Yukon University

A Qualitative Overview of Climate Change and Business Risks: An Analysis of Potential Risks for Canadian and Yukon Businesses

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0.0 List of Abbreviations

AMPs - Administrative Monetary Penalties

ATIP – Access to Information and Privacy

DFAA – Disaster Financial Assistance Arrangements

DFO – Fisheries and Oceans Canada

ENGOs – Environmental Non-Governmental Organizations

EU – European Union

GHG – Greenhouse Gas

ICT – Information Communication Technology

NAICS - North American Industry Classification System

NWT – Northwest Territories

RCP - Representative Concentration Pathways

SMEs – Small and Medium Enterprises

TCFD - Task Force on Climate-related Financial Disclosures

UNFCCC- United Nations Framework Convention on Climate Change

YESAA - Yukon Environmental and Socio-economic Assessment Act

YESAB – Yukon Environmental and Socio-economic Assessment Board

YG – The Government of Yukon

1.0 Introduction

A multitude of scientific studies and models have demonstrated that climate change is causing a fundamental shift in human and natural systems (Abdollahbeigi & Salehi, 2020; Er Kara, Ghadge & Bititci, 2020; Cavaciuti-Wishart, Heading & Kohler, 2024). While some parts of the business world have continued to plan expansion and growth as if the world remained in a state of stable status quo instead of fluctuating because of climate change (Revell, Stokes & Chen, 2010; Walker, Redmond & Giles, 2010; Thistlethwaite & Wood, 2018), others are realizing the risks posed by climate change and are beginning to change their practices in order to adapt (Lemmen et al., 2021).

Recognizing the risk that climate change poses to businesses, the United Nations Framework Convention on Climate Change (UNFCCC) – Adaptation Committee has sought to improve public awareness by creating a *Business Case for Adaptation*. The Business Case for Adaptation aims to spur private sector voluntarism and spur governments to take more concrete regulatory action if more voluntary actions were not demonstrably taken (United Nations Adaptation Committee, 2019). It outlines five categories of risk associated with climate change that will impact businesses globally: physical risk, price risk, regulation risk, reputation risk, and liability risk (United Nations Adaptation Committee, 2019).

This qualitative overview explores the risk categories described by the UNFCCC Adaptation Committee to the major categories of economic activity in the Yukon. As such, the objective statements for this paper are as follow:

> *O1: Apply the UNFCCC Adaptation Committee's risk categories to major categories of economic activity in the Yukon to inform local decision-makers of the potential risks to the Yukon's business community.*

O2: Understand to what extent climate change is expressly incorporated in Yukon Business' project plans and proposals.

O3: Expand the UNFCCC Adaptation Committee's risk categorization and add a new category known as "ancillary risks" to the conversation around business risks and climate change.

Climate change has grown in manager/owner awareness in the last decade, and many are now considering it a threat to their operations (Clemo, 2017; Torres-Bagur, Palom & Vila-Subirós, 2019; Er Kara, Ghadge & Bititci, 2020). In a recent poll of business leaders by the World Economic Forum, Canadian business leaders suggested extreme weather events tied to climate change were the third largest concern for the future, after economic downturns which came first and labour shortages in second place (Cavaciuti-Wishart, Heading & Kohler, 2024). In the Yukon, the general nature of climate risk to business is broadly identified in "Assessing Climate Change Risk and Resilience in the Yukon" (Government of Yukon, 2022). However, the need for specific incorporation of climate change in project plans and proposals is crucial. Is this need reflected at a planning and organizational level in the Yukon?

1.1 Context and Structure

1.1.1 Risk Categories

This paper will begin by expanding on the risk categories outlined by the UNFCCC, as well as the added category of ancillary risk. It should be noted that these categories tend to intersect, or cause knock on effects that interplay with each other (see Appendix A). In addition, the term risk used in this paper is broader than how it is traditionally used in assessments or models. When this qualitative overview uses the term risk, it denotes what could potentially happen to the industry but does not specifically mention likelihood or severity. The first risk category, physical risk, is perhaps the most self-evident, as physical risks concern "…damage to physical assets,

such as real estate and equipment, resulting from climate change impacts …. Such impacts can negatively affect company performance" (United Nations Adaptation Committee, 2019). Physical risks include damage from heatwaves, storm surges, floods, wildfires, and other fast-moving extreme weather events (United Nations Adaptation Committee, 2019). Slow-moving events like sea-level rise, erosion, and permafrost thaw should also be considered physical risks so long as they impact business assets directly (United Nations Adaptation Committee, 2019).

The UNFCCC Adaptation Committee's next category is price risk. Price risk is where climate change substantially impacts the cost of materials or commodities produced by a business (United Nations Adaptation Committee, 2019). The UNFCCC Adaptation Committee focuses on things rising in price due to extreme weather, making them unaffordable (United Nations Adaptation Committee, 2019). A recent example of this rise would be the cost of chocolate and cocoa based products, which tripled due to drought and climate change-related disease during the growing season of 2024 (Benchetrit, 2024). In addition, aspects of climate change and adaptation/mitigation can also make things more difficult to sell, driving prices down and making a business model unsustainable. This aspect of price risk shall also be integrated into this paper.

The third category of risk that the committee described focused on regulation. To combat climate change and adapt to its effects, governments will create new controls on business activities through policy and regulations (United Nations Adaptation Committee, 2019; Nobanee et al., 2022). For this paper, *regulation* is defined as "rules, laws and codified norms which are part of the legal framework of business, and which govern its ethical, social and environmental responsibilities" (Matten, 2007). These are prescribed by governments, trade agreements, or multinational institutions like the European Union (EU) (Eberlein & Matten, 2009).

Consequences for businesses not adhering to these regulation changes can include noncompliance fines or levies, increased operating costs, or the withdrawal of subsidies (United Nations Adaptation Committee, 2019).

The UNFCCC Adaptation Committee describes the next category, reputation risk, as one that targets a company's reputation in the context of climate change or environmental management (United Nations Adaptation Committee, 2019). Reputation risks are the most difficult to quantify. It can take many forms and emerge from many business-related and societal actions/non-actions (United Nations Adaptation Committee, 2019). Additionally, reputational risks might have a more personal dimension, with management or board members at risk of damage to their business's actions or inaction (Eccles, Newquist & Schatz, 2007; Williams & Schaefer, 2013).

The last of the committee categories is liability risks. As the UNFCCC Adaptation Committee states:

> "…[these] arise when individuals, businesses, governments, or other actors seek compensation from a company for losses suffered as a result of a company's alleged contribution to the problem of climate change or their failure to adapt their practices. This might include investors seeking compensation for losses when a company fails to account for or disclose climate change risks." (United Nations Adaptation Committee, 2019)

However, this paper moves further than the financial aspect that the committee describes. In an extreme context, liability risks can sometimes involve personal liability if a business actively flouts its liability to its stakeholders or customers. An example is ClientEarth's lawsuit against Shell's board of directors (ClientEarth, 2024). Although this suit was thrown out in the UK's high court in 2024 (ClientEarth, 2024), it sets an interesting international precedent for ENGOs (Environmental Non-

Governmental Organizations) and watchdogs who might wish to pressure business leaders to make more effective climate change decisions with personal liability.

Finally, we approach our expansion of the UNFCCC Adaptation Committee's categorization. To further study this, we propose "ancillary risks" as an additional category of climate business risk. We define *ancillary risks* as those that occur when an event occurs to another actor but has indirect impacts for the business. In other words, another organization may have responsibility to manage a given climate risk. Their failure to do so may create a knock-on, or ancillary, risk for a business. Climate change may affect a public institution, infrastructure, or system that a private enterprise might rely on for consumer transportation, supply chains, safety, funding, or productivity. Ancillary risks are not directly focused on the business or its operations; they are understood as part of an interconnected component of society. Hence, ancillary risks focus on the broader contextual environment the business operates within and understand there is an inherent risk. This interconnected nature means that these ancillary risks can accelerate and exponentially impact physical, price, reputation, regulation, and liability risks. The ancillary risks demonstrated in this paper, are northern-centric where dependencies on limited infrastructure are more pronounced than other areas of the world.

