Comox Valley
REGIONAL DISTRICT

Will Cole-Hamilton, Director
City of Courtenay

July 9, 2020

File: 530-20

Chair and Directors
Regional District Board

**Re: External Appointment Update**

The Vancouver Island and Coastal Communities Climate Leadership Plan (VICC-CLP) Steering Committee is an independent group of local government representatives from Vancouver Island and the coast from Powell River northwards. We are working to build a climate action plan for Vancouver Island and Coastal Communities that draws on and builds from the unique circumstances of our individual communities - rural and urban - at the same time as thinking and working as a whole region. This plan is to be presented at the April 2021 AVICC conference.

The VICC-CLP Steering Committee is working towards an online conference to be help November 6, 2020. This conference aims to bring together local government elected officials, relevant staff, provincial and federal cabinet ministers and staff from UBCM and the Climate Secretariat.

As preparation for this conference two pieces of work have been prepared by University of Victoria professors Tamara Krawchenko and Katya Rhodes who have been supporting the work of the VICC-CLP Steering Group thanks to a grant from the Pacific Institute for Climate Studies.

Professor Krawchenko has prepared a Territorial Analysis of the region, a draft of which was presented at the June meeting (copy attached). The territorial analysis provides an overview of the regional geography, socio-economic composition, critical infrastructure, and anticipated climate change impacts. It is an impressive piece of research and worth the read if you find that you have time.

Professor Rhodes has created an online survey which was sent out to elected officials and key staff in the region in May. The survey sought to identify the policies, priorities, barriers, and opportunities that are currently shaping municipal and regional planning processes. The results will help create efficiencies, cross-boundary integration of projects, and ultimately more resilient communities. The results of the survey will be presented at the next meeting on August 10, 2020.

The results of both will be made publicly available at the day-long online conference in November. The survey, territorial analysis, and feedback from this workshop will help inform the VICC Climate Leadership Plan that will catalyze climate change mitigation and adaptation throughout the region.

Respectfully

***W. Cole-Hamilton***

Will Cole-Hamilton
Director

Enclosure: Territorial Analysis

# Territorial Analysis
# Vancouver Island and Coastal Communities Climate Action Strategy

*This Territorial Analysis develops a collective understanding of the Vancouver Island and Coastal Community (VICC) region for the purposes of supporting a regional climate action strategy. It provides an overview of the region's: i) governance, ii) land use and the built environment, iii) population and demography; iv) economy and industry, v) community wellbeing, vi) the state of greenhouse gas emissions and vii) present and future climate change scenarios.*

*Document produced for the Vancouver Island Climate Action Planning Group by: Kimberly Harrison, Tamara Krawchenko, Kara Shaw, Astrid, Brousselle, Katya Rhodes, Tara Ney, Katherine Pearce (University of Victoria).*

*Contact: Tamara.Krawchenko@uvic.ca ; ph. +1 (250) 508 1936.*

We gratefully acknowledge the support of the Pacific Institute for Climate Solutions to undertake this work.

# Contents



## List of Tables



## Table of Figures

# Introduction

## *Territorial Acknowledgement*

The authors respectfully acknowledge that the Vancouver Island and Coastal Communities Region is located upon the traditional unceded territories of many different Indigenous peoples. Although every effort is made to use unbiased data, much of the data is not framed to adequately reflect Indigenous realities.

## *The climate change challenge*

Climate change is a complex and ongoing challenge that communities across the Vancouver Island and Coastal Communities Region (VICC) are tackling through a range of approaches. By 2050, it is anticipated that British Columbia will experience:

- Temperature increases of 1.3 to 2.7 °C;
- Increases in average annual rainfall from 2% to 12%, with summers being increasingly drier;
- Loss of glaciers resulting in changes to fish habitat, declining quality and storage of drinking water; and
- Continued rising sea levels along most of B.C.'s coast (Province of British Columbia, 2020).

These environmental changes will have wide-ranging effects, from more frequent and severe heat waves and a greater propensity for forest fires to major disruptions in agricultural growing conditions. Climate change impacts all sectors of society and the economy now and in the future. Our communities are connected in tackling this challenge.

## *Why coordinate at the regional scale?*

British Columbia has been at the forefront of actions to promote climate change mitigation and adaptation and there is widespread support for these efforts.[i] Communities big and small across the province have adopted a range of initiatives and there are a growing number of regional plans that aim to scale up these efforts and to promote co-ordinated actions. Climate change impacts are experienced at a local level, yet existing municipal and regional district governance structures can constrain climate action plans, making planning at a broader regional scale essential. An expanded regional scale for action has proved effective in other contexts, leading to the development of institutional arrangements better able to coordinate regional with local interests to navigate structural change (Birkmann, Garschagen, Kraas, & Quang, 2010; Gore, 2010). Regionally-scaled planning can help municipalities and Regional Districts to:

- Pool knowledge and map and understand functionally connected territories;
- Share expertise and build capacity;
- Share the costs of environmental assessments and other upfront planning needs;
- Co-ordinate and scale-up investments in adaptation and mitigation efforts;
- Speak with a common and louder voice to upper level governments about the region's unique needs and priorities; and

- Mutually support communities of all sizes to meet their climate goals, with larger administrations supporting smaller ones.

It is for this reason that three Vancouver Island Mayors—Lisa Helps (Victoria), Josie Osborne (Tofino), Michelle Staples (Duncan)— have convened an ad-hoc group (Vancouver Island Climate Action Planning Group—VICAPG) including representatives from each of the regional districts on the island, Sunshine Coast, and North Coast to produce a plan that will catalyze climate mitigation and adaptation throughout island region.

The VICC represents a promising geographical region for this type of planning: comprised of island and coastal communities, the region shares a common history, as well as vulnerabilities, adaptation, and mitigation challenges. Its economic diversity and urban-rural linkages offer differential capacities and priorities, supporting the potential for building circular and sustainable economies with shared resources and coordinated action. The VICAPG group shares a clear vision and priorities for its work, suggesting the potential for rapid collective progress. Collaborative planning at this scale thus offers a potential to build consensus and poly-benefits for climate action, including a shared regional vision to guide that action effectively and rapidly (Tomaney, Krawchenko, & McDonald, 2019).

This Territorial Analysis supports a collective understanding of the key geographic, socio-demographic, economic, and environmental features of the VICC region in support of establishing a regional climate action plan. The analysis proceeds in six parts: i) about the region, ii) land use and the built environment, iii) population and demography; iv) economy and industry, v) community wellbeing, vi) the state of greenhouse gas emissions and vii) present and future climate change scenarios. This document identifies key trends and common challenges and opportunities in order to assist VICAPG with its planning and strategy development.

## About the Region

- **The Vancouver Island and Coastal Communities Region is comprised of 11 Regional Districts, 89 First Nations Reserves and Indian Government Districts and 53 municipalities.**
- **The entirety of Vancouver Island and coastal mainland BC are the traditional territories of Indigenous peoples.**
- **Much of the territory and population is rural and remote with numerous small coastal and island communities: 40% of the population lives in Greater Victoria, 20% in medium sized population centres and 40% in small urban population centers and rural areas.**

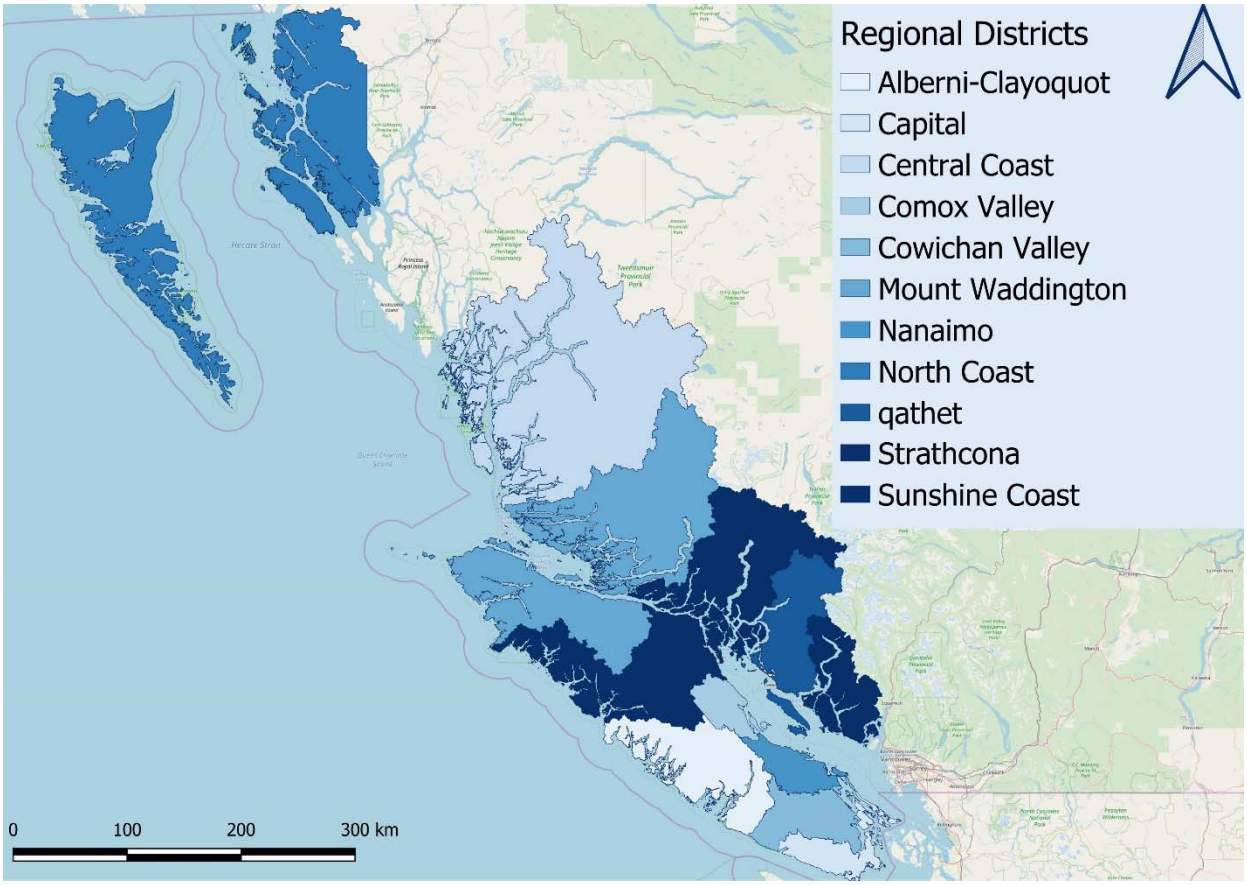
The Vancouver Island and Coastal Communities region has unique characteristics that pose both a challenge and an opportunity for collective climate change adaptation and mitigation strategies. The region is shaped by its proximity to water and includes approximately 40,000 islands of vastly different sizes and around 67 inhabited major islands, the largest of which is Vancouver Island. Many communities rely on connections to water for both transportation and livelihoods. Given the prevalence of coastlines, sea level changes pose risks as does the prospect of more frequent and severe storms. The mainland part of the region north of Vancouver is coastal and mountainous, with many areas having limited accessibility. In this region land transport connections flow east-west towards the Pacific. Coastal routes are the life-blood of communities.

### *The Vancouver Island and Coastal Communities region is one of five Area Associations in BC*

The territory of analysis in this document corresponds to that of the Association of Vancouver Island and Coastal Communities (AVICC), which is one of five area associations in BC. The area association was established in 1950 and includes including 41 municipalities, 11 regional districts, and Islands Trust (see Figure 1 Vancouver Island and Coastal Communities Regional Districts) that stretch from Haida Gwaii down to the tip of Vancouver Island and includes Powell River/qathet, the Sunshine Coast, the Central Coast and the North Coast (AVICC, 2020). The Capital district at the southern tip of Vancouver Island is the largest district in the territory in terms of population and number of municipalities; it is also the seat of the provincial government. All districts contain both municipalities and electoral areas except for the Central Coast regional district, which contains only electoral areas.

The entirety of Vancouver Island and coastal mainland BC are the traditional unceded territories of Indigenous peoples. All of the Regional Districts have First Nations reserves; the Alberni-Clayoquot Regional District has the largest number of First Nations reserves with 17, as per 2016 Census records (Table 1). The Capital Regional District has the largest on-reserve population at just over 5,000 (2016). Both qathet and Sunshine Coast Regional Districts have an Indian Government District municipality (the Sechelt Band IGD has lands in both regions) and, like Comox Valley, one reserve. There is a large population of Indigenous people living off reserve – comprising as much as 30% of the population in the North Coast district, 17 in Mount Waddington Regional District and 13% in Alberni-Clayoquot Regional District.

Figure 1 Vancouver Island and Coastal Communities Regional Districts




*Source: British Columbia Data Catalogue. https://catalogue.data.gov.bc.ca/dataset/d1aff64e-dbfe-45a6-af97-582b7f6418b9 & https://catalogue.data.gov.bc.ca/dataset/nts-bc-coastline-polygons-1-250-000-digital-baseline-mapping-nts#edc-pow*

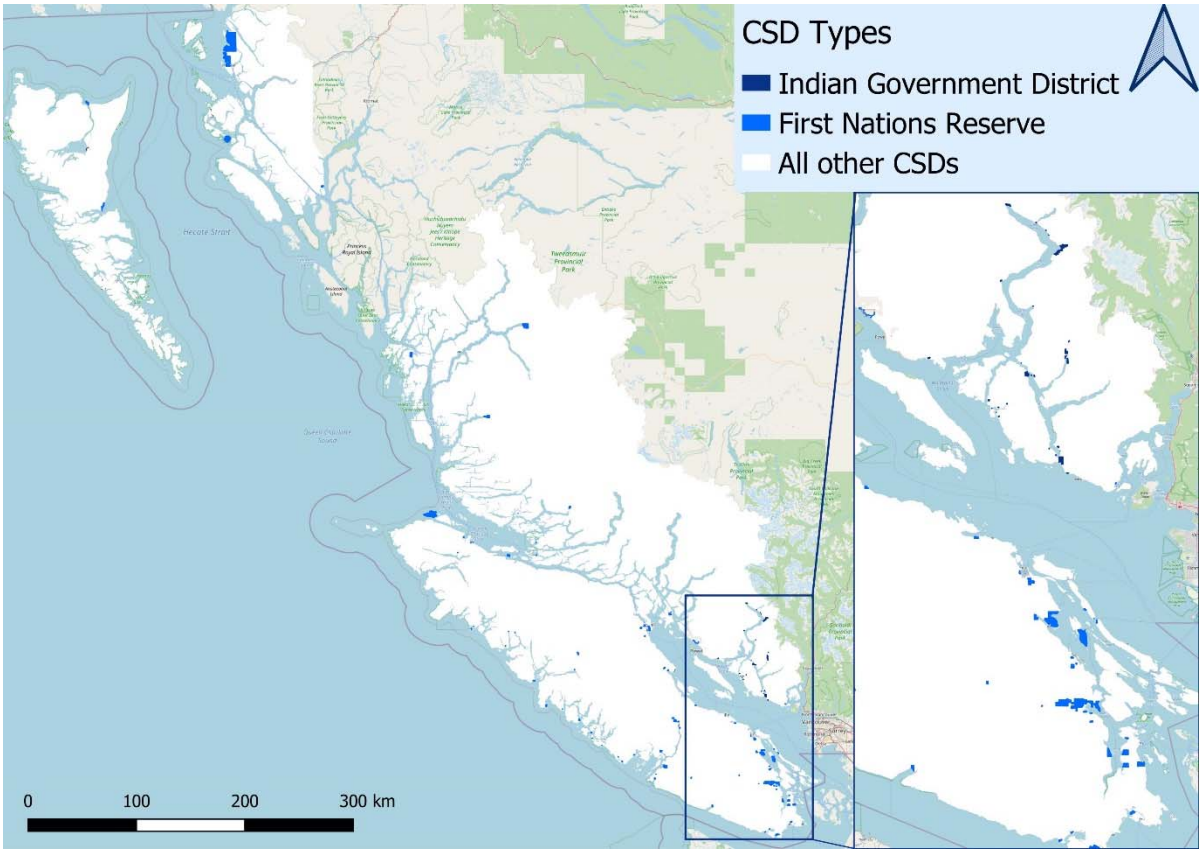
Table 1 Municipalities, Population, and First Nations Reserves, by Regional District, 2016

| Regional District | Municipalities | Total Population by District | First Nations Reserves and Indian Government Districts by Census Divisions | Population of First Nations Reserves and Indian Government Districts by Census Divisions, 2016 | Population of Indigenous people living off reserve |
|---|---|---|---|---|---|
| **Alberni-Clayoquot** | 3, + 6 electoral areas, 3 Modern Treaty First Nations | 30,981 | 17 | 1,986 | 4,049 |
| **Capital** | 13, + 3 electoral areas | 383,360 | 10 | 5,244 | 12,631 |
| **Central Coast** | 5 electoral areas | 3,319 | 3 | 1,916 | 129 |

| | | | | | |
|---|---|---|---|---|---|
| **Comox Valley** | 3, + 3 electoral areas | 66,527 | 2 | 222 | 3,603 |
| **Cowichan Valley** | 4, + 9 electoral areas | 83,739 | 16 | 4,076 | 5,584 |
| **Mount Waddington** | 4, + 4 electoral areas | 11,035 | 12 | 1,490 | 1,850 |
| **Nanaimo** | 4, + 7 electoral areas | 155,698 | 4 | 1,035 | 9,600 |
| **North Coast** | 5, + 4 electoral areas | 18,133 | 7 | 2,531 | 5,504 |
| **qathet** | 1, + 5 electoral areas | 20,070 | 2 | 728 | 847 |
| **Strathcona** | 5, + 4 electoral areas | 44,671 | 14 | 1,579 | 4,276 |
| **Sunshine Coast** | 3, + 5 electoral areas | 29,970 | 2 | 671 | 1,349 |

*Sources: Regional District Websites & Statistics Canada; Census Profile 2016; Census Divisions and Census Subdivisions, Statistics Canada. 2017. Focus on Geography Series, 2016 Census. Statistics Canada Catalogue no. 98-404-X2016001. Ottawa, Ontario. Data products, 2016 Census.*

Figure 2 First Nations Reserves and Indian Governments Districts, VICC, 2016



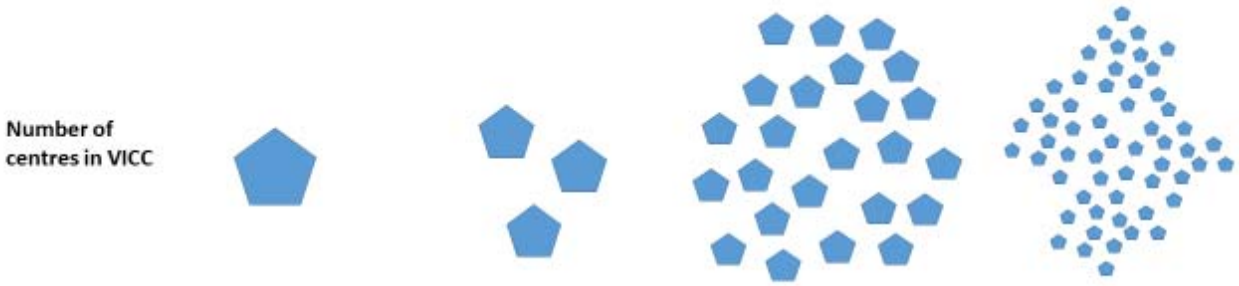

*Source: Statistics Canada; Census Profile 2016; Census Subdivisions*

### *Much of the region is low density, characterised by small communities—rural-urban connections are critical to this region*

The vast majority (80%) of the VICC population resides in small to large population centers, while the remaining 20% live in what can be defined as rural areas—i.e., those without a population centre (Figure 3). However, despite this definition, rurality is best understood along a gradient of more connected and dense places to less connected and dense ones. Smaller communities and rural areas may access services and labour markets in larger population centres; at the same time, these communities provide many resources and amenities that larger communities consume and enjoy, and are also a source of employment. Rural-rural connections are equally important. Across VICC, the nature of these connections and interrelationships are a key character of society and economy.

Greater Victoria is the only large population centre with a population greater than 100,000 (Figure 4Figure 4 Population Centres, VICC). Population centers are those places that have a population density of 400 persons or more per square kilometre and include more than one municipality. There are three medium-sized population centres across the region, all on the eastern coast of Vancouver Island: Nanaimo, Courtenay, and Campbell River (Figure 4). The majority of the population centres in the region are in the middle and southern regions of Vancouver Island, forming a land-based network of urban agglomerations. There are few centres on the mainland coast, the largest being Prince Rupert. There are 24 small urban population centres. There is only one regional district without any population centres: the Central Coast.

