fall into the trap of the future perfect. The future will not become perfect with infrastructure. It is much more complex. It is imperfect. In this sense, thinking about the future perfect captures an ambivalence required at points of friction, where objects and ideas are set in motion. Friction is necessary on a runway for aircraft to take off and land. This physical force is an integral component of Nunavut's lifelines. However, limited infrastructure concentrates the flows of people, goods, and medicine, and it also directs what people think can happen. In some areas of Nunavut, infrastructure embodies the desire for a bright, strong community; in others, it conveys a feeling of demise, a destiny that is beyond residents' control in a territory repeatedly deemed too expensive and too challenging, for investment. In Nunavut, the materiality of a runway is a deciding factor of a community's future precisely because extraterritorial interests do not regard gravel-classified aircraft as a priority investment. As the discussion in this article has shown, applying friction as an analytical lens in infrastructure discussions may support improved alignment of future development and desires to direct change in ways that embrace the socio-material specificities of Nunavut's territory.

Pond Inlet needs others to believe in their dreams, Grise Fiord needs others to understand their geographic limitations, but to continue to invest. Kimmirut needs a new runway and more residents to sustain its population. Resolute Bay and Iqaluit, along with every Nunavut community, need long-term engagement and investment, both from the federal government but also, most importantly, from within the communities themselves. All these require an understanding of what the lived realities in communities are; what it means when planes do not make it in for two weeks, or when the motor grader breaks down, there is no mechanic in town, sealift is months away, and it is mud season. From these specific tracings of people's interactions with transport infrastructure today, we can sit together and sketch how people might engage with infrastructure in the future and discuss what communities need now, whether in direct relation to transport infrastructure or beyond, in order to achieve the level of self-determination Nunavummiut have fought for.

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Notes

1 An individual of Inuit heritage.

2 Residents of Nunavut.

3 Inuit knowledge.

4 Aged around 18 to 35.

5 The material used for the Iqaluit runway is DuPont™ Styrofoam™ Brand Highload 40 XPS Foam Insulation.

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