1.1.2 Yukon Context

Before continuing, some important context about the state of business in the Yukon is required. The largest contributors to Yukon's GDP as of 2023 are public administration (23.2%); Real estate and rental and leasing (13.8%); mining, quarrying, and oil and gas extraction (13.0%); construction (11.7); health care and social assistance (8.2%) (Yukon Bureau of Statistics, 2024). All remaining industries make up less than 5% of the total GDP, but some of sectors of note are retail trade (4.9%); educational services (4.0%); professional, scientific and technical services (3.0%);

transportation and warehousing (3.7%); finance and insurance (2.1%); and Utilities (1.9%) (Yukon Bureau of Statistics, 2024). These statistics are not totally clear on some areas of business, such as tourism, which is split into numerous categories due to Yukon Bureau of Statistics use of NAICS (North American Industry Classification System) but nonetheless have a substantial impact on Yukon's economy. The last official estimate from the Sustainable Tourism Dashboard for the GDP impact on tourism was around 4.4% (The Government of Yukon, 2022a). As of December 2024, public administration, trade, health care and social assistance, construction and educational services lead the way in terms of employment. (Yukon Bureau of Statistics, 2025).

All these prominent Yukon industries can be impacted by the climate change-related hazards that the Yukon faces. Thawing permafrost, wildfires, floods, changes to precipitation patterns and air quality and unforeseen other climate change hazards can have a substantial impact on the viability and productivity of these industries.

1.2 Methodology

This study uses two methodological approaches to achieve its objectives. The first approach was a targeted literature review. The second method consists of original research using keyword analysis focused on Yukon Environmental and Socio-economic Assessment Board (YESAB) registry documents.

The literature review looked at a total of 70 sources. Of these, 38 were academic journal articles, 25 were industrial or ENGO grey literature reports, two books, two book chapters, two Canadian statutes, and a university business magazine article. After this point, saturation was achieved, and no new information was found relating to the business risks from climate change. These sources were

supported by web content from government, news, and ENGO websites. Notes related to climate business risk were taken on every source. These notes were then codified to make finding different types of climate business risk more efficient. Codes generally were quite varied but typically included a one of the types of risk defined above unless one was not evident in the text.

The YESAB registry keyword analysis looked at every proposal document publicly available from January 1, 2023, to May 14, 2024.[1] The purpose of this was to reinforce the Physical Risk section. The business areas studied in this YESAB analysis can be seen in Table 1, along with the total number of applications.

Where applicable, multiple proposal documents were investigated for some applications. For example, with placer mining applications, the proposal, water license and mining land use forms, and Department of Fisheries and Oceans Canada (DFO) worksheets were all reviewed when application documents referred to one another. In the application document(s), a keyword search was performed using the "CTRL-F" function on Adobe Acrobat Pro. The keywords that were searched for were: "Climate Change," "Mitigation," "Adaptation," "Flood," "Fire," and "Permafrost." The inclusion of the terms "Flood, "Fire", and "Permafrost" were included to see if businesses considered these aspects, as these are particularly frequent hazards in the Yukon context, but their link to climate change could potentially be overlooked or go unmentioned within these documents. Often when analyzing these documents, there was overlap with other forms of risk mitigation that were not related to climate change. For example, contamination through fuel spills when using

[1] This arbitrary date was the end this author's YESAB document review process. However, it still comprises enough data for a comprehensive keyword analysis.

machinery was often mentioned when searching for mitigation. Fuel spills, although harmful to the

YESAB Business Area	Number of Applications
Forestry	1
Agriculture and Aquaculture	2
Energy – Petroleum	2
Energy – Power Generation	2
Energy – Transmission	1
Mining – Other[2]	4
Mining – Placer	58
Mining – Quartz	10
Other Industrial Activity	1
Recreation and Tourism	19
Residential, Commercial, and Industrial Land Development	8
Scientific Research/Wildlife Management	6
Transportation – Roads, Access Roads, and Trials	10
Utilities – Telecommunications	2
Utilities – Water and Wastewater	2
Waste Management – Contaminated Sites	3
Waste Management – Solid Waste	6
Waste Management – Special and Hazardous Waste	2
Total	**139**

Table 1
Business Categories and Number of Applications Jan 1, 2023 – May 14, 2024

environment, are not related to climate change. To ensure that examples like "Fuel Spill Mitigation" did not skew the results, the context that the keywords "Mitigation" and "Adaptation" were considered to ensure they pertained to climate change.

It is understood that YESAB applications do not provide a complete picture of how a given business assesses risk. However, it does give us one publicly available perspective into how much thought these industries give to climate change when planning projects and what aspects of climate change (if any) concern them. If the YESAB application incorporated these terms (as they pertain to climate change risk), they were assigned a "yes," "no," or "yes + plan," if they did not only mention it as an issue but proactively described a strategy to address the keyword in their proposal.

[2] Mining – Other comprises things like quarries and gravel pits.

"Yes + Plan" should be viewed as a more proactive approach to climate change and business risks. These responses were tracked and analyzed in an Excel document.

2.0 Physical Risks

Of all the business risk resources that were reviewed for this paper, physical risks were the most discussed. This focus is a fair representation of many aspects of climate change, including media focus (Nyberg & Wright, 2016; Weber & Kholodova, 2017; Nobanee et al., 2022) and mounting evidence of the connection between extreme weather frequency, physical risks, and climate change (Weber & Kholodova, 2017; Andrews-Key, LeBlanc & Nelson, 2021; Sarraf, 2021). Physical risks are discussed in three sub-categories: building damage, asset damage, and workforce risk.

2.1 Building Damage

Building damage was the physical risk that businesses most frequently identified in the literature. There are numerous ways that climate change may damage business buildings or make them inaccessible. Wildfires, flooding, permafrost thaw, snow loading, extreme heat, sea level rise, windstorms and other tangible changes in Canada's climate will have profound consequences for business real estate (Weber & Kholodova, 2017; Elijido-Ten & Clarkson, 2019; Woetzel et al., 2020; Er Kara, Ghadge & Bititci, 2020; Sarraf, 2021; Ness et al., 2021; Aviva Canada Inc., 2023; Allianz Global Corporate & Specialty SE, 2023).

Building damage can have numerous knock-on impacts that can harm business operations and productivity (Weber & Kholodova, 2017; Woetzel et al., 2020; Andrews-Key, LeBlanc & Nelson, 2021; Sarraf, 2021). In cases where the location is damaged, a business may face delayed opening, prolonged closure, or complete closure (Lam et al., 2012; Addoum et al., 2023). This is especially true for businesses

such as restaurants, bars, clubs, and hotels, as they cannot shift to a different business model after the damage from extreme weather has occurred (Clemo, 2007). By contrast, businesses in other industries can sometimes decentralize their production or shift their sales to an online model.

In addition, Woetzel et al. warn that external to the damage itself, there can be knock-on risks that include increases to insurance premiums, a reduction of credit ratings, and harm their ability to finance other assets (2020). Climate-related damages and interruptions can significantly hinder a business's long-term viability.

Businesses with significant real property, such as mines, property development companies, Small and Medium Enterprises (SMEs) that own their buildings are often subject to climate related hazards. Adaptation measures can include assessing climate risk for these properties based on established methods such as the PIEVC protocol, adjusting insurance coverage, developing business continuity plans, and directly addressing the climate risk on a property (e.g., fire-smarting or flood mitigation). To address building damage, owners can work with insurance agencies and the wider community to address underinsurance and insurance literacy, which are common issues within Canada's business communities (Lyth et al., 2015; Woetzel et al., 2020).