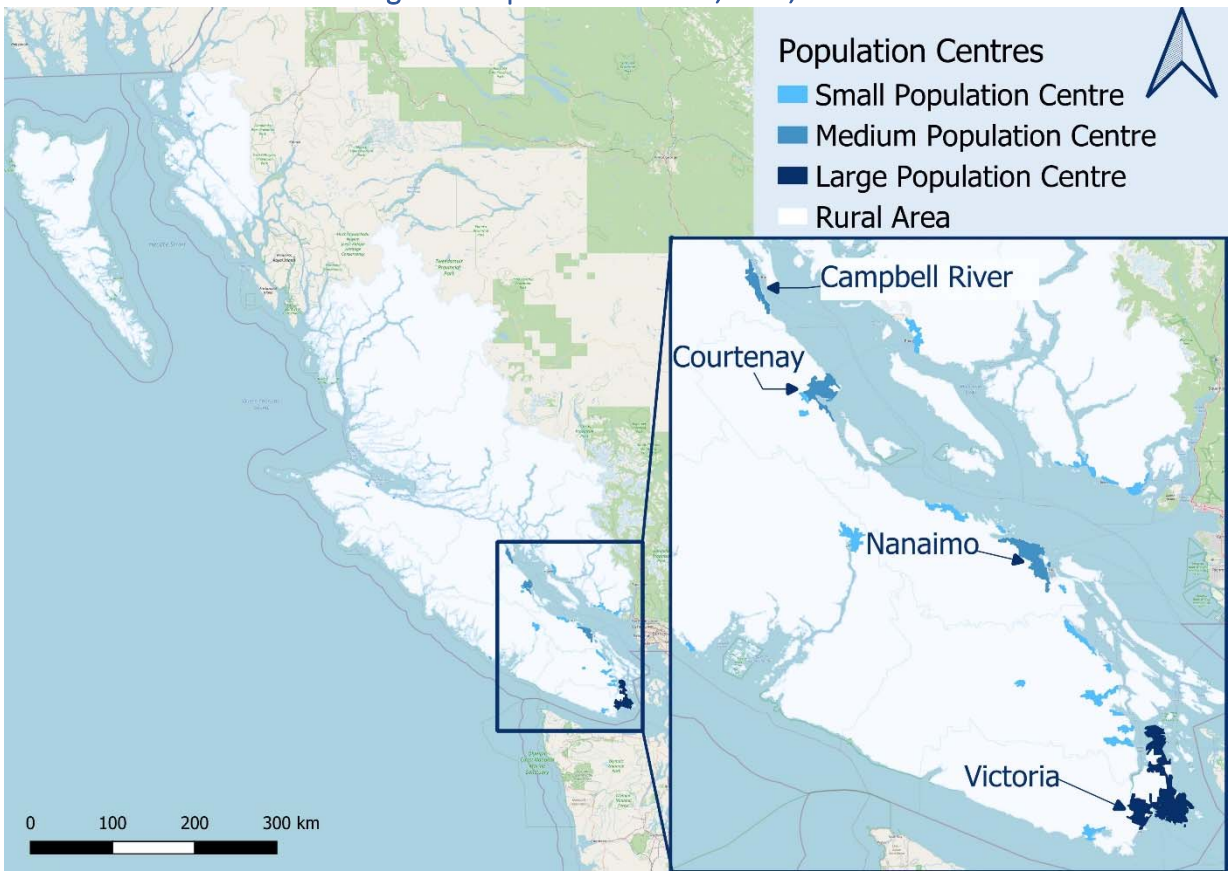
Figure 3 Urban Hierarchy by Population Centre, VICC, 2016




| Type | Large urban population centres | Medium urban population centres | Small urban population centres | Rural area |
|---|---|---|---|---|
| Population range | 100,000+ | 30,000 – 99,999 | 1,000-29,999 | <1,000 |
| Population by type | 335,696 | 172,160 | 168,017 | 171,630 |
| Share of population out of total | 40% | 20% | 20% | 20% |

*Source: Statistics Canada; Population Centre and Rural Area Classification 2016 & Population Centre Profiles, 2016 Census*

Figure 4 Population Centres, VICC, 2016




*Source: Statistics Canada; Census Profile 2016; Population Centres.*

## Land Use and the Built Environment

- **The VICC has vast forested land (60%); around 7.5% of the land has been recently or selectively logged (logged within the past 20 years)**
- **The VICC has rich ecosystems and many protected areas, including marine protected areas and Tribal Parks.**
- **A vast networkof roads, ferry routes, and air travel connect people and trade across the territory; rural, remote and islands communities are at higher risk of transport disruption and isolation due to hazards (e.g., rising sea levels and more frequent and severe storms).**
- **Rural and urban areas are connected; around 8.4% of the population commutes long distances between Census Metropolitan Areas (CMA) and Census Agglomerations (CA).**
- **There are many car commuters across the southern and eastern areas of Vancouver Island; this may be in part due to high housing costs in some locales leading individuals to live in more affordable communities further from their places of work (growing suburbanisation).**

Land is life sustaining. It provides food, places to live and its uses are fundamental to the robustness of ecosystems, air quality and even global temperatures. Human transformation of land uses has caused the fragmentation of habitats, the loss of biodiversity and the degradation of soil and water and has impacted the global carbon cycle.[ii] Health outcomes are linked to land use in a myriad of ways—from the health benefits of walkable communities to the impacts of greenspaces on mental health. A wide range of social outcomes are influenced by land use; land availability is one of the major determinants of housing costs. Land and the property built on it constitute a major share of society wealth and can be a source of inequality. Land and its use also matters because people are attached to land and how it is used. Land is tied to places, communities, cultures and identities. For Indigenous peoples, land holds special importance—it provides sustenance for current and future generations; it is connected to spiritual beliefs, traditional knowledge and teachings; it is fundamental to cultural reproduction; moreover, commonly held land rights reinforce nationhood.

### *The unique geography of VICC creates both opportunities and challenges*

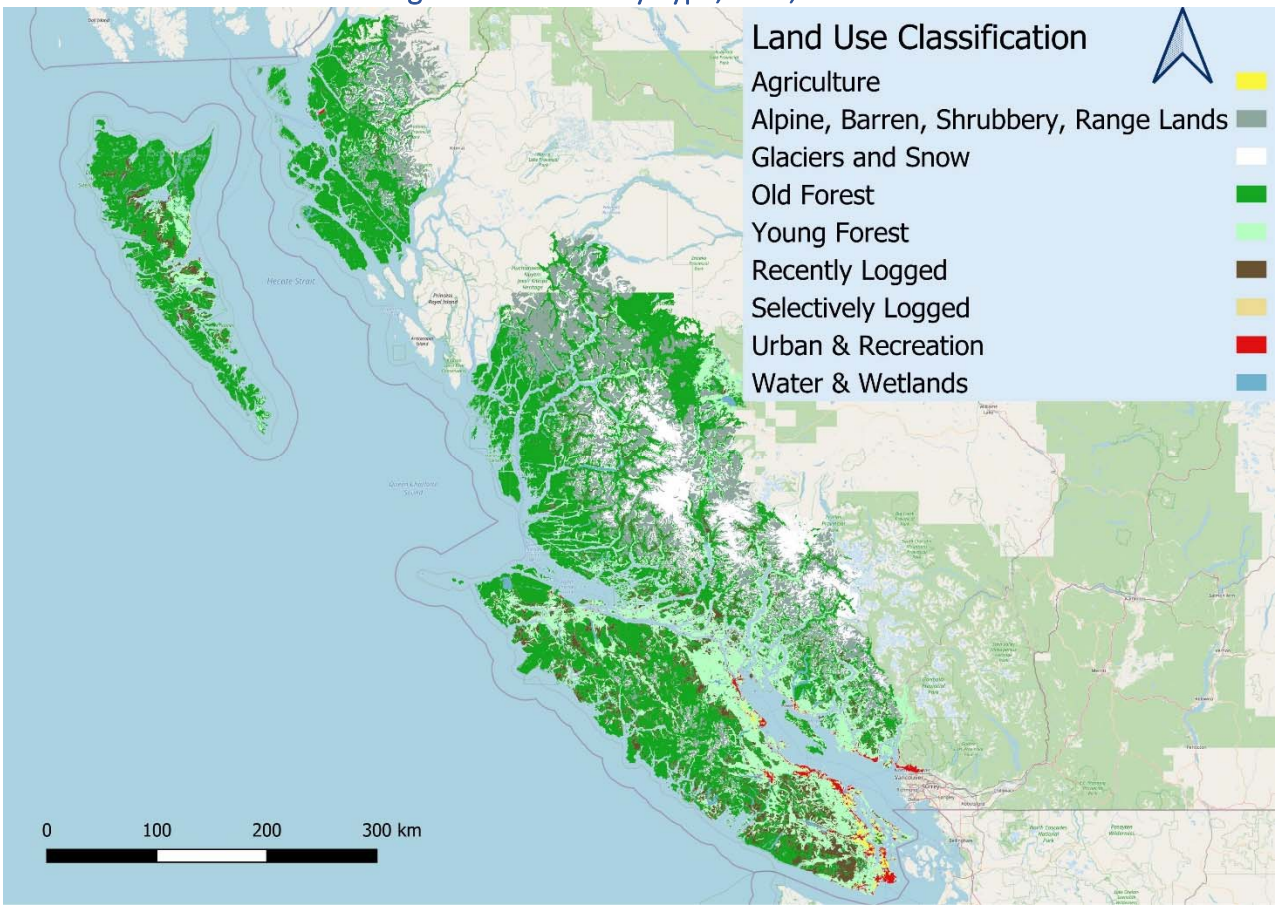
VICC is a complex terrain. Included in its geography are the Coast Mountains, the Vancouver Island Ranges, and vast forests largely of Hemlock, Fir, Western Red Cedar, and Spruce (CFCG, 2020). Because of this, VICC has a range of landcover, from Alpine areas to Wetlands. The variety of landforms create great topographic relief, resulting in various climatic shifts and ecosystem changes. Due to the fact that much of VICC is in the windward shadow of the Coast Mountains, there is an abundance of precipitation resulting in rich rainforests flanking the coast. Much of the VICC is covered by forest: 45% of VICC is old forest (140 years or older), and 14.7% is young forest (less than 140 years old) (

Figure 5), and large tracts of the forest have been designated for logging. Approximately 7.5% of the total land of VICC is either recently or selectively logged, providing crucial revenue and jobs for the region.[iii] Forestry is an important economic sector for many communities in the VICC which has faced challenges in recent years. Its strength as an industry going forward will require sustainable logging practices combined with higher value added activities.

A small share of land (0.03%, or 43km²), of the region is used for mining purposes, another goods-based industry. Finally, VICC is home to a unique agriculture industry. Less than 1% of land across the VICC is agricultural.[iv] Areas used for this industry commonly flank urban areas in the southern reaches of Vancouver Island and the mainland coast. These tend to be highly specialized and much smaller sized farms than that of the mainland crops in Delta, Abbotsford, and surrounding areas. That which is not forest, mining, or agriculture is mostly alpine, barren, shrubbery, or range lands, which are areas not as often utilized for resource extraction, and commonly flank the sides of mountain ranges. A large portion of the mid-eastern part of VICC is covered in glaciers and snow, providing a valuable source of pack melt freshwater in the summer seasons. The availability of pack melt, regular precipitation, and the proximity to the ocean keep the relative humidity of VICC fairly high, which is fortunate in light of the increasing threat of wildfires to the province. Even so, 99 km² of VICC has been recently burned. However, as climatic zones shift in the coming years (discussed in the next section), the region may not be able to expect the same conditions, and both the natural and built environments of VICC may face a greater risk.

The majority of built environments in VICC cluster on the coastlines, mainly on the southeast coast of Vancouver Island and in the north around Prince Rupert, which is convenient for trade and transportation but leaves these urban areas vulnerable to changes such as sea level rise.

Figure 5 Land Use by Type, VICC, 2020

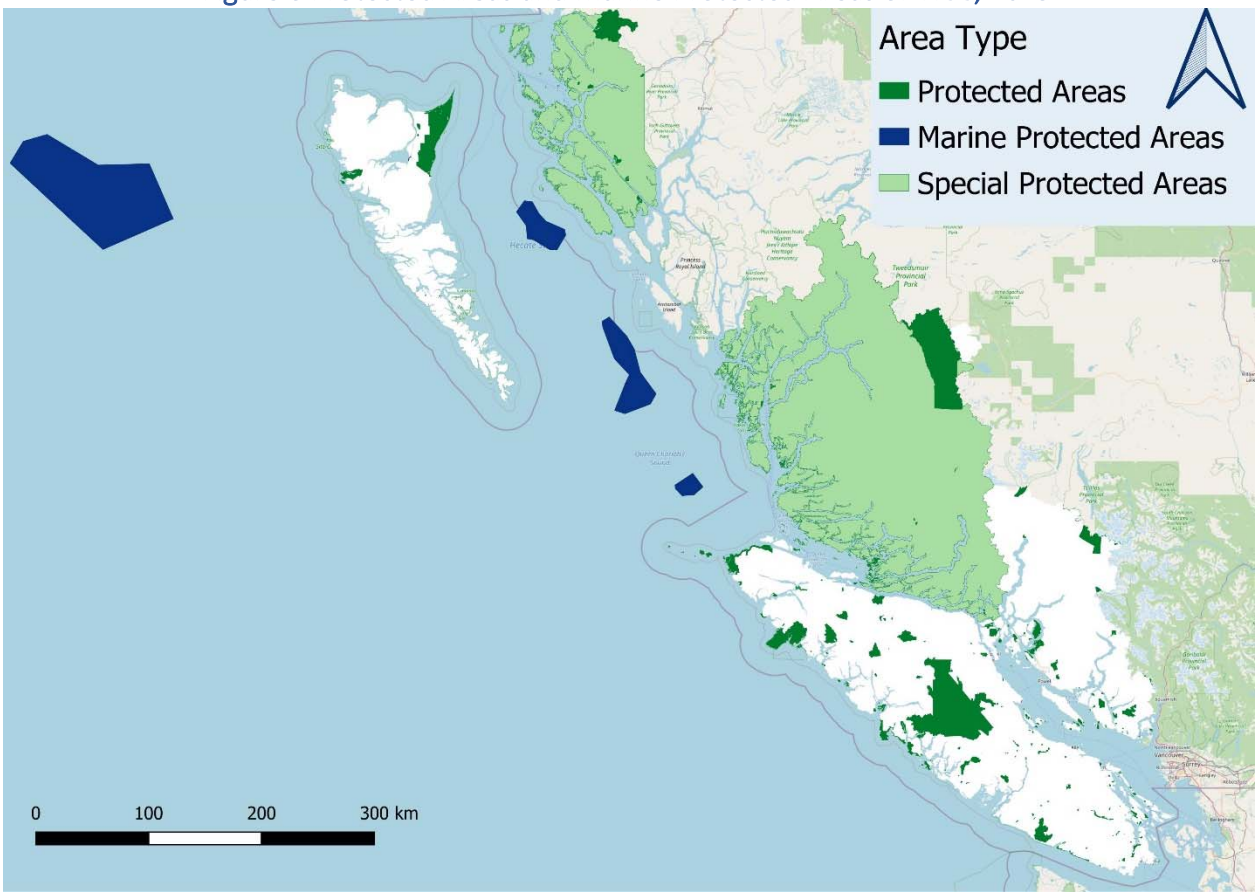



*Source: BC Data Catalogue* (2020), *Baseline Thematic Mapping Present Land Use Version 1 Spatial Layer.*

### *VICC is home to many Protected Areas and Marine Protected Areas, and needs more in the future to conserve lands and protect cultures*

Coastal British Columbia is known for its rich ecosystems, and many areas within the VICC region have been placed under protection in the form of Protected Areas and Marine Protected Areas. Figure 6 below outlines the Marine Protected Areas established under the Oceans Act Marine Protected Area designation. Also illustrated are the BC Parks, Ecological Reserves, and Protected Areas, which symbolize the land-based areas dedicated to conserving and preserving the natural environments found there, along with Special Protection Areas such as the Great Bear Rainforest and other Special Forest Management Areas. Protected Areas of all types are important to the VICC region in many ways, not only are they crucial for protecting wildlife and ecosystems, but also to preserve areas of important cultural significance. As such, there are many initiatives to create more and expand existing Protected Areas, as well as creating more sites under Indigenous supervision, such as Tribal Parks. Tribal Parks are unique from other types of Parks as they are created via Indigenous leadership, and they aim to support sustainability and Indigenous rights and cultures. The combination of all kinds of Protected Areas are vital to sustainability and adaptation in VICC.

Figure 6 Protected Areas and Marine Protected Areas of VICC, 2019



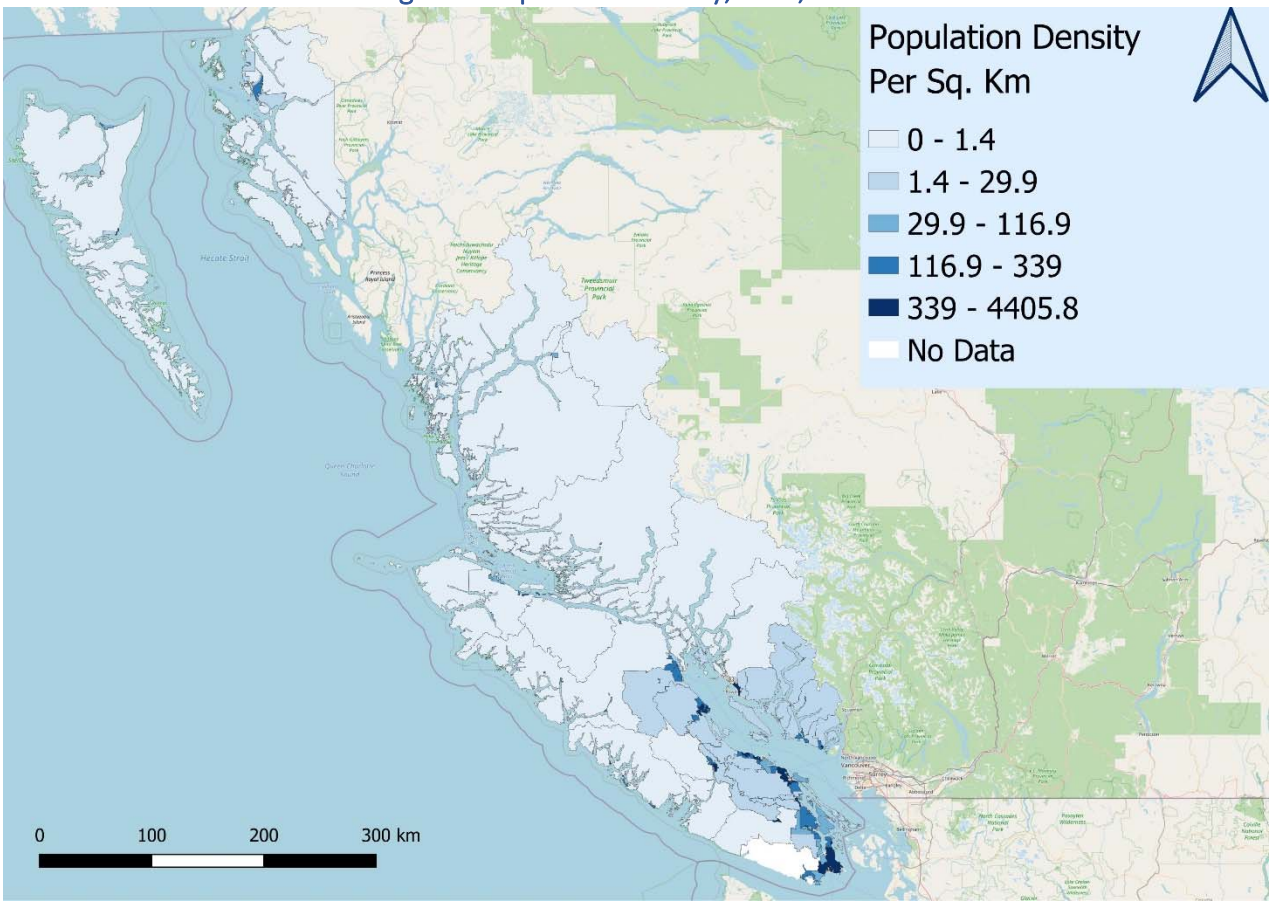

*Sources: Government of Canada; (2019) Oceans Act Marine Protected Areas Shapefile; BC Data Catalogue; (2019). BC Parks, Ecological Reserves, and Protected Areas.; BC Data Catalogue; (2019). FADM – Special Protection Area.*

### *Although there are many busy population centres, much of VICC is rural land*

Population density within VICC clusters around population centres. The southeast coast of Vancouver Island boasts the highest density, with moderate population densities in the areas north of Vancouver, as well as the areas immediately surrounding Prince Rupert. The denser census subdivisions in the north of VICC are very isolated from the highly populated areas in the southern reaches of the region. The areas of high-density correlate to areas which have connectivity to other population centres, especially Vancouver. These areas have major highways, ferries, and several airports to accommodate travel by citizens.

