Increasing Resilience in Rural British Columbia Through Nature-based Solutions and Trade-Offs

by

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Abstract

Rural communities are more vulnerable to climate change shocks and stresses due to community-based vulnerabilities associated with low and ageing populations, out-migration of youth, less funding distribution, and less access to skill based human resources. As a result of these vulnerabilities, the ability for local governments to be prepared to address localized impacts of climate change is limited, contributing to reduced resilience. This research examines the rising uncertainties related to climate risk and stressors in rural British Columbia communities, offering recommendations to guide planners, and academics on how to more effectively apply and use the concepts of NbS and trade-offs to achieve increased resilience.

To understand existing planning and environmental practices in local government, literature reviews, a qualitative survey, and document analysis were conducted. The literature review provided the academic understanding of NbS, trade-offs and relevant environmental planning concepts that support resilience. While some of the findings confirmed existing understandings of vulnerabilities faced by rural communities, which impact their ability to establish greater resilience, findings indicate that NbS are used by rural BC communities for addressing hazard risk or natural assets.

However greater initiative from planning practitioners is needed to not only meet their professional obligations to communities, but to also guide the transition of planning policy in local government. While the concept of trade-offs are understood broadly in the academic world, in the scope of planning strategic decision making is more commonly used. Therefore terminology needs to be adjusted for the rural context and directed at decision makers for more effective applications, and trade-offs that better represent rural needs.

The findings were used to supplement a set of recommendations that can contribute to the application and implementation of NbS and trade-offs in local government, and possible future academic work based on information gaps found during this research. The recommendations direct rural planners to more effectively apply their skills and planning practice to capture a broader range of NbS in policy and strategic documents, and weaving these concepts into the corporate level of governance. Two new trade-off dimensions of finance and values were developed, which capture rural priorities based

on the literature review and survey responses, and implementing financial valuation of natural assets into corporate strategic decision making. Since capacity was noted in the literature review as a critical issue for rural communities, and the survey results showing the same, strengthening internal capacity was also recommended.

Keywords: Rural planning; Nature-based solutions; Adaptation; Trade-offs; Rural British Columbia; Climate resilience

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List of Acronyms

BC	British Columbia
ESS	Ecosystem Services
GI	Green Infrastructure
IRRT	Increasing Rural Resilience with Trade-offs
IPCC	Intergovernmental Panel on Climate Change
NbS	Nature-based Solutions
OCP	Official Community Plan

Chapter 1. Introduction

The recent wildfires, extreme heat, and drought experienced in British Columbia (BC) during the summer of 2021 has shown the extreme shocks and stresses that many rural communities in the interior of BC have experienced. In some cases, entire communities, such as Lytton, have been evacuated and unfortunately succumbed to the wildfires. Rural communities in BC are therefore in need of resources and tools to assist in increasing their resilience to future climate events, and preparing for these inevitable climate shocks, as noted in the 6th Intergovernmental Panel on Climate Change (IPCC) report published this year (Masson-Delmotte et al., 2021).

This project will directly benefit the planning community by responding to rising uncertainties and challenges in rural settings brought on by anthropogenic climate change using resilience trade-offs and nature-based solutions (NbS). While only 1/5 of Canada's population resides in rural areas, these communities are often exposed to extreme vulnerabilities related to demographic and geographic circumstances. Rural areas are often located in areas prone to flooding, extreme weather, temperatures, and in some cases sea level rise, and experience low and ageing populations, and outmigration of younger residents, leaving rural communities more vulnerable to economic, ecological, and social shocks. Rural communities are often extremely productive both from an ecological and economic standpoint, as such resource extraction and agricultural economies have established in these areas over time, and in turn communities have developed to support the working populations that take part in these economies of the land. Existing tools and practices for environmental planning and sustainable community design are often directed at urban or higher density communities. The range of rural academic literature available at that the time of this research addressing the use of trade-offs and NbS, either together or separately, was not widely found, especially in context of rural BC. As such, this research intends to fill a gap not only for rural planning applications in BC, but also for rural academic literature. The primary research is:

- Can rural communities in BC implement resilience trade-offs and Nature-based Solutions to increase their resiliency?

Specifically, this research will address socio-ecological resilience, which recognizes the linkages that occur between social and ecological systems. Adaptive capacity is an important component of resilience because it provides context for how well systems and practices can change to address stressors. Using trade-offs and nature-based solutions are possible tools to enhance the adaptive capacity of a system, and in turn increase resilience in a community. Trade-offs can be understood as the resulting impacts of choices or decisions made on other systems (i.e,. long or short-term impacts, species, or functional priorities). Resilience trade-offs then address how these trade-offs are used in terms of managing resilience. Nature-based solutions are actions that can enhance, protect, or conserve ecosystem services, and often provide additional benefits related to human health, well-being, and biodiversity (Cohen-Shacham, et al 2016). Together, using resilience trade-offs and nature-based solutions, adaptative capacity can be enhanced and in turn contribute to increased resilience in rural communities. Whether these tools and practices are functional in a rural context will be explored further in my research.

The following supplemental questions were developed to understand the current understanding, capacity, and the use of trade-offs and NbS.

- How are NbS used in rural planning and what barriers exist for future implementation?
- How are trade-offs be applied specifically to rural communities?
- What capacity do rural communities have to undertake these practices?

These questions will be answered through a literature review and use of survey responses. Afterwards, recommendations will be developed based on the findings from these two exploratory research approaches to assist local government and planning practitioners (and other professionals) in practical applications of trade-offs and NbS.

Chapter 2 reviews the context of rural BC. It covers what rural is from an academic and community perspective, then provides a summary of the demographics, economy, and environmental challenges in BC. Chapter 3 presents a series of literature reviews, it is structured into two parts, rural planning, and environmental planning. Chapter 4 explains the methodological approach for this research. Chapter 5 presents the findings of the survey. Chapter 6 is the discussion, where the three supplemental questions from the research question are answered using the findings of the survey and literature review.

The discussion of these three questions is then used to answer the main research question, which leads into the recommendations of this paper in Chapter 7. Chapter 8 offers a conclusion and provides final thoughts on the subject matter addressed in this research project.

Chapter 2. Context

This chapter offers an overview and discussion of rural Canada from both an academic and mainstream perspective. This will provide a foundation for how rural is understood in different circles of thought, including social and political. Following this, the context of rural BC will be presented to understand the provincially specific considerations challenges, such as addressing climate change in rural BC communities.

2.1. What is rural?

Rural communities across Canada are diverse, with varied landscapes, populations, economies, and industries. Individual rural communities exist as a combination of these components. Despite these variations, there are issues and challenges that rural communities collectively face, such as ageing populations due to the out-migration of younger populations, decline in primary industries, and social and economic restructuring (Canadian Rural Revitalization Foundation, 2015). There is no singular definition of rural, however academic research and Statistics Canada are the primary sources of definitions. The way in which 'rural' is understood and addressed varies, where scholarly definitions provide an analytical understanding of rural, and government for administrative purposes (Flora Butler et al., 2015).

Rural Canadian communities have historically been staple-based economies, with sparsely populated areas (Markey et al., 2015). Staple-based economies are built around core resources and exports of a country. In rural Canada these include agriculture and natural and extractive resources. Between 2010-2014 $27 billion per year was derived from natural resource sectors in Canada (10 key facts on Canada's natural resources, 2016). This understanding of rural emphasizes the spatial scale, with policy development reflecting this through sector focused mandates (Reimer & Bollman, 2010, pg. 46). Reimer & Bollman (2010) present two alternative ways in which rural is understood, one where rural is a social construction and place-based, and the other where rural is viewed as the 'leftovers' after urban centers are identified. The latter is also spatially focused. The former uses a place-based approach to understand rural, which is an emerging area of research (Markey et al., 2015, pg. 875), where the focus of

investment of resources is in the people, rather than sector-focused investing (Reimer & Bollman, 2010, pg. 46).

A variety of additional characteristics have been developed to identify rural. These include:

- Diversity
- Smaller size
- Enhanced vulnerability to internal and external disruptions
- Scope and scale of engagement by citizens
- Abundance of land
- Great distances between settlements
- Lower average incomes

The first four characteristics are place-based and social, where the capacity of the people and community are defining characteristics, rather than spatial attributes (Hallstrom et al., 2017). The remaining characteristics are spatially and economically influenced, where factors of access and distance to resources are being used to define rural communities (Laycock & Caldwell, 2018; Wiggins & Proctor, 2001). Statistics Canada defines rural by using the classification of Rural Areas by calculating the population within these areas. The primary classification used Statistics Canada to measure populations is Population Centres. Population Centres are defined as an area of 1,000 or more and a density of 400 or more people per square kilometer. Population Centres are further split into three types, large urban population centres (100,000 people or more), medium population centres (30,000-99,999) and small population areas (1,000-29,999). Rural Areas include all territory lying outside Population Centres. Rural populations include all populations living in rural areas of census metropolitan areas and census agglomerations, as well as population living in rural areas outside CMAs and CAs (Population and Dwelling Count Highlight Tables, 2016 Census, 2018).

Another important definition of rural comes from the Canadian Rural Revitalization Foundation (CRRF), a national non-profit organization that works to revitalize and increase the sustainability of rural Canada. They propose two dimensions to understand

rural, they are (low) density and (long) distance to dense human settlements (Canadian Rural Revitalization Foundation, 2015; Main et al., 2019). This is adapted from Reimer & Bollman (2010), where the authors note the economic and social service mandates behind this understanding, which has guided public policy of rural areas. This definition is again a reflection of a spatial and economic understandings of rural, however, 'low' and 'long' are relative terms and would benefit from further refinement. The characteristics identified by Laycock & Caldwell (2018) are reflective of a space-based lens that is influenced by economic factors and has guided Canadian development policy for decades (Markey, et al., 2015).

The understanding of what rural is in Canada has been influenced by the economic drivers of our economy. However, these drivers are changing, as labour and capital are impacted by far more diverse variables that require a place-based understanding, the understandings of rural are also changing. A place-based understanding and approach to rurality in Canada recognizes the diversity of rural communities across Canada. It also recognizes changes in the economy from being spatially scaled and sector focused, to place-based (Markey, et al., 2015). Further, place-based understandings of rural allow for stronger social perspective of the individual issues and challenges that these communities face, providing a multi-faceted approach to addressing and understanding the broader needs of a community to address their socio-ecological resilience.

The ways in which rural and rural areas are defined change how issues are approached within these communities. The reviewed definitions provide some diversity in understanding, but most are based around a spatial and economic lens. This focus propagates a sector-based approach to rural policy development, this is not to say that spatial understandings of rural are not valuable, but there should be a combination of social and place-based factors to reflect the diversity of rural communities. We know that a host of factors differentiate places, and therefore Canada's economies and investments (Markey, et al., 2015), by focusing on spatial components of a community it can restrict the understandings of local issues and result in siloed decision making. If a marriage of space- and place-based rural definitions are applied, a more holistic rural understanding can be established, which better represents rural communities as places, rather than just spaces.

In the case of this research, the recommendations and framework being developed are not solely directed at rural areas as defined by Statistics Canada, or even the matrices developed by State of Rural Canada. They are directed at those communities who identify themselves as rural, regardless of how they have been identified by outside organizations. Being rural is more than fitting within a certain set of criteria, it is a place and a community that is created by the people who reside there regardless of the designations given by institutions or other organizations.

2.2. Context of Rural British Columbia

In this section the demographics, rural economy, and environmental challenges of rural BC will be introduced to provide a current understanding of factors that challenge the resilience of rural BC communities.

Demographics of BC

As of 2016, BC had a total population of 4,648,055, with approximately 40% living outside the Vancouver-Victoria metropolitan region, of that 40%, 631,776 are designated as being part of the rural population (Population and Dwelling Count Highlight Tables, 2016 Census, 2018), accounting for 13.6% of the province's total population. There are eight regions that make up BC, North Coast/Northwest, Northeast, Nechako, Cariboo, Vancouver Island/Coast, Mainland/Southwest, Thompson-Okanagan, and Kootenay, with 162 municipalities spread across these regions (Municipalities in B.C., n.d.). These eight regions represent a diversity of rural communities with coastal, interior, northern, and mountain range environments. As such, the diversity of the communities presents a set of unique and place-based challenges and opportunities, no two communities are the same, and as such this project attempts to provide flexible and functional approaches to addressing resilience in all its facets for these communities.

Although some regions, such as the southern Vancouver Island and Fraser Valley, have seen population growth from the metropolitan regions due to proximity and the availability of amenities (*Halseth et al., 2015*). Most rural communities have experienced a decrease or decline in younger populations resulting in a primarily aging population. This can be attributed to long-term trends of youth and younger populations leaving due to limited education and employment opportunities (Halseth, et al., 2015; Laycock &

Caldwell 2018). As a result of the continued aging population and out migration of younger populations, the investment in community infrastructure and housing landscape has not been renewed, which leads to declining local services and community attractiveness for the next generation of residents (Halseth, et al., 2015). This is reflected in a 2018 provincial engagement report for rural development in BC, where many of the regions in BC expressed concern with retaining youth and providing adequate services for the growing ageing population(Rural Development In BC, What We Heard, 2018).

The issues of ageing populations, limited migration, skill retention, and declining populations are experienced by many rural communities across Canada, not just in BC (Caldwell & McInnes, 2020). Having the skills and knowledge to address these issues and adapt to the changing populations and demographics of a community provides appropriate resilience measures. When rural communities have the tools and practices to address community capacity, their adaptive capacity is strengthened, leading to an increase in their resilience as a community.

Rural Economy of British Columbia

The rural and non-metropolitan regions of BC are diverse and offer varied landscapes, population distribution, and contributions to the economy of the province. Although a small percentage of the BC population resides in rural and remote communities, these are often some of the largest contributors to BC's provincial revenue. Many of the rural and non-metropolitan communities are economically based around natural resource extraction (i.e., oil, gas, lumber/timber, mineral), tourism, agriculture, and real estate and resort development (The Pathway to Prosperity in British Columbia Runs Through Its Rural Places, 2016). The Okanagan Valley provides economic diversity through the prominent low-value fruit production that contributes to fruit crops and wine products, and tourism. In addition to the agricultural and tourist opportunities, this region has over time become a connecting point to the rest of the mainland and northern communities due to infrastructure upgrades, and as a retirement and seasonal migration point. The Northern Vancouver Island and Northern BC regions are significant natural resources regions, however issues of low employment opportunities and substitution of capital labour have resulted in steady or even declining populations in these regions (Halseth, et al., 2015).