2.2 Asset Damage

Like section 2.1, asset damage can be incredibly detrimental to a business's ability to operate successfully. For example, businesses that operate with perishable goods (food, for example) can be vulnerable to extreme events. Consequences of loss from an extreme event can include a loss of inventory, which would be nearly impossible to replace cheaply and efficiently (Zeuli et al., 2018; Collier & Ragin, 2022). Similarly, losing a significant piece of equipment can be business-ending for

industries requiring large capital investments. As climate change progresses, many extreme events are projected to become more common. This extreme weather can cause varying degrees of damage to assets required to produce goods or provide services (Zeuli et al., 2018; Van Houtven et al., 2022).

In other cases, climate change is creating unexpected conditions that put assets at risk. Equipment that is used regularly for transportation in snow and ice environments can be lost or damaged and lead to expensive recovery efforts when unexpected conditions are encountered. Contemporary examples of this include machinery that has fallen through ice or become mired in un-frozen soil. A recent Yukon example would be the loss of a snowcat that sank to the bottom of the Yukon River while being used to construct the Dawson City ice bridge (Croft, 2019).

In the Yukon, construction, transportation and mining businesses have made significant investments in assets to make their business viable. Most of these assets can be moved from site to site, but this is not always possible in the context of a climate-related emergency, due to their permanence, volatility or fragility (Er Kara, Ghadge & Bititci, 2020). An example of this would be the chemicals and explosives left in storage at Eagle Gold during the 2023 forest fire that encroached on site (Lang, 2023). In cases such as flooding or wildfire, emergency response requirements may override the ability of companies to move assets to safer locations. Even if the asset itself is not at risk, the loss of access to the asset can be disruptive and costly.

Mines, construction companies and other with heavy capital investments around the country have worked towards mitigating asset risk by conducting thorough and continuous site monitoring, especially around hydrological, permafrost and soil conditions (Duerden et al., 2014). Additionally, these companies can shift their operational planning. For example, after Capstone's Minto Mine had

issues with precipitation (in 2008 and 2009) and their tailings pond, they shifted to a dry-stack tailings system (Duerden et al., 2014). Unfortunately, this shift was maladaptive as the dry-stack tailings encouraged permafrost degradation, but eventually they were able to build an abutment to stabilize the stack and began more heavily monitoring trends in its degradation around site (Duerden et al., 2014).

2.3 Workforce Risk

The final physical risk sub-category revolves not around objects but people. Our changing climate can have detrimental physical risks to employee well-being, and this can result in increased risk of injury, burnout and lower productivity (Kjellstrom et al., 2019; Er Kara, Ghadge & Bititci, 2020; Woetzel et al., 2020; Van Houtven et al., 2022; Hurlbert, Das & Vitto, 2023). Heat stress is an area of workforce risk that the existing literature prioritizes. In Canada, however, models tell us that the impact of heat on labour productivity will be negligible (Kjellstrom et al., 2019).

Other forms of extreme events can also play a role in causing workforce risk. For example, prolonged exposure to wildfire smoke for first responders, or simply for outdoor workers downwind of wildfires is a cause for health concern, particularly for those with underlying health conditions (Health Canada, 2024). Similarly, increased precipitation and changes in winter precipitation can make driving conditions more dangerous and increase vehicle accidents, impacting occupations like taxi and delivery drivers (Hambly et al., 2012; Ness et al., 2021). Hazards such as whiteouts, intense snow squalls and high winds may impair vision, and winter rain, rapid freeze/thaw cycles, and overbank icing/*aufeis* make driving conditions difficult and potentially unsafe (Hambly et al., 2012; Ness et al., 2021; Turcotte, Dubnick & McKillop, 2023). Workplace health and safety measures that protect employees can include providing access to cooling and air filtration and proper protective gear,

improvement of monitoring protocols for isolated work (Kjellstrom et al, 2019), and continuity planning to support employees in continuing their work when access to a physical job location may be interrupted.

Additional research would be required to gain a more comprehensive understanding of where Yukon's businesses stand as it pertains to addressing climate change impacts. Very little has been written that specifically focuses on the Yukon business community outside of reports commissioned by mining companies. Research would provide insight into how large of a risk SMEs believe climate change is to their business or if its something that they do not plan for or consider whatsoever. Their perceptions of risk could be important, as it cannot be captured in the YESAB data as they usually do not have to go through that process.

2.4 YESAB Data

YESAB data will give us a means to quantify how businesses are considering climate change when they plan new projects. The YESAB registry is a publicly accessible resource that can provide some insight as to the priorities and worries of the companies that need to apply through this review process. Under YESAA (Yukon Environmental and Socio-economic Assessment Act), a project must be submitted for assessment if it is in the Yukon, it is listed as non-exempt on the YESAA regulations, and the proponent is a federal agency/regulator, or is a territorial agency/regulator, municipal government, first nation and land is required for a private individual or government entity to engage in the activity, or if authorization from the governor in council is required to partake in that activity (Yukon Environmental and Socio-economic Assessment Board, 2025). In the *Guidelines for Mine Waste Management Facilities* developed by YG (The Government of Yukon) there are procedures of how the topic of climate change should be addressed when

planning mine sites. Primarily, information around climate change is found in Appendix A, section 8 of these guidelines. This section includes how to select climate data for the site,[3] how to infill missing data gaps, quantifying climate trends and extremes, and protocols for observed permafrost, precipitation and rainfall (Hamilton et al., 2023). This data should then be used to inform design for class III[4] tailings management, heap leach, and mine rock management facilities in the Yukon (Hamilton et al., 2023). YESAB proposals often take these guidelines into consideration.

With this in mind, the term “climate change” was one of the terms that was searched for in the proposal documents. Climate change was mentioned in only 15 proposals out of 139 (11%). However, it should be noted that more proposals could have followed the guidelines, but just not mentioned the term “climate change”.

[3] Based on length of record, continuity of the record, proximity, elevation, geographic siting, age of observations and monthly data availability (Hamilton et al., 2023).
[4] A facility and/or set of practices that contain the highest level of risk. (Hamilton et al., 2023)

The data from our YESAB analysis demonstrates that businesses are regularly identifying climate-related natural disasters that have relevance to their intentions,