The majority of VICC, however, is far more rural, with an average population density ranging from 0-1.4 persons per square kilometer. These communities are more vulnerable to environmental hazard, as their relative isolation can limit access to emergency assistance and resources. More generally, rural communities face the penalties of distance. They can have higher infrastructure and energy costs and higher transport costs for goods both in and out of the community. For example, rural, remote, and Indigenous communities in British Columbia spend up to three times the provincial average to heat their homes (Ecotrust Canada, 2020).

Figure 7 Population Density, VICC, 2016




*Source: Statistics Canada; Population Data of 2016 Census via Canadian Census Analyser* (CHASS, 2020).

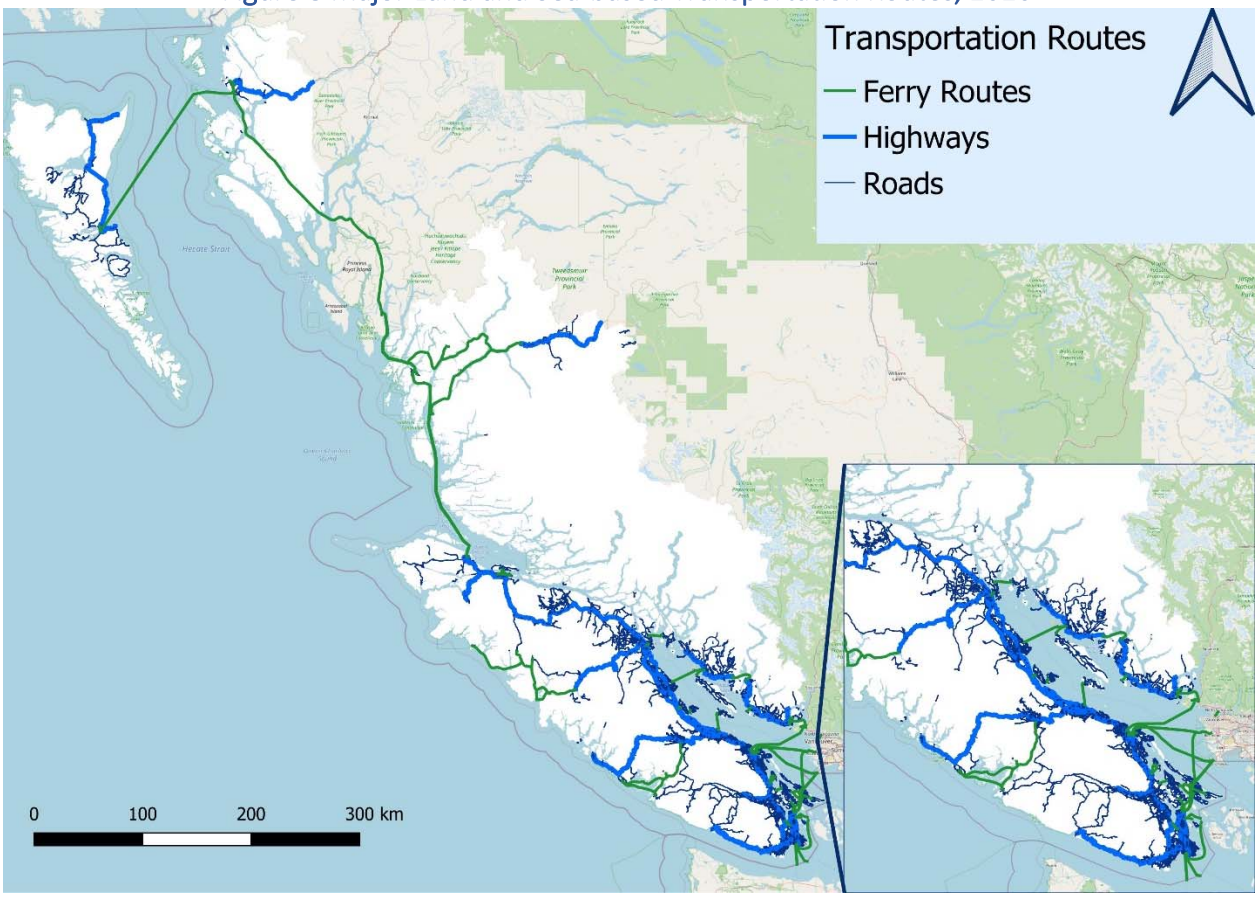
### *VICC is well connected to other population centres, but some rural areas are at risk*

Though VICC is physically expansive, the vast networks of roads, ferry routes, and air travel connect people and trade. There are 16 highways, 73 ferry routes, 12 airports and numerous aerodromes and seaplane landings (Figure 8). Connectivity is most concentrated in the southern reaches of VICC, linking population centres to the mainland and Vancouver. The four largest population centres in VICC are the most connected, with several highways and ferry terminals boasting high traffic thoroughfare daily.

The northern communities, such as Bella Coola and Prince Rupert, are more isolated from the rest of the territory, as the only vehicle access is through the two highways which terminate at these cities or the ferry services. The highways run on a latitudinal axis, connecting communities to the interior of BC, while the ferries run longitudinally creating a linkage of coastal communities. Some of the more rural reaches of VICC have fewer links to depend on, which creates a vulnerability especially when storms or other hazards threaten to block or wash out the local roads. Many communities have only one road which connects them to the rest of VICC, which if obstructed leaves the community cut-off from assistance and supplies by land. VICC hosts many island communities whose only transportation method is by ferry. These communities face many of the

same challenges as the rural communities with only single road access. Since many of these communities rely on food and resources from other areas, especially agricultural production, they are reliant completely upon the ferry systems which can be affected by both natural and mechanical hazards.

Figure 8 Major Land and Sea-based Transportation Routes, 2020




*Source: BC Data Catalogue* (Government of British Columbia, 2020b).

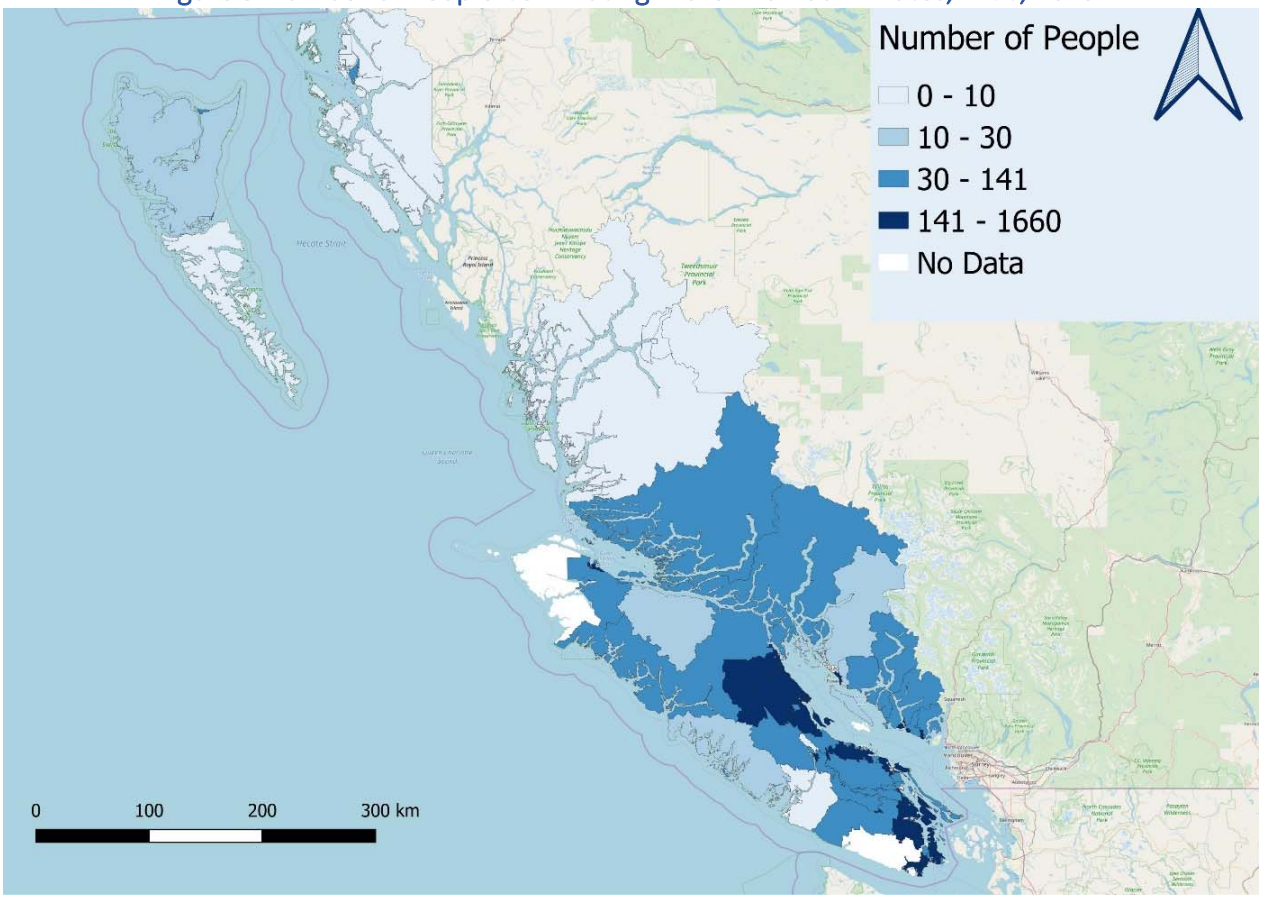
### *Rural and urban areas are connected by labour market commuting zones*

Communities across the VICC are connected by labour market zones—the places across which people travel to live and work. On average, 8.4% of those working in the Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs) of VICC commute to work *from other cities or municipalities* (Statistics Canada, 2020b). CMAs and CAs are defined as areas formed by municipalities centered around a core, which is a population centre. Therefore, this figure is only capturing long commutes between CMAs and CAs and not within them. It bears noting that while much of VICC is rural, smaller communities are connected to urban centres by these labour market commuting zones.

The southern sections of VICC have the largest commuting zones; in some cases over a thousand people commute more than one hour to work (Figure 9). As anticipated, commuters in Victoria use the largest variety transportation modes (Figure 10). Parksville has the highest proportion of workers commuting into the city, at just over 30%; most of these commuters reside in the

neighbouring population centre of Nanaimo. The share of people commuting from other cities may be the result of workers being "locked out" of the city due to high housing prices. In addition, the relatively high percentage of workers commuting from other areas contributes a great deal of emissions, mainly from vehicle exhaust but also ferry and air fuels.

Figure 9 Number of People Commuting More Than 60 Minutes, VICC, 2019

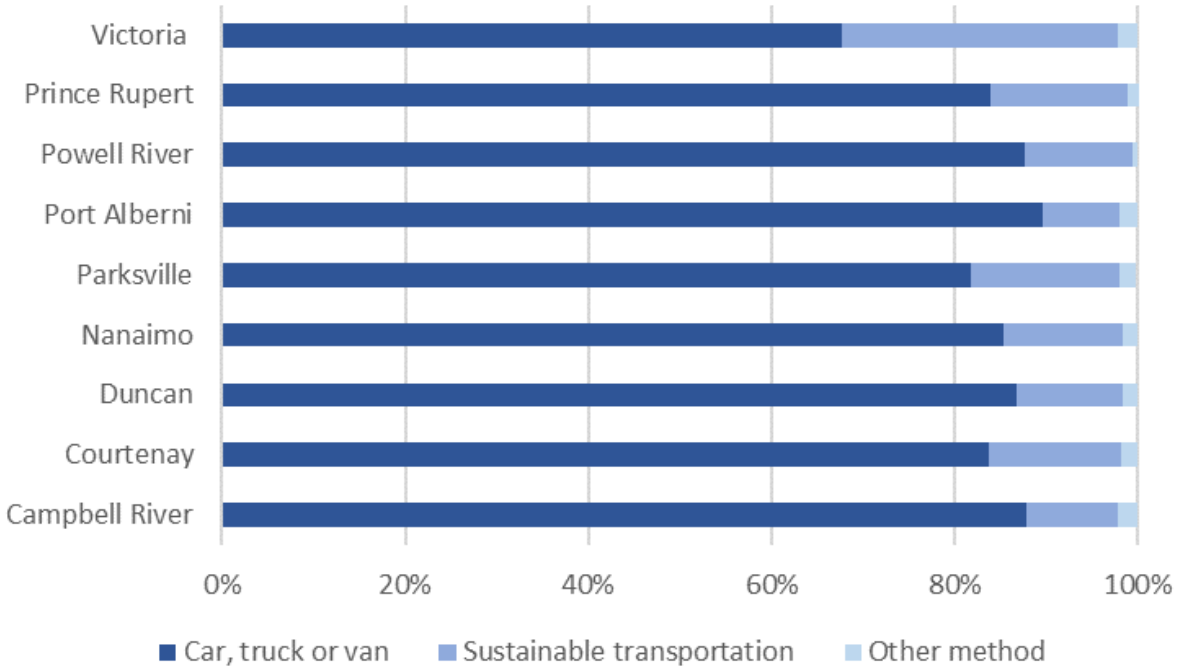



*Source: BC Data Catalogue* (Government of British Columbia, 2020a).

### *The vast majority of VICC citizens commute by car to work*

In the major cities of VICC, the vast majority of commuters drive to work; over 80% in all but Victoria. There are many, however, who choose to travel by more sustainable means, such as public transit or walking/riding a bicycle. The highest percentage of sustainable travel is found within Victoria, a reflection on accessible public transit, the "walkability" of the city, and other ongoing initiatives stemming from the 2014 updates to the Bicycle Master Plan. Note that these data are form the 2016 Canadian Census and that, in the intervening years, modal share may have increased towards sustainable transportation due to ongoing investments.

Figure 10 Commuter Transportation Type, Major Cities, VICC, 2016




*Note: Data captures commuting for the purposes of work.*
*Source: Statistics Canada* (2020b). *Commuting Flow from Geography of Residence to Geography of Work, 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016327.*

## Population and Demography

- **All Regional Districts in VICC are forecast to experience population growth over the next 20 years—by between 2-18% (2020-2040).**
- **Population growth is uneven: population areas in the southern VICC are growing while rural areas are shrinking. There is a trend of suburban population growth.**
- **The VICC has an older age profile than that of the province as a whole: the average age of the population of the VICC region is above that of the provincial average (44.8 years of age versus 42.3 provincially).**

Population and demography are key considerations in climate change adaptation and mitigation planning. Communities that are experiencing population growth face pressures to manage land use demand and to develop in a sustainable way while maintaining, upgrading, and expanding public amenities and infrastructure investments. Meanwhile, those communities that are losing population need strategies to address fixed capital assets and maintenance. In these contexts, key considerations include energy efficiency and community resilience against floods, coastal erosion, and other hazards amidst sometimes shrinking budgets.

Age is also an important factor in planning. The location and prevalence of different age cohorts creates demand for certain types of public amenities and services and at the same time, can intersect with increased propensities for vulnerability. Across the VICC, there are communities of very different profiles—some places are losing population while others are rapidly growing, creating a need for different, yet often interconnected, response strategies.

Another demographic aspect which is important to address in planning is culture. The abundance of differing—yet all equally important—cultures in this region creates another dimension to be considered in climate change adaptation and mitigation planning. Reaching a consensus on common goals and values between cultures is vital for the support and success of climate change programs and projects.

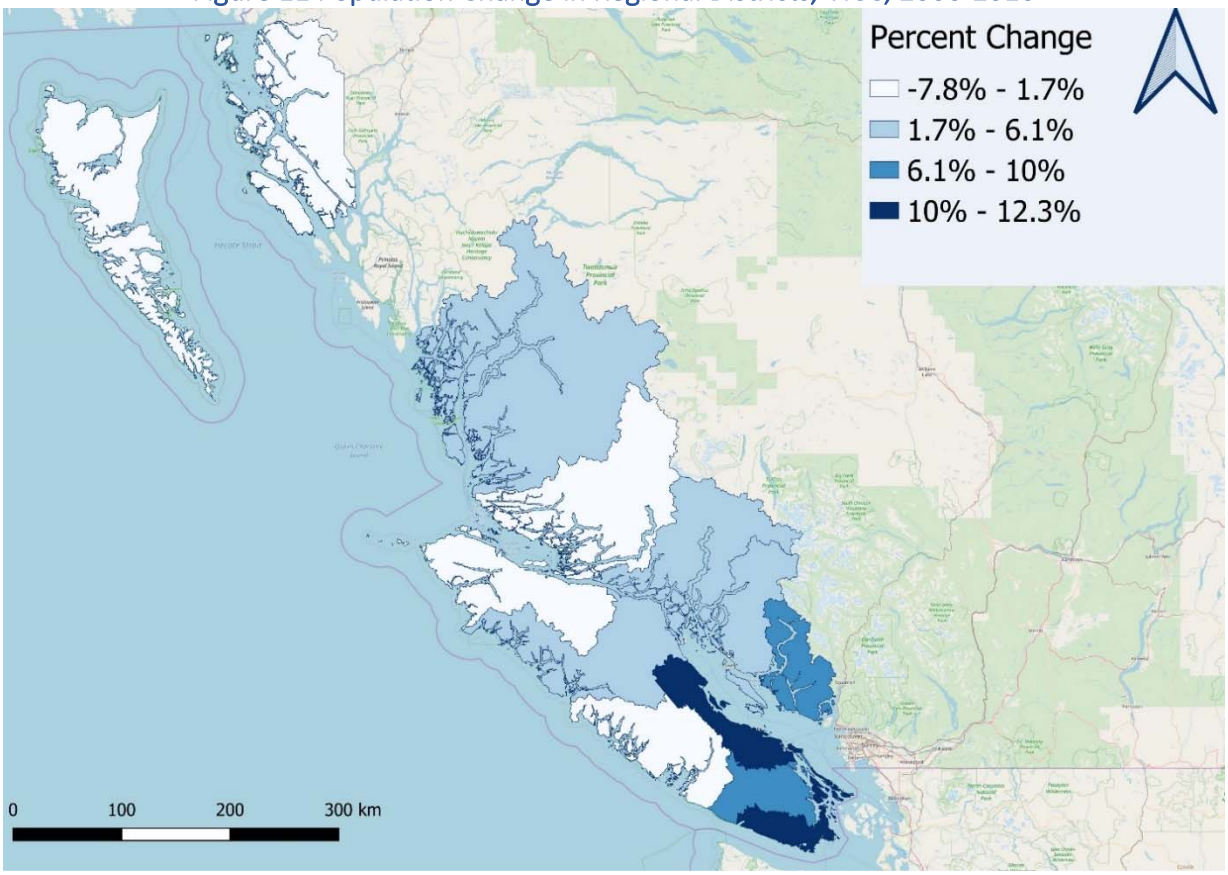
### *Population centers in the south are growing, while many rural areas are shrinking*

The Regional Districts of VICC have a wide range of population growth in the ten-year period from 2006-2016, ranging from an increase of 12.3% to a decrease of –7.8% (Figure 11). The Regional District of Nanaimo has grown the most in the ten-year period while the Comox Valley and Capital Regional Districts had the second and third highest population growth respectively. The three districts with the highest growth rates from 2006-2016 all correspond to districts with large or medium population centres. The only other regional district with a medium population centre is the Strathcona Regional District, which falls in the middle of the range with population growth of 6.3% over 2006-2016.

The districts with highest population growth from 2006-2016 tend to be located in the southern reaches of the VICC, centred around the southern tip of Vancouver Island. On the opposite end of the region, the North Coast Regional District has had the greatest decrease in population over this

time period, followed closely by Mount Waddington. Most of these districts are rural, with some small population centres scattered throughout.