Rural communities and small towns across Canada are often economic drivers, this is no different in BC where a 2016 report published by the Ministry of Forests, Lands and Natural Resource Operations found in 2013 more than 156,000 jobs were in natural resources and agriculture sectors, and more than $2.9 billion direct annual revenues were from natural resource contributions(Accelerating Success for British Columbia's Rural Communities, 2016). Ensuring these small towns and rural communities are resilient to changes and stressors and have the capacity to adapt to these changes is critical for the continued economic stability of these communities. The economic resilience of these communities becomes far more important considering the current climatic changes, where weather events, drought, flooding, and wildfires can threaten the prosperity of these primarily natural resource based rural communities (Caldwell & McInnes, 2020; Laycock & Caldwell, 2018). Further, the establishment of appropriate practices and tools in other aspects of a community, such as social, political, and environmental, can help establish strategies to address the unique challenges faced by rural communities, and be resilient to fluctuating changes (Caldwell & McInnes, 2020).

Environmental Challenges in rural British Columbia

BC's landscape is diverse, which provides for equally diverse climatic and environmental conditions, such as extreme weather, wildfires, sea level rise, flooding, geologic events (i.e., earthquakes, landslides) and extreme temperatures. Many of these are further amplified by the ongoing changes due to anthropogenic climate change (Joseph & Krishnaswamy, 2010). Rural communities are particularly threatened by the climatic changes because of the vulnerabilities they face in other aspects of their community, such as social, political, and economic. The capacity to address these environmental issues and changes through political will, expert knowledge, and social capacity to make change are limiting factors for rural communities.

In BC, wildfires are one such threat that has increased over time due to climate change, where they can be more sever and longer lasting. Rural communities are often located in areas that are more isolated, further away from larger urban or population centres, and closer proximity to forest ecosystems (Krishnaswamy et al., 2012). As such, with increasing severity and longer lasting wildfire risks, these environmental and situational conditions threaten rural communities at a greater scale. The north of BC has also been experiencing increasing temperatures, water shortages, pine beetle devastation due to

increasing temperatures over the winter months, and coastal communities will be impacted over time by rising sea levels (Brown, 2012).

Need for Increased Capacity

In the 2018 Rural Development of BC engagement report the province identified skills training as a priority for economic growth, as well as retention of residents within these communities (G. of BC, 2018). Like many rural communities across Canada, BC is no different in the collective challenges that face rural communities for skill retention and acquisition, job opportunities, and funding availability (Main et al., 2019). These capacity issues directly relate to a community's ability to adapt, which are a "fundamental determinant of how vulnerable a specific system is to external or internal stresses" (Wall & Marzall, 2006 pg. 377), such as environmental stressors. The vulnerability of a community is determined by the scale and scope of adaptability of a community, which can be addressed by increasing capacity through institutional, human, and social resources (Wall & Marzall, 2006), as well as plans for long term growth and success (Halseth, et al., 2015). To ensure that rural BC communities are prepared for current and future environmental and climatic chocks and stresses, addressing capacity gaps is an important factor to consider towards increasing resilience.

Chapter 3. Literature Review

This chapter presents a series of literature reviews to bring together rural planning and resilience through the examination of environmental planning concepts and practices, and how they are used in both areas.

The literature review has been divided into two sections:

1. Rural planning: Capacity and trade-offs within rural planning
2. Environmental planning: the use of NbS, adaptive capacity and trade-offs within resilience.

The literature reviews are used to address the following secondary questions for this research:

- How are NbS used in rural planning and what barriers exist for future implementation?
- How can trade-offs be applied specifically to rural communities?
- What capacity do rural communities have to undertake these practices?

Research from urban practices and environments are not always consistent with the social, cultural, and political scope of rural communities (Cruickshank, 2018). As such, the literature review will be important in bringing together current academic work that covers case studies, regionally specific research, and planning practices related to rural planning, creating a baseline for how these concepts are being applied in rural contexts. The review of literature for the concepts of trade-offs, NbS, resilience, capacity and adaptative capacity and rural planning will contribute to the development of recommendations for this project. The recommendations will be developed for rural planning practitioners and professionals to help understand how resilience can be increased in their communities' using trade-offs and NbS. The recommendations will also be developed using the findings from the survey which are analyzed in the next chapter.

3.1. Rural Planning

Planning and Rural Planning

Planning is a spatially based practice requiring long and short-term approaches to policy and involves understanding relations between people, places, and environments in consideration of social, economic, and environmental issues (Healey, 2009; van Assche et al., 2016). Planning as a practice intends to improve and enrich the activities and places that humans interact with, as well as improve the natural and built parts of their environments (Healey, 2008). Planning is not static, systems of planning have changed over time influenced by different methods and goals, as well as the modes of governance and local politics (Van Assche et al, 2016; Marcuse, 2016). More recent approaches to planning and community development have changed to address the short- and long-term shocks and stresses of climate change, which impacted our local, national, and global economy, environments (natural and built), social structures, and political systems (Daniels, 2014).

Environmental and sustainability planning is a growing field within planning, which addresses the impacts on our communities due to climate change, biodiversity loss, and pollution. This planning approach has enabled planners to become key players in bringing a more balanced approach to economic growth, the environment, and social justice through the common goal of developing sustainable communities and developing policy and development to adapt to and mitigate climate change (Campbell, 2016; Daniels, 2014). Since the first iteration of ‘sustainable development’ in 1987 as defined in the Brundtland Report, the concept has now been associated with the principles of meeting human needs; the protection of environmental resources; the integration of economic and environmental considerations in decision making; public participation in environment and development related processes; and the needs and responsibilities of the Global North and South (Meadowcroft & Kenny, 1999, pg. 16). Sustainable and environmental planning is crucial to deliver the actions needed to embody these principles in current and future communities and direct social movements to meet these principles (Meadowcroft & Kenny, 1999; Norman & Steffen, 2018).

Urbanization has been a focal point in environmental and sustainability planning because of the resources needed to supplement rapidly growing urban centers and

populations (Norman & Steffen, 2018). However urban centers are not the only communities that have contributed to the impacts of climate change, nor are they the only ones prone to climate change impacts. Rural communities are important to consider in the realm of environmental and sustainability planning because of the more prevalent vulnerabilities they face socially, economically, and environmentally (Sander-Regier et al., 2009). Rural communities do not have the same accessibility to expertise, funding, or political support to address adaptation or mitigation to climate change, and therefore require additional considerations before addressing these environmental issues (Sander-Regier et al., 2009; Markey et al., 2010). Applying an appropriate rural lens to environmental and sustainability planning can provide necessary policy and development strategies for rural communities based on their specific economic, cultural, and social needs.

Capacity

Capacity building can be described as increasing the ability of institutions and communities to meet their needs (Murray and Dunn, 1995), through accessibility of resources, creation of networks, leadership through stakeholders, and collective problem solving (Franco and Tracey, 2019). Improvements to capacity building can be achieved through investment of information and knowledge, promoting appropriate institutions to contribute to these changes and learnings, and increasing the degree of access to resources (Mayagoitia et al., 2012). Capacity building is a continuous process of developing skills and knowledge bases and should not be a reactive response to stressors or other factors that impact the community (Franco and Tracey, 2019).

Capacity building in planning is often used to measure the availability of resources, whether it be information, personnel, or skills based. In rural communities, the ability to retain professionals and have access to funding for development projects or community development often hinders capacity building initiatives (Murray and Dunn, 1995). These systemic challenges include a smaller population base to pull participants from, less availability of specialists and more reliance on less skilled bodies, and the remoteness of many rural communities' further limits accessibility to skilled specialists and resources (Murray and Dunn, 1995). The depletion of capacity in rural communities through these factors can contribute to difficulties in maintaining a strong community base that can provide for sufficient capacity building (Fischer and McKee, 2017). This is especially

relevant when progressing rural sustainability, which requires the mobilization of local capacity to provide economically viable, socially appropriate, and ecologically sound development (Markey et al., 2010, pg. 5).

Trade-Offs

Trade-offs in planning occur when decision makers, planners, or policy makers frame or bring forward information that may be critical to understand what actions are (not) taken, and what those implications are at a social, ecological, economic, political, and environmental scale. Trade-offs can be defined as land-use or management choices that increase the delivery of one or more services, at the expense of the delivery of other services (Turkelboom et al., 2018).

Using trade-offs can further assist in understanding when trade-offs may take place, encourage open dialogue, engagement, and transparency with stakeholder groups, and improve management decisions, which can work towards equitable decision making (Turkelboom et al., 2018). In Canada, local governance requires decision making to occur through elected officials in the form of a council. Final decisions for planning and development proposals are balanced around their compliance to local regulations (i.e., zoning bylaws, policy, design standards, strategic plans, etc.), Official Community Plans (OCP), concerns from community and stakeholders, and relevant provincial legislation. These compliance requirements act as criteria to guide the development of a community as they act as minimum standards and objectives to be met as part of decision making, and manage potential conflicts, also known as trade-offs (de Magalhães et al., 2019).

In rural communities, trade-offs resulting from decisions made at the local level may have a greater impact because of the existing vulnerabilities in the social, economic, political, and environmental sectors. Many rural communities are dependant on resource availability, land use, and a strong local economy; therefore, trade-offs may be more frequently applied at an economic and social scale (Jurjonas & Seekamp, 2018). Land use policies can be useful in addressing and understanding the scope of trade-offs, as policies can be designed to reflect strategic decision making, which needs to account for how it may influence other sectors in a local government (Goetz et al., 2005).

The value of land is an important consideration for rural communities because the establishment of natural resource development and economies and have resulted in strong cultural and social connections to the land. As such, the conflicts, or trade-offs, that may occur between development and land in rural communities' highlights community values related to social, cultural, and environmental dimensions (Bergstrom, 2005). The interdisciplinary values associated with rural land can result in conflicts between development due to the historical emphasis of commercial growth on rural land, while the remaining values are seen as less economical. The development of new institutional arrangements through increased community engagement has been suggested to address these conflicts more effectively, bringing about a more balanced decision-making process and maximizing trade-offs that reflect rural land values (Bergstrom, 2005).

Summary

Rural communities in Canada face ongoing vulnerabilities and challenges in their social, economic, and environmental sectors, which have been further exasperated due to climate change, exposing these communities to additional stressors. Environmental planning is intended to encapsulate holistic planning, encompassing all aspects of the environment, built and natural, and those who inhabit the environments, and is aimed at making decisions that prioritise the welfare of people and the environment at present and in the future (Selman, 1999). The integration of principles for sustainable development and long-term community priorities is an ongoing challenge for rural communities (Markey et al., 2010). Bridging together environmental planning concepts and practices and making them attainable and functional for rural communities requires an understanding of the challenges rural communities currently face, and how sustainability concepts can bridge or address those challenges.

Although trade-offs and related decision making for rural communities is practiced, especially those that are natural resource based, there is still a need to ensure that the values of rural communities are applied within these decisions. The skill and knowledge capacity for rural communities is a commonly noted deficiency in academic literature, however, to address climate change and sustainability within rural communities a different knowledge and skill base will be required. Understanding the full scope of what these skills, practices, and concepts are and how they can be acquired in rural local

government needs to be examined. The next section of the literature review will examine applications of relevant environmental planning practices and concepts, including resilience, NbS, and adaptation capacity. The review will present the current understandings and applications of these concepts in the context of planning and their ability to address issues relating to environmental climate change.

3.2. Resilience

Resilience

The three main types of resilience in municipal and planning contexts are engineering, ecological, and socio-ecological (Davoudi et al., 2013). Engineering resilience can be described as having one optimal condition, whereby one equilibrium point is present in the system, and resilience is measured by how quickly the system can bounce back to this optimal state (Holling, 1996; Marsden and Kotilainen, 2018). Ecological resilience was first described by Holling (2013) as the capacity of an ecosystem to tolerate disturbances, without losing its identity and collapsing into a qualitatively different state. Extending the definition of ecological resilience, it is the furthest extent of disturbance it can tolerate before it needs to renew and re-organize (Gunderson, 2000; Liao, 2012). Ecological resilience is described as bouncing forward, rather than bouncing back in engineering resilience (Liao, 2012).

Socio-ecological resilience is recognized as having both social and ecological systems interlinked that can adapt, change to shocks and stresses, recognizing that systems are connected (Scheffer et al., 2009; Marsden and Kotilainen, 2018). Instead of finding an equilibrium, socio-ecological resilience encourages systems to instead change and adapt to the stressors (Carpenter, Westley and Turner, 2005; Bush and Doyon, 2019). Socio-ecological resilience has emphasized the need to recognize and pair social and ecological systems together and view them as one system to sustainably address community adaptability (Gallopín, 2006; Walker & Salt, 2006; Davoudi et al., 2013). Through this understanding, ecosystem resilience and development can be balanced through social actions and decisions, and strengthen community resilience (Marsden & Kotilainen, 2018; Krishnaswamy, Simmons, & Joseph 2012).

Nature-based Solutions

NbS are defined by the International Union for Conservation of Nature as, “actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits” (Cohen-Shacham et al., 2016). NbS can help expand the spatial and physical components of natural processes and systems to provide protection, adaptation, and mitigation strategies for built and natural environments.

There is a growing body of planning literature that has investigated the benefits of using NbS for adaptation planning and promoting resiliency. The combination of gray infrastructure with green and blue, which address vegetation and water, provides resilience to the effects of climate change by enhancing the natural systems or ecosystem processes that occur in a community (Rouse & Bunster-Ossa, 2013). Ecosystem services (ESS) are the benefits that natural ecosystems provide for people, such as water filtration, pollination, carbon capture. ESS are split into four types, provisioning (material products that are used by people), regulating (climate, water quality), supporting (factors necessary for production such as soil formation, nutrient cycling), and cultural services (non -material benefits such as recreation, cultural, or aesthetic) (Rouse and Bunster-Ossa, 2013; Smith, 2013). Kabisch & Annerstedt van den Bosch (2017) provided an extensive review of NbS and examined its applications to improve three areas: climate change, urban areas, and health and social benefits. The authors noted the use of NbS in cities can function as a health resource, counteracting some of the health and social impacts from climate change on vulnerable populations. Depietri & McPhearson (2017) found that using a combination of gray, green, and blue infrastructures reduced costs for infrastructure and increased co-benefits of the hybrid system.

Applications of NbS in rural communities have included the protection and preservation of important landscapes that provide goods and services within natural resource sectors, which have created urban and rural landscape linkages (Gebre & Gebremedhin, 2019). In, Huron County, southwestern Ontario, they used NbS to supplement their sustainability plan, by including community projects that connected and protected natural areas, addressed rural water quality and ecological restoration (Caldwell et al., 2016).

The County also developed a School Yard Planting project, which brought residents together to plant trees around Huron County and provided engagement and engagement opportunities for youth (Caldwell et al., 2016). In addition to addressing environmental issues, the application of NbS has been shown it to be effective in addressing and bringing together social and cultural components while providing practical and effective environmental strategies that can contribute to increased resiliency.