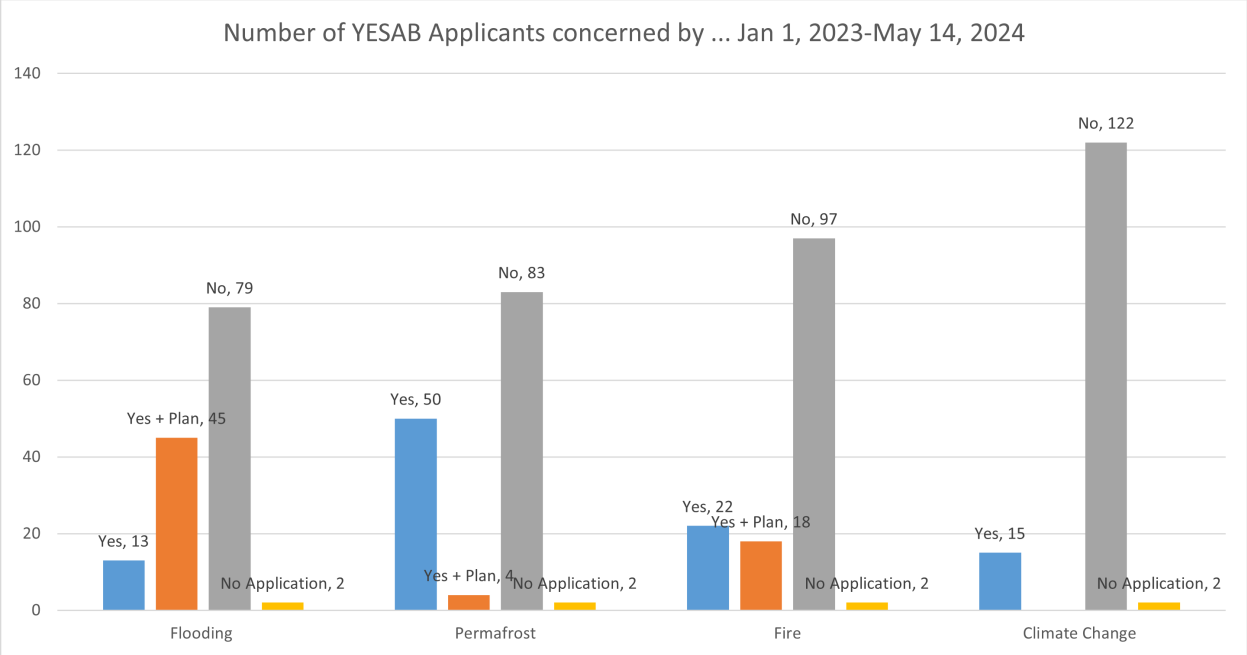

Fig. 1

Number of YESAB applicants concerned by specific climate change-related events in their proposals: Jan 1, 2023-May 14, 2024

even if the word climate change was not directly in their proposals. For example, 41.7% of proposals wrote about flooding, and 77.5% of these included some plan for when flooding occurs. Permafrost was mentioned in 38.8% of proposals but only 0.8% of these proposals having a clear plan for permafrost thaw related impacts. Finally, wildfires were considered in 28.7% of proposals. However, 81.8% of those who had considered wildfires had a plan to go alongside that consideration. There were 49 applications (35.25%) that considered risk from a combination of two or more hazards, and 88 (63.31%) that considered only one.

Overall, these datasets demonstrate that applicants have an understanding that climate-related extreme events could cause damage, are inconclusive on whether businesses are accounting for a change in risk levels due to climate change. There could be a relational disconnect between business risk and climate change, or

it could simply be that most businesses perceive extreme weather as a threat, only as it garners a large amount of media attention (Nyberg & Wright, 2016; Weber & Kholodova, 2017; Nobanee et al., 2022). Interestingly, it should be noted that although permafrost was often noted as a concern, there was an apparent lack of planning around how to mitigate the risks associated with its degradation. Unfortunately, the data does not tell us why this is, but one hypothesis is that could be a lack of understand on how businesses can address permafrost. Another possibility is that businesses do not perceive permafrost degradation to have the same destructive impact as flooding or fires and, therefore, do not plan for it in the same capacity.

3.0 Price Risk

Outside of the physical risks of climate change, the literature regularly pointed to price risks as one of the next significant challenges that climate change will impose on businesses. Price risk can take on many shapes and forms, but we will focus on shortages, devaluation risks, all aspects that can have substantial market impacts.

3.1 Shortages

3.1.1 Natural Resource Shortages

As climate change becomes more evident and extreme weather becomes more common, we will see more shortages (Cavaciuti-Wishart, Heading & Kohler, 2024). Shortages can come in many forms. Drought, for example, can prompt shortages in a multitude of different ways. First, it can hinder the required materials for production or provision of services (Kara, Ghadge & Bititci, 2020). Water is required for many industries, and drought can limit access to available water sources (Galbreath, 2011; Elijido-Ten & Clarkson, 2019; Er Kara, Ghadge & Bititci, 2020; Woetzel et al., 2020). An example relevant to Yukon would be the water requirement

for mining processes, especially tailings management, dust suppression, and mine drainage (Pearce et al., 2010; Duerden et al., 2014). Being unable to conduct these industrial activities could lead to challenges maintaining production, while also adhering to environmental standards (Pearce et al., 2010).

3.1.2 Shortages Disrupting Supply

Multiple slowdowns in production mean that a single shortage will cause prices to rise due to the scarcity of supply, making additional industries that use these materials more expensive to buy (Government of Alberta, 2024). This price increase continues through the network or the "web of [business] relationships" (Er Kara, Ghadge & Bititci, 2020). For example, we can see the cost of timber rise due to the continuous impacts of forest fires in British Columbia. The latest report from the British Columbia Ministry of Forests suggests that 2.8 million hectares were impacted by forest fires in 2023, the largest area impacted ever (Office of the Chief Forester, 2024). This compounds the lack of supply of BC lumber, as the next largest loss of forest area came in 2017 (1.2 million hectares), 2018 (1.3 million hectares), and 2021 (0.9 million hectares) (Office of the Chief Forester, 2024). As a result of this devastation, and of other Canadian lumber producing areas being impacted by forest fires, the price of lumber futures rose to just short of 20% in June and July 2023 (Lindsay & Pelai, 2024).

Shortages can also impact the movement of goods to difficult-to-reach areas, causing price increases. Food is a good example. Groceries in large cities are estimated to have enough fresh food[5] for three days and seventeen days for all food products[6] (Zeuli et al., 2018). In the Yukon, this statistic can vary widely by time of

[5] Fresh food means unfrozen vegetables, fruit and meat.
[6] Includes fresh food and frozen, preserved or canned foods.

year and community, but there are recent examples where interruptions to surface transportation have led to short-term food shortages in Whitehorse (CBC News, 2022). In dire situations, critical materials like food and fuel are flown in, which also increases the price of materials needed for business operations (Pearce, 2010).

A more chronic food shortage may rightfully be described as an ancillary risk. The Yukon is heavily dependent on food that is imported from areas that are themselves experiencing climate change impacts. A recent example was the loss of BC stone fruit in Spring 2024 following a freezing event (Strachan, 2024). While government programs have helped minimize the impact for agricultural producers (Agriservice BC, 2025), events of this nature can lead to increased food prices for businesses and individuals in the Yukon. The result can be changes to consumer behaviour and increased costs for food retail and food service businesses.

3.1.3 Shortages Impacting Non-Industrial Sectors

Finally, shortages are not always direct and do not always have to involve goods or materials. Shortages can also affect services and non-industrial production. For example, most models predict a shortage of favourable conditions in Southern Canada and the United States for skiing and other winter activities, especially under an RCP (Representative Concentration Pathways) 8.5 scenario[7] (Butsic, Hanak & Valletta, 2011; Steiger et al., 2019; Scott et al., 2020; Wilkins et al., 2021; Filho, 2022). Low-altitude and non-glacier skiing will not cope with the temperature change, even with advanced snowmaking (Butsic, Hanak & Valletta, 2011; Stieger et al., 2019). As a result, there is an anticipation that available ski destinations will shrink, causing a

[7] RCP scenarios are essentially potential future pathways that could occur by the end of the 21st Century. They consider factors like greenhouse gas emissions, land use, air pollutants, and more. Scientists often use these scenarios to model and predict climate change. (IPCC, 2014)

shortage of opportunities for this recreational activity (Scott et al., 2020; Wilkins et al., 2021).

Perceiving an opportunity, athletes have been coming to Mount Sima to begin training early (Desmarais, 2021). As a business, Mount Sima has accommodated this by leveraging their knowledge of cold-weather climate to support snow-making efforts in anticipation of this early-season revenue opportunity. As the temperature change reduces the number of options for pre-season training to the south, it would be fair to expect this trend to continue or grow (Desmarais, 2021). As a shortage of options becomes the norm, it will be interesting to see how Mount Sima adapts to the increase in demand from southern skiers who have had their local seasons shortened or cancelled.

3.2 Devaluation

Another form of price risk comes when climate change contributes to the devaluation of goods and services due to their loss of appeal, (potential or actual) damage, or factors regarding the transition required to mitigate climate change. Devaluation can devastate a business and cause an existential crisis to a business model/plan (Woetzel et al., 2020). Loss of appeal and damage devaluation is best explained by looking at real estate but can also be explained through the tourist industry as well.