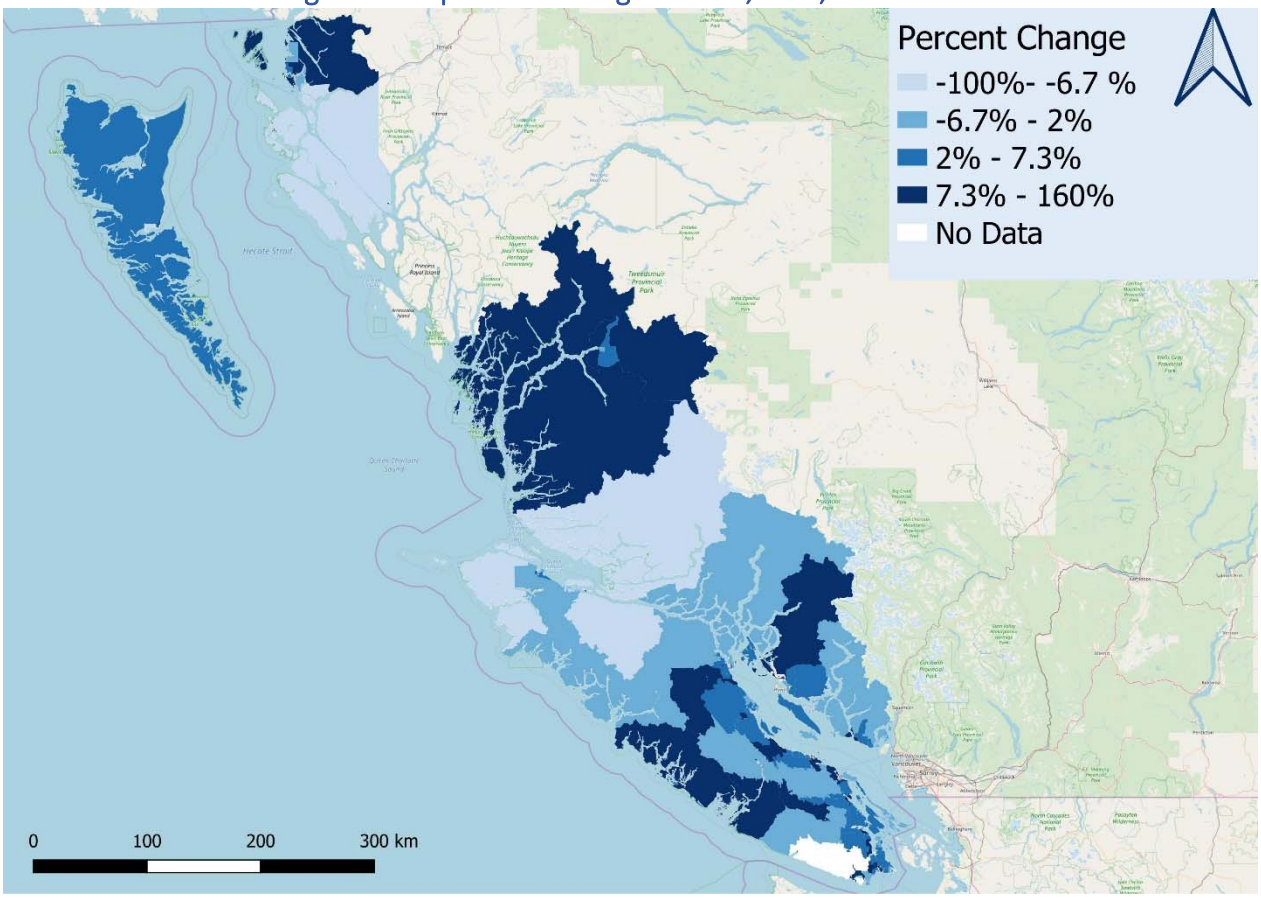
Figure 11 Population Change in Regional Districts, VICC, 2006-2016




*Source: Statistics Canada; Census Profile 2016; Census Divisions.*

The Census subdivisions (CSDs) of VICC provide further insight into population dynamics; CSDs are a general term for municipalities (as determined by provincial/territorial legislation) or areas treated as municipal equivalents for statistical purposes (e.g., First Nations Reserves, Indian Government Districts, and unorganized territories). The five-year timespan illustrated shows that many of the CSDs in VICC are decreasing in population. However, these decreases are often offset by large growth occurring in other neighbouring CSDs, accounting for a net increase when classed by Regional District. These increases are not only internal growth, but also contributed to by people moving from out of province and out of country to these CSDs. Many of the CSDs with the largest decreases contain First Nations Reserves and several have recorded populations of 0 in 2016.

Figure 12 Population Change in CSDs, VICC, 2011-2016




*Note: there is no data for either timespan for the CSD of Juan de Fuca in the Capital Regional District*
*Source: Statistics Canada; Focus on Geography Series, 2016 & 2016 Census Boundary Files.*

The three CSDs with the largest populations in 2006 (Saanich, Nanaimo, and Victoria) remained the largest in 2016 and all experienced population growth over that time (Table 2). Among these three, Nanaimo saw the greatest rate of growth at 15% over this time.

Among all CSDs (with populations larger than 100), those that saw the greatest population growth between 2006-2016 are a mix of urban and rural communities: Langford at 57.3%, Central Coast A at 47%, and South Saanich 1 at 44% (Table 3). While Langford and South Saanich 1 are part of the same economic region as Victoria (suburban municipalities), Central Coast A is in the district which contains no population centres and is classified as entirely rural. Central Coast A is the largest of the five electoral districts in the Central Coast Regional District, spanning well over 19,000 km², and includes parts of the Great Bear Rainforest. This may account for some of the increases, as investments flowing from the Great Bear Rainforest Agreements may have helped expand economic development opportunities in the area. Thus, growing populations are not just an urban phenomenon across this region.

Those CSDs that have seen the greatest population declines over the 2006-2016 period are largely rural and remote. The size of these population decreases should be interpreted with a note of caution. Communities with smaller populations may demonstrate population fluctuations which

are in fact a product of seasonality—reflecting when the data was collected more than the year-round population. Among CSDs in the VICC region, the communities of Kulkayu (Hartley Bay) 4, North Coast Mount Waddington B, and Refuge Cove 6 show the greatest population declines.

Table 2 Top 3 largest populations by CSD, VICC, 2006, 2016

| | Population 2016 | Population 2006 | Percentage change 2016-2006 |
|---|---|---|---|
| **Saanich (Capital Regional District)** | 114,148 | 108,265 | 5% |
| **Nanaimo (Nanaimo Regional District)** | 90,504 | 78,692 | 15% |
| **Victoria (Capital Regional District)** | 85,792 | 78,057 | 10% |

*Source: Statistics Canada; Census Profile 2016; Census Subdivisions.*

Table 3 Top 3 population increases and decreases, by CSD, VICC, 2006, 2016

| CSDs with highest population increase, 2006-2016 | CSDs with highest population decrease, 2006-2016 |
|---|---|
| Langford, 57.3%, 22459 - 35342, RD: Capital | Kulkayu (Hartley Bay) 4, -66%, 157 - 52, RD: North Coast |
| Central Coast A, 47%, 138 - 203, RD: Central Coast | Mount Waddington B, -60%, 150 - 60, RD: Mount Waddington |
| South Saanich 1, 44%, 571 - 822, RD: Capital | Refuge Cove 6, -57%, 103 - 44, RD: Alberni-Clayoquot |

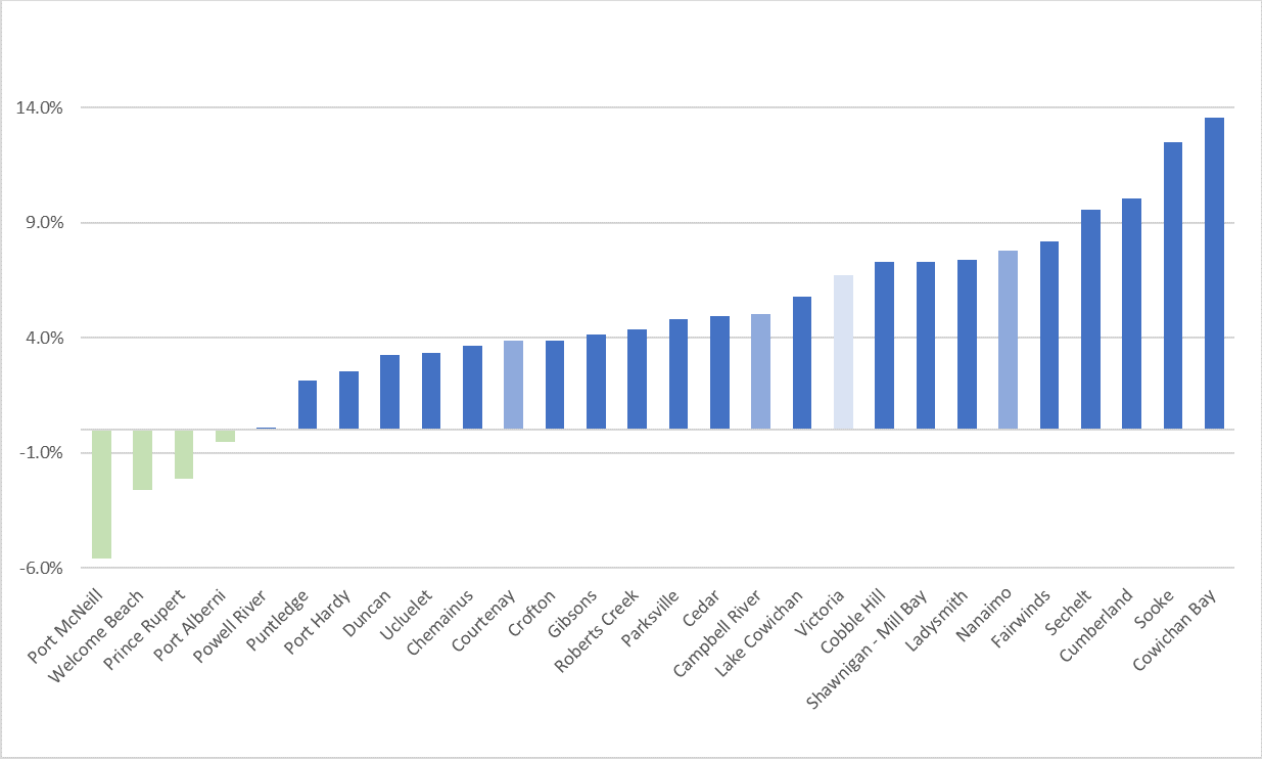
*Note: Only CSDs with populations greater than 100 included in analysis*
*Source: Statistics Canada; Census Profile 2016; Census Subdivisions.*

### *Cowichan Bay and Sooke lead for population growth, while remote resource-based economies are losing population*

The majority of population centres in VICC are growing, and many are growing at a rate greater than 4% (relative to their individual populations) on a 5-year timescale (Figure 13). Some small centres are growing at a much more rapid pace, such as Cowichan Bay and Sooke, advancing at 13.6% and 12.5%, respectively. The medium and large population centres are all growing at a relatively similar rate, at an average of 5.9%.

Four population centres in VICC are losing population: Port Alberni, Port McNeill, Prince Rupert, and Welcome Beach. Of these, Port McNeill is decreasing the fastest, at a rate of –5.6%, which is related to declines in the logging industry—a dominant industry in the region. All four of these population centres are at a distance from other centres and require either several hours of driving and/or ferries to access. Remoteness combined with a lack of economic diversification has made these places vulnerable to exogenous shocks (i.e., external market demand).

Figure 13 Percent Population Change, Population Centres, VICC, 2011-2016

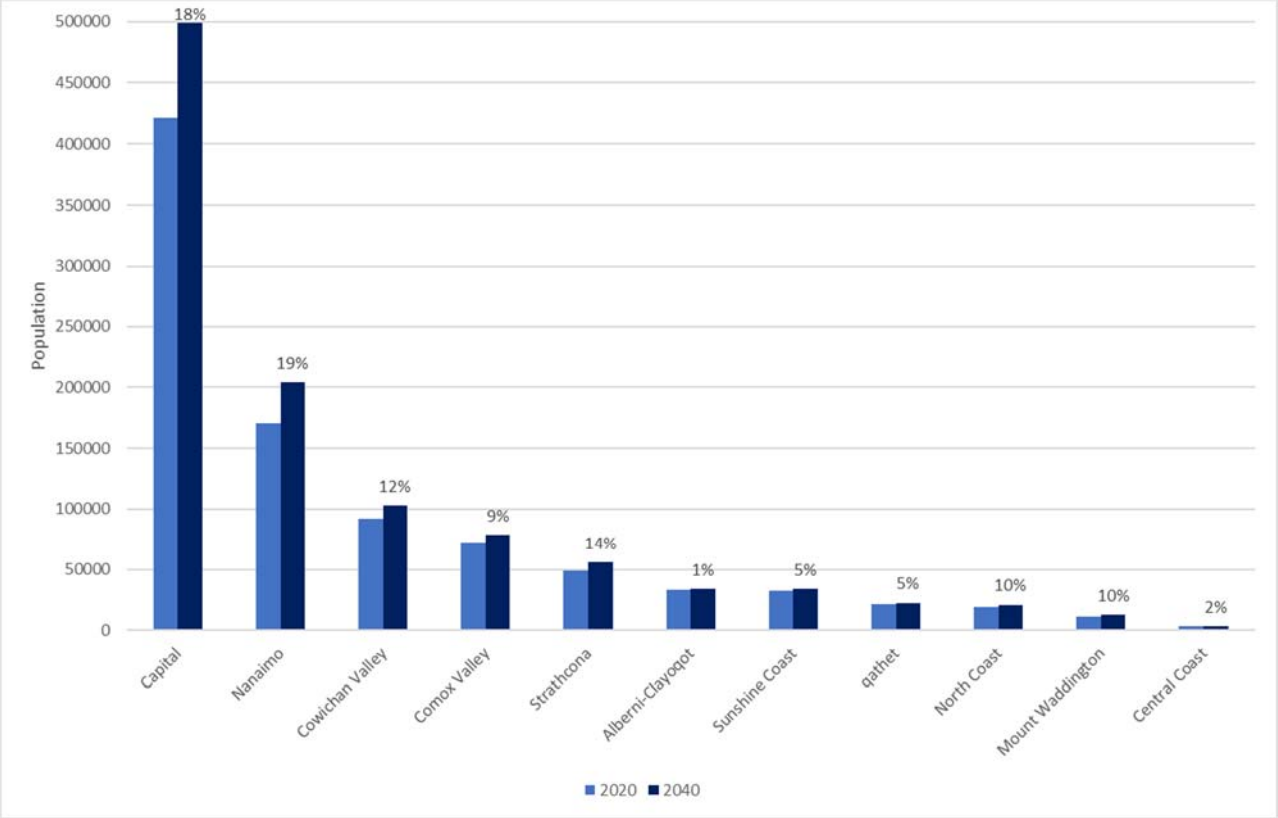



*Note: Dark Blue denotes small population centres, Blue for medium population centres, and Light Blue is the large population centre.*
*Source: Statistics Canada; Census Profile 2016; Population Centres.*

### *Over the next 20 years, all regional districts are anticipated to experience some regional growth, with the population centres leading the pack*

All Regional Districts in VICC are predicted to continue to grow in the next 20 years. Some, such as Alberni-Clayoquot and Central Coast, are only projected to grow by a small percentage. Others, including Capital, Nanaimo, Strathcona, and Cowichan Valley, are expected to increase by over 10%. VICC is a desirable place to live and the options available in population centres such as Victoria and Nanaimo add to the incentive for people to move there. Though this provides many opportunities, it is also the source of some challenges such as increasing house prices and growing traffic congestion, to name a few.

Figure 14 Projected Population Change, VICC Regional Districts, 2020-2040




*Source: BC Stats Population Projections, Data Version PEOPLE 2019;* https://bcstats.shinyapps.io/popProjApp/

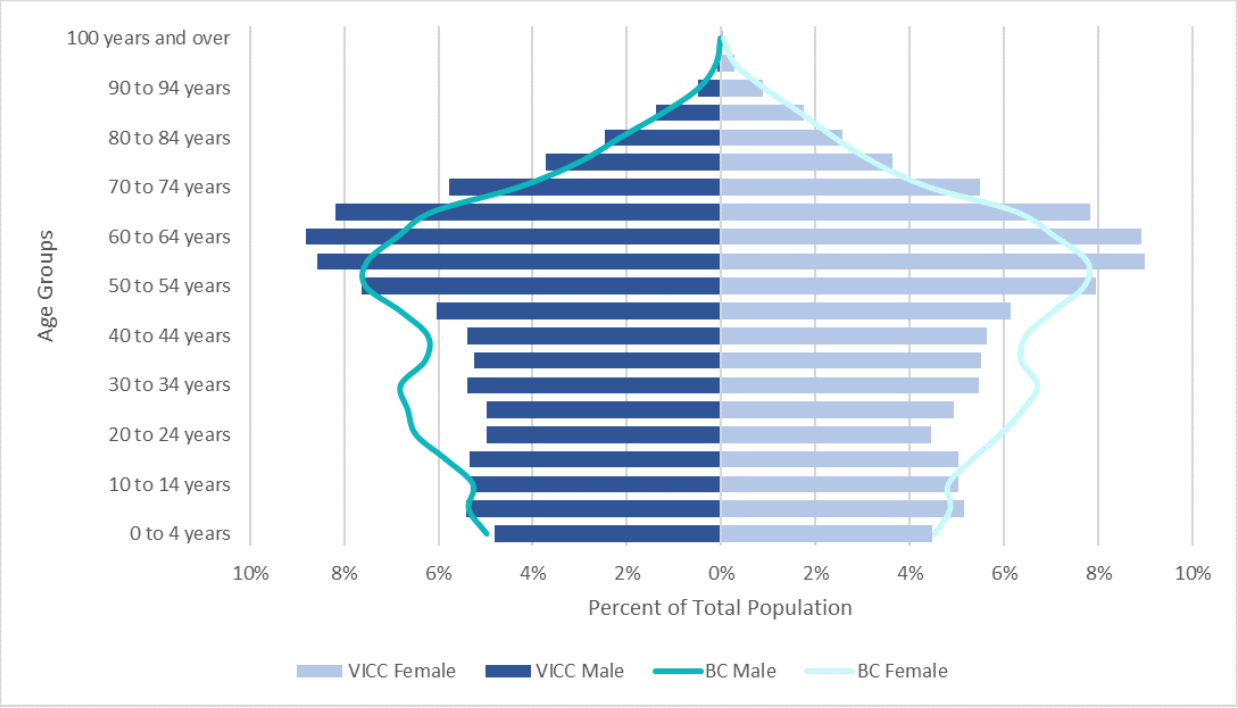
### *There is a large and growing senior population across the VICC*

The average age of the VICC region is 44.8 years of age; this is above the provincial average of 42.3 (Figure 15). The dependency ratio (the ratio of the young and working age versus seniors 65+) is 72% in the region and 63.2% across the province.[v] Thus, the VICC has an older age profile than that of the province as a whole.

Population aging is a great accomplishment; people in Canada and across the world are living for longer and in better health than ever before. At the same time, population aging can be associated with a number of social vulnerabilities—i.e., the inability of individuals or groups to withstand negative impacts from stressors given their locality—which is connected to climate change. For example, more frequent and extreme weather events leading to coastal area flooding and other hazards can present a risk for residents and the infrastructure and services they rely on. This is particularly the case for seniors, who can be disproportionately impacted by extreme heat and cold fluctuations and who can experience greater social isolation, increasing their risk to hazard. Across the VICC region, these risks are compounded for seniors living in coastal rural and/or remote communities as environmental hazards can impact their access to assets that support Instrumental Activities of Daily Living (IADL), such as grocery stores. This is true of the population at large, but can be particularly challenging for seniors who have lower incomes, experience social isolation, have limited mobility, etc.

Certain CSDs within VICC are experiencing changes in age balances more acutely than others; during the ten-year time span of 2006-2016, the Southern Gulf Islands experienced a -14% and -21% decrease of young and working age cohorts, while simultaneously having an increase of seniors by 51%. Even more profound are the changes found in the CSD of Sunshine Coast D: the youth population decreased by -23%, the working age population decreased by -10%, and the senior population increased by 97%. These examples illustrate the more extreme cases of changing population demographics within VICC.

Figure 15 Ages cohorts, VICC, BC, 2016




*Source: Statistics Canada* (2020) *Age and Sex Highlight Tables, 2016 Census.*

## Economy and Industry

- **The services sector is dominant across the VICC, comprising around 87% of all jobs in the region. This sector is vulnerable in the wake of COVID-19.**
- **The VICC also have important goods-based economies including the forestry, agriculture, and energy sectors.**
- **Greater Victoria had the 8th highest GDP per capita among Canadian metropolitan areas in 2016; but it underperforms in economic growth.**
- **While incomes are higher in the urban population centers than in smaller more rural communities, urban centers have higher rates of income inequality.**
- **Rural communities face high transport and energy costs, which decreases their competitiveness.**

Economic composition has a wide-ranging impact on climate change adaptation and mitigation activities. It impacts how land is used, where and how people are employed, the intensity of energy usage, environmental impacts, and a wide range of other factors. The VICC has a mixed economy with both tradable and non-tradable sectors. Key industries include tourism, agriculture, aquaculture, forestry, manufacturing, high tech, and education, though the composition of these sectors across each sub-region differs (VIEA, 2020).

A central challenge across the VICC (and elsewhere in Canada) is to transition away from carbon intensive and environmentally harmful activities towards more sustainable ones and to support local value chains where possible (thus reducing the carbon footprint of locally consumed goods). Such a shift requires careful attention to how people and communities are impacted. Single industry resource dependant economies are especially vulnerable to industrial transitions as they have a less diversified economy. At the same time, low-income individuals are at risk when the price of goods and energy increases.