Adaptive capacity

The IPCC has defined adaptive capacity as “the ability of a system to adjust to climate change” (McCarthy et al., 2001). Adaptive capacity is not to be confused with adaptation, which refers to the changes in processes, practices, and structures on an ecological, social, and economic scale in response to actual or expected climatic effects or impacts (United Nations: Climate Change). Adaptive capacity is associated with its ability to influence resilience and facilitate transformations or transitions (Engle, 2011), and how social-ecological systems manage changing stressors and conditions (Mortreux & Barnett, 2017; Wall & Marzall, 2006). By assessing and analyzing capacity at a community level, adaptive capacity can be more effectively implemented to address specific issues or goals and increased to improve a system’s ability to manage stressors and contributes to resilience (Smit and Wandel, 2006; Engle, 2011).

Adaptive capacity is also determined by a community’s socio-economic characteristics, which means it is important to understand the underlying conditions that may constrain adaptive capacity (Pilifosova & Smit, 2001). Smit & Pilifosova (2001) developed a set of characteristics to understand the main features of a community that determines their adaptive capacity, these included: economic wealth, technology, information and skills, infrastructure, institutions, and equity (Smit & Pilifosova 2001, pg. 895). Swanson et al., (2007) later added the characteristics of information and skills and management, and institutions and networks to assess adaptive capacity to climate change for agriculture. These additions are intended to encompass broader human abilities and emphasizes the importance of social capital. These characteristics provide a baseline for how to assess a community or region’s adaptive capacity. If these characteristics exist it can enhance the adaptive capacity of a community.

Trade-Offs

Resilience trade-offs are a result of prioritisations within strategic decision making, which are assessed for policy design to provide optimal benefits, and to reduce unsustainable, unjust, and socially exclusive outcomes (Coaffee et al., 2018). Trade-offs emerge in resilience because of the actions taken to address and develop resilience in a community, which results in negative trade-offs at the temporal or spatial scale (Coaffee, et al., 2018). However, resilience should not be approached from a singular application of 'climate-proofing,' rather it should be used to achieve sustainable development on a broader scale, and resilience trade-offs need to similarly reflect this (Chelleri et al., 2015). Bush & Doyon (2019) identified five types of resilience trade-offs from their literature review, these being spatial, temporal, functional, social equity, and species. The collection and analysis of these trade-offs in their paper highlights the scope of resilience trade-offs across a broader scale of application and considers more tensions or conflicts that may arise at the community level.

Common goals (or trade-offs) in environmental and sustainability planning are "planning for socio-economic systems; life support systems; social learning; and environmental modernization and sustainability transition" (Selman, 1999, pg. 157). Managing resilience can be operationalized through collaborative and strategic planning; collaborative planning aims to create an open discourse for decision making, and strategic planning aims to make fair and structured responses to problem (Bush & Doyon, 2019). These planning approaches balance decision making, and set goals and objectives, which provides structure to the inherent decision-making process that results in trade-offs (Bush & Doyon, 2019). Spatial planning has also been used to address ESS trade-offs, by bringing in necessary spatial awareness through stakeholder involvement (their values, needs, and use of ecosystems) to achieve solutions. Spatial approaches can contribute to the regulation of ESS, and in turn contributes to resilience of socio-ecological systems (Turkelboom et al., 2018).

Summary

Socio-ecological resilience is a combination of two complex systems, social and ecological, this chapter has emphasized the need to bring the two systems together with a strategic approach to address systemic challenges. Adaptive capacity is used to

understand the scope of vulnerabilities within a system and its ability to bounce forward after being impacted by shocks or stresses. NbS for resilience is a multifunctional tool that can be implemented to apply effective measures and practices to adapt to those shocks or stresses. The use of trade-offs can strategically address resilience to ensure various implications are understood when making decisions. The analysis of these concepts has shown they can assist in achieving resilience, but also require strategic approaches for implementation to be effective and include both the social and ecological systems. A stronger connection between adaptive capacity and resilience is needed in both research and practice to effectively support and increase resilience in rural communities.

Chapter 4. Methodology

This chapter presents the methodology approach for this research project. First, the methodological approach is presented, followed by the research method, then analytical approach, and finally the project's limitations.

4.1. Approach

The objective of this project is to support the increase of resilience in rural communities. This objective is centred within the primary research question asking how can rural communities in BC implement NbS and resilience trade-offs to increase their resilience? This project selected a qualitative approach. Qualitative research can be approached in two ways, exploratory and conclusive, this project is using an exploratory approach. Exploratory research is used to expand current knowledge or provide new insights on a particular issue (Singh, 2007), which is the intent of this project. This project uses Yin's (2011) five features of qualitative to guide this research, see Table 1.

Table 1. Research features (adapted from Yin, 2011)

Qualitative research feature	Project's research features
Studying the meaning of people's lives in their real-world roles	• The aim of the research is to document planners and related professionals understanding of environmental planning specific concepts
Representing the views and perspectives of the people in a study	• The aim of the research is to elicit planners' perspectives on environmental planning and practices applied in BC local governments
Explicitly attending to and accounting for real-world contextual conditions	• The aim of this research is to investigate the understanding, use, and capacity of environmental planning practices such as resilience, NbS, and trade-offs in rural communities in BC
Contributing to insights from existing or new concepts that may help to explain social behavior and thinking	• This research is addressing well documented concepts of trade-offs, nature-based solutions, capacity, planning, and resilience, but within rural communities, which are less documented • This work expands on the lesser researched area of rural planning and the implications climate change, climate change hazards, and resilience

Acknowledging the potential relevance of multiple sources of evidence rather than relying on a single source alone	• This research project combines academic literature, policy documents and surveys

4.2. Method

For this research, understanding current practices used in planning and the range of understanding of resilience and NbS related concepts will be necessary to fill gaps not provided in academic literature. A survey approach was chosen as it provides an efficient method of data collection that reduced potential barriers surrounding time and space, especially when the target audience are planners in rural and remote regions of BC (Ruane, 2016; Bryman, 2004). A survey is defined as a "data collection tool that gathers information by asking questions," (Ruane, 2016 pg. 164), which provides structure to the data collection (Bryman, 2004). Using a survey provides an optimal format for data collection across a range of topics, as they are versatile and have very few limits for the information that can be obtained through the questions (Ruane, 2016).

The survey designed for this project includes a combination of open-ended and closed-ended questions (multiple choice, check box, and ranking); open-ended being those that asked the respondents to provide their own answer to the survey and closed-ended being those that have predetermined response options (Ruane, 2016). A mix of open ended and close-ended survey questions is ideal to avoid overwhelming and deterring respondents if too many open-ended questions were used, and with too many close-ended questions elaboration or additional specificity might be needed (Bryman, 2004). In addition, the use of open-ended questions allows for a deeper understanding of the respondents' views on the subject matter and brings in a real-world context to the responses.

Survey questions were developed using (Fowler & Cosenza, 2013) four characteristics of a good question. They are:

1. Questions need to be consistently understood.
2. Respondents need to have access to the information required to answer the question.

3. The way in which respondents are asked to answer the question must provide an appropriate way to report what they have to say.

4. Respondents must be willing to provide the answers called for in the question.

The questions were developed to understand how the concepts of resilience, NbS, capacity, and trade-offs are used in rural BC planning. To start the survey the participants answered a series of contextual questions that helped to understand what type of communities they worked in, what their professional roles were, and their perception of environmental issues as they are addressed or understood in the community and local government. These questions help to understand how the communities perceive environmental issues and the actions they are taking to address these issues. The following questions were categorized around the concepts of resilience, NbS, capacity, and trade-offs. The survey questionnaire can be viewed in Appendix B.

The survey was conducted using Survey Monkey, a web survey tool, and circulated via the Planning Institute of BC (PIBC) electronic newsletter, and by email through my own contacts, Resource and Environmental Management faculty contacts and alumni. The target audience for the survey was planners or other professionals working for rural communities in BC.

In addition to a survey, document analysis was used as a secondary research method to supplement the findings from the survey. Some of the questions from the survey asked respondents to provide examples of where and how NbS or trade-offs were used in the context of policy and documents. This included grey literature, such as resource management strategies, climate resilience plans, and green infrastructure plans from BC municipalities. The use of the grey literature provided additional context and analysis for some of these responses and was also used to supplement the discussion. The document analysis was also important for triangulation of resources, where in addition to the literature review and survey, more specific references could be referenced from local government documents, providing more robust information and examples for the discussion and critical analysis.

4.3. Analysis

The aim of my research is to understand how resilience, NbS, and trade-offs are used in rural communities, and whether there are issues with limited capacity that may challenge future implementation. Although the aim of the survey and the research was not to make comparisons between urban and rural communities, because the survey was circulated to a wide network of planners in BC, separating the data was necessary to identify the rural responses for certain questions. The results from the survey showed the distribution of respondents (n=29), with ‘urban’ being the highest (55%), ‘rural’ (48%) and ‘suburban’ and ‘peri-urban’ tied (21%). The remainder included Indigenous communities (17%) and other (13%), which included professional working across multiple community types.

The survey data was organized in Excel across three spreadsheets, one sheet was used to organize and compile the responses from two rounds of survey responses, this was done by adding up the total responses for each question manually. Then the remaining two tabs were organized based on those who responded from urban (urban, peri-urban, and suburban) and rural and Indigenous, this was done in Survey Monkey by sorting the responses based on what the respondent chose in the first question of the survey. The close-ended questions were analyzed by calculating the response percentage, using Excel formulas, for each of the response options, while the open-ended questions had the written responses copied from the survey. The open-ended questions were analyzed by grouping together similar responses for each question in Excel and generating lists of answers. Graphs and tables were then generated using a mix of bar and pie graphs, which helped to identify patterns between sets of data more easily. Pie graphs for ‘yes/no’ questions and those related to scaled ‘agreeing or disagreeing’ statements, and stacked bar graphs were used for closed-ended questions that used ‘choose all that apply’ responses.

Recommendations will be developed that directly respond to the identified weaknesses, strengths, and gaps that emerged from the survey data, which helps respond to the research question by understanding the current baseline of how the practices and concepts are currently applied. The main differences from the urban and rural responses were the responses related to the concepts of trade-offs and NbS. Where urban responses had a higher level of understanding and use of the concepts, and rural

respondents not seeing the benefits. The scope of application of resilience was also apparent between urban and rural responses, where urban respondents applied the concept more broadly across multiple documents, and rural responses showing a narrow scope in application. More detailed findings will be discussed in Chapter 5.

Where a higher percentage of negative or ‘no’ responses were seen in questions, these were identified as concepts that had gaps or weaknesses in their application or use, and where there were more positive or ‘yes’ responses, these were seen as strengths in use or knowledge of the concept. The bar graphs helped visualize the range of responses for the scaled or ‘click all that apply’ questions, distinguishing the familiarity in terms (the thicker the stacked bar the more familiar), or capacity areas that were lacking (the higher the response percentage the lower the capacity in that area). The open-ended questions were used to provide additional context and information that could not be captured in a range of responses and can be used to help elaborate on the current applications of the concepts addressed in the survey.

4.4. Limitations

Subjectivity of participants

The subjectivity of what rural means and what makes a community rural could have impacted how respondents chose what communities they worked in. Peri-urban and suburban characteristics may be present in some rural communities, or rural communities that have urban centers may be perceived as urban. Providing a set of definitions could have potentially clarified this research’s definition of rural and urban, which could have helped respondents identify the community types and provided consistency with responses.

Number of Participants

Of the 29 responses, only 48% were from those working in rural communities, and in some cases had cross over with urban work. The low number of rural-based respondents limits the range of rural data, in addition to the smaller total responses from the survey itself. Having access to a larger pool of rural planners to collect data from would have helped solidify the findings and provided a better picture of the current

issues or perspectives in rural communities. Therefore, while the research and findings presented here provide important insights and analysis, they are not reflective of all rural BC communities.

Regional Spread of participants

Although data was split between urban and rural to understand the rural context of respondents, some participants chose multiple community types within the survey as they work across many communities in BC. As such, the data is slightly skewed as the responses would be noted within both urban and rural data due to them providing single responses for all the communities they selected. For future, clarity of the question can be given to provide context into the rural communities they work for to ensure that responses are contextually provided for rural experiences.

Time and resources

The time frame for this survey collection was over a total of 4 weeks in December 2020 and January 2021. The window of time used to circulate was based on a timeframe around my own ability to conduct data synthesis in between my work schedule and restrictions due to the COVID-19 pandemic. If more time and flexibility were possible for this project the ability to spread circulation over multiple months could have provide a larger set of data. In addition, resources for networks of people/planners were limited, there is not a strong set of rural BC networks or groups, although planning groups and affiliates exist, they are comprised of a range of planners and professionals. If there was a more direct and current set of resources for rural BC planners, the survey could have been circulated to a more focused group.

Chapter 5. Findings

This chapter presents the results from the survey. The data is presented in the same order they were organized within the survey, beginning with contextual, trade-offs, NbS, resilience, and capacity questions. The survey results provide contextual understandings of the scope of knowledge of planners and professionals in BC communities regarding the key concepts in this research. These insights are not widely detailed in the literature, especially for rural BC and will be valuable for providing insight for understanding how some of these concepts and practices are both understood and implemented. Findings from the survey will then be used with the literature review to inform recommendations for implementing resilience trade-offs and NbS (see Chapter 6).

5.1. Survey respondents

In total 29 individuals responded to the survey. The survey respondents were from a mix of different types of communities, see **Figure 1**, the two largest types of communities were urban and rural, the remaining being suburban, peri-urban, Indigenous, or other. More than three quarters identified themselves as planners, and other roles included policy analyst and senior positions such of Director of Lands, or Executive Director, see **Figure 2. Figure 3** shows the location of the survey respondents, the survey recruitment processes emphasized getting respondents from across the province.