3.2.1 Appeal Devaluation

Real estate is one of the most significant investments a business can make. Many businesses do not own their properties, but those that do likely have a fair amount of capital. Nonetheless, real estate devaluation because of climate change affects not only those businesses that own property, but also the housing development companies and real estate transfer facilitators like real estate agents,

bankers, and lawyers (Sarraf, 2021). One of the largest sudden devaluations comes with the public realization of a loss of appeal. For example, Butsic et al. modelled home prices in popular skiing areas in Western North America (2011). They found that once consumers realized that the ski season length would decrease, housing prices in the area would fall simultaneously, with southern ski areas in the United States seeing a devaluation between 44-55% (Butsic et al., 2011). Such a devaluation in housing prices would devastate communities and the broader real estate market. A further devaluation of the real estate market in one area can lead to a re-appraisal of other assets in different but similar locations, like along a flood zone or near densely forested areas at risk of wildfire (Woetzel et al., 2020).

Appeal devaluation can happen in response to either an extreme event such as a flood or wildfire, or a gradual change such as reduction in snow at a ski resort (Steiger et al., 2019; Torres-Bagur, Palom & Vila-Subiros, 2019). However, in some instances, a business can market other characteristics that allow them to maintain their appeal. For example, a ski resort may push and invest into summer activities, or experiences such as mountain biking, spa treatments or fine dining that reach beyond their core raison d'etre (Butsic et al., 2011; Steiger et al., 2019). Other resorts have invested further into snowmaking capacity and technology, but depending on the location, temperature and access to cheap water this might not be the best option for adaptation (Butsic et al., 2011; Scott et al., 2020; Wilkins et al., 2021).

3.2.2 Damage Devaluation

Damage, whether perceived or actual, can devalue the market price of real estate or harm business opportunities. Perceived or potential damage is the public anticipation of damage occurring, either because of location or a rise in public

awareness.[8] For example, the Yukon has long struggled with a reputation for "rough roads" (Nicol et al., 2019). Permafrost thaw is often cited as a culprit (Pearce et al., 2010; Duerden et al., 2014; Ness et al., 2021). The tourist industry has perceived this as a barrier to attracting tourists who are willing to "brave" our roads (Tourism Industry Association of the Yukon, 2018) even when most of our highways here are maintained to a standard above or on par with the northern portion of all Canadian provinces. Although these things may not cause damage to businesses, the perception that it could happen still has a devaluating effect. Another prominent example of this would be the influence of wildfires in a popular tourist area. A study was conducted after the 2003 wildfire that impacted the Okanagan region of British Columbia, focusing on Kelowna. Although none of the businesses were impacted directly, many saw devaluations through lost revenues to 30-40% for that year (Hystad & Keller, 2006). Similarly, the BC Fruit Growers Association noted a loss of tourist fruit picking revenues due to wildfire smoke in the last couple of years (BC Fruit Growers Association, 2023).

4.0 Regulation Risk

Regulations guide the way business is conducted within our free-market system. They enshrine rules to ensure that the activity is fair, not just regarding competition, but also that there are no unjust societal/environmental ramifications and that operations are ethical.

Historically, Canada's regulatory culture has been one focused on voluntarism. Voluntarism emerged as a concept in the Canadian business landscape in 1993, during which the Federal Government, under financial pressure because of the early

[8] E.g. after a devastating weather event or reoccurring weather events.

1990s recession, decided to make sweeping cuts to environmental departments (Macdonald, 2008; Eberlein & Matten, 2009). Territorial, Provincial and Municipal Governments followed suit, and the collective protection of the environment had dissipated (Macdonald, 2008). Hence, strict regulation and monitoring of business activities were swapped for a policy of voluntary commitments, especially around greenhouse gas emissions (GHGs), where usually large companies voluntarily made environmental performance adjustments under the tacit threat of heavier regulation (Macdonald, 2008). It should be noted that Canada was one of many nations at this time to enact voluntarism as an environmental strategy. Notably, the UK has also moved in this direction, especially regarding SMEs (Williams & Schaefer, 2013). In retrospect, it has been demonstrated that the move towards voluntarism has not yielded the intended results of mitigating GHG emissions and achieving Canada's international commitments (Hurlbert, Das & Vitto, 2023). Considering this context, it is fair to suggest that both large and small businesses are behind on mitigation and adaptation efforts, leaving their operations at risk (Hurlbert, Das & Vitto, 2023).

Regulations concerning climate change may incur increased costs and efforts to satisfy the new requirements (Er Kara, Ghadge & Bititci, 2020). Large businesses can deal with the costs and efforts that come with new regulations efficiently, but SMEs might need help adapting to these new rules (Nobanee et al., 2022). Although costly, not following regulation can have an even greater cost. Noncompliance can result in fines known as Administrative Monetary Penalties (AMPs) (Environmental Violations Administrative Monetary Penalties Act, 2009; Canada Energy Regulator, 2020), imprisonment (Canadian Environmental Protection Act, 1999) or loss of an operating license (Canada Energy Regulator, 2020). Regulation can take many forms, including regulations around damage impacts, and climate change impact recovery subsidies.

4.1 Damage Impact Regulation

Federal, and territorial regulations may emerge from a climate change-related disaster (Elijido-Ten & Clarkson, 2007; Weber & Kholodova, 2017; Cavaciuti-Wishart, 2024). In some cases, these regulations might cause risk for companies that were not impacted by that disaster. After a series of floods in the province, Quebec buildings in 20-year floodplains that are forbidden from being rebuilt or built anew (Woetzel et al., 2020). Such a regulation can be a barrier for land developers, restoration specialists or construction companies from finding additional projects. Locations for future developments should be chosen to avoid actual and potential damage and property devaluation, through extensive researching of locations and how they will be impacted by climate change. This exercise should be a collaborative with interested industry, researchers, and local and federal government. In addition, businesses that do not focus on real estate should conduct background checks on their physical location to ensure that their place of production will not be affected by climate disasters, but it is difficult to formally require this through regulation. Future government-mandated regulatory standards may also emerge from damage-related incidents to encourage business adaptation and resilience. These that may have an impact on things like insurance, equipment, technical and safety practices and social responsibilities that may lead to costs for businesses and put them at risk (Standards Council of Canada & Manifest Climate, 2021).

4.2 Subsidies

Subsidies are financial benefits that the government gives to a targeted business, group of businesses, or entire industry (Corkal & Gass, 2020). These often take shape as a tax break or a direct money transfer to the business or direct money transfer to the consumer (Corkal & Gass, 2020). The aim is to make the product, service, or material more affordable or spur a specific change within the industry. In

Canada, federal and provincial/territorial governments can grant subsidies, which is common in our system.

The federal subsidy is known as Disaster Financial Assistance Arrangements (DFAA) is a relevant example of a subsidy intended to support adaptation by business. Recently, an update was provided explaining how this program would function after April 1, 2025 (Public Safety Canada, 2025). Although this type of subsidy is helpful for businesses after a disaster, there is a risk associated with it. First, the emphasis is on homes, small businesses and public infrastructure, which means there are no measures for larger companies (Public Safety Canada, 2025). Larger businesses should take appropriate measures to ensure that if they are impacted by a climate change disaster, that they can adequately recover in a timely fashion. Secondly, there is business risk with relying on disaster subsidies as they only cover *uninsurable* damage to structures and assets (Public Safety Canada, 2025). The DFAA does not mention underinsured assets. This could mean that a business could be losing out if they fail to find adequate insurance for crucial assets or only received a partial payout from the insurance company.