### *An uncertain economic climate*

The BC economy overall has experienced solid growth and a favourable labour market climate. Following strong momentum in 2019, BC was forecast to lead economic growth in Canada in 2020 (Government of British Columbia, 2019). However, the COVID-19 crisis has brought great uncertainty; economic growth forecasts for all provinces have declined with many forecasting negative growth in 2020. The TD Bank has forecast BC's economic growth at 0.5% for 2020 (on par with Ontario).

While global financial conditions pre COVID-19 indicated fiscal tightening leading to growing concerns about debt burdens in BC and beyond, we are now entering into an unprecedented time of government-backed loans and stop gap measures to reduce the employment losses and maintain industries. While it is uncertain what the future will hold and in the coming months and years, the public sector will play an oversized role in the economy, akin to the fiscal and monetary stimulus post the 2008 economic crisis. This presents both challenges and opportunities. It could be a chance to focus public investments on climate adaptation and mitigation efforts, particularly

infrastructure, as part of a programme of broader public investment to spur the economy and get people back to work.

### *The VICC has a services-dominated economy—which in the short term is vulnerable to the impacts of COVID 19*

Like the province as a whole, the VICC has a services dominated economy. Across the VICC, 87% of all occupations are service-based (CHASS, 2020). The largest services sectors by occupation are sales and services, trades and transport, and business, finance and administration. Some areas, especially those closest to population centres, are almost entirely services-based. The impacts of COVID-19 and negative price shocks have harmed all economic sectors, however they has been particularly harmful to services sector industries like tourism which are an important economic contributor across the VICC and the province as a whole. In 2018, the tourism sector in BC contributed $8.3 billion to GDP, which is higher than that of the mining ($5.2 billion), oil and gas ($4.9 billion) and agriculture and fishing industries ($3.2 billion) (Government of British Coumbia, 2018). The real estate sector has also been a major economic contributor in recent years, especially in the growing urban areas like greater Victoria and Nanaimo. It is not yet clear how this sector will be impacted by the COVID-19 crisis. The B.C. Real Estate Association presently estimates the declines in home sales to be short term, with sales recovering in 2021 (BCREA, 2020).

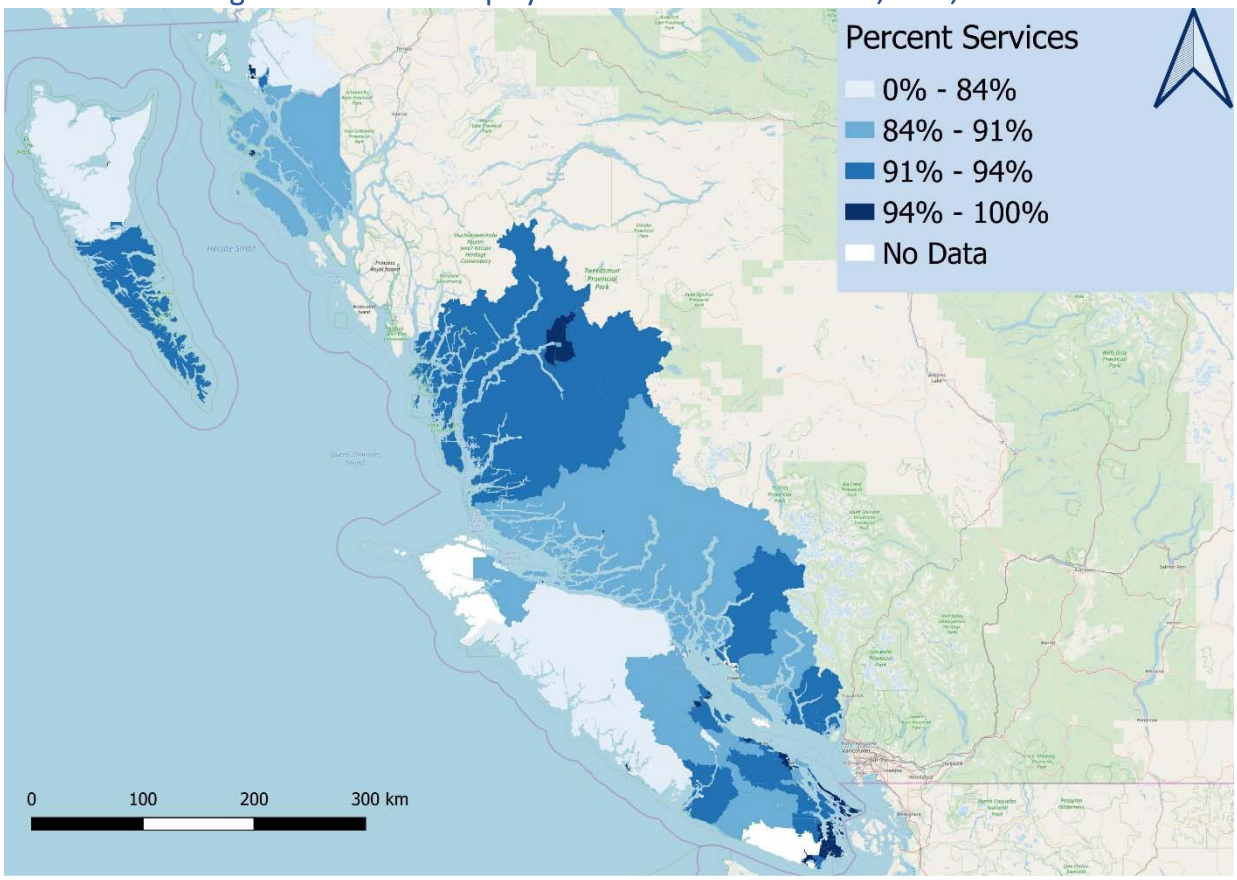
Victoria—as a metropolitan area and the capital of the province—has the largest, services-dominated, economy. Victoria has many important assets for the region including three post-secondary institutions. The economy's tech sector has shown strong growth in recent years and is linked to the broader Cascadia megaregion (Seattle to Vancouver). Among Canadian metropolitan areas, Victoria had the 8th highest GDP per capita in 2016, falling just below metro-regions of Hamilton and Vancouver.[vi] It is however not a dynamically growing economy. Between 2009 and 2016, Greater Victoria had the second lowest increase in GDP per capita among Canada's metropolitan areas (with a net decline of -0.54%, second only to Ottawa at -2.35%)(OECD, 2020). This indicates that it may not be making the most of its agglomeration benefits.

While the services sector is dominant, communities across the VICC also have important goods-based economies including the forestry, agriculture, and energy sectors. Goods-based industries are especially important in the northern halves of Vancouver Island and Haida Gwaii, as well as the mainland sections of the North Coast (Figure 16). These industries are vulnerable on a number of fronts. BC's forestry sector is currently in crises due to a number of factors such as low timber prices, reduced demand from Asian markets, U.S. tariffs, high cost structures, government fees or stumpage rates, and timber supply shortages. Transportation and energy costs are a major factor impacting the competitiveness of these industries; investments in more sustainable and affordable transport and energy options are thus important to their robustness.

BC's largely mountainous topography is not amenable to agriculture and the sector is relatively small; the smallest among Canadian provinces second only to Newfoundland. However, the VICC includes some of the province's prime agricultural areas such as Comox, Sayward and Cowichan valleys, Saanich Peninsula, Nanaimo lowlands, Alberni Valley, Powell River lowlands and many Gulf Islands. Farms in these areas tend to be smaller and specialized: the region accounts for only around 2% of total provincial farmland but 15% of total farms (Government of British Columbia,

2011). Farms across this region mostly supply local and tourism-oriented markets as well as those on the mainland. A 2004 study of Vancouver Island food systems found a high reliance on imported food: an estimated 85% of food was imported to the region (Macnair, 2004). The agricultural sector is highly vulnerable to climate change. At the same time, it is a sector that can help communities across the VICC reduce the carbon footprint of their food consumption and to diversify food security through local supply chains.

Figure 16 Share of Employment in Services Industries, VICC, 2016



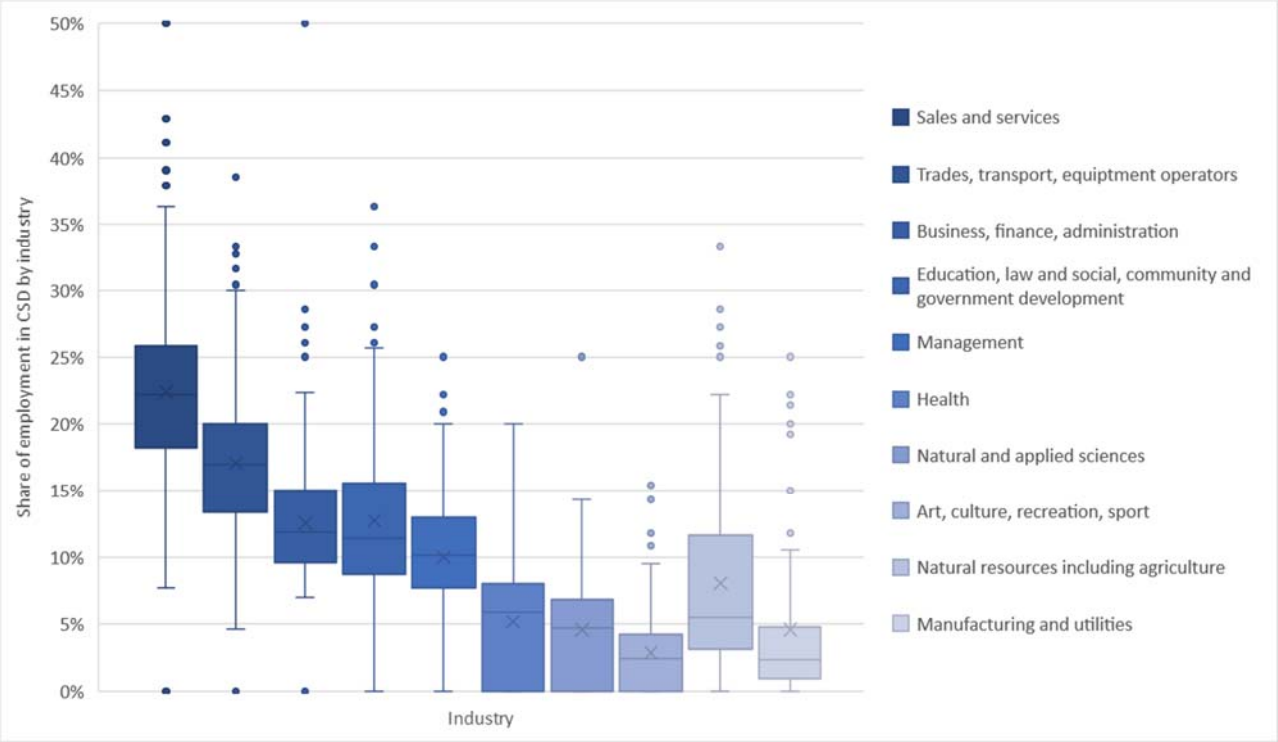

*Notes: Based on National Occupational Classification, NOC.*
*Source: Statistics Canada; Labour Data of 2016 Census via Canadian Census Analyser* (CHASS, 2020).

### *While the sales and services sector is dominant, the trades and transport sector is also a major source of employment across many communities*

Occupations in the sales and services sector represent a large proportion of employment in most of the CSDs in VICC (as seen in Figure 11, which illustrates the share of employment in CSDs that is attributed to specific industry sectors). In some areas, as much as half of the total employment in the area is in the sales and services sector; the area surrounding Tofino, a renowned surfing and tourist destination, is an example of such an area (Opisat 1 CSD). The importance of trades, transport, and equipment operating occupations also stands out. There is a large proportion of employment across many CSDs in these professions particularly on the Tsimshian Peninsula, Powell River and Zeballos. The geography of the VICC, with island and coastal communities and mountains regions on the mainland, makes the transport sector absolutely critical.

Linked to the transport sector, manufacturing is a major employer in communities like Prince Rupert (Skeena Queen Charlotte CSD). As BCs main northern transportation hub and port, the region's industries are well connected to regional and international markets. The arts culture and recreation, health, natural and applied sciences and manufacturing are smaller occupational groups across the majority of CSDs but a major contributor to quality of life and wellbeing.[vii]

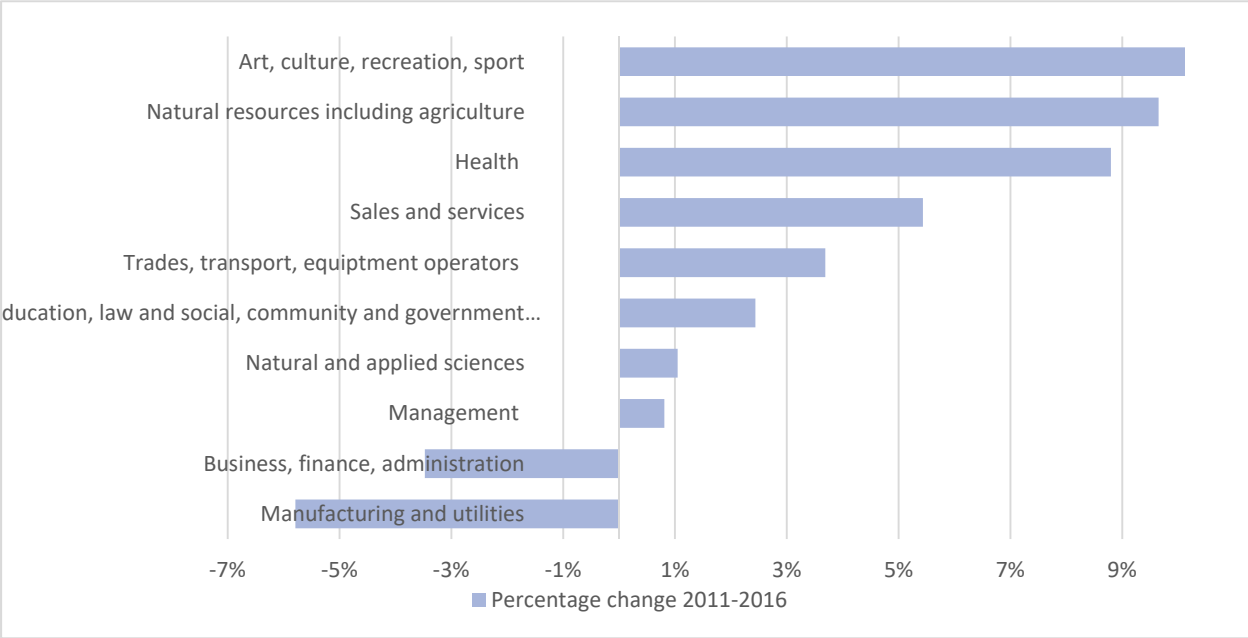
Figure 17 Share of Employment by Industry, CSD, VICC, 2016




*Note: Occupational categories by industry according to single digit National Occupational Classification codes, NOC.*
Source: Statistics Canada; 2016 Census Labour Data, Accessed via *Canadian Census Analyser* (CHASS, 2020).

Between 2011-2016, employment across the majority of occupational categories by industry increased. Among all sectors, jobs in arts, culture, recreation, and sport showed the strongest increase over this period growing by around 10% with the greatest gains seen in the Capital and Nanaimo Regional Districts. Jobs in natural resource occupations also showed a strong increase over this time, growing around 9.5% between 2011-2016 with the greatest gains seen in the Capital Regional District, Cowichan Valley, and Nanaimo Regional District. Sectors that saw the greatest employment losses over this time are manufacturing and utilities at around 6% and business, finance and administration at around 4.5%. Jobs in manufacturing and utilities saw the greatest declines in the Capital Region while those in business, finance and administration showed the greatest declines in the Nanaimo and Mount Waddington Districts.

Figure 18 Percentage Change in Employment, by Industry, VICC, 2011-2016

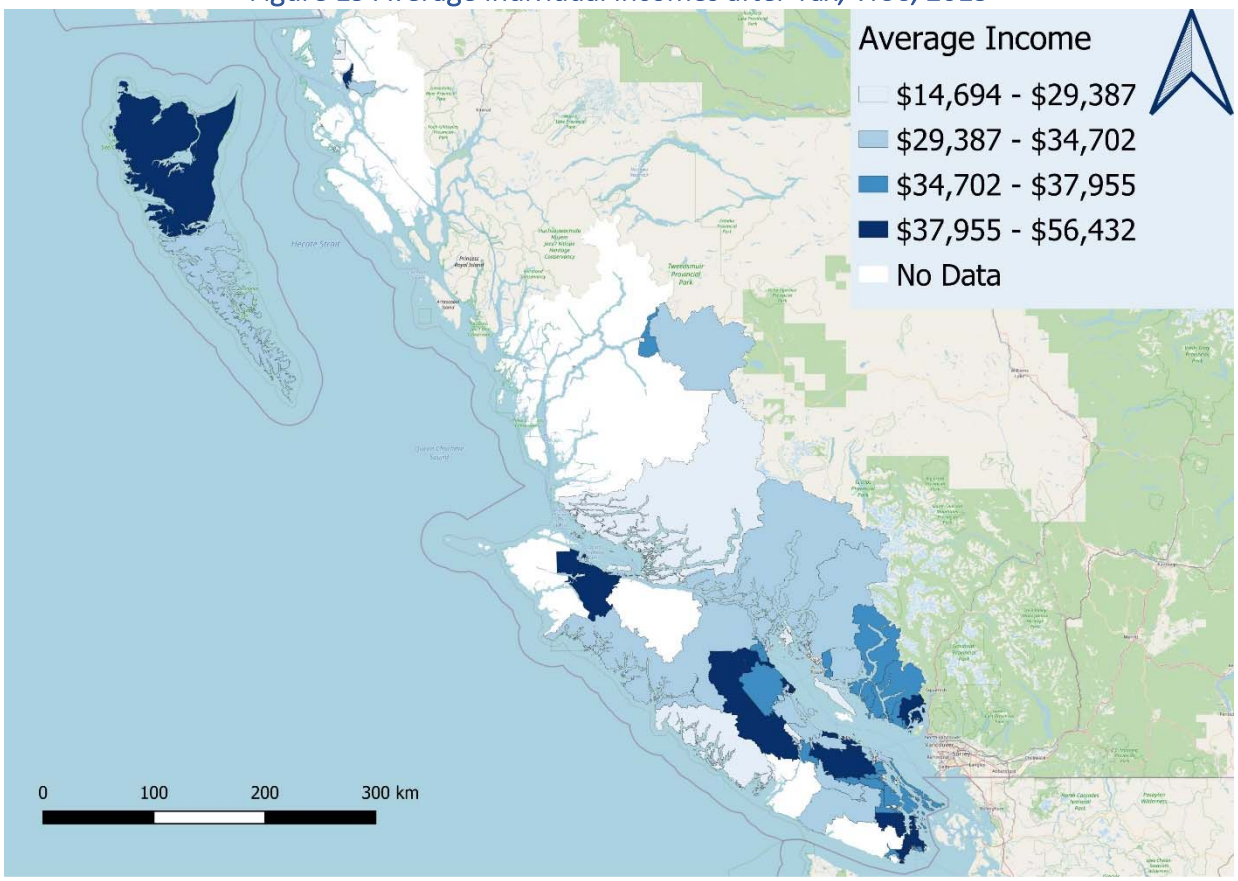



*Notes: Based on National Occupational Classification, NOC.*
*Source: Statistics Canada; 2017 & 2013, Labour Highlight Tables, 2016 Census & 2011 National Household Survey.*

### *Average incomes are higher for CSDs that are more connected to population centres*

The average individual income (after tax) for all VICC CSDs in 2015 was $33,435. The range of average incomes was large, spanning from $14,694 to $56,432. The CSD with the lowest average income was Penelakut Island 7, a reserve in the Cowichan Valley Regional District. The CSD with the highest average income was Oak Bay, in the Capital Regional District. Interestingly, both of these CSDs are in the Southern Vancouver Island region, however Oak Bay is part of the main island, and Penelakut Island 7 is clustered near the Gulf Islands. Indeed, many of the Gulf Islands have median incomes below the territory's average. This may indicate a link between proximity and transportation to population centres, as well as a reflection upon the high average age of Gulf Island communities which correlates to a large retired population. The widest range of incomes centralize around the southern end of Vancouver Island, corresponding to locations of several population centres. Indeed, this illustrates the disparity within and around cities in respect to income.