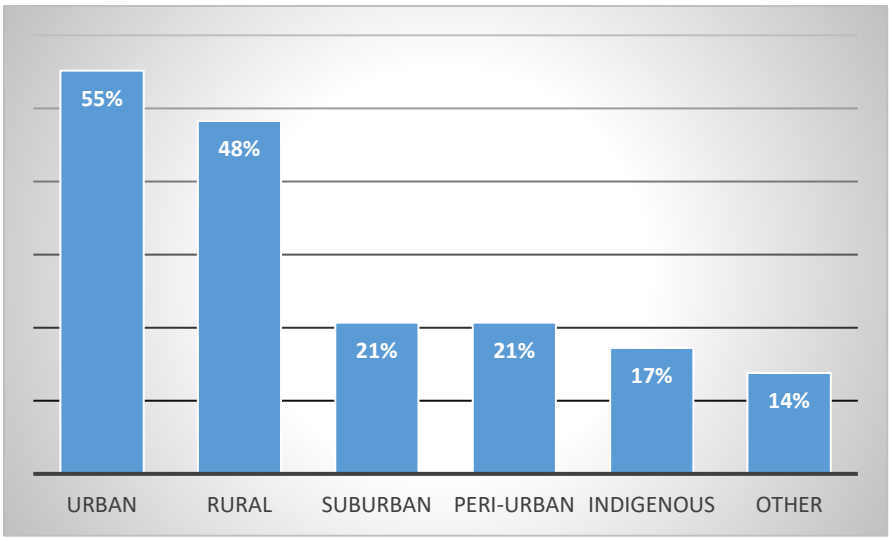

Figure 1. Community content of survey respondents

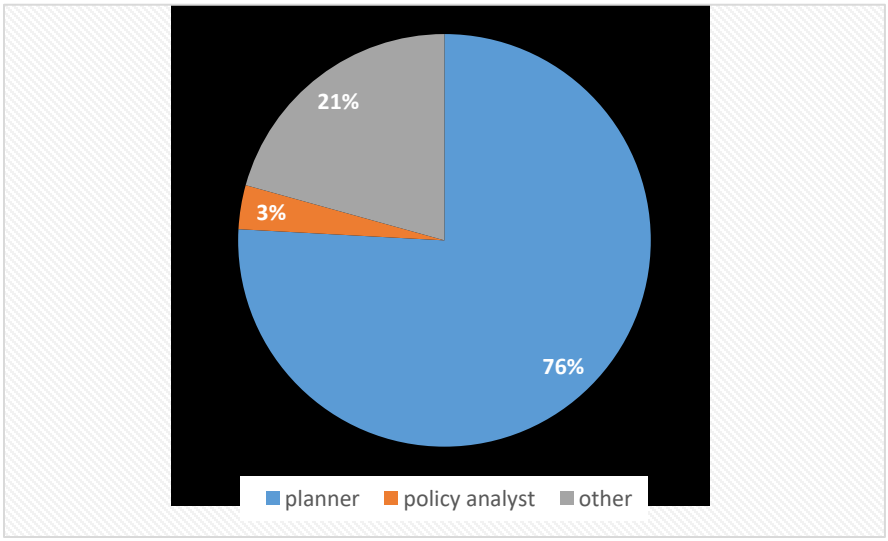

Figure 2. Positions of survey respondents

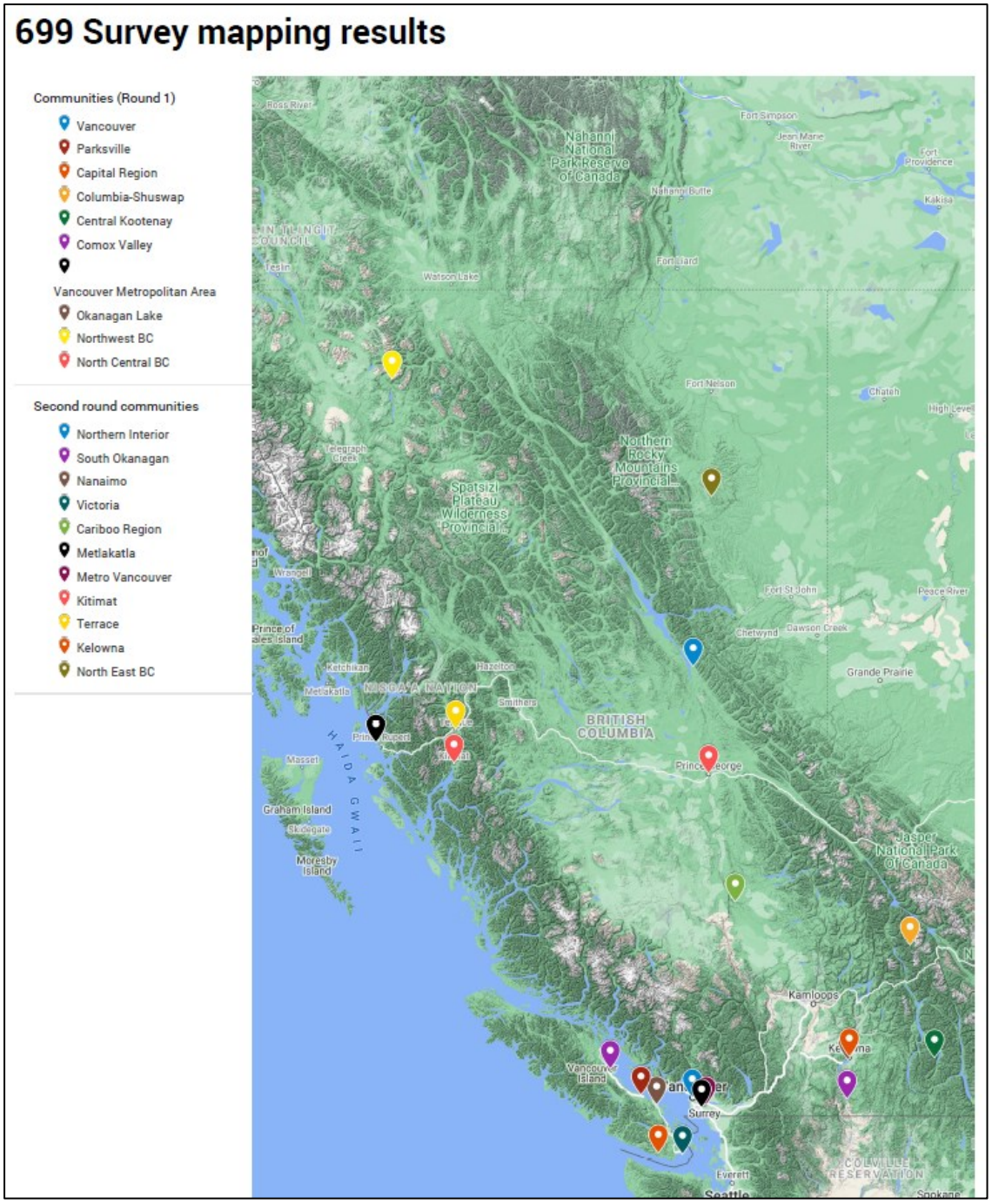

Figure 3. Location of survey respondents

5.2. Community priorities

The survey respondents were asked to prioritize five sectors (environmental, economic, social, governance, and cultural) from the perspective of their communities. Understanding how communities prioritize their decision-making is important for

addressing gaps in environmental planning work. In some cases, provincial or municipal government legislation may indicate where and how to integrate environmental considerations and practices. The Official Community Plan (OCP) is one such document that is a provincially regulated document through the Local Government Act of BC. OCPs are municipal strategic planning documents that have been used to address environmental issues to support community sustainability and resilience. Many of the survey responses identified the OCP as the main way environmental issues have been addressed, this was similar across urban and rural responses. The strategies and objectives implemented within the OCP are not enough to adequately address climate change impacts, although they do provide a broader higher-level set of sustainability and resilience actions for municipal governments to consider in their work. Other documents that included environmental provisioning were zoning, subdivision servicing, development plans, and specific plans such as environmental management plans, flood hazard management and agricultural plans. **Table 2** provides a summary of the survey responses for the different types of documents that address environmental issues related to climate change.

Table 2. Documents used to address environmental issues related to climate change

Documents	Total mentions (#)
OCP	14
Subdivision Servicing	1
Sustainability plan	1
Zoning	5
Climate Crisis declarations	1
Climate Change Plan	3
Development plans	1
Sustainability checklist for developers	1
Development permits	1
Management Plan	1
Strategic Priority document	1
Environmental Management plans	1
Corporate climate action strategy	2
Community Energy and Emission Plan (CEEP)	2
Sustainability Strategy	1
Flood Hazard Management Plan	2
Wildfire Management Plan	1
Regional Growth Strategy	1

Corporate Internal mandatory policy	1
Transportation Master Plan	1
Asset management plan	1
Healthy City strategy	1
Agriculture Plan	1

The diversity of documents that address environmental plans shows an integrated approach to addressing environmental issues across development and planning areas. However, many of these documents were only referenced once in the survey responses, which shows inconsistent approaches across communities, and that singular documents in each of these communities do not address the broader scope of environmental issues within each community. One potential reason for the lack of integration across communities and local strategic documents is the lack of political support, which was noted as a reason for why environmental issues were not addressed by respondents. If decision makers in a community are not supportive of environmental policy goals or objectives, trying to implement them across all departments and sectors will not be possible. Capacity was also noted as an issue, such as lack of skill or worker availability and capacity to address these environmental issues substantially.

The economic sector (See **Figure 4**) was prioritized the most in communities, outranking environmental considerations, in fact, environmental issues appeared approximately midway in the collective rankings of different priorities. For rural communities the economy was ranked first with 58.3% and urban responses at 45%. Responding to environmental issues is often guided by how they can meet economic goals and objectives. Although a community's economic well being is important, when it becomes the most important issue it supports neoliberal decision making, which prioritizes economic development and capital gain, over the well being of a community (Tonts & Horsley, 2019, Chapter 10).

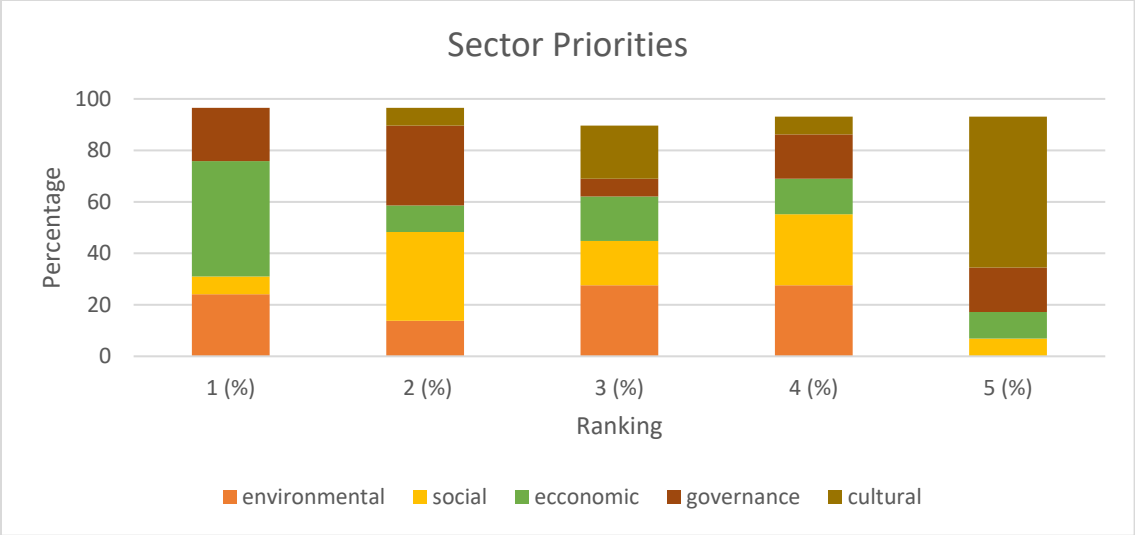

Figure 4. Survey results for sector ranking

Culture was consistently ranked last as a priority, which can impact how social issues are addressed, urban responses, ranked culture in two places, third at 30% and 50% for fifth. The rural responses ranked culture fifth at 83%. Like the environmental sector, social was also ranked midway, with rural responses ranking social fourth with 42% and environment in third at 42%, urban responses ranked environment fourth at 45%, while social did not rank, it's highest ranking was in second with 35%. Social issues that have become more prevalent due to the pandemic may change how communities prioritize future social and cultural issues. While governance did not have a ranking when it was collectively compared to other sectors, but in urban and rural results ranked it second, 40% and 41% respectively. Governance is related to the political or decision-making processes in a community, if processes are largely consistent and/or well-established, this sector may not be of concern for most communities.

5.3. Resilience

The respondents were either extremely familiar or familiar with the terms with the concepts: resilience, adaptation, and mitigation. In comparison, urban responses stated a 67% extreme familiarity with the term resilience, and rural responses were 88% extreme familiarity. Resilience, or the need to increase resiliency, was a concern for both the community and local government, and half or more of the urban and rural respondents stated resilience was being applied in practice, with slightly more from

urban respondents at 56%. Mitigation plans had the highest application of resilience, followed by adaptation, and climate change plans urban responses 75% used resilience across mitigation, adaptation, and climate change plans. Whereas all rural respondents noted application of this concept in mitigation plans, and 80% stated use in adaptation and climate change plans Respondents working in urban municipalities also noted that resilience was being applied to design standards. Literature on resilience has found that operationalizing resilience has been more challenging, and that resilience is often used as a goal rather than a practice (Coaffee et al., 2018; Bush & Doyon, 2019). The application of resilience to built infrastructure and human settlements is important due to the impacts that climate change, hazards, and other disturbances can have on them. Understanding how the built, natural, social, and economic environments interact and respond to hazards or disturbances enables planners to strengthen these sectors so they do not fail or negatively impact a community's well being (Romero-Lankao & Jorgelina, 2015). As such, the integration of resilience through planning ensures the built infrastructure has increased resilience to potential climate change disturbances, and not just goals and objectives that aren't transcribed into planning strategies.In addition to the documents mentioned in the survey, rural respondents provided other areas of resilience application, this included a climate action plan, hazard risk assessment, and sea level rise adaptation plan. One example of where resilience is applied and integrated within design standards is in the City of Nanaimo's Climate Change Resilience Strategy. The strategy notes the application of resilience in existing policies within the municipality, such as the City's Manual of Engineering Standards and Specifications. The projected changes in rainfall and sea level rise attributed to climate change are used to inform infrastructure design and construction (Nanaimo Climate Change Resilience Strategy, 2020). Also noted in the Strategy are potential infrastructure impacts from overland flooding due to heavy rainfall, as a result the City requires design requirements to be continuously updated for on site water retention and peak flow capacity (Nanaimo Climate Change Resilience Strategy, 2020).

A second example is from the Village of Anmore in Metro Vancouver where the Village incorporated resilience within their OCP to address the effects of climate change. They have included policies to reduce the risk of climate change on their resources and to enhance their natural resources and ESS (such as watershed and forests) (Village of Anmore Official Community Plan, 2014). The Anmore OCP has included both mitigation

and adaptation policies, which help Anmore achieve resilience to climate change in two ways: by reducing emissions that contribute to climate change and adapting to stressors and changing environment. The combination of using adaptation and mitigation together for climate change is called low carbon resilience, which is a proactive response to climate change by reducing risk, emissions, and results in co-benefits for communities (Shaw et al., 2021). The policies in Anmore's OCP for mitigation include building design for alternative energy and energy retrofits, supporting alternative and active transportation, and solid waste diversion through recycling and compost (Village of Anmore Official Community Plan, 2014). Adaptation policies include watershed setbacks, identification of hazardous lands (i.e., subsidence, steep slopes, erosion), and best practices for hillside development, and reinforcing natural landscapes in Anmore that will become more prone to environmental and climate changes over time (Village of Anmore Official Community Plan, 2014).