Next, applying for a subsidy through the DFAA is only possible through the province/territory, and must be done within six months of the end the disaster (Public Safety Canada, 2025). There are a couple of risks with this aspect of the DFAA subsidy. Primarily, there is no way for a business to directly access this subsidy and must request it from the territorial government. Without the autonomy to apply directly for it, these businesses become reliant on the government to take swift action. Additionally, although a quick recovery time is of the essence for businesses, sometimes physical damage to assets or structures can take time to materialize or be discovered. An example of this would be the rusting of machinery, or the rotting

of wooden structures, which could be overlooked and constitutes a large risk to business operations.

Under the DFAA, the disaster that impacts a business must be considered *eligible* by both the territory and the federal government; the disaster is investigated by the territory and a letter from the Premier is sent to the Prime Minister for DFAA Funding (Public Safety Canada, 2025). It is possible that not every flood, fire or other disaster would be submitted to the Prime Minister for approval. Theoretically, if a forest fire only impacts a couple residential/commercial dwellings they might not be eligible to receive funds under the DFAA because it was never perceived as a disaster by the Territory. This could be a huge risk for those businesses relying on the subsidy to cover response and restoration expenses.

Finally, the DFAA has a cap financial cap based on population of $3.84 per person (Public Safety Canada, 2025). Although the DFAA is supposed to be used in conjunction with the Yukon Disaster Financial Assistance Program and be cost-shared between the territorial and federal governments,[9] the DFAA only offers the Yukon $180,280 for 2025 (Public Safety Canada, 2025). Depending on the nature of the disaster, this might not be adequate for covering the costs of uninsurable losses. In summary, although these disaster subsidies can be helpful, it is best not to rely solely on them when responding to a disaster. Good practices are finding insurance that covers all potential climate threats and reserving some funds for recovery before a disaster occurs and borrowing funds if the reserves are not enough and if the capital is available after a disaster (Collier & Ragin, 2022). Furthermore, business

[9] 90% federal, 10% territorial for costs relating to disaster response. 80% federal, 20% territorial for costs relating to disaster restoration (Public Safety Canada, 2025).

owners should try to keep up to date on the available provincial and territorial subsidies to see if they are eligible and how they can be used to recover.

Subsidies, and whether to provide them to industries, are crucial talking points of the contemporary governance of Yukon. In June 2024, an Access to Information and Privacy (ATIP) request revealed that YG was considering giving the mining companies subsidies to spur a reduction in GHG emissions and ensure that investment in this industry remains stable (Greene, 2024). In North America, there are few examples of equivalent subsidies that would support proactive adaptation action. Under the DFAA, there is a cost-sharing[10] stream of funding that is aimed at encouraging investments that "...reduce disaster response and recovery costs and lessen the impacts of disasters on people, businesses, and communities" (Public Safety Canada, 2025). This stream of the DFAA could be mobilized to spur industrial-government investment into climate change adaptation and resilience business infrastructure, but only after a disaster has occurred.

5.0 Reputation Risk

In business, reputation is a massive component of investor and consumer retention, attracting new investors and consumers, breaking into new markets, or appealing to new employees (Eccles, Newquist & Schatz, 2007). Reputation is vital in business, especially for SMEs that rely on a local customer base. Climate change increases the risk of reputational damage or a shift in how a business is perceived (Weber & Kholodova, 2017; Elijido-Ten & Clarkson, 2019; Sarraf, 2021). Indeed, media coverage, ENGO campaigns and the increasing rate of natural disasters have made

[10] The federal government covers 40% of this subsidy, insofar as "...a defined set of risk reduction actions taken prior to the disaster" (Public Safety Canada, 2025).

humans more critical and aware of what businesses are or are not doing about climate change (Nyberg & Wright, 2016; Weber & Kholodova, 2017; Nobanee et al., 2022) and this has an impact on whether people want to be associated with a company.

Reputation is about a customer's perception of a business. So, if a business is perceived as inactive or even counter-productive regarding climate change matters there can be a loss of investors/customers (Nyberg & Wright, 2016). Even worse, is getting exposed for greenwashing. Greenwashing is a highly contentious subject in the business world. The culture of regulatory voluntarism also saw the rise of greenwashing[11] as a means of gaining social license and legitimacy for large-scale business operations in Canada (Macdonald, 2008). What is greenwashing, and how can businesses avoid it as a reputation risk?

Greenwashing comes from a long stream of '-washing' vernacular. The term comes from the verb *whitewash*, which in the seventeenth century was commonly used to describe the hiding of crimes or the exoneration of an individual based on the biased presentation of evidence (Blackmer, 2019). This term became prominently used in political science and international relations discourses to describe certain ways states took a progressive stance towards a certain issue, to shift the gaze away from a more pressing issue. Examples of this in the international relations sphere

[11] In essence, greenwashing is the intersection of two business aspects: positive communication about environmental performance, while continuing poor environmental performance to make the business appear more progressive on environmental and climate issues. (Freitas Netto et al., 2020, 2).

include *pinkwashing*[12] (Blackmer, 2019) or *sportswashing*[13] (Bergkvist & Skeiseid, 2024).

In contrast, greenwashing is rarely levied at states, but usually at prominent businesses that have a large GHG footprint (Allianz Global Corporate & Specialty SE, 2023). First used in 1992 by the prominent ENGO Greenpeace (MacDonald, 2008), *Greenwashing* can be defined as "the intersection of two firm behaviours: poor environmental performance and positive communication about environmental performance" (Freitas Netto et al., 2020, 2). Reputation damage can occur if strides to combat or adapt to climate change are taken, but details about the action are opaque.

Being perceived as inactive regarding climate change harms the public's view of a business, but steps can be taken to ensure that reputation damage does not occur. Businesses that take meaningful steps to demonstrate their understanding and action on climate change issues but ensure that their solutions are visible to the public are able to actively manage their reputation (Nyberg & Wright, 2016). Furthermore, it might seem unfair that a business may incur some reputational damage after being impacted by a storm or forest fire. However, a prolonged loss of availability will drive people to other goods or service providers (Sarraf, 2021).

A relevant northern example would be the switch many northern residents are making regarding internet providers. Northwestel (NWTel) is the primary telecommunications provider in Yukon, Northwest Territories and Nunavut, but

[12] Pinkwashing is the promotion of a pro-LGBT stance to cover up other human rights abuses. Academics have used it to critique pre-war Israel's colonial relation to Palestine (Blackmer, 2019).
[13] Using a major sporting event or investment to prop up an authoritarian regime or bad human rights record. Academics have used it as a concept to look at Russia and Qatar, as they both hosted the 2018 and 2022 FIFA World Cup, respectively (Bergkvist & Skeiseid, 2024).

there is a perception that climate-related interruptions (Lam et al., 2012; Woetzel et al, 2020; Ness et al., 2021) to service such as floods and fires in BC and Alberta have not been well managed by NWTel. Some customers have opted for an alternative, usually found in Starlink's satellite internet (CBC News, 2023). Meanwhile, Yukon Government has announced that service interruptions of this kind are no longer likely with the completion in November, 2024 of the "Northern Fibre Loop" (The Government of Yukon, 2024). This fibre will be operated by NWTel. Whether this risk reduction action influences public perception is yet to be seen, but there is at least circumstantial evidence that the perception of inaction has influenced some consumer behaviour.

6.0 Liability Risk

Business liability risk is gaining more attention as ENGOs and other interest groups investigate prominent businesses' activities and businesses experience direct cost from climate change. As stated elsewhere, this paper expands this concept of liability risk to include more personal legal action instead of solely focusing on the macro-business approach. Liability risks can emerge from numerous business practices, so likely, they will not all be captured in this high-level paper.

6.1 Failure to Report

One of the most prominent issues that businesses may face regarding liability risks is a failure to report. Not every business in Canada is required to report or disclose, but those that are publicly traded are required to disclose information about any aspect of the business that could be at risk under provincial or territorial securities laws (Kovacs et al., 2021). In addition, "commitments, events, risks or uncertainties…as well as the company's policies and procedures related to risk

management and oversight" should be disclosed insofar as they are at *material* risk[14] (Kovacs et al., 2021). Specifically, there are no requirements particular to climate change on reporting, but it is undoubtable that climate change will cause material risk that will need to be disclosed (see section 2.0 on Physical Risks).