Figure 19 Average Individual Incomes after Tax, VICC, 2015

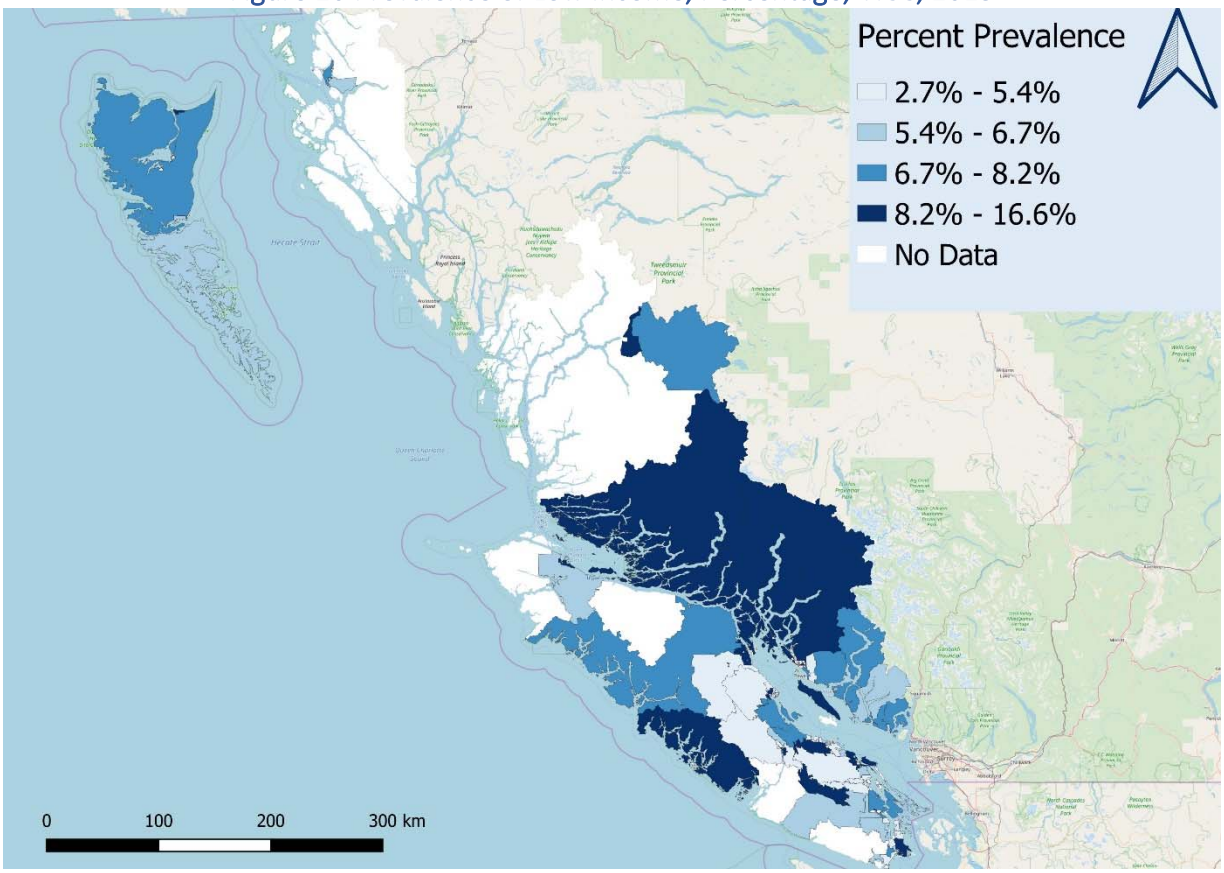



*Source: Statistics Canada; Income Data of 2016 Census via Canadian Census Analyser.*

### *There is a higher prevalence of low-income individuals in population centres of the VICC*

The prevalence of low income within the CSDs of VICC ranges from 2.7% to 16.6% as per 2015 data (Figure 20 Prevalence of Low Income, Percentage, VICC). The three CSDs with the highest rate of low income are Strathcona B (16.6%), Alberni-Clayoquot C (15.5%), and Victoria (14%). The CSDs with the highest population in 2016 (Table 3) correspond with high prevalence of low-income persons, ranging from 9.5%, 10.6%, and 14%, in Saanich, Nanaimo, and Victoria, respectively. There appears to be a correlation of low-income persons and high population regions, informing us that population centres (i.e., cities) may have more options for those in need of low-income services, and as such there is a higher concentration of people who need such assistance moving to more urban areas. This highlights the need for more accessible housing and other social services related to low-income in population centres in order to better support the citizens who reside there.

Figure 20 Prevalence of Low Income, Percentage, VICC, 2015

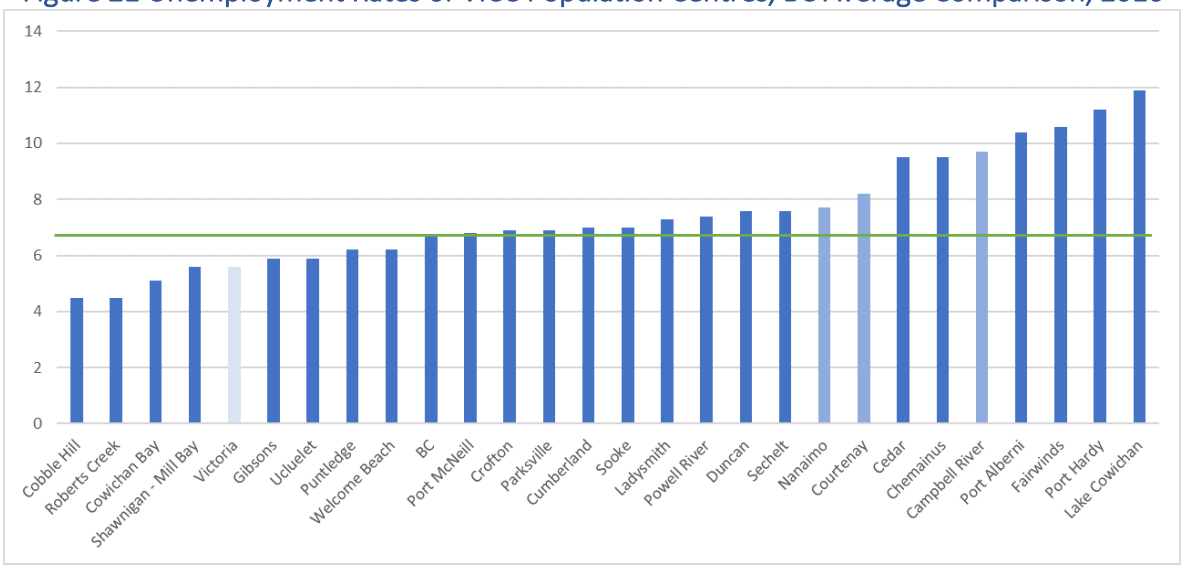



*Note: Classed by LICO-AT: Income levels at which families or persons not in economic families spend 20 percentage points more than average of their after-tax income on food, shelter and clothing.*
*Source: Statistics Canada* (2020b). *Income Highlight Tables, 2016 Census.*

### *The unemployment rate in most population centres across the VICC is above the provincial average*

Unemployment rates in the VICC population centres are varied, ranging from 4.5% in Cobble Hill to 12.7% in Prince Rupert. The average unemployment rate for British Columbia is 6.7%, and 19 of the 28 population centres (69%) have rates higher than this average. The large population centre, Victoria, is below the average, at 5.6%, and yet the three medium population centres, Campbell River, Courtenay, and Nanaimo are situated above the average rate at 9.7%, 8.2%, and 7.7%, respectively. This indicates a relatively high unemployment rate within the VICC's towns and cities, which could be in response to individuals seeking assistance services which are not available in rural areas, but are abundant within these urban agglomerations. Note that these unemployment rates are from the 2016 Census and do not reflect current unemployment rates which are much higher due to COVID-19.

Figure 21 Unemployment Rates of VICC Population Centres, BC Average Comparison, 2016




*Note: Dark Blue denotes small population centres, Blue for medium population centres, and Light Blue is the large population centre.*
*Source: Statistics Canada* (2020c). *Labour Highlight Tables, 2016 Census.*

## Community Wellbeing

- **Rural communities have lower levels of wellbeing according to Canada's Community Well-Being than their urban counterparts.**
- **Indigenous communities have lower levels of wellbeing according to Canada's Community Well-Being than non-Indigenous communities.**
- **Rural and remote communities, both Indigenous and non-Indigenous, have limited or no internet access, which detracts from their wellbeing.**

### *Community wellbeing scores across the VICC indicate rural-urban and First Nations-non-Indigenous community divides*

Community wellbeing is a dynamic concept that links quality of life and material conditions to the goal of sustainable well-being over time. It is a multidimensional concept that is grounded in the view that economic conditions should be viewed as part of broader social and environmental systems and conditions. There are a number of different ways to measure community well-being. The Government of Canada's Community Well-Being (CWB) index measures socio-economic well-being for individual communities based on four components: education, labour force activity, income, and housing. Importantly, this index facilitates a comparison of variations in well-being across First Nations and Inuit communities and non-Indigenous communities over time. According to the Canadian Well-Being index, which uses data from the 2016 census to derive well-being scores for CSDs in Canada, the CSDs in VICC with more urban populations (those over 1000) scored higher on average than rural CSDs (those with populations less than 1000) (Figure 22 Rural and Urban Community Well-being, VICC, 2016).

Akin to the rural-urban split, First Nations communities in the VICC also have lower well-being scores across the four indicators when compared to non-Indigenous communities (Figure 23). This data should be interpreted with caution. The proxy indicators that the well-being index draws on is just one way to depict the concept of well-being. This Index does not capture many aspects of well-being that may be important to Indigenous communities such as social and spiritual connections or informal and reciprocal economies that are also important to community well-being. Furthermore, it does not capture the domains of health, food, governance, ecology, or infrastructure and does not reflect a self-assessment of well-being.

Figure 22 Rural and Urban Community Well-being, VICC, 2016

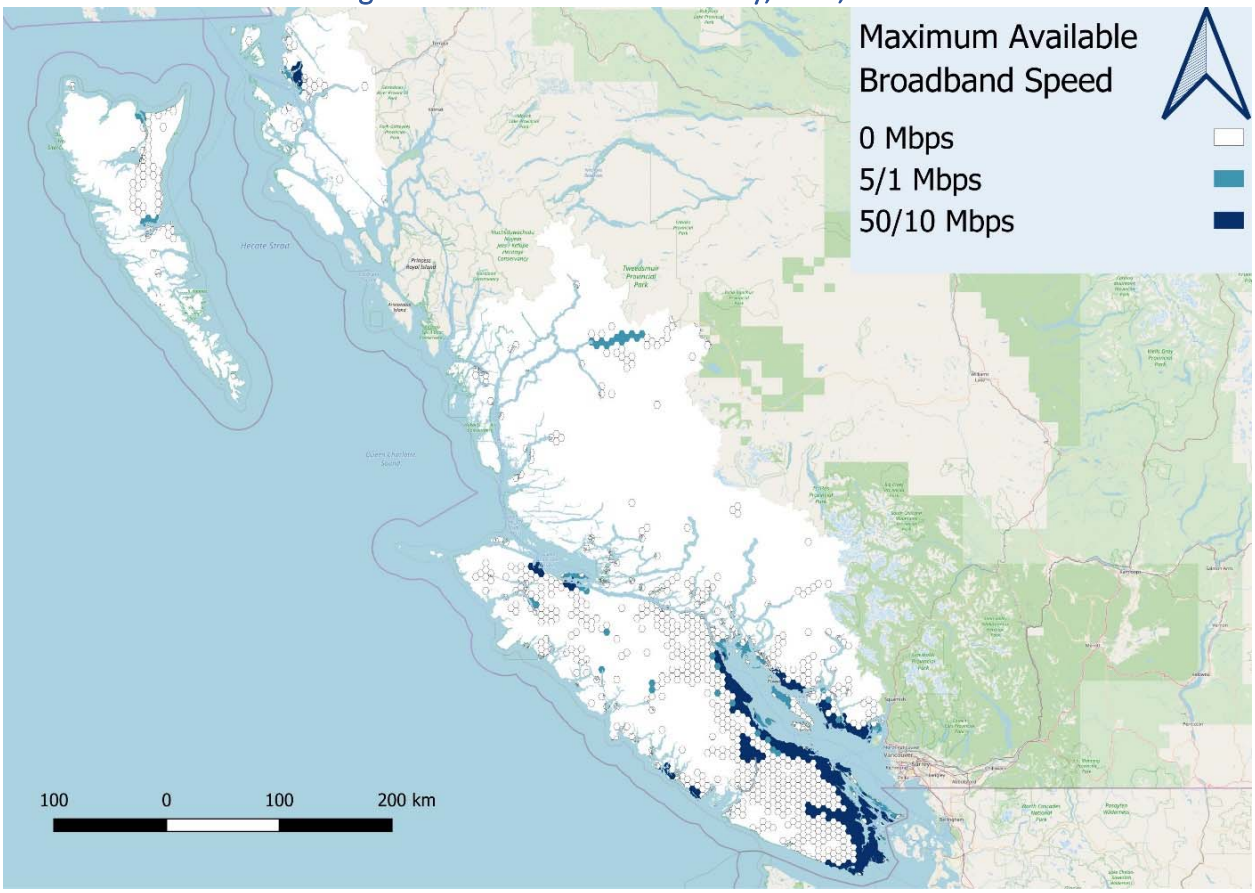

Figure 23 First Nations and Non-Indigenous Community Well-being, VICC, 2016


*Source: Government of Canada (2020). Community Well-Being Index - Open Government Portal.*

### *Digital network connectivity is important to community wellbeing—many rural areas and First Nations communities are poorly connected*

Access to the Internet has rapidly become one of the most important sources of connectivity within a region. This digital connectivity is what helps keep communities linked and supported through challenging times, as experienced with the distancing implications of COVID-19. Although population centres and the communities adjacent to them have access to high speed broadband services, many more remote communities have limited or no access (Figure 24). This has implications for the well-being of the communities, as internet access has been associated with helping with social isolation, purchasing of goods, accessing educational material, and acquiring jobs (Kearns & Whitley, 2019). What is more, access to the Internet was not correlated to lower levels of physical activity, according to a recent study from the UK (Kearns & Whitley, 2019). These findings exemplify the necessity for more vulnerable rural and remote communities to have access to broadband Internet services, especially when one considers the amount of health-related care becoming more accessible online.

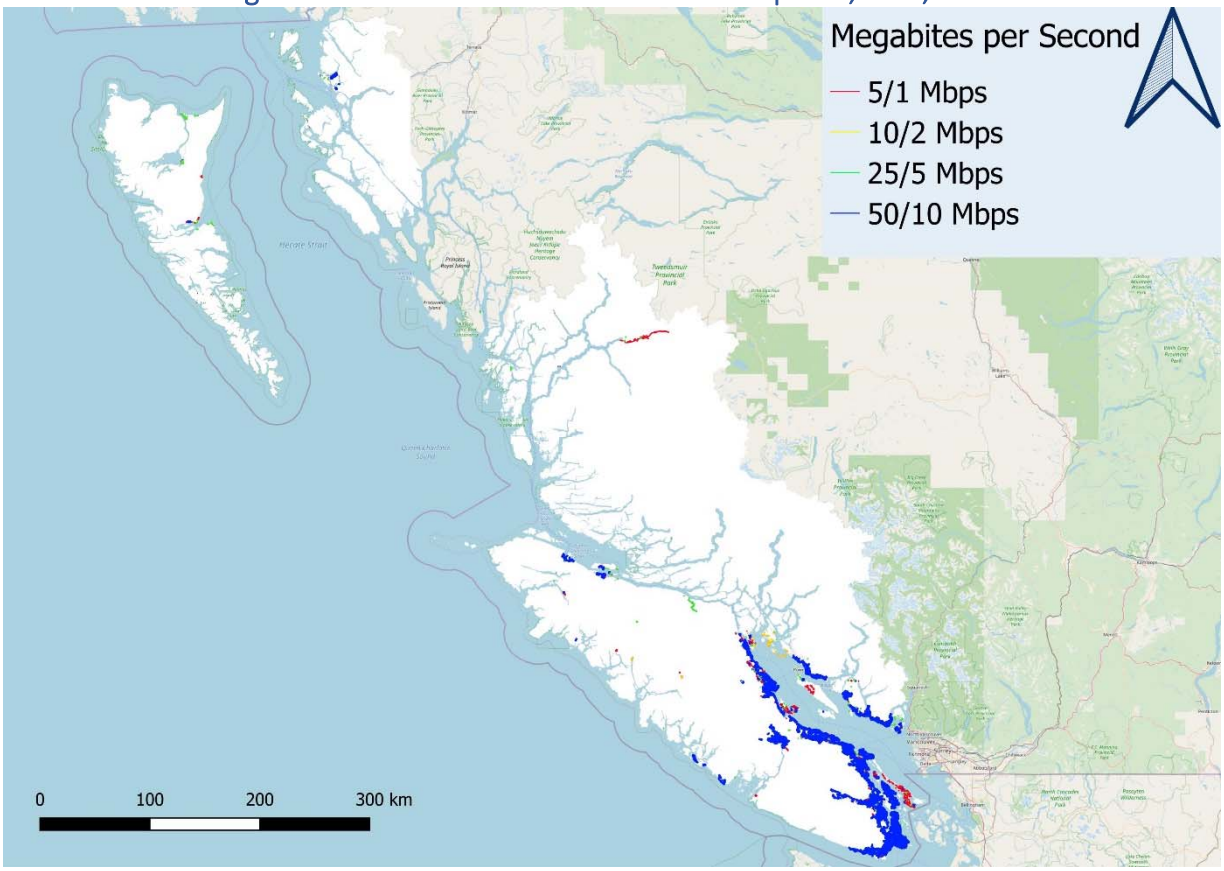
Figure 24 Broadband Connectivity, VICC, 2017




*Source: Government of Canada* (2020b), *National Broadband Data Information.*

Urban areas have the fastest Internet, with speeds up to 50/10 Mbps, and although some more remote communities have access to the Internet, many have "slow" access, meaning the rate of which data can travel to a household per second is much lower than urban areas (Figure 25). More remote communities with slower internet access include Tahsis, Zeballos, Gold River, Bella Coola, and Tlell. Many of the islands of VICC have slower internet access, as seen in concentrations in the Gulf Islands, Texada Island, and the islands clustered around Desolation Sound. Therefore, while communities may have internet available, the access may be inadequate to use for certain internet services, such as video conferencing and streaming—functions which are important for the delivery of e-services such as health and education.

Figure 25 Households Internet Broadband Speeds, VICC, 2017




*Source: Government of Canada* (2020b), *National Broadband Data Information.*

## The State of Greenhouse Gas Emissions

- **Residential greenhouse gas (GHG) emissions across the VICC decreased by 10% between 2007-2017.**
- **Declines in residential GHG emissions were uneven; many rural areas have high residential GHG emissions and have high energy costs, especially those that rely on diesel power generators.**
- **Commercial and small/medium industrial (CSMI) emissions decreased by 15% from 2007-2017.**
- **Urban centres have the highest CSMI emissions.**

British Columbia's Greenhouse Gas Emissions Inventory provides data for 57 communities across the VICC. Data involving single large industrial emissions which amount to greater than 50% of a community's total emissions are withheld due to confidentiality, but commercial and small/medium industrial (CSMI) emissions are available (CAS, 2007). Although not all-inclusive, this data is a good representation for the territory, and outlines some important features. Different kinds of emissions are counted. Residential GHG emissions are an inventory of all energy consumed for different types of homes.