Despite these applications of resilience, lack of political support was shown to hinder more widespread implementation, where 60% of rural respondents noted this limitation, and 80% from urban (See Figures 5 and 6). The lack of political support goes against current provincial goals and objectives. In fact, the Provincial Government has encouraged local governments to include policies in their regional growth strategies and OCPs that support sustainability and resilience (Government, n.d.). If local governments and decision makers are not supporting the implementation of resilience actions and practices within their own communities through policy and planning work, they are hindering a collective advancement to adapt and mitigate to climate change.

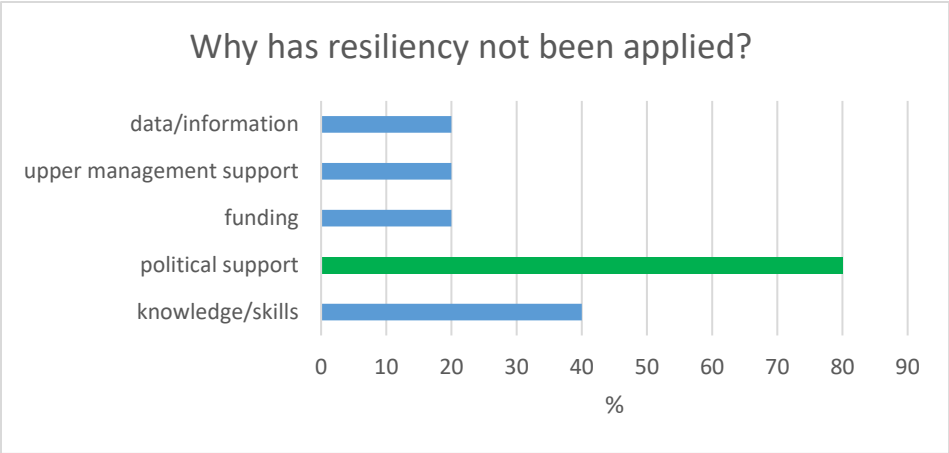

Figure 5. Limiting factors for Resilience Application in Urban Responses

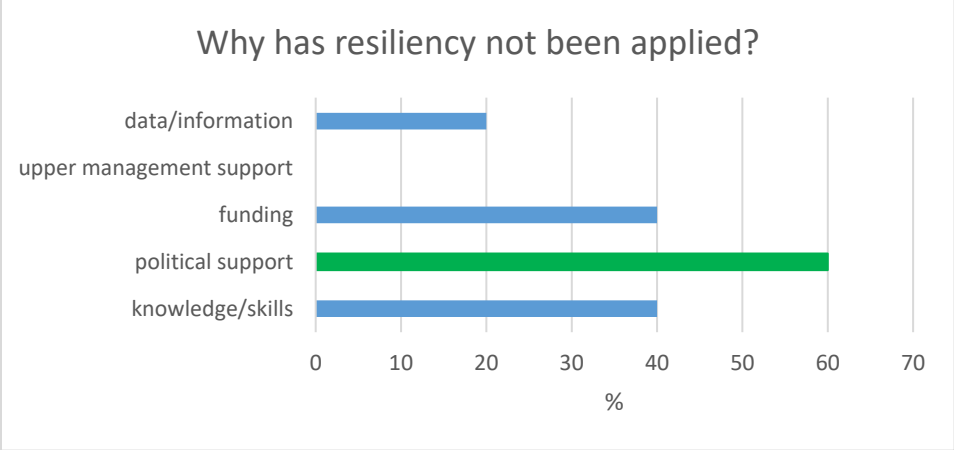

Figure 6. Limiting factors for Resilience Application in Rural Responses

5.4. Nature-Based Solutions

This research sought to understand current perceptions and applications of NbS in local BC governments. When asked about their familiarity with the concepts: NbS, ESS, and green infrastructure (GI), most of the respondents were either extremely familiar or familiar, with urban respondents being between 50-58% extremely familiar, and rural respondents between 63-75%. However two urban respondents and one rural were unfamiliar with the term and practice of NbS. Table 3 summarizes the ways NbS had been applied in the respondents' communities, those highlighted in grey are those provided by rural respondents. The responses had a heavier weighting towards different types of GI (i.e., green shore guidelines, forest strategies, flood protection). Some of the

more social applications of NbS included recreation opportunities, community character, and safe drinking water. Other types of NbS, such as infrastructure support (i.e., stormwater management) showcase the many co-benefits that NbS practices provide, such as biodiversity, lower ambient air temperatures, riparian protection, and wildfire mitigation.

The wide range of applications and benefits that come from using NbS make this practice a good match for contributing to socio-ecological resilience. Where socio-ecological resilience links social and ecological activities and systems to address community adaptability, and to recognize the interconnections between these two systems in how they impact one another to achieve resilience. As shown in the responses, NbS can provide a range of co-benefits, where in conserving, preserving, or enhancing existing natural and ecological systems, these applied systems and features can provide cultural, health, and social benefits to a community.

Table 3. Application of nature-based solutions in communities across British Columbia

Application of nature-based solutions in communities across British Columbia
Parks and protected areas
Flood protection
Urban forest strategy
Municipal natural asset initiative
Green infrastructure
Flood hazard management
Stormwater management
Wetland analysis for ecosystem services
Wildfire protection
Watershed protection
Trail networks

In the City of Salmon Arm, a Greenway Strategy was passed in 2011 that developed a plan to provide design standards for a trail and pathway network. The objectives for this plan included recreation, alternative transportation, and ecological connectivity, which can provide numerous co-benefits such as, ecological protection, tourism, economic well-being, social cohesion, accessiblity and safety, and health benefits (Greenways Strategy: Weave It Green, 2011). These benefits align with the core principles of developinging and managing NbS, such as connectivity between people and resources,

access to nature, supporting ecological networks, sustainable praxis, strategic investment and management, and the delivery of socio-economic benefits across urban and rural landscapes (Mell, 2019). The strategy outlines five different types of trail designs to accommodate the different needs and capacities of the trails such as recreational, transportation and ecological. In addition trail siting helps to determine where trails are appropriate based on new development and the landscape, which are informed by sustainable trail design guidelines from the province (Greenways Strategy: Weave It Green, 2011).

In 2011, the Regional District of East Kootenay, developed a management plan to provide recommendations for the management of the lake and shoreline along Lake Windermere, which is currently impacted by recreational activity. The plan recommends the use NbS through practices such as ecosystem-based management for enhancing or conserving riparian/shoreline habitat, and GI for retaining and enhancing native vegetation, protecting trees, and encouraging landowners to instill good practices for shoreline vegetation protection and erosion reduction (Lake Windermere Management Plan, 2011). Landscape design recommendations encourage practices such as permeable surfaces for rainwater infiltration (Lake Windermere Management Plan, 2011, pg. 82), and also references the Ministry of Environments 'Best Management Practices for Lakeshore Stabilization,' which promotes the use of natural shorelines to protect against erosion (M. of E. BC, 2006).

Despite 69% of urban and 64% of rural responses stating NbS is used in policy making and development, responses suggest there is still hesitancy in its effectiveness. Only 30% of urban and 33% of rural responses agreed that the use of NbS is an effective tool, a larger majority from both urban and rural were neutral in their responses. Many respondents noted limitations of application due to lack of data and knowledge (50% in rural and 65% in urban for knowledge), and in urban regions the lack of interest (65%) was also noted as a factor for low uptake. Capacity and resource limitations in smaller municipalities and cities have been noted as barriers to implementation for NbS due to the limited scope of work that can be taken on and having the right data and ability to measure results (Advancing Nature-Based Solutions: Panel and Breakout Sessions Outcomes Report, 2020). The literature review provides more context for this observation, as noted in Section 3.1, rural and small-town communities often struggle

with resource availability and skill and expertise capacity, which can limit the scope of work and application of new practices if the skill base is not available.

5.5. Capacity

Overall, the resources required to address environmental issues were not available to respondents, with 60% of rural respondents acknowledging this, and 47% from urban. The lack of accessibility of resources in rural communities is a known challenge, the difficulty in retaining professionals, low job opportunities, (which can be attributed to a smaller population base), and access to funding limits opportunities for improved planning and development (Murray & Dunn, 1995; Main et al., 2019). A lack of knowledge and skills were found to be the main limiting factor in addressing resilience (65% for urban, and 88% for rural), although a similar question was asked in the resilience section of the survey, it was limited to those who responded that resiliency was not applied, and therefore only a select number of respondents participated. In asking this question a larger set of information can be captured for resilience limitations, showing that even when those who do apply resilience, there are still limiting factors to it.

Lack of support from elected officials (75% in rural, 42% in urban), budget (63% in rural, 58% in urban), and funding from government (88% in rural, 59% in urban) were additional capacity issues from the responses. A similar finding was noted in Whitney & Ban (2019), who developed web-based survey to understand perceptions of practitioners (coastal managers and planners) for climate change risks, adaptation actions for social and ecological systems and barriers to adaptation within the BC coastal region. Their survey responses showed that knowledge gaps could be improved to better incorporate climate change into their work, and lack of resources limited incorporation of climate change adaptation in work plans. Responses from rural planners also noted lack of political support as a major contributor, this was also noted as a knowledge and implementation gap from Whitney & Ban (2019). The effectiveness of legal frameworks was not included in the survey questions, while this is related to political considerations, this may present a gap in some of the responses. In BC, the government recommends that OCPs include community sustainability and resilience, and provide countless funding programs that address adaptation, resilience, disaster mitigation, and wildfire for projects and infrastructure.

5.6. Trade-Offs

When asked about their familiarity with trade-offs, of the urban respondents 44% had familiarity, and 39% extreme familiarity with the term. Rural respondents were slightly more familiarity with 50% either having extreme familiarity or familiarity; only urban respondents had unfamiliarity with the term at 17% Although trade-offs are understood as the management of conflicts (de Magalhães et al., 2019) the language related to trade-offs is not commonly found in rural policy itself, rather it is reflected in how policy is designed to reflect these strategic decision-making processes. This could be the reason for lesser familiarity with the term and practice. The disconnect with how trade-offs are used and applied, and their perceived benefit for understanding environmental issues was noteworthy, where 78% of urban responses stated they did not use them in policy development, but 62% agreed it was a good tool. Rural responses were similar with 77% and 63% respectively. de Magalhães et al., 2019) the language related to trade-offs is not commonly found in rural policy itself, rather it is reflected in how policy is designed to reflect these strategic decision-making processes

Table 4 below summarizes the responses from the survey regarding where trade-offs have been applied in policy development, those highlighted in grey represent rural responses. Many of the applications are land use based, with high level applications noted such as cost benefit analysis, comparative analysis, and gender-based/social equity analysis representing a portion of responses that are reflective of senior level insight. Where trade-offs are applied can help pinpoint the scope of its application in local government, and determine gaps for where it is not applied, and provide opportunities for expanding the application of trade-offs into other components of planning and development.

Table 4. Summary trade-offs used in planning decisions

Examples of Trade-off applications
Land use planning
Development permit processes
Cost/benefit analyses
Professional comparative analyses
Review of action options and alternatives by leadership (council) and community-members
Protection of the environment / environmental impact
Climate impacts (mitigation and adaptation)

Fiscal implications
Impact on Indigenous communities
Gender-based analysis / social equity

Regarding how trade-offs were applied, the responses differed based on whether the respondents worked at the provincial or senior government level, or in rural or urban communities. One response from a senior government planner stood out for its detail, and high use and understanding of trade-offs. They stated that:

> *"All major policy decisions made by cabinet include a rigorous analysis of tradeoffs, including fiscal, impact on indigenous communities, GBA+, environmental etc. However, the weakness is the depth of analysis of these tradeoffs (often thin or principled) and lack of public transparency on some. In natural resource policies "trade-offs" is often done through a multiple accounts analysis framework (see Gunton et al). This has continued to be the model in BC for land use planning decisions, but its the absence of land use planning itself that has been a problem. With a renewed land use planning program, the province is updating its assessment procedures to include items like an explicit evaluation of climate impacts (mitigation and adaptation). A deeper dive on how these are applied in practice, how widely used, etc would be beneficial."*

This response demonstrates a high level of capacity to apply and practice trade-offs application in this manner, which enables trade-offs to be more effectively and strategically applied. The integration of land use planning and climate change impact considerations bring together critical skills, resources, and applications in practice. In Smith et al., (2013) they note that although policies address air, water, and climate regulation are increasingly integrated, there are still some areas that remain disconnected. The authors suggest bringing together an ESS framework to address the full spectrum of connections, noting that in doing so not only can more policy connections be made, but a larger breadth of trade-offs can be determined as well. By bringing together a more diverse portfolio of experts, practices, and method into policy making and legislation, a more rigorous set of trade-offs can be determined and applied.

At the rural level, the responses largely noted the use of council reports to communicate trade-offs and strategic decision-making options, both for final decisions as well as the alternatives and actions not taken. The urban practitioners noted that trade-offs were applied in land use planning and permitting processes to consider land use and development implications. The limited application of trade-offs in rural responses may be

due to the scope for which decisions are made in rural communities, where economic and social issues take precedence due to the priorities of resources, land use, and economic well being (Jurjonas & Seekamp, 2017). The trade-offs for these priorities may not be contemplated in a rigorous and detailed manner (like the response provided by a provincial level planner), but rather through the policy development and decisions made that showcase a precedence for those actions, policies, and strategies that support the sectors deemed critical for that community. The language and processes used to understand trade-offs could be markedly different than those processes used in urban or provincial level planning processes.

Half of the rural practitioners responded that trade-offs were not used as part of the decision-making process, which is slightly more than the 44% of urban respondents who do use it. Reasons included that it was too complex; a lack of understanding and knowledge regarding how to use or apply trade-offs; no formal process; it was found to be ineffective; and finally, balancing the needs of the public and the desires of elected officials was determined to be incredibly difficult. The limited ways in which trade-offs are used and applied, and the general lack of integration with policy development can be attributed to lack of capacity. The skills and knowledge needed to fully integrate and apply the practice of trade-offs may not available; where issues of complexity, or lack of knowledge and understanding of trade-offs highlight the struggles in using this concept for rural planners.