Disclosure, especially around climate change impacts, is an important aspect of a business's liability, as it informs numerous interested parties. These reports inform investors, lenders, regulators, employees, consumers, voters, stakeholders, and legislators and failure to report can impact future climate change adaptation planning, policy and regulation (Kovacs et al., 2021). There can also be knock-on impacts outside of the responsibility to these parties. Failure to disclose could be depriving local communities of information leading to increasing their climate vulnerability (Kovacs et al., 2021). An example of this would be if a company knew their warehouse was in a 10-year flood zone, and their failure to disclose this would put other local businesses and homes in the immediate area at risk. This would leave the company and individuals liable for corporate malfeasance or negligence, which can be prosecuted either in civil or criminal courts, depending on the severity of the outcome (The Department of Justice Canada, 2003). Additionally, it is worth noting that there are no limits for fines or jail time for the most serious, indictable offenses of corporate negligence (The Department of Justice Canada, 2003).

Publicly traded companies should exceed the requirements of their disclosure reporting required by provincial/territorial securities laws. Despite potentially impacting share prices and reputation, this is the only way that businesses can shed their failure to report liability risk. Getting exposed for hiding or obscuring

[14] Information is considered *material* in investment terms if it would reasonably affect a rational investor's decision to buy, sell, or hold investments in a company (Kovacs et al., 2021).

information related to material climate change impacts would do more damage to a business and its leadership[15] then disclosing potential risk ever would. Non-publicly traded companies should consider the growing movement of voluntary disclosure and potentially follow the Task Force on Climate-related Financial Disclosures (TCFD) recommendations. The TCFD recommends publishing regular voluntary reports regarding company governance, strategy, risk management and specific metrics and targets to inform and reassure interested parties and demonstrate that the company is taking series measures towards addressing its climate vulnerability (Kovacs et al., 2021). This recommendation is already being used by all major Canadian banks and publicly traded insurance companies (Kovacs et al., 2021). In the Yukon, the YESAB registry review indicates that many of the publicly traded companies that are submitting applications for review are at least somewhat considering and disclosing climate-related risk. However, there is little consistency to the extent to which this occurs. Further study could reveal the extent to which individuals are making investment decisions while considering the relevance of climate risk even in the context where disclosure is mandatory.

6.2 Inactivity Liability

The perceived lack of attention to climate change from businesses also has a liability component. When a company has an insufficient understanding of the climate change impacts that they are trying to address, it can create a similar inactivity liability risk effect.

For example, a series of lawsuits emerged during the construction of the Mackenzie Valley Fibre Optic Link in NWT. Of particular interest, a subcontractor, Rohl

[15] The “directing minds” can also be liable under corporate negligence, not just the business as an entity but individuals or groups too (The Department of Justice Canada, 2003).

Enterprises, countersued the main contractor, Ledcor, for poor planning and faulty design (Quenneville, 2016). The main complaint from Rohl comes from Ledcor's inability to adapt their planning to warmer-than-usual winter conditions, leading to damage to the line and Rohl's removal from the project (Quenneville, 2016). These conditions are likely due to climate change and the increased warming in the north (Ahktar et al., 2019; Woetzel et al., 2020) and have impacted the project regarding erosion (Quenneville, 2016) and likely permafrost. Unfortunately, meaningful court documents related to this case could not be obtained for this report, which could mean that this trial is still ongoing, or the records are not publicly available. Nonetheless, it is a good example of how misunderstanding can contribute to maladaptation and lead to increased liability.

6.3 Dual Owner Liability Dynamic

Many SMEs do not own the building that houses their business. For example, 82% of restaurants in Toronto do not own their own space (Zeuli et al., 2018). This is referred to as a "dual-owner dynamic". The dual-owner dynamic can complicate things, as there may be miscommunications or assumptions about the types of insurance each party holds (Zeuli et al., 2018).[16] As Collier & Ragin show, after Hurricane Harvey, only 15% of businesses received a settlement from their insurance company, despite having insurance; many who could borrow did for the survival of their business and those who did not have the ability ultimately ended up closing their doors for good or turned to informal financing to survive (Collier & Ragin, 2022).[17] A relevant Canadian parallel, would be the businesses of Kelowna being unable to

[16] This is commonly a problem with flood insurance, for example.

[17] Informal financing, in this context, refers to borrowing money from family and friends. This form of financing played a crucial role in the recovery of many businesses after Hurricane Harvey, with nearly 50% of businesses resorting to it to repair their operations (Collier & Ragin, 2022).

recover after losing out on their peak-season during the 2003 forest fires, with the tourist sector being the slowest to recover (Hystad & Keller, 2006). Commercial insurance in Canada is not mandated by the federal or provincial government (KASE Insurance, 2023). The exception is regarding a company that owns company vehicles, or is in the shipping/transportation business, in which Commercial Auto Insurance is required (KASE Insurance, 2023).

A dual owner dynamic can also delay reopening, as responsibilities may be shifted between the business and building owner, with the responsibility legally with the building owner but utilized and maintained by the business owner (Zeuli et al., 2018; Lapointe, Lebon & Guillemard, 2020). This becomes a liability risk when the building owner cannot fulfill their obligations to the renting business. A version of the principal-agent problem can also be seen here. Although tactfully applied to Ng et al.'s analysis of barriers to dry and wet port adaptation in Canada, it can also be applied to other industries (Ng et al., 2016), like the tourism/hospitality sector that this section has used as an example. In this case, the principal, or the user/stakeholder, would be the business owner, who needs things to be repaired, or retroactive adaptation to take place so that the business may not suffer other additional climate-related stoppages in the future. However, the agent, in this case, the property owner, may not be in a rush to make such repairs or costly adaptations so long as rental capital is maintained, or the value of the property is stable (Ness et al., 2021).

These issues will likely apply to the Yukon, specifically in its larger communities. Commercial and industrial real estate statistics are suppressed for confidentiality in YG's Yukon Real Estate Reports (Yukon Bureau of Statistics, 2023). If we look at the local large development corporations, we can see a considerable interest in commercial and industrial real estate. For example, the Da Daghay

Development Corporation has invested heavily in the River Bend Subdivision of Whitehorse and Black Street Commercial Property in Whitehorse (Da Daghay Development Corporation, 2023). In addition, the Hougen Group owns and rents out the Hougen Centre, Hougen's Broadcast Centre, and the Sword Building, all commercial buildings in Whitehorse (Hougen Group of Companies, 2024). Finally, Northern Vision Development, perhaps the most extensive development corporation in commercial and industrial real estate, rents out numerous commercial and residential properties in the Yukon, including Tàgä Shrō Station, Waterfront Station and NVD Place in Whitehorse (Northern Vision Development LP, 2024). Many Yukon businesses will likely be subject to the principal-agent problem when climate change-related weather events damage the buildings that host their operations.

7.0 Ancillary Risks

While ancillary risks were not a part of the original matrix of business risks proposed by the UNFCCC Adaption Committee it is a unique addition that are of relevance in a Northern context. Ancillary risks confer that problems can occur within the public space, creating direct knock-on effects that impact business operations. These are often posed as failures in societal aspects that businesses take for granted in stable modern economies. However, although they are perceived as avoidable failures, our current system and its overreliance on these public assets tends to expedite their decline and/or consume these requirements, leading to greater instability when they no longer function as intended (Fraser, 2023).

7.1 Loss of Natural Capital

Water, air, food, and materials for shelter all comprise "natural capital". The term "capital" is used in economic discourse to demarcate nature's services in financial terms (David Suzuki Foundation, 2022; Reza & Sabau, 2022), but the term

risks a vast oversimplification in more holistic worldviews. Whether explicitly acknowledged or not, businesses often require stable natural capital to act as a complementary mechanism to their human-constructed systems (Reza & Sabau, 2022).