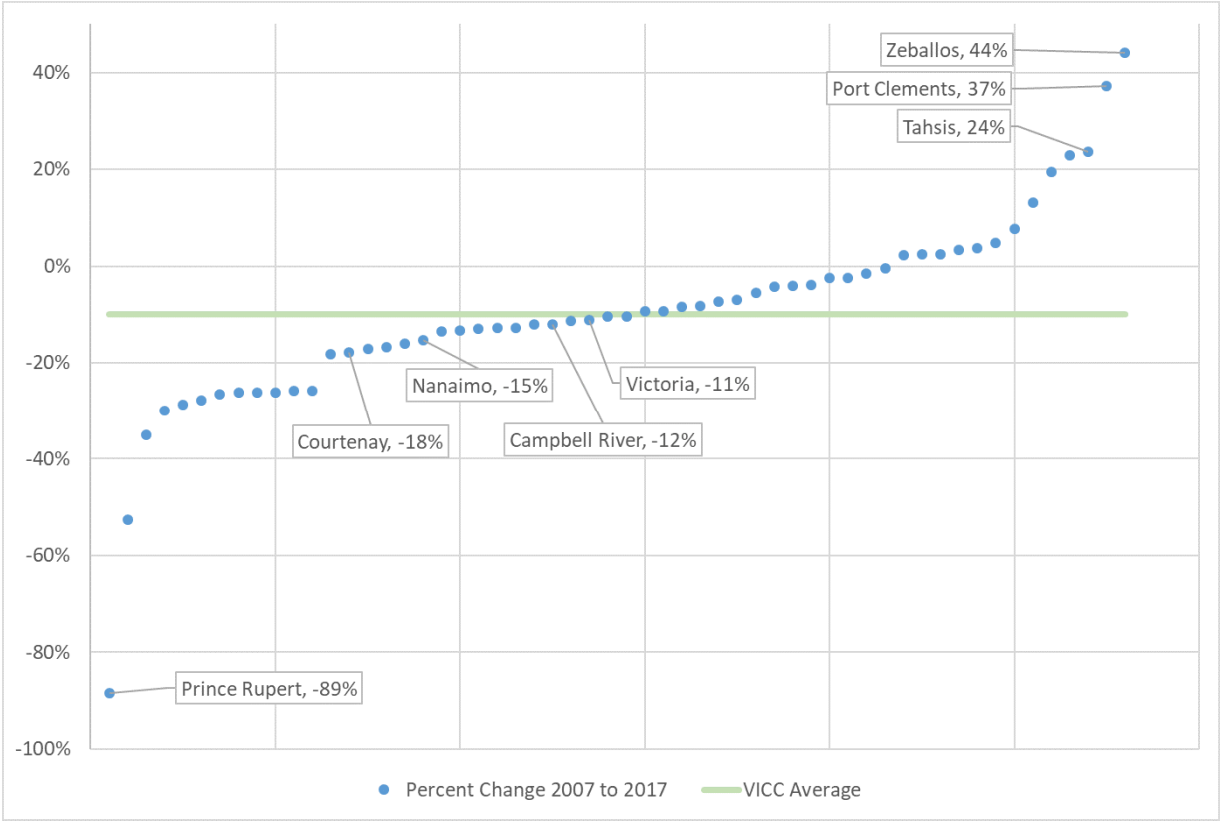
### *On average, residential GHG emissions have declined across the VICC*

Residential GHG emissions across the VICC decreased by 10% between 2007-2017 (Figure 26).[viii] At the lowest end, Prince Rupert has the greatest decrease in GHG emissions, at –89%, as well as having the lowest per capita residential emissions for 2017 at 0.14 tonnes of carbon dioxide equivalent (tCO2e) (CAS, 2019). Port Edward, another northern community, is the next lowest with a decrease of –53% (CAS, 2019). However, not all northern communities are experiencing decreases in emissions; Masset and Queen Charlotte (Charlotte) on Haida Gwaii both have increases over the decade. This is likely a reflection on the remoteness of the islands, and is reflected in other island communities such as the Gulf Islands, which also are experiencing an increase in emissions.[ix]

The community which had the highest residential emissions per capita in 2017 was Tahsis, at 5.17 tCO2e; but they also have among the lowest commercial and small-medium industrial GHG emissions per capita (at 0.13 in 2017, see Figure CC) (CAS, 2019). More rural communities tend to have higher emissions because they do not have the capital to invest in the same scale of projects as more urban areas do, and often are having to rely on diesel generators for much of their energy. These generators are not only high in emissions, but also in cost - a heavy burden for smaller communities. Higher energy demands may also be related to their location in colder climates.

The medium and large population centres of VICC all have changes below the territorial average, ranging from –11% to –18% (Figure AA) (CAS, 2019). The decrease in tCO2e reflects the ability for urban areas to invest in greener infrastructure, low-emissions public transportation, and sustainable energy. These urban areas have had the ongoing opportunity to make such changes and investments and the data reflects the effectiveness of some of these initiatives.

Figure 26 Percent Change in Residential per capita TCO2e Emissions, 2007 to 2017

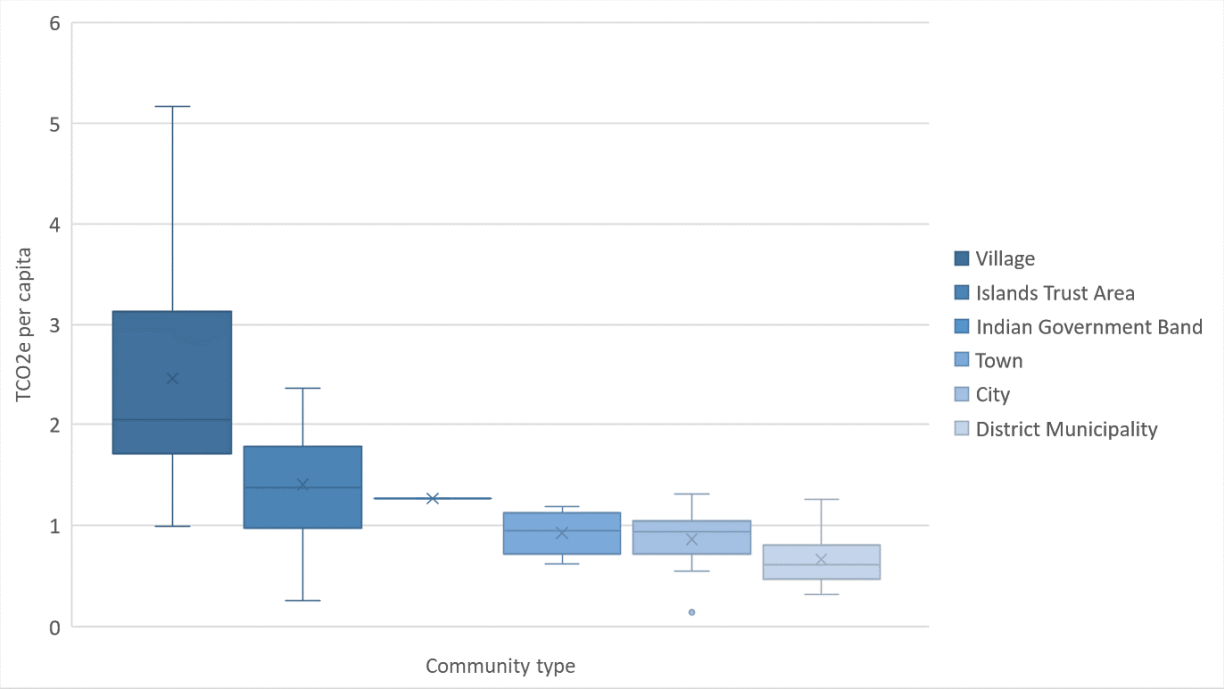



*Source: Government of British Columbia Climate Action Secretariat (2019). 2017 Provincial Inventory, Statistics Canada; Census Profile 2016; Designated Places; Statistics Canada; Census Area Profiles 2006; Designated Places,*

### *Rural communities have the highest GHG emissions on average*

Figure 28 further illustrates the disparity between smaller communities and urban areas; the rural communities (villages) of VICC have the highest average residential GHG emissions in 2017, and includes places such as Tahsis, Zeballos, Masset, and Port Clements. These areas are all very remote in comparison to the population centres of VICC, and do not have access to the same connectivity or capital resources. Villages also display the largest range in emissions, indicating that some communities have cleaner energy options which they have invested in, and others do not have that ability as of yet.

Figure 27 Tonnes of Residential GHG Emissions per capita, by Community Type, VICC, 2017

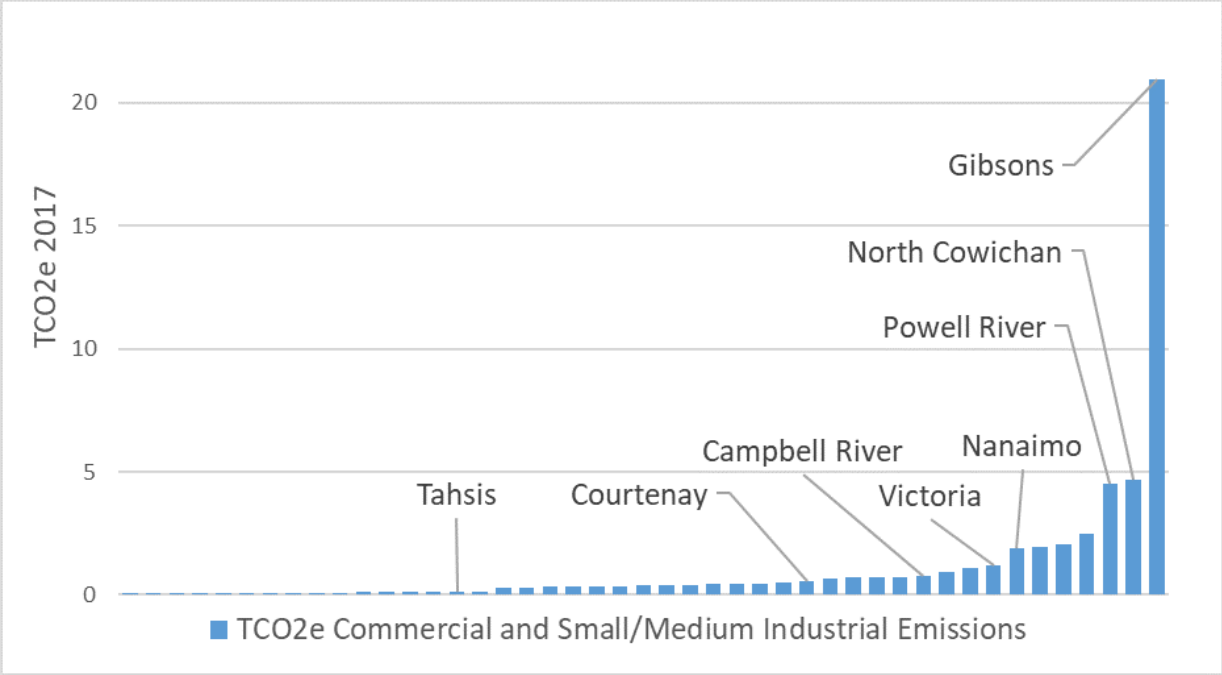



*Source: Government of British Columbia Climate Action Secretariat (2019). 2017 Provincial Inventory, Statistics Canada; Census Profile 2016; Designated Places; Statistics Canada; Census Area Profiles 2006; Designated Places,*

### *There is little correlation between high industrial and commercial GHG emissions and communities with goods-based economies*

In VICC many communities either do not have data on CSMI, or have a CSMI emission of zero; and are not illustrated in Figure CC, below. All of these communities are Islands Trust Areas and, as aforementioned, there is only data for these communities pertaining to estimated oil, wood, and propane. Other communities have significant CSMI emissions; the communities which have the greatest CSMI emissions are Gibsons, North Cowichan, and Powell River. There is little correlation between high CSMI emissions and whether or not the community has a goods-based economy. It is population centres with large commercial and industrial sectors (not just goods based) that have among the highest CSMI emissions.

Figure CC TCO2e Emissions for VICC Communities including CSMI, 2017




*Source: Government of British Columbia Climate Action Secretariat (2019). 2017 Provincial Inventory, Statistics Canada; Census Profile 2016; Designated Places, Statistics Canada; Census Area Profiles 2006; Designated Places.*

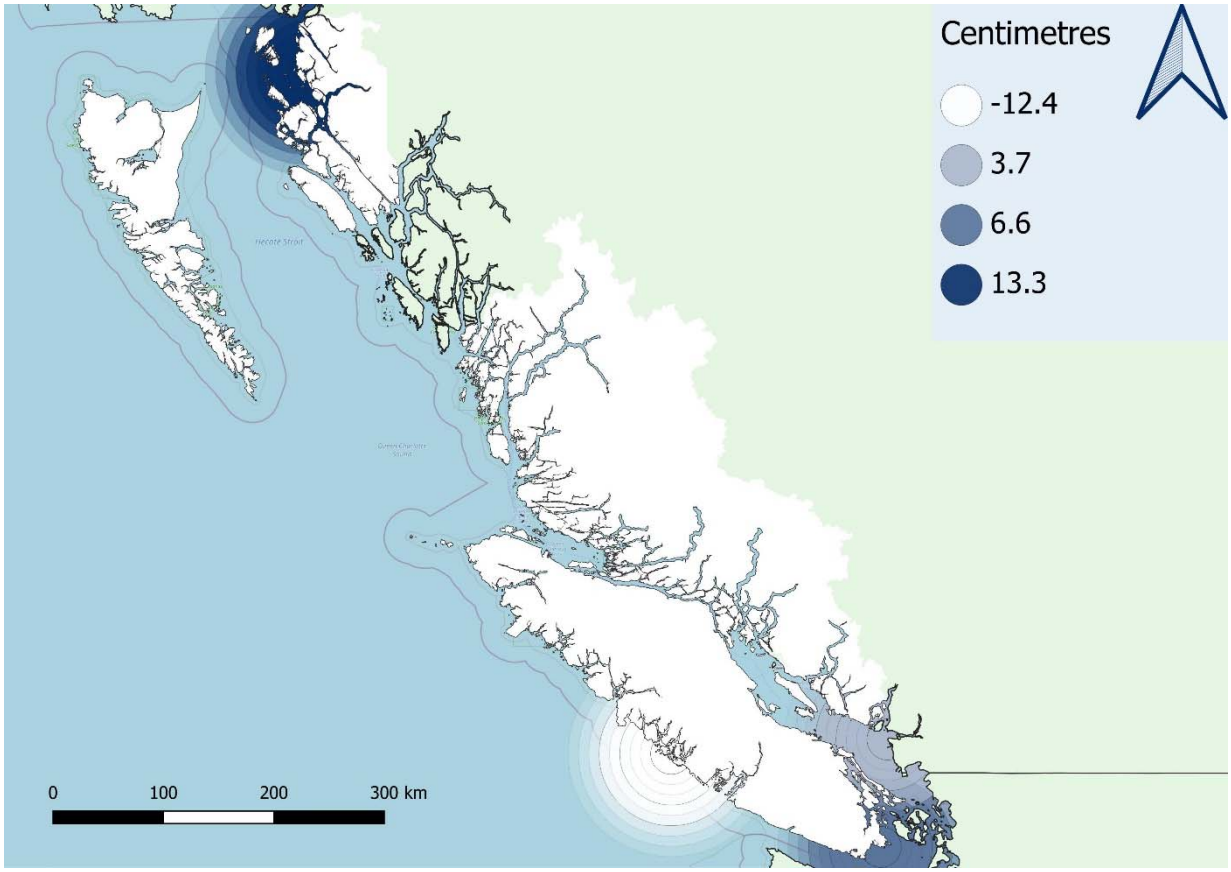
## Present and Future Climate Change Scenarios

- **Sea-level rise together with more frequent and severe storms due to climate change poses hazard to VICC communities and industries.**
- **Sea level rise over the past century has been uneven across the VICC due to isostatic rebound from the last glaciation; some areas are under greater threat than others.**
- **Ocean surface temperatures vary across the VICC, but overall depict a warming trend, threatening marine life.**
- **Communities face current and ongoing risk of flooding, landslides, and structural damage to critical infrastructure.**

### *As a coastal territory, the changes in the ocean pose a serious threat to communities within VICC*

The VICC region is intrinsically connected to the ocean, and therefore the changes to the ocean due to climate change are of significant importance to the region. Globally, mean sea level has risen 0.19m from 1901-2010, and it is very likely that the rate of sea level rise was 1.7mm/yr within that time range, but 3.2mm/yr from 1992-2010 (IPCC, 2014). It is very likely that the rate of rise will continue to increase in the coming years (IPCC, 2014). However, sea level rise varies across the VICC (Figure 28). In Prince Rupert the average sea level rise was 0.13m/century, and 0.06m/century in Victoria, while in Tofino the average sea level dropped at -0.12m/century (BCMoE, 2016). At first this may seem counter-intuitive, but there is a simple explanation; due to the isostatic rebound from the last glaciation, parts of Vancouver Island are rising at ~0.25m/century, while other areas are not moving (to a significant degree) (BCMoE, 2016).

Figure 28 Observed Change in Centimetres per century in Sea Level, Coastal British Columbia, 1910-2014




*Sources: BC sea level data* (Government of British Columbia, 2020e)*; US cartographic file* (US Census Bureau, 2020)*; BC cartographic file* (Government of British Columbia, 2020d).

Isostatic rebound is the lifting of land after a large quantity of ice in the form of glaciers has retreated from the area; it is a slow response which takes place over thousands of years. This rising of the land is responsible for the apparent lowering of sea level in Tofino, and accounts for the large differences between there and Prince Rupert where there is little rebound occurring. The implications of sea level rise within VICC are vast, including:

- Flooding, especially beaches, wetlands, coastal dunes, and waterfront properties;
- More frequent extreme high-water occurrences, impacting property, infrastructure (docks, wharves, port facilities), especially in Prince Rupert;
- Salinification of agricultural lands from intrusion of saltwater into groundwater aquifers and;
- Wave changes, including magnitude and direction, as well as storm waves and surges (BCMoE, 2016).

In addition to sea level rise, the oceans are also experiencing an increase in temperature. From 1971 to 2010, the ocean surface increased on average by 0.11°C/decade (IPCC, 2014). In VICC

the temperatures at the ocean surface vary from a low of 0.6°C at Kains Island to a high of 1.4°C at Entrance Island, but on average agree with the IPCC numbers (BCMoE, 2016). Marine organisms are very sensitive to temperature increases, and as such the warming of the surface layer of the ocean impacts the fish and shellfish which are crucial sources of food and income for many residents of VICC, and are of significant cultural importance. Additionally, the heating of the surface layer is increasing stratification in the ocean – the warm, less dense water "floats" upon the deeper, colder, and more saline water below. The problem with this is that the mixing of surface and deep water is what brings mineral-rich water in autumn to replenish the nutrients in the surface layer, which are necessary for feeding the phytoplankton that are the basis of the marine food chain. The lower the mixing, the less nutrients are available, and the lower the productivity of the ocean (BCMoE, 2016).

Alongside temperature increases, the increasing amount of $CO_2$ entering the ocean is altering the pH of the water, making it more acidic (Canadian Climate Forum, 2017). Ocean acidification occurs as the $CO_2$ from the atmosphere dissolves into multiple ions, notably hydrogen ions, which lower the pH of ocean water and make it more acidic (Canadian Climate Forum, 2017). The implications of ocean acidification include deteriorating habitats for fish and shellfish, and decreasing carbonate ions needed by shellfish to build their shells (Canadian Climate Forum, 2017). This is just one of the several impacts of climate change to shellfish, which are an especially vulnerable but equally important class of life to the VICC region. As an example, in 2014 ten million scallops died in the waters near Qualicum Beach (Shore, 2014). These types of die offs have been increasing over the past decade.

### *VICC is experiencing rising temperatures, putting vulnerable populations at a higher risk*

Average global surface temperatures have been warming since 1850 (IPCC, 2014). In BC, the temperature changes are felt more acutely: globally, temperatures have increased on average by 0.85°C/century, while BC on average has experienced increases on average of 1.4°/century from 1900-2013 (BCMoE, 2016). Due to the complex geography of VICC, there are variations in the average temperature increases. The southern coastal reaches of VICC have experienced increases of 0.8°/century, while more northern areas, such as Prince Rupert, have experienced increases of 1.1°C (BCMoE, 2016).

One of the further changes predicted to occur is the increase of heat waves; heat waves are expected to happen more often in urban areas, because the built environment (paved roads, buildings, other infrastructure) retains heat more so than the natural environment (BCMoE, 2016). As such, the heat waves are felt more acutely in urban agglomerations where there is a higher concentration of people, as well as more vulnerable populations, especially seniors. In Victoria, between 1951-1980, there were usually only 3 days a year which reached temperatures above 30°C, but within this century that is expected to increase more than four-fold, to 13 days per year (BCMoE, 2016).

### *Increased precipitation and glacial meltwater help soil moisture, but increase flooding hazard to communities*

VICC spans two unique ecoprovinces; the Georgia Depression, which covers Victoria and the southeast sections of Vancouver Island, and the Coast and Mountains, covering the remaining portions of VICC (BCMoE, 2016). Within the Georgia Depression, precipitation increased by 14% per century, and by 10% per century in the Coast and Mountains ecoprovince, The increase in precipitation has many implications for VICC (BCMoE, 2016). Some of these implications are beneficial to the territory, the increased precipitation assists in adding to groundwater stores, replenishing soil, and adding to river discharge (BCMoE, 2016). However, increased precipitation does have some negative effects, namely increased risk of flooding, landslides, and damage to infrastructure (BCMoE, 2016). Flooding is a common hazard in British Columbia, and the increasing precipitation is an indicator that this hazard may become more frequent. As such, it is an important event to be prepared for, with attention to storm drains, culverts, and river characteristics.

Much of BC's freshwater is stored in glaciers, however from 1985-2005 BC lost 2525km² of glacial coverage (BCMoE, 2016). Most of the glaciers within VICC are found in the Coast and Mountains ecoprovince, yet the glaciers with the greatest percentage of area loss are found in the Georgia Depression (BCMoE, 2016). The increased melting of glacial ice has similar implications to increased precipitation; the added meltwater increases the discharge of rivers, which has both positive and negative ramifications.