5.7. Summary

Overall, the findings from the survey show capacity as being the main inhibitor for the advancement and implementation of certain practices, either due to lack of knowledge, skills, or political support. Considering the capacity issues noted in the responses, there are also important observations for where these practices have been applied, in many cases they are documents that address specific landscape feature management plans or hazard plans for the community. The overwhelming identification of the economy as being an important sector for many communities is also an important consideration for both the discussion section (Chapter 6) and recommendations (Chapter 7). It is important that the recommendations align or support rural interests to be effective and relevant to communities today. Further discussion of these findings and how the

literature supports and or provides additional insight into gaps within the survey are discussed in the next chapter.

Chapter 6. Discussion

This chapter brings together the survey findings and literature reviews to provide critical analysis to answer the three secondary research questions that will contribute to answering the primary research question, can rural communities in BC implement NbS and resilience trade-offs to increase their resiliency? First, the research findings are discussed more generally, then each research question is answered beginning with the secondary questions and ending with the primary research question.

Knowledge, skills, and capacity were also noted as components hindering the application of resilience and NbS. Although rural communities are known to have limitations related to capacity and skill workers (Markey et al., 2015; Laycock & Caldwell, 2018), seeing these three areas as issues for urban respondents as well shows that these limitations exist province wide. To address these capacity issues requires more than strategically designed policies, it requires additional skill-based workers in rural communities, as well as availability of resources to help existing planners increase their knowledge on resilience applications and develop planning strategies that incorporates resilience (Mayagoitia et al, 2012). Although many respondents stated that resilience is a concern in their communities, and it is being applied, the respondents also noted was a lack of future applications of resilience. This could be tied back to the lack of political support, knowledge, and capacity that can limit communities and planners to implement resilience and NbS.

The survey respondent noted a hesitancy of the effectiveness and success of NbS. This may be due in part to lack of capacity. Efforts to address increase capacity will not only benefit the application of NbS in rural communities, but also in the overall capacity and success of a local government office as well. Several key success factors were summarized for NbS implementation in a report by the Action for Climate Change Team (ACT), “Advancing Nature-based Solutions: Panel and Breakout Sessions Outcomes Report” (2020), these included:

a) Establishing consistent terminology and goals for NbS, where consistency in a community for what and how NbS is understood can help streamline planning and policy development;

b) Shifting the conversation to what a community and individuals can do for nature, which expands the scope of what NbS; and

c) The availability and accessibility of data, which can help communities and private sector planners and professionals have access to the necessary information to make better informed decisions, policies and monitoring and evaluation practices of NbS.

Another possible reason for the hesistency of NbS effectiveness is the ability to properly quantify the value of NbS. Rouse and Bunster-Ossa (2013) note the long term sustainability benefits of GI, and the importance of long range planning in the effectiveness of NbS. This could be a reason for some of the hesitancy, where the long term results of projects using GI are not seen right away. However, small projects and applications of NbS are also possible and just as effective, where they can bridge connections to and with community members, while providing small scale changes and build up an evidence base (Advancing Nature-Based Solutions: Panel and Breakout Sessions Outcomes Report, 2020). Knowing that many communities place economic prosperity and growth ahead of other sectors within a community (See Section 5.2 from this chapter), quantifying biodiversity, natural assets, and natural spaces within a community can help align the practice within existing community priorities and put it in a ‘language’ that is understood by decision makers.

Romero-Lankao et al. (pg. 10, 2016) noted four factors that can affect the scope and effectiveness of actions to pursue sustainability and resilience, with some of these being reflected in the survey responses:

1. Composition of the group—as defined by the multilevel actors and networks involved, and the mechanisms in place for actor engagement and participation;

2. Legal frameworks in place to define responsibilities, decision making power, and planning mechanisms;

3. Generation and transmission of information and different ways of knowing; and

4. Financial resources, decision-making power, and leadership.

The composition of the group relates to the diversity of government and intergovernmental actors that contribute to effective policy development for climate change. Without alignment from different levels of government, appropriate, and

effective sustainability and resilience cannot be achieved (Romero-Lankao et al., 2015). Lack of political support, and lack of funding from the government, were noted as being either a major or contributing factor to why environmental issues were not addressed, or why specific practices not applied. Without the necessary political support at local and provincial levels, work towards climate change becomes more difficult and hinders increasing resilience for communities.

The generation and transmission of knowledge refers to both scientific data and local knowledge, which provide valuable information for decision making and policy development. In the case of addressing resilience and sustainability, access to knowledge is essential to adequately address regional problems. Lack of data and knowledge were seen as major contributing factors to not being able to address resilience and climate change or implement certain practices to mitigate or adapt to climate change. The accessibility of data for rural and remote communities specifically is noted in the 2019 State of Rural Report, many rural municipalities are not only concerned with addressing climate change, but also sustaining their communities. Romero-Lankao et al (2015) notes the importance of how information is being shared and given to local municipalities, where scientific literature and studies are often disconnected to what local governments need to guide and inform policy development.

Lastly, financial resources, decision-making power, and leadership relate to the participation of actors from local government, private sector, academia, and the community. In asking whether the community supported efforts for climate change most responses were positive in this manner, although further details of what this support looked like were not asked. Romero-Lankao et al. (2015) suggests "…climate change decision making be broadly participatory and that local and cross-sectoral participation and accountability be part of the decision making process…" (pg. 197). Community participation can increase support of climate change initiatives. It also enables the incorporation local knowledge into policies. Romero-Lankao et al. (2015) note that support and participation must go together with inclusive and balanced decision-making processes.

In both traditional planning practices and NbS, trade-offs need to be addressed as part of the decision-making process (Mexia et al., 2018; de Magalhães et al., 2019). Yet, the application or consideration of trade-offs were largely not incorporated into policy making

processes despite over half of the responses stating that trade-offs are a good tool to understand environmental issues and solutions. The transferal of information from scholarly and academic circles needs to be shared with local governments in a way that reflects the needs of planning and policymaking of those communities (Romero Lanko, 2015). This can be attributed to the fact that local government and municipal level work relies on relatable language and concepts. This is important to note for this research, as the language and terminology used not only in local government, but in rural contexts will be understood and applied differently compared to urban and scholarly applications. When developing the recommendations as part of this research, terminology will be important to consider, as well as how these concepts and practices translate from academic work into relatable policy and planning scales.

6.1. How are Nature-based Solutions used in rural planning and what barriers exist for future implementation?

This research sought to understand how NbS are used in rural communities and potential barriers to their implementation to adequately answer the main research question. This was done by conducting literature reviews on topics related to rural planning and NbS, a survey of planners across BC, and policy analysis of relevant provincial and municipal documents. Most of the NbS practices identified by the survey respondents, or found in the strategic documents, aimed to address hazards such as wildfires and flooding, or maintain or restore existing natural assets, such as forest canopies, trails and parks, wetland analysis, and watershed protection (See **Table 3**, Chapter 5). The use of NbS in these instances are primarily directed towards hazard mitigation and enhancement of existing natural resources and services.

When done correctly, NbS can provide a multitude of benefits to a community, where their application and implementation can foster cooperation between sectors, build capacity, tackle socio-economic and environmental issues, and address challenges such as climate change (Klimmek & van Ham, 2017). For example, the implementation of NbS across multiple scales can ensure that all levels of planning, such as visioning, policy development, and regulations are consistent. NbS planning, design, and delivery can provide co-benefits such as recreational opportunities, increased human health and well-being, increase biodiversity, and enhancement of natural environments (Hoyle & Sant'Anna, 2020). By scaling down NbS to the site level of planning and local

government, the practice becomes more than a high-level policy, it can be embedded within all levels of planning application and decision making (Rouse and Bunster-Ossa, 2013; Kabish et al., 2017). NbS can also be a tool to help effectively manage rural land and water resources, and economic activities, to support adaption and mitigation activities in the face of climate change (Kabish et al., 2017; Cohen-Shacham et al., 2016).

According to the survey respondents, a lack of data and knowledge, and a perceived lack of effectiveness of NbS were noted as barriers to future implementation, despite some respondents previously noting that NbS were beneficial for addressing environmental and climate change related issues. Kabisch et al., (2016) identified several potential barriers to implementing NbS, these include fear of the unknown, disconnect between short-term actions and long-term plans, sectoral silos, and paradigm of growth, which can provide some insight into the perceived effectiveness of the NbS.

The ‘fear of the unknown’ considers uncertainties and risks associated with NbS, the survey respondents identified lack of data and knowledge as an issue. Although they did not identify a disconnect between long- and short-term planning as a problem, Kabish et al., (2016) argue for a stronger distinction between the two. Projects are examples of short-term actions, whereas strategic planning and setting community wide goals and visions are examples of long-term actions and should be able to withstand changes in local governance (Kabish et al., 2016). The second barrier is sectoral silos, this is a common problem in many local government offices regardless of size or community type. Bukvic & Harrald (2019) noted that inter-jurisdiction collaboration (for coastal flooding) benefits communities and can help emphasize that climate hazards and impacts are not isolated events, and solutions need to be cross-jurisdictional and multi-sectoral. Lastly, the paradigm of growth refers to a cities’ adherence to a direction and vision of growth with a focus on economic oriented growth and development, rather than budgeting and accounting for green development and spaces (Kabish et al., 2016). When asked to prioritize sectors, the survey respondents identified economic and social as the most important, with the environmental sector following closely behind. This prioritization shows that many communities across BC follow the growth paradigm, potentially contributing to the perceived lack of effectiveness of NbS when it is seen as not aligning with standard existing economic growth objectives.

6.2. How can trade-offs be applied specifically to rural communities?

As mentioned in Section 3.1, trade-offs are those services delivered at the expense of other services from land use or management choices, this practice was found to be understood in rural communities through strategic decision-making practices and in sectors that align and support the development of community priorities. In spatial planning this is important for balancing interests across multiple stakeholders, which is a critical practitioner standard of practice for maintaining fair governance (CIP, 2016). The term ‘trade-off’ was more commonly used in academic literature and references and not found within reviewed rural strategic plans. This may also explain the lower level of familiarity with ‘trade-offs in comparison to other environmental planning terms presented in the survey (See Chapter 5), where the term itself is not widely referenced in practice. Using practitioner terminology, rather than academic, can help with comprehension and ensure that terms are relatable and applicable, and may assist practices more effectively. If the term ‘trade-off’ is not commonly understood, any recommendations that use that terminology may continue to be misunderstood and less likely to be applied by practitioners.

In adapting to rural contexts, strategic decision-making needs to be refined to ensure that decision-making reflects the economic, social, and environmental priorities in rural communities. Examples of strategic decision-making provided by the survey align with existing urban resilience trade-offs identified by Bush and Doyon (2019), spatial, temporal, functional, species, and social equity (See **Table 5**). The survey responses from rural practitioners indicated that trade-offs are used to present recommendations and action items to Council and community leaders. The literature also shows that rural applications of trade-offs are primarily employed as decision-making, with prioritization of key sectors that reflect community values and economic well-being (Jurjonas & Seekamp, 2017; Bergstrom, 2005). Survey respondents stated that trade-offs would not be actively used in the future, this may be due in part to the perceived complexity, and lack of knowledge and understanding of using trade-offs in local government and rural planning contexts. This can also explain the general lack of diversity in trade-off applications from rural respondents.

Table 5. Resilience trade-offs with survey responses

Temporal	Spatial	Functional	Social Equity	Species
Land use planning	Review of actions and alternatives for council and community leaders	Cost benefit analysis	Indigenous community considerations	Protection of environment
Development permit	Land use planning	Fiscal implications	Fiscal implications	Climate change impacts
Review of actions and alternatives for council and community leaders	Development permit		Gender based/social equity	

We know there are priority sectors that rural communities focus their decision making, but they may not have the tools and knowledge necessary to apply trade-offs more effectively and in a way that best reflects the goals and priorities of rural communities and their sectors. To account for rural themes from literature and noted contextual differences between rural and urban landscapes, two additional dimensions are being suggested to add to Bush and Doyon's (2019) framework, financial and values (See **Table 6**). These additional dimensions can assist rural decision makers and planners by providing strategic decision-making dimensions that relate to important rural issues and concerns. They can also account for additional service delivery through financial and value-based resources, expanding the understanding of land use and management choices that arise from these rural contexts. The table below outlines the rural characteristics of these strategic decision-making dimensions, and what information would be needed to assist planners to apply them for the purposes of increasing resilience using NbS. The proposed new trade-offs are highlighted in green to differentiate from the trade-offs identified by Bush and Doyon (2019).

Table 6. Strategic decision-making for rural communities (adapted from Bush and Doyon, 2019)

Dimension	Rural planning characteristics	Additional information needed for rural application for socio-ecological resilience
Financial	The outcomes on the landscape from financial decisions, and the monetary value of the ESS available.	What are the current natural assets in the community? In what ways have NbS been applied with existing natural assets?
Value	The cultural and social values of places, spaces, and landscapes. The ecosystem value of these natural assets to the community and landscape.	What natural assets or places are valued by the community? What are some of the co-benefits of these assets? How are social and cultural assets being addressed in current policy?
Temporal	Short- and long-term planning practices, and community planning (Bush and Doyon, 2019).	What are the current and future needs of the community for infrastructure? Where can NbS and natural assets support these infrastructure needs?
Spatial	Impacts of decisions across multiple spatial scales, being neighborhood, community, regional scale, as well as place-based approaches (Bush and Doyon, 2019).	Which natural assets provide neighborhood, community, or regional wide services? NbS applications at different spatial scales to assist in enhancing existing natural assets, or in adapting/mitigating for climate change.
Functional	Decision making processes need to account for all stakeholders and interests and help create structure and land use rules and restrictions (Bush and Doyon, 2019).	What are the existing policy and bylaw actions in place for addressing natural assets and landscape features? Who are the subject matter experts?
Social Equity	Older populations, younger generation, low population, transient populations – h ow protected are these populations to climate shocks and stresses?	What climate hazards are most prevalent in the communities, and what groups or populations do they impact? Fine-grained spatial socio-economic, cultural, and demographic data can help determine vulnerability and risk (Bush and Doyon, 2019).
Species	Who is being favored or prioritized when considering landscape decisions, people, or flora/fauna? Need to have a greater balance of the human and natural aspects of rural communities due to the intertwined relationships that come from rural land use (i.e., agriculture, natural resource extraction, etc.).	Knowledge of species assemblages within ecosystems and of habitat preferences and requirements across species lifecycles will help with prioritization (Bush and Doyon, 2019)

The financial dimension is intended to encapsulate the impacts of financial decisions on ESS in a community. The natural resource based economic structure that is characteristic of many rural and remote communities (See Chapter 2) makes it

necessary for rural communities to ensure their natural resources and the associated ESS are properly managed. The consideration of financial impacts on these services will inform decision makers on the financial value that is lost or gained in relation to climate change adaptation and/or mitigation practices. The financial impacts can be presented through monetary units, which not only speaks the language of decision makers and local governments, but also highlights the impacts on and against these services in a way the public can understand (Costanza et al., 2014).