Loss of natural capital can reduce extreme weather resilience systems (Woetzel et al., 2020) and human-made systems such as agriculture (Reza & Sabau, 2022). Furthermore, the loss of specific pieces of natural capital may harm economic sectors such as tourism as the attraction may be wiped out (Torres-Bagur, Palom & Vila-Subirós, 2019).

The loss of natural capital not only threatens the natural systems we depend on for survival, but also burdens these systems through overconsumption, leading to a detrimental outcome for business and society (Fraser, 2023). In the Yukon, there is an unusual abundance of relatively undisturbed natural capital – at least compared to other parts of the world. However, climate change impacts are threatening natural systems throughout the North, with potential knock-on effects for human-built systems while considering development. This underscores the urgent need to understand, recognize and value natural capital (Fraser, 2023).

7.2 Public Infrastructure

Well-planned, resilient and efficient public infrastructure is vital to any business's survival. Generally, the construction and care of infrastructure are left to governmental entities. Companies are dependent on decision-making processes they don't directly control when infrastructure they rely on is impacted by climate change. In this section, we will focus on three types of infrastructure that support Canadian and Yukon businesses and where climate risks may be relevant.

7.2.1 Transportation

For most businesses, people need to be able to safely and effectively get themselves to a business to engage with it. Society requires the safe maintenance of roadways, sidewalks and bike paths. Transportation infrastructure can fail by being washed out (Ness et al., 2021; Reza & Sabau, 2022), flooding (Woetzel et al, 2020), buckling and cracking from extreme heat (Woetzel et al, 2020; Ness et al., 2021), differential settlement from permafrost thaw (Ness et al., 2021), and ice roads can break and melt (Pearce et al., 2010). The literature studied did not include statistics substantiating that short-term road closures may increase due to climate change, however, events such as rain-on-snow events, windstorms, increased heavy precipitation and decreased visibility from wildfire smoke are all factors considered in safe operation of highways and are expected to increase with climate change. Although temporary, these disruptions will have a negative impact on business particularly if they become more frequent or prolonged because of public sector inaction. Many of the failures mentioned above also apply to rail-based systems, aerodromes and airports (Woetzel et al., 2020; Ness et al., 2021).

While many of these risks are managed by the public sector on an ongoing basis, the North is unique relative to other parts of North America because of the limited redundancy in our transportation networks. Populations are small and spread over a vast geographic area. Typically, there are only one or two roads to and from a community. Climate-related disruption to a network – even if temporary – can be highly disruptive to business, as well as public safety, more generally.

7.2.2 Electricity and Communications

Second, businesses require stable, secure to access electricity and Information and Communication Technology (ICT). Access to these resources increases business productivity, and we have become dependent on them for exchange. Credit and

debit cards have become a staple of payment, not to mention the emergence of services like Apple Pay or Google Wallet (Zeuli et al., 2018). All these methods have become normalized but entirely rely on electricity and ICT networks (Abdollahbeigi & Salehi, 2020). Without these payment systems, many businesses will likely be forced into only accepting cash or closing temporarily until the outage is resolved.

In addition, most businesses require electricity for operation. Heating, cooling, cooking, and access to water are all linked to electric systems (Ness et al., 2021). When power is lost, production is halted, employees are idle or are sent home, and data can be lost (Ness et al., 2021). Those businesses that operate with perishable goods lose access to refrigeration or other electric systems to ensure their survival, causing financial distress (Zeuli et al., 2018).

In the Yukon, three key factors add to the vulnerability businesses have with respect to electricity and ICT. First, the Yukon is an isolated place, meaning that there are not often redundancies in place (The Government of Yukon, 2022). ICT infrastructure redundancies are beginning to be added, and the Dempster Fibre Line Project is a good example (The Government of Yukon, 2024). Second, we rely on an electricity source that itself is climate sensitive. While we have thermal generating capacity, Economic, social, and environmental factors make it vital to carefully manage water. If water use is constrained, the alternative is thermal generation using fuel – leading to significant costs that are passed on to business. Finally, the Yukon's population is spread all over the territory, making many Yukon businesses susceptible to extreme events (Ness et al., 2021; The Government of Yukon, 2022). A single disruption in the system could lead to days of downtime, resulting in significant losses for businesses. A recent instance of this vulnerability was the loss of phone and internet service in NWT (Northwest Territories) and Yukon due to wildfires in northern BC damaging a fibre optic cable near Fort Nelson, BC (CBC News, 2024).

While the exact financial impact on local businesses in Whitehorse is yet to be determined. The lack of comprehensive redundancies and isolation require a robust energy and ICT network in order to limit ancillary risk.

7.2.3 Health Services

Finally, and perhaps the service that businesses most take for granted, is the health services provided by provincial/territorial governments. As we have seen with the COVID-19 pandemic, a well-functioning and well-resourced public health system is crucial to business operations and the well-being of customers and employees. Ness et al. even go as far as to report that efficient and dependable healthcare services benefit services by increasing productivity and reliability, therefore creating a long-term form of growth, higher returns on investments and, generally, a higher standard of living; all aspects that benefit businesses (Ness et al., 2021).

As mentioned in section 2.3, with climate change, there will be new infectious diseases, asthma, preeclampsia, pest-related incidents and a decline in cardiovascular health (Filho et al., 2022; Reza & Sabau, 2022; Cavaciuti-Wishart, Heading & Kohler, 2024) along with increased heat stress (Kjellstrom et al., 2019) and other potential climate-related injuries. It is in the interest of Yukon's business community to ensure that we have a robust public health sector to ensure this ancillary risk does not impact their enterprise. Larger businesses can use their influence on lobby for more a stronger and more comprehensive health system (Andrade & de Oliveira, 2015), supporting healthy workplace programs, allowing for flexible work arrangements to support work/life balance (World Business Council for Sustainable Development, 2022), and through health-focused philanthropy and pro bono services (Kassler, 2020).

8.0 Conclusion

The impact of climate change poses substantial risks to businesses worldwide, including those in the Yukon and other Northern territories and provinces within Canada. The research aims to inform local decision-makers and the business community about the specific risks the Yukon's business community face by utilizing the risk categories outlined by the UNFCCC Adaptation Committee. Our analysis delves into various aspects and examples of the risks the UNFCCC Adaptation Committee identified, drawing from a wide range of literature sources. Local government, popular and academic sources were used when possible to integrate Yukon or northern aspects into this paper.

Key findings are as follow:

- Like most parts of North America, physical risks are the most commonly identified risk considered by Yukon businesses. YESAB Registry documents show that a majority have considered climate-related risk, but that comparatively few specify a plan for managing this risk. This was particularly apparent for proposals facing risk from permafrost thaw.
- Examples of price, regulation, reputation, and liability risk are also identified, but specific publications that provide added detail on how businesses consider these risks and manage them are relatively sparse.
- In addition to the risk categories described by the UNFCCC Adaptation Committee, the relevance of a category called “ancillary risk” is discussed. Yukon businesses have a high reliance on a network of other actors and organizations when it comes to the overall management of climate related risk.

- Adaptation measures can span from direct management of physical risk to business continuity planning and review of insurance coverage with particular attention to risk related to recovery from natural disasters.

This study underscores the critical and immediate need for proactive measures to mitigate climate change risks. It also highlights the necessity of explicitly integrating climate change considerations into project plans and proposals. By addressing these concerns and taking decisive actions, businesses in the Yukon and beyond can enhance their preparedness for the challenges brought about by climate change. Importantly, this can also lead to adopting sustainable and resilient business practices, which not only mitigate risks but also open new opportunities and improve long-term business viability.

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Appendix A: Business Risk Category Web