### *Increasing temperature means more available energy for plants, but may decrease yield of crops*

The temperature increases within VICC do have some benefits, as there is an increase in available heat energy for plants, which stimulates growth, and correlates to an increase of Growing Degree Days (BCMoE, 2016). The result is that plants are able to successfully grow for more days out of the year than in previous years. This has implications for agriculture in VICC, which has been able to expand due to a more favourable climate. However, the IPCC warns that if these annual temperature increases are more than a few degrees then there will be a generalized loss in mid-latitudinal potential crop yields, a threat to VICC's food security (IPCC, via BCMoE, 2016). These changes may be important to keep in mind while decisions are made upon the type of crops to be planted. As well, the increase of temperature may bring more droughts to the region; this will impact both agricultural activity and the supply of drinking water for the communities of VICC. Not only that, but the decrease in relative humidity experienced in droughts increases the risk of wildfire activity.

### *Species are relocating as their zone of tolerance within their habitat shifts*

Additionally, the climatic changes appear to be altering the tree coverage within VICC: there is a decrease in Mountain Hemlock, which is being replaced by the more abundant Western Hemlock (Wang, Hamann, Spittlehouse, & Carroll, 2016). This illustrates the movement of species to be expected in VICC: certain species are able to thrive or adapt to higher temperatures and increased precipitation, but for some that change will put the territory of VICC outside of their range of tolerance, and they will cease to grow in this region. This altering of ecosystems in turn changes

habitats, as many faunae in VICC are dependent on specific flora to provide food and/or shelter. With the changes in coming years it is expected that the habitats of animals may also shift. This impacts not only the flora and fauna, but also the people who reside in these habitats; certain species are vitally important to communities, especially Indigenous communities. The relocation of key species may be damaging not only in a resource-based frame, but also culturally, and as such reforestation and habitation efforts need to be a collaborative process respecting values from all sides. There are already examples of species moving from traditional habitats because of the various climate changes, including increased precipitation, changes in river discharge, drought impacts, wildfire, and flooding, to name a few.

### *Climate change impacts on the health of VICC communities*

The result of these many changes to the environment have far reaching ramifications for the citizens of VICC. Water quality is already a concern for many communities, and the changing climate has impacts on this as well. As aforementioned, the rise in sea level may flood low-lying areas, bringing in salt water and contaminants from the ocean (BCMoE, 2016). Further, the increased risk of flooding due to heavy precipitation has the ability to overwhelm sewage systems and to carry runoff into drinking reservoirs, a hazard experienced previously in BC several times, leading to outbreaks of disease transmitted from both sewage and animals (BCMoE, 2016). An example from the CRD comes from 1995, where an outbreak of toxoplasmosis was thought to be linked to a municipal water reservoir following two heavy precipitation events which caused significant turbidity in the reservoir concerned (Bowie et al., 1997). Another implication of sewage runoff is the negative effects it has on shellfish, this in turn not only harms the ocean life but also has threats to the shellfish industry and the consumers of it. There are additional ocean borne diseases which transfer from shellfish to humans, and are also implicated with climate change (James, Carey, O'Halloran, Van Pelt, & Škrabáková, 2010).

Other health considerations associated with climate change include the illnesses related to air quality which is degraded by emissions from vehicles and industrial activities; the smog which can form from emissions is created faster at warmer temperatures, and as such the occurrence of respiratory illnesses may increase (BCMoE, 2016). Heat related illnesses, as aforementioned, are an ongoing concern, and combined with that citizens will see that although they may spend less on heating in the winter, they may be spending more in the summer to keep their houses cooler (BCMoE, 2016). This highlights the importance of energy efficient upgrades, as the cost of energy required to maintain "room temperature" is heightened with older less efficient systems. However, the cost of replacing heating and cooling systems is outside the budget of many families, and as such retrofits and other more economical solutions may be presented as more attainable.

Social inequities are major determinant of population health and play an important role when trying to understand the health impacts of climate change. Vulnerable populations are at greater risk of phenomena such as flooding, heatwaves and extreme cold because they have less capacity to adapt to environmental and health risks.[x] The populations most at risk of harmful consequences from climate change events are the most disadvantaged and vulnerable, and those living in arctic ecosystems, drylands, small islands, and least developed countries (IPCC, 2018). In Canada, the most affected are "those living closest to the land" (Baier & Brown, 2019), many of whom are farmers and Indigenous communities in coastal and remote communities. The IPCC (2018) also warns that "poverty and disadvantage are expected to increase in some populations as global

warming increases." As climate change is already occurring creating climate event sand potentially crisis, it is important to increase population resilience.

## Our shared future

Climate change—sea level rise, an increase in ocean temperatures, more frequent and severe storms, flooding and landslides—challenges communities across the VICC to pursue adaptation and mitigation measures. These trends impact all communities across the VICC, but in different ways. Some communities are more vulnerable than others both in terms of how they are impacted by climate changes and in terms of their capacity to address it through adaption and mitigation measures.

This Territorial Review has highlighted the interconnectedness of the VICC region and critically, the importance of rural-rural and rural-urban linkages and partnerships. Rural and urban communities are linked by their environments and ecosystems, social connections, labour markets and economies. Rural areas provide critical resources and environmental amenities for the region while urban areas are important service centers and transport hubs. Remote rural communities are especially vulnerable to climate related hazards due to their greater isolation and less diversified transport connectivity and critical infrastructure. Small town and rural VICC communities have inherently smaller administrations and fewer resource with which to manage increasingly complex issues. Rural-rural and rural urban partnerships can help build economies of scale through such measures as joint procurement, infrastructure and land management and service agreements. These types of partnerships are critical to the region's resilience.

## References

Ancient Forest Alliance. (2016). Action Alert: Speak up for Ancient Forests to the Union of BC Municipalities (UBCM)! - Ancient Forest Alliance. Retrieved May 30, 2020, from https://www.ancientforestalliance.org/action-alert-speak-up-for-ancient-forests-to-the-union-of-bc-municipalities-ubcm

AVICC. (2020). AVICC - Association of Vancouver Island and Coastal Communities. Retrieved March 16, 2020, from https://avicc.ca/

Baier, G., & Brown, D. (2019). No Title. In H. Bakvis & G. Baier (Eds.), *Contested Federalism: Certainty and Ambiguity in the Canadian Federation* (pp. 197–216).

BCMoE. (2016). Indicators of Climate Change for British Columbia, 2016 Update. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf

BCREA. (2020). Sketching Out the Potential Impact of COVID-19 on the BC Housing Market - British Columbia Real Estate Association. Retrieved April 27, 2020, from https://www.bcrea.bc.ca/economics/sketching-out-the-potential-impact-of-covid-19-on-the-bc-housing-market/

Birkmann, J., Garschagen, M., Kraas, F., & Quang, N. (2010). Adaptive urban governance: New challenges for the second generation of urban adaptation strategies to climate change. *Sustainability Science*, *5*(2), 185–206. https://doi.org/10.1007/s11625-010-0111-3

Bowie, W. R., King, A. S., Werker, D. H., Isaac-Renton, J. L., Bell, A., Eng, S. B., & Marion, S. A. (1997). Outbreak of toxoplasmosis associated with municipal drinking water. The BC Toxoplasma Investigation Team. *Lancet (London, England)*, *350*(9072), 173–177. https://doi.org/10.1016/s0140-6736(96)11105-3

Canadian Climate Forum. (2017). *Ocean Acidification in Canada's Coastal Waters*. Retrieved from https://climateforum.ca/wp-content/uploads/2017/04/CCF-IP_6-OA-MAR-30-2017-SCREEN-FINAL.pdf

CAS. (2007). *Technical Methods and Guidance Document for CEEI Reports, 2007. Government of British Columbia, Climate Action Secritariat*. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/climate-change/data/ceei/technical_methods_and_guidance_document_for_the_ceei_reports.pdf

CFCG. (2020). About BEC and BGC units, Centre for Forest Conservation Genetics. Retrieved May 9, 2020, from https://cfcg.forestry.ubc.ca/resources/cataloguing-in-situ-genetic-resources/about-bec-and-bgc-units/

CHASS. (2020). Canadian Census Analyser . Retrieved May 13, 2020, from http://dc1.chass.utoronto.ca.ezproxy.library.uvic.ca/census/

Ecotrust Canada. (2020). *Moving Toward Energy Security in British Columbia's Rural, Remote and Indigenous Communities* .

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R., … Snyder, P. K. (2005, July 22). Global consequences of land use. *Science*, Vol. 309, pp. 570–574. https://doi.org/10.1126/science.1111772

Gore, C. D. (2010). The Limits and Opportunities of Networks: Municipalities and Canadian Climate Change Policy. *Review of Policy Research*, *27*(1), 27–46. https://doi.org/10.1111/j.1541-1338.2009.00425.x

Government of British Columbia. (2011). Census of Agriculture . Retrieved April 27, 2020, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/statistics/census/agricensus_2011_bchighlights.pdf

Government of British Columbia. (2019). Making life better, first quarterly report 2019. Retrieved April

27, 2020, from Government of British Columbia website: https://www2.gov.bc.ca/assets/gov/british-columbians-our-governments/government-finances/quarterly-reports/2019-20-q1-report.pdf#page=32&zoom=100,0,0

Government of British Columbia. (2020a). Baseline Thematic Mapping Present Land Use Version 1 Spatial Layer - Datasets - Data Catalogue. Retrieved May 13, 2020, from https://catalogue.data.gov.bc.ca/dataset/baseline-thematic-mapping-present-land-use-version-1-spatial-layer

Government of British Columbia. (2020b). Coastal Ferry Routes - Datasets - Data Catalogue. Retrieved May 13, 2020, from https://catalogue.data.gov.bc.ca/dataset/coastal-ferry-routes#edc-pow & https://catalogue.data.gov.bc.ca/dataset/digital-road-atlas-dra-demographic-partially-attributed-roads%23edc-pow

Government of British Columbia. (2020c). Definition of "Old Growth" . Retrieved June 1, 2020, from https://engage.gov.bc.ca/oldgrowth/definition

Government of British Columbia. (2020d). NTS BC Coastline Polygons 1:250,000 - Digital Baseline Mapping (NTS) - Datasets - Data Catalogue. Retrieved May 13, 2020, from https://catalogue.data.gov.bc.ca/dataset/nts-bc-coastline-polygons-1-250-000-digital-baseline-mapping-nts

Government of British Columbia. (2020e). Sea Level - Environmental Reporting BC. Retrieved May 13, 2020, from http://www.env.gov.bc.ca/soe/indicators/climate-change/sea-level.html

Government of British Coumbia. (2018). *2018 Value of Tourism A Snapshot of Tourism in BC = $1 billion*.

Government of Canada. (2020a). Community Well-Being Index - Open Government Portal. Retrieved May 9, 2020, from https://open.canada.ca/data/en/dataset/56578f58-a775-44ea-9cc5-9bf7c78410e6#wb-auto-6

Government of Canada. (2020b). National Broadband Data Information - Get connected. Retrieved May 13, 2020, from https://www.ic.gc.ca/eic/site/139.nsf/eng/00007.html

IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva.

IPCC. (2018). Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments — IPCC. Retrieved June 1, 2020, from https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/

James, K. J., Carey, B., O'Halloran, J., Van Pelt, F. N. A. M., & Škrabáková, Z. (2010, July). Shellfish toxicity: Human health implications of marine algal toxins. *Epidemiology and Infection*, Vol. 138, pp. 927–940. https://doi.org/10.1017/S0950268810000853

Kearns, A., & Whitley, E. (2019). Associations of internet access with social integration, wellbeing and physical activity among adults in deprived communities: Evidence from a household survey. *BMC Public Health*, *19*(1), 860. https://doi.org/10.1186/s12889-019-7199-x

Macnair, E. (2004). *A baseline assessment of food security in British Columbia's Capital Region*.

OECD. (2020). *OECD Regional Database*. Retrieved from https://stats.oecd.org/Index.aspx?Datasetcode=CITIES

Province of British Columbia. (2020). Impacts of Climate Change. Retrieved April 10, 2020, from https://www2.gov.bc.ca/gov/content/environment/climate-change/adaptation/impacts

Shore, R. (2014). Ocean acidity wipes out 10 million scallops near Qualicum Beach. *Vancouver Sun*.

Statistics Canada. (2020a). Age and Sex Highlight Tables, 2016 Census - Population by broad age groups and sex, Canada and economic regions. Retrieved May 13, 2020, from https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/as/Table.cfm?Lang=E&T=14&type=1

Statistics Canada. (2020b). Commuting Flow from Geography of Residence to Geography of Work - Census Metropolitan Areas and Census Agglomerations: Main Mode of Commuting (10),

Commuting Duration (6) and Sex (3) for the Employed Labour Force Aged 15 Years and Over Having a Usual Place of Work, in Private Households, 2016 Census - 25% Sample Data. Retrieved May 13, 2020, from https://www150.statcan.gc.ca/n1/en/catalogue/98-400-X2016327

Statistics Canada. (2020c). Income Highlight Tables, 2016 Census. Retrieved May 13, 2020, from https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/inc-rev/index-eng.cfm

Statistics Canada. (2020d). Labour Highlight Tables, 2016 Census. Retrieved May 13, 2020, from https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/lab-tra/index-eng.cfm

*Strategies to Improve Rural Service Delivery*. (2010). https://doi.org/10.1787/9789264083967-en

Tomaney, J., Krawchenko, T., & McDonald, C. (2019). Regional planning and rural development. In M. Scott, M. Gallent, N., Gkartzios (Ed.), *The Routledge Companion to Rural Planning* (pp. 170–182). Retrieved from https://books.google.ca/books?hl=en&lr=&id=FXyCDwAAQBAJ&oi=fnd&pg=PT264&dq=info:8eb70XnhxlgJ:scholar.google.com&ots=ihnOdFTNN8&sig=XUba9KE5b1X6UelVejaUKbyIbOE&redir_esc=y#v=onepage&q&f=false

US Census Bureau. (2020). *Cartographic Boundary Files - Shapefile*.

VIEA. (2020). Economic Overview . Retrieved April 26, 2020, from https://viea.ca/economic-sector/economic-overview/

Wang, T., Hamann, A., Spittlehouse, D., & Carroll, C. (2016). Locally Downscaled and Spatially Customizable Climate Data for Historical and Future Periods for North America. *PLOS ONE*, *11*(6), e0156720. https://doi.org/10.1371/journal.pone.0156720

## Data sources

British Columbia Data Catalogue. 2014. Indian Reserves - Administrative Boundaries. Last Updated January 30, 2020. https://catalogue.data.gov.bc.ca/dataset/indian-reserves-administrative-boundaries

Statistics Canada. 2017. Census Profile 2016; Census Divisions. Catalogue no.: 98-316-X2016001 Last Updated November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/search-recherche/lst/results-resultats.cfm?Lang=E&TABID=1&G=1&Geo1=&Code1=&Geo2=&Code2=&GEOCODE=59&type=0

Statistics Canada. 2017. Population Centre and Rural Area Classification 2016. Last Updated February 8, 2017. https://www.statcan.gc.ca/eng/subjects/standard/pcrac/2016/introduction#s1

Statistics Canada. 2017. Census Profile 2016; Population Centres. Catalogue no.: 98-316-X2016001 Last Updated November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/search-recherche/lst/results-resultats.cfm?Lang=E&TABID=1&G=1&Geo1=&Code1=&Geo2=&Code2=&GEOCODE=59&type=0

Statistics Canada. 2017. 2016 Census Boundary Files. Last Updated April 15, 2019. https://www12.statcan.gc.ca/census-recensement/2011/geo/bound-limit/bound-limit-2016-eng.cfm

Statistics Canada. 2017. Focus on Geography Series, 2016 Census. Catalogue no.: 98-404-X2016001 Last Updated November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/as-sa/fogs-spg/Index-eng.cfm

Statistics Canada. 2017. Census Profile 2016; Census Subdivisions. Catalogue no.: 98-316-X2016001 Last Updated November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-

pd/prof/search-recherche/lst/results-resultats.cfm?Lang=E&TABID=1&G=1&Geo1=&Code1=&Geo2=&Code2=&GEOCODE=59&type=0

Statistics Canada. 2017. Census Profile 2016; Population Centres. Catalogue no.: 98-316-X2016001 Last Updated November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/search-recherche/lst/results-resultats.cfm?Lang=E&TABID=1&G=1&Geo1=&Code1=&Geo2=&Code2=&GEOCODE=59&type=0

Statistics Canada. 2007. Age and Sex Highlight Tables, 2016 Census. Catalogue no.: 98-402-X2016002 Last Updated June 9, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/as/Table.cfm?Lang=E&T=14&type=1

Statistics Canada. 2017. Income Highlight Tables, 2016 Census. Catalogue no.: 98-402-X2016006 Last Updated September 12, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/inc-rev/Table.cfm?Lang=Eng&T=306&S=86&O=A

Statistics Canada. 2017. Income Highlight Tables, 2016 Census. Catalogue no.: 98-402-X2016006 Last Updated September 12, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/inc-rev/Table.cfm?Lang=Eng&T=106&S=86&O=A&RPP=25

Statistics Canada. 2017. Income Highlight Tables, 2016 Census. Catalogue no.: 98-402-X2016011. Last Updated August 15, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/inc-rev/Table.cfm?Lang=Eng&T=106&S=86&O=A&RPP=25

Statistics Canada. 2017. Labour Highlight Tables, 2016 Census. Catalogue no.: 98-402-X2016011. Last Updated August 15, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/lab-tra/Table.cfm?Lang=E&T=23&Geo=00

Statistics Canada. 2013. Regional Districts., British Columbia (Code 5923) (table). National Household Survey (NHS) Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013.http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E

Statistics Canada. Table 36-10-0468-01 Gross domestic product (GDP) at basic prices, by census metropolitan area (CMA) (x 1,000,000) **DOI:** https://doi.org/10.25318/3610046801-eng

Statistics Canada. 2017. Island Trust Area, IST [Designated place], British Columbia and British Columbia [Province] (table). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

Statistics Canada, 2006 Census of Population, Statistics Canada Catalogue no. 94-575-XCB2006008.

Government of British Columbia Climate Action Secretariat (2019). 2017 Provincial Inventory, Accessed from: https://www2.gov.bc.ca/assets/gov/environment/climate-change/data/provincial-inventory/2017/utilities_energy_data_2007-2017.xlsx

## Notes

[i] For example, British Columbia was the first jurisdiction in North America to have a revenue-neutral carbon tax and the government's CleanBC Plan has been notable across Canada for its vision and comprehensive ambitions.
[ii] Since 1850, roughly 35% of anthropogenic CO2 emissions resulted directly from land-use practices (Foley et al., 2005).
[iii] Recently logged timber is that which was harvested within the past 20 years, or older if tree cover is less than 40% and under 6 metres in height. Selectively logged timber does not have a defined timeline, it is determined by viewing aerial imagery (areas where the practice of selective logging can be clearly interpreted on the Landsat TM image and TRIM aerial photography). It bears noting that the government of BC's land use data may overestimate the share of old growth forest by including low productivity bog and subalpine forests; they should thus be interpreted with a note of caution (Ancient Forest Alliance, 2016). Furthermore, there is no commonly accepted definition of an old growth forest but that "most of B.C.'s coastal forests are considered to be old growth if they contain trees that are more than 250 years old. Some types of Interior forests are considered to be old growth if they contain trees that are more than 140 years old" (Government of British Columbia, 2020c).
[iv] Agriculture accounts for 310.22km2 (or 0.25% of total) mapped VICC land. Residential Agriculture Mixtures: 109km2 --- 0.10% of total mapped VICC land. This totals to only 0.35%, or 419.22km2, of total mapped VICC land being used for agricultural purposes. As per data catalogue: Agriculture is defined as land based agricultural activities undifferentiated as to crop (i.e. land is used as the producing medium); Residential Agriculture Mixtures are defined as areas where agriculture activities are intermixed with residential and other buildings with a building density of between 2 to 0.2 per hectare. Areas must be 15ha or larger to be mapped.
[v] Dependency ratio calculated according to Stats Can age groups of 0-19, 19-64, and 65+.
[vi] GDP per capita (USD, constant prices, constant PPP, base year 2015) in metropolitan Victoria ( Functional Urban Area) was $38,828 in 2016 (*Strategies to Improve Rural Service Delivery*, 2010) (OECD, 2020).

[viii] Note that this excludes the Sechelt Band which experienced a 140% increase over this time. That being said, Sechelt Band does not have the highest per capita emissions in 2017 (see Figure BB – Sechelt Band is the only Indian Government Band in this dataset), the rate is 1.27 TCO2e per capita, but have had a significant increase from 2007s 0.53 TCO2e (CAS, 2019).
[ix] Note: This dataset must be partially interpreted with caution, as oil, propane, and wood values are estimates from 2007. Those estimates have been scaled by referencing weather changes to create values for 2017. Further considerations for this data can be found at https://www2.gov.bc.ca/gov/content/environment/climate-change/data/ceei.
[x] See for example: (Cutter, 2006; Douglas et al., 2012; Nicholas et al., 2015)