The value dimension is intended to capture the impact that decisions have on the places, spaces, and landscapes that community members value, and in turn the ecological value of those places. Social and cultural aspects of rural life are closely tied to the local environment. In considering the social and cultural importance of places, decision makers need to ensure there is a balance of rural landscape values embodied within the development and planning processes in their community (Krishnaswamy et al., 2012; Bergstrom, 2005; Elbakidze et al., 2017). The inclusion of community values at the landscape, social, and cultural level, are important for increasing socio-ecological resilience because it contributes to the well-being of individuals, groups, and communities due to their dependence and connections to the landscape (Adger, 2000). The ability for communities to have access to and maintenance of these places contributes to their ability to withstand shocks and stresses because of changes (i.e., climate change). It can also directly impact their individual and community adaptive capacity, which contributes to their ability to be resilient.

6.3. What capacity do rural communities have to undertake these practices?

The (lack) of capacity and resources for rural communities are well documented, this was addressed in Section 6.2 where the vulnerabilities of communities are attributed to capacity and resources, such as people, funding, and data. The survey respondents noted lack of knowledge and data as the primary capacity issues for applying trade-offs and NbS. The 2019 State of Rural Report identified data accessibility for rural communities as a widespread issue in Canada, and recommended establishing a resource with practical information, including both qualitative and quantitative data, to support capacity building and transparency of rural data within all levels of government data (Main et al., 2019). Although the survey respondents noted a variety of capacity

issues, many reported a significant familiarity with terms such as resilience, NbS, and other sustainability planning terms and practices. This shows that while there are some specific capacity gaps, there is an existing baseline understanding of terms and practices across some of these communities. Meaning rural communities have some capacity to undertake these practices, so the emphasis needs to be on increasing their existing capacity to ensure more informed decision making and strategies are implemented.

In addition to capacity issues, political support was noted by the survey respondents as being a primary hinderance for addressing environmental issues. Without political support, seeking approval for plans and strategies that incorporate new features will be more difficult. If trade-offs (strategic decision making) are not properly implemented or used to address and meet community goals and visions, long term planning may not be as effective. Bringing in practices such as NbS to address environmental issues will need political support, which means decision makers need to understand the application, value, and benefits of NbS to achieve their short- and long-term planning and development goals related to climate adaptation and mitigation (Cohen-Shacham et al., 2016).

6.4. Can rural communities in BC implement NbS and resilience trade-offs to increase their resiliency?

Rural resilience can be understood as the capacity of a rural region to adapt to changing external circumstances while maintaining a good standard of living, and balancing the social, economic, and ecosystem functions of the region (Heijman et al., 2019). Adaptive capacity is a critical determinant of overall system resilience, and the adaptive capacity of individuals, communities, and regions affects the “resilience landscape” of any city or town (Chelleri, 2015; Bryant, 2015). Using NbS and trade-offs (strategic decision making), can both contribute to increased adaptive capacity and in turn increased resilience.

Building capacity at an institutional level, has the potential to increase adaptive capacity for rural communities and reduce existing vulnerabilities (Smit and Pilifosova, 2011). Carefully moderated and designed trade-offs with community involvement can help reduce existing vulnerabilities in rural communities. Planners can play an important role

by coordinating land use decisions and spatial planning through strategic decision making that communicate the broader impacts on each sector and establish more transparency between local government and the community. Ecosystem planning and development needs to be balanced with social dimensions to the resilience of communities (Marsden & Kotilainen, 2018; Krishnaswamy, Simmons, and Joseph 2012), which can be supplemented by applying trade-offs in rural communities to balance decisions across sectors, contributing to increases in adaptive capacity.

NbS can be used to increase resilience in rural communities as it can contribute to increases in adaptative capacity. While Section 6.1 identified some of the barriers to implementation of NbS, these are barriers not due to the lack of effectiveness of NbS as a tool, but rather the institutional limitations that have developed over time. The application of NbS in rural communities have been successful through bottom-up approaches (Kušar, 2019; Elbakidze, et al., 2017). This success may be due to the existing social and cultural platforms present in rural communities where a sense of place and connection to those places are strongly held. In fact, Kušar (2019) and Elbakidze et al., (2017) found NbS were more accepted by rural communities when they were applied by locals. In addition, NbS in rural communities are also dependent on spatial scale, where local level applications at regional scales have been shown to be both functional and successful (Kušar, 2019). NbS support the enhancement, protection, and conservation of natural areas or ecosystems, which help rural communities increase their adaptive capacity to withstand the stressors of climate hazards. NbS and trade-offs can be applied in rural regions to contribute to the economic, social, cultural, and environmental well-being of communities (Rouse and Bunster-Ossa, 2013; Cohen-Shacham et al., 2016).

Chapter 7. Recommendations

This chapter presents four recommendations for advancing implementation of NbS and resilience trade-offs in rural communities. The following recommendations were developed using the research and findings from the previous chapters and bring together literature reviews, survey results, and document analysis. These recommendations emphasize relevance and useability; these recommendations are intended to support practical applications of the concepts and practices addressed in this research project to assist rural communities to increase their resilience.

7.1. Use planning practices to integrate NbS across existing statutory and strategic documents.

Rural planners should take the lead and implement relevant NbS practices within and across planning documents, such as zoning bylaws, community plans, landscape guidelines, or plan areas. A similar recommendation for addressing NbS in urban resilience applications was noted in Bush & Doyon (2019), where they state planning has the practical capabilities to provide appropriate spatial guidance of landscapes, and planners have the capacity to support the adoption of new practices and regulatory recommendations that include NbS. While urban and rural communities are notably different in density and size, some rural communities have ‘urban’ centers that common urban based NbS practices can be applied to, such as rain swales, increasing tree canopy, and enhancing existing landscapes with natural vegetation, to name a few. Rural planners can learn from and adapt existing NbS plans and projects from urban locations to incorporate NbS applications into their statutory and strategic planning documents. Those communities that do not have ‘urban’ centers, can still use NbS at the landscape scale to manage resources and protect critical areas or species (Mell, 2019). In addition to other municipalities, there are several institutes, organizations, and provincial bodies that have developed guidelines for applying NbS that can be used by planners to assist in their work (See Appendix C).

When planners take greater initiative to incorporate environmental planning practices, such as NbS, into existing land use planning and strategic documents, it can assist in advancing the capacity of a community to be more prepared for climate hazards and

stressors. This in turn increases the adaptive capacity and the resilience of the community. In addition, applying NbS through planning increases the skill and knowledge capacity within planning departments and at the larger institutional level.

There is a professional obligation for planners to acknowledge the relationship between planning decisions and the consequences of the natural and human environments (CIP, 2016). Academic and scientific findings are sound on the anthropogenic impacts on our natural environment (Masson-Delmotte et al., 2021), planners work across the built, natural, and human environment and need to bring this thinking, knowledge, and practices when planning, developing, and guiding recommendations for communities. Through the implementation of NbS into planning practice, community visions and goals through community plans, zoning, and strategic documentation planners can uphold their professional standards to ensure appropriate long- and short-term planning accounts for impacts on these environments.

More research is needed on why NbS has not been applied at a broader scale through strategic planning documents. Many of the respondents noted high-level planning documents, such as the OCP, being the primary document to address environmental issues. While the OCP serves an important purpose at the local government level, it is not specific enough to properly address hazard, resource management, or specific climate change issues. Whitney and Ban (2019), further note that the strength of OCPs is in policies and goal setting, rather than implementation, which does not translate well for on the ground action. For communities to integrate provincial and/or federal goals and objectives of climate action and emission reduction at the municipal level, better incentives are needed to adapt existing plans and strategies. Some survey respondents noted that financing mechanisms were a prohibitive factor for implementing more environmentally focused strategic planning. Varied capacity between urban and rural/remote communities can create discrepancies with higher level goals and objectives to work towards resilience, where the limited resources in smaller communities make it difficult to achieve these national goals (McGregor et al., 2021). More research is needed to better understand why NbS have not been more widely applied at a rural scale, and to determine if provincial and federal levels of government are providing enough incentives, policy guidance, and funding to ensure communities can implement appropriate strategic decision making to reach these goals.

7.2. Increasing accessibility to resources and information by examining institutional capacity.

In rural communities, the accessibility of skilled professionals and knowledge are more difficult to attain. Research has also shown that to improve disaster risk reduction and resilience, improving local planning capacity is critical to effectively address these challenges (McGregor, Parsons & Glavac, 2021; Whitney & Ban, 2019). The survey results showed a lack of familiarity with terms such as trade-offs and nature-based solutions, and that a lack a familiarity was often related to lower levels of application. Developing a consistent set of terms can help bridge the gap in understanding data, and data accessibility (ACT et al., 2020).

Building internal capacity can be increased through internal resources, and professional skills and knowledge (McGregor, Parsons, and Glavac, 2021). Interdepartmental collaboration in local government was noted to foster advancement of NbS practices and is an essential component for advancing climate change resilience within communities (Advancing Nature-Based Solutions: Panel and Breakout Sessions Outcomes Report, 2020; Shaw et al., 2020). However, the existing capacities of organizations and individuals need to be understood. This can be achieved through a review of the organizational structure both for efficiency and composition (Choi, 2021). Developing an internal catalogue of existing skill sets across departments to understand what personnel resources are currently accessible can help to increase efficiencies, as well as identify gaps in skills, knowledge, or process. This catalogue can also be used to help guide strategic decision making by senior management or elected officials/decision makers regarding availability of human and financial resources for projects.

Interdepartmental collaboration and reduction of department silos can assist in increasing capacity improve information sharing, transparency, and skill development for nature-based solutions (Advancing Nature-Based Solutions: Panel and Breakout Sessions Outcomes Report, 2020). Building internal capacity at an institutional level is also important to ensure the institution has enough resources, skills, and knowledge to address community specific issues, including those related to environmental hazards and climate change. In working towards institutional capacity building, the adaptive capacity of a community can be increased through human resources (Larson et al.,

2017). When a community is prepared and has the skills, knowledge, and fortitude to address shocks and stresses more effectively their overall resilience can be increased.

As previously noted in section 6.3, data accessibility, interpretation, and transparency are issues for rural communities in Canada. Part of these issues is related to the different uses and understandings of terminology across rural communities, higher levels of government, and academics. To remedy this, the terminology used across strategic planning in rural communities needs to be examined in the academic realm, and how that translates into how data is understood, made available, and accessed. Whitney and Ban (2019) also noted the issues of lack of understanding of climate change concepts, ineffective communication of existing scientific knowledge, and misinformation as being a barrier to implementation of climate adaptation. This information can be used to make data more accessible for rural communities, as well as create shared understandings of terms across communities. This would support more informed planning and strategic decision making in rural communities.

7.3. Incorporating ecosystem service valuation with financial objectives in rural communities strategic decision-making processes.

Many rural communities rely on natural assets and ESS as part of their economic backbone; however, they also provide a range of services outside monetary economics, these include increased human health, well-being, and livelihoods (Costanza et al., 2014). These non-economic values are not always accounted for as part of financial considerations, or in asset management planning. The neoliberal focus of community development can result in misaligned prioritization as it relates to addressing environmental issues and climate change, where economic growth supersedes and often clashes with strategic environmental and sustainability practices. Strategic decision making for rural communities' economic stability needs to account for climate change impacts and work towards increasing their adaptive capacity and resilience. While establishing economic stability is an important component of rural communities, current economic practices are not comprehensive enough to address the value of a community's natural assets through the ESS they provide (Costanza et al., 2014).

Financial systems play a role in shifting how we address and prioritize sustainability, governments can invest in nature through direct projects that are complementary to nature, rather than ones that will negatively impact the environment (Dasgupta, 2021). Local governments can establish positive environmental financial investment by including natural assets as part of their asset management to supplement financial decision making (See Table 5 in Section 6.2). By including the financial value of these ESS and natural assets, we can ensure protection of these resources. In doing so, communities can be held more accountable to their decisions, while also providing a functional way to understand the value of the landscape. Economists have developed ways to calculate the value of natural capital (plants, pollinators, intrinsic, and global climate), and communities across Canada have implemented this approach into their own financial systems (e.g., District of Sparwood1). Rural communities often struggle with small financial budgets and availability of financial resources to support new and ongoing infrastructure, by incorporating natural asset management into financial planning, rural communities can begin investing more sustainably in infrastructure, while improving their own financial well-being (Caldwell et al., 2016).

Incorporating natural assets into financial decision making, operations, and reporting supports advanced ecosystem protection, enhancement, and conservation. This can contribute to increased community and institutional capacity through financial management and enhancement of natural assets and resources, which can contribute to increased adaptive capacity and resilience.

7.4. A strategic decision-making tool that accounts for rural contexts

Rural communities would benefit from using a trade-off tool that is designed with their needs, values, and vulnerabilities in mind to assist in their strategic decision-making processes. The tool, ‘Increasing Rural Resilience with Trade-offs (IRRT)’ (See Table 7) was developed to provide guidance for planners and Council when applying NbS and broader climate action considerations in their community. This has been adapted from

[1] The District of Sparwood used natural asset management to assist in improving its water quality from the Elk River. The report provided an economic analysis of the costs for an existing pond that was used as part of the case study analysis, as well as enhanced and engineered alternatives.

Bush and Doyon's (2019) trade-off framework, with modifications made to reflect the differences between urban and rural contexts, the inclusion of the 'Finance' and 'Values' trade-offs, and inclusion of 'Council' and 'Community' actions. The aim of IRRT is to guide conversations and critical thinking in terms of strategic decision making around community, social, cultural, and environmental issues in rural communities. In addition, IRRT will assist in increasing accountability, integrating the values of the community, which can lead to more informed decision making. Expanding trade-offs for rural communities does more than just provide additional spheres of possible application, but also informs and enhances community understanding and awareness of a broader spectrum of possible outcomes or conflicts that may arise from decision making. This transparency was similarly echoed by Turkelboom et al. (2018), who state that by improving the understanding of underlying causes of trade-offs, decision making can be more effective, efficient, and credible. Improved strategic decision making (trade-offs) can increase communities' understanding of how their decisions impact the natural environment when an NbS lens is applied, and in turn enhance their adaptive capacity

The three columns address 'Planners,' 'Council,' and 'Community' all have focused actions and considerations, which are implemented by planners and Council, or work that is directed at the community. By providing actions that account for integration of these trade-offs at different local government levels (administration, council, and community), operationalization can be more effective and thorough, addressing all necessary levels of governance. The columns for 'Planners' and 'Council' can be implemented by those groups where relevant and functional, while also considering the professional obligations of those roles. Whereas the 'Community' column actions are intended to be used as a guideline for planners and Council to help direct work for the community as it relates to those trade-offs. It is difficult to suggest what individual community members can do because of the range of interests and capacity of individuals in the community, but if planners and council can ensure these actions are directed in the best interest of the community the community can respond and engage at their own capacity.

Table 7. Increasing Rural Resilience with Trade-offs

Dimension	Planners	Council	Community
Financial	Incorporate financial considerations of landscape impacts within land use policy and strategic documents. Increase transparency of the financial impacts on the landscape and natural assets from land use developments to landowners, developers, and residents. Engage in professional development that expands knowledge on financial valuation of the landscape.	Establish consistent financial consideration for the landscape across all departments, policy, and with senior management. Review the corporate economic priorities to reinforce sustainability and climate resilience. Increase transparency of financial impacts on infrastructure and natural assets to the community. Review economic development goals and align with provincial climate action strategies and targets.	Understand what residents, landowners, developers, and business owners want to prioritize financially in their community. Establish community support and develop an understanding of financial valuation of natural assets, nature-based solutions, and sustainability. Provide incentives to encourage residents, developers, and businesses to incorporate NbS within their properties and buildings. Provide information on how community financial priorities can be reinforced using NbS, including protection and enhancement of natural assets.
Value	Ensure planners are considering community values as part of the recommendation process. Develop a natural/cultural asset inventory to use alongside land use development applications and assessments. Work with other departments to identify and inventory these assets, and to expand knowledge and understanding of them.	Determine where Council and community values align and incorporate within strategic priorities. Open and maintain communication avenues to hear and acknowledge community values and concerns that may influence or impact decision making. Review broader corporate strategies to ensure they support community values.	Engage with the community to develop an inventory of community values as they relate to cultural and social landscapes and places. Support and engage with community groups, organizations, and local NGO's that advocate for protection, enhancement, or conservation of the landscape, and cultural and natural assets.

			Engage with Indigenous communities to understand the social and cultural assets that are important to them. Establish a steering committee that includes key community stakeholders to provide review on sustainability projects and development.
Temporal	Include short- and long-term actions/policies to address climate change and environmental hazards for land use development Align vision, goals, and objectives for OCP and other long-range documents with projected community climate impacts. Advocate for the development of a risk and vulnerability assessment and asset management plan to understand community risks associated with climate change.	Establish short- and long-term strategic priority direction for climate resilience and risks. Align community goals and objectives with provincial goals for climate change. Ensure alignment with the BC Energy Building Code is part of the community climate action timelines.	Educate community members about short- and long-term climate risks within their community. Include the community in the development of long- and short-range community goals as they relate to addressing climate change.
Spatial	Ensure alignment of climate action across all relevant planning and development documents. Recommendations should consider the impact a development may have at multiple spatial scales. Establish relationships with other sectors, departments, agencies to better understand the landscape linkages for climate change and NbS.	Incorporate NbS practices across all relevant departments through strategic priorities. Include community goals for each spatial scale (i.e., community, neighborhoods, regional). Establish good working relationships with other municipalities and communities to establish linkages at the landscape and jurisdictional scale.	Consult the community, knowledge holders, and/or local organizations on what issues they have seen in their neighborhoods as it relates to climate impacts. Provide tools and information to the community on how their actions may impact different areas of their community.

	Establish a guideline that directs how to implement appropriate NbS for different spatial scales in the community (i.e., neighborhood, community-wide, regional).		Provide the community with information about the different natural assets in their community, and how they contribute to various ecosystem services on different spatial scales.
Functional	Incorporate NbS were relevant across planning and development documents. Utilize resources from research groups and the province to assist in application of NbS practices. Ensure the community has opportunities to engage and be part of engagement for new development or community projects. Incorporate community co-benefits as part of development recommendations.	Include relevant experts in the field when addressing more complex climate, social, or cultural related decisions or community issues. Ensure knowledge and understanding of NbS, climate change, and resilience are provided to Council. Use scientifically supported data and information when making community wide decisions as they relate to climate change.	Provide transparency and clarity on the decision-making processes to the community, and how natural assets, spaces, and services are being accounted for in decision making. Ensure all relevant stakeholders and community members have access to amenities that allow them to take part in the decision-making process Identify any local knowledge holders or field experts in the community and engage with them when necessary.
Social Equity	Include impacts from climate change on vulnerable people and groups in policy and strategic planning. Educate and inform planners of community vulnerabilities and risk within the context of climate change to guide work in underserviced areas.[2]	Investment in the use of Green Infrastructure for neighborhood improvements and increasing capacity of vulnerable populations. [3] Establish corporate priorities that reflect the needs of vulnerable populations and broader climate vulnerabilities.	Engage with the community to identify places and people that are impacted by climate hazards.[4] Provision of social and community resources for vulnerable people and groups to assist in addressing vulnerabilities.

[2] (Hunter & Harford, 2021)

[3] (Hunter and Harford, 2021)

[4] (Hunter and Harford, 2021)

	Develop tools and resources that map out where these vulnerabilities are located, or which groups need to be considered. Use NbS to enhance and conserve natural and engineered assets with consideration for existing climate vulnerabilities related to populations, groups, and climate change.	Ensure a risk and vulnerability assessment includes the social and cultural impacts on the community.	Establishment of amenities and facilities that can provide support for vulnerable populations due to climate change. Ensure engagement events are inclusive and plan for possible barriers and limitations of engagement.[5] Collaborate with local Indigenous groups on community projects to bring their voice and values into the community. [6]
Species	Educate planners and associated admin on what natural assets are, their value in communities, and incorporation within broader community development. Provide necessary policy considerations that support or enhance natural assets and the landscape. Development of an inventory of natural assets and ecosystem services in the community.	Provide support and work towards (natural) asset management through a strategic action for a plan and/or inventory. Take part in collaborative and interdisciplinary practices to address issues, actions and projects that consider the use of natural assets, ecosystem services, and NbS.[8] Collaborate with research groups and organizations to increase administrative knowledge and understanding of climate change on the community.	Provide education and awareness opportunities to the community about natural assets, resilience, climate change, and nature-based solutions.

[5] (Hunter and Harford, 2021)

[6] (Hunter and Harford, 2021)

[8] (Satzewich and Straker, 2019)

	Examine existing NbS and climate strategies, identify opportunities to integrate or update these, and design and introduce new tools for integration of climate action and NbS.[7]	Incorporate consideration of climate change, NbS, and natural assets in corporate policies.	

[7] (Satzewich and Straker, 2019)

Chapter 8. Conclusion

Local governments and municipalities are the responding bodies to climate change shocks and stresses at the community level. As such they need to have sufficient capacity to address and respond to these challenges. While some of these capacities, such as funding and political support, were outside of the scope of this research, this research has emphasized the need to increase the capacity of decision makers and planning in rural communities through advancement of existing planning practices and standards, increasing institutional capacity, integration of environmental planning concepts, and consideration of community financial and social values to effectively implement NbS and resilience trade-offs. In urban literature the use of trade-offs and NbS were found to be successful in increasing resilience for the purposes of addressing climate change impacts. While most of the research of these practices has been directed at urban applications, these approaches were also found present for rural applications, but in varied capacities. Academic literature has confirmed that gaps in funding, resources, and skill-based workers exist across various departments and sectors in rural communities. This research has found that the ability to apply NbS and resilience trade-offs in rural communities has been limited due to these capacity issues.

As part of the research project, four recommendations were developed to address the capacity issues noted in the survey and literature review and provide suggestions that can be applied in rural communities using existing planning practices:

1. Use planning to integrate NbS across statutory and strategic documents;
2. Increasing accessibility to resources and information by examining institutional capacity;
3. Incorporating ecosystem service valuation with financial objectives to in rural communities strategic decision-making process; and
4. The development of ‘Increasing Rural Resilience with Trade-offs (IRRT)’ that accounts for rural contexts.

In particular, the addition of two trade-off dimensions to Bush and Doyon’s (2019) Planning nature-based solutions for urban resilience framework, being financial and values, incorporates important rural considerations within the context of planning and decision making. The financial dimension acknowledges that economic prosperity is

prioritized within rural resilience. The values capture the strong social and cultural connection to the land and community values present in rural communities. Including these two additional dimensions, strategic decision making can better capture the priorities of rural communities while ensuring aspects of the landscapes are included. The use of NbS was found be a familiar term and applied tool in some rural communities, and in BC NbS are being applied more broadly through strategic planning. However, NbS could be more specifically applied to hazard and community development plans to address the concerns of climate change across all levels of planning and development.

Finally, this research ends with two additional recommendations for future academic research:

1. More research is needed on why NbS have not been applied at a broader scale through strategic planning documents; and
2. The terminology used across strategic planning in rural communities needs to be examined in the academic realm, and how that translates into how data is understood, made available, and accessed.

This research is a first step in a large set of work that needs to be done to assist rural communities in BC, and Canada, to properly address the unique and often overlooked climate change impacts. NbS and resilience trade-offs are functional and well supported tools and practices that can assist local governments and planners to work towards increased resilience. This research has shown a way in which these are applied and adjusted to the specific community contexts can make them even more effective across a broader range of communities.

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Appendix A. Approved Survey Questions

Contextual Questions:

1. What Region do you work in? (Comment box provided)
2. What type of community do you work in?
    a. Urban
    b. rural
    c. suburban
    d. peri-urban
    e. Indigenous
    f. Other (please state)
3. What is your position?
    a. Planner
    b. Policy Analyst
    c. Elected official (mayor, reeve, councillor)
    d. Development Officer
    e. Other (please state)
4. Which terms are you familiar with in the context of addressing environmental or climate change issues? (**check all that apply, OR a sliding scale of familiar to unfamiliar**
    a. Resiliency
    b. Adaptation/adaptive capacity
    c. Trade-offs
    d. Green infrastructure
    e. Nature based solutions
    f. Ecosystem services
    g. Mitigation
    h. Capacity building
5. Are environmental and/or climate change issues addressed in statutory documents in the local government you work for? **(Yes/No)** ***Filter Question***
    a. If Yes, What type(s) of plans or documents are used to address these issues? Please provide examples. **(comment box)**
    b. If Yes, do you think they provide strong enough actions/goals for environmental issues and or climate change? ***Contingency Question***
    c. If no, why? **(Comment box)**
6. Is there strong support from the public on environmental issues related to climate change are? **(strongly agree to strongly disagree)**
7. Is there support from the local government/elected officials on environmental issues related to climate change in your community? **(strongly agree to strongly disagree)**
8. How does your local government currently prioritize the following **(Ranking 1-5)**
    a. Environmental issues/climate change
    b. Social issues/equity
    c. Economic development
    d. Governance/political leadership
    e. Cultural issues/diversity

Trade-Off Questions:

Trade-offs can be described generally as the alternative result of a choice made, which can have positive or negative effects or increase or decrease the delivery of a service or function. In the context of this research, we are looking to use trade-offs as one component to support resiliency of communities in addressing environmental issues related to climate change. By understanding the scope of trade-offs policy and development can be developed to address these gaps and contribute to more effective decision making for environmental issues related to climate change in relation to community resiliency. An example of a specific trade of is species trade-offs, where a decision on the scale of ecosystem management will favor the protection and management of one species, that results in the exclusion of another.

9. Are trade-offs incorporated in your policy development or local government documents to highlight or understand the impact of environmental decision making? **(yes/no)** ***Filter question***
    a. If yes, in what way have trade-offs been incorporated in policy or other documents? Please provide examples. **(Comment box)** ***Contingency Question***
    b. If yes, do you think trade-offs are an effective tool to highlight or understand environmental issues and solutions? **(strongly agree to strongly disagree)** ***Contingency Question***
    c. If no, are there other ways for which trade-offs (or the concept of it) are understood or considered? **(comment box provided).** ***Contingency Question***
10. Are trade-offs considered as part of the decision-making process by decision makers from the recommendations provided by civil servants? (yes/no)
    a. If yes, in what format have trade-offs been presented to decision makers? Please provide comments.
    b. If no, why do you think there has been a lack of consideration for this type of strategic planning and decision making? Please provide comments

Nature Based Solutions Questions:

11. Does your community and/or local government use nature-based solutions/ecosystem services/green infrastructure in your policy making and development? **(yes/No)** ***Filter Question***
    a. If yes, have they been an effective tool for addressing environmental or climate change issues in your community? **(strongly agree to strongly disagree)** ***Contingency Question***
    b. If yes, how have they been implemented in policy making and development? Please provide examples **(Comment box)** ***Contingency Question***
    c. Have you used the implementation of NBS to address other issues in the community? If so, please provide examples
    d. If no, why have they not been used? **(comment box provided)** ***Contingency Question***
        i. Are there plans to implement these practices in future planning or policy development? ***(yes/no) Contingency Question***

Resiliency Questions:

12. Is resiliency to environmental issues related to climate change a concern for your community and or local government? **(strongly agree to strongly disagree)**
13. Have environmental/climate change resiliency been implemented or addressed in your community and local government? **(Yes/No)** ***Filter Question***
    a. If yes, how has it been incorporated? **Check all that apply** ***Contingency Question***
        i. Adaptation Plans
        ii. Mitigation Plans
        iii. Climate Change Plans
        iv. Design standard plans
        v. Other
    b. If no, why? (comment box) ***Contingency Question***
    c. Are there plans to implement these practices in future planning or policy development? ***Contingency Question***

Capacity Questions:

14. Does your community/local government have the resources and/or expertise to address environmental issues related to climate change? **(Yes/No)**
    a. If no, what factors have limited the capacity to address resiliency? **(Select all that apply)**
        i. Lack of funding from government
        ii. Lack of budget
        iii. Lack of skills/knowledge in staff
        iv. Lack of support/priority from elected officials
        v. Lack of support/priority from senior management
        vi. Lack of relevant data/information to prepare documents/plans
        vii. Other (please comment)

Appendix B. Resources

To assist in supplementing NbS at the land use planning level, the use of frameworks and guidance documents from institutes, organizations and provincial bodies have developed guidelines for applying NbS. These can be used by planners to supplement their own work in land use planning at the rural level, and even referenced in these strategic documents to ensure developers, landowners or decision makers have these resources at top of mind.

Green shorelines Guideline (BC)	https://stewardshipcentrebc.ca/green-shores-home/gs-resources/
Adaptation to Climate Change Team (ACT)	https://act-adapt.org/reports/
Pembina Institute	https://www.pembina.org/pubs
Smart Prosperity Institute	https://institute.smartprosperity.ca/library