Toward A Resilient Food System for Bowen Island
Agrarian Analysis

Collins Farmhouse by A.H.Reed, 1931

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Food, and the by-products of it, can be seen being trucked on and off Bowen Island on a daily basis. We see the Sysco Trucks delivering food to our local restaurants as well as a variety of grocery companies bringing boxes of food to homes across the island. We see our green waste being trucked off and loads of soil for people's gardens being trucked on. All this coming and going highlights the disconnection and vulnerability in our local food system. Our dependence on the ferry and food providers from the mainland is not only appalling in terms of greenhouse gas emissions, but it means that our community is at risk in the event of a natural disaster.

If that weren't enough to raise concerns, the emerging consequences of climate change are directly correlated to rising prices, disruption in supply, and a shrinking diversity of plants and animals for human consumption.

All the evidence points to the critical need for Bowen Island to develop a more dependable, sustainable and affordable local food system.

-- A concerned Bowen Islander

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Acknowledgments

I would like to acknowledge that Nexwlélexm, also known as Xwlíl'xhwm or Bowen Island, is located within the unceded territory of the Squamish Nation. Gratitude goes to all the ancestors and spirits of this land for thousands of years of stewardship in right relationship with the land and sea, and thanks for the privilege of living here.

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To the board members of Bowen Island Conservancy, the Knick Knack Nook, Bowen Island Community Foundation, Bowen in Transition, Bowen Agricultural Alliance, Bowen Island Museum and Archives, and Bowen Island Municipality, especially Councillor Maureen Nicholson, thank you for your trust and support.

Finally, I am grateful to all Bowen Islanders who contributed to this work, and all representatives in various jurisdictions and at all levels of government who provided information and guidance. Thank you all.

Julie P. Sage, M.Sc., A.Ag.

Climate Change Emergency

On March 25, 2019, the Islands Trust Council declared a climate change emergency, joining the City of Vancouver, the Capital Regional District (Southern Vancouver Island, BC), and the cities of Los Angeles and London, among many other regional and local governments worldwide. The declaration constitutes a commitment of the Islands Trust Policy Statement amendment project (Islands Trust Council, 2019) to develop climate change mitigation, resilience, and adaptation policies.

Disclaimer

This analysis contains recommendations that are general and based upon consolidated data from the Province of British Columbia. None of the soil recommendations should be followed before a professional agrologist experienced in soil surveys confirms and reconciles them with on-site inspections and a site-specific assessment.

A more in-depth assessment (including soil pit excavation) is required to determine the agricultural capability of each polygon and to compare it with the mapping presented in this report. The professional hired to carry out this assessment should be a credentialed professional agrologist registered with the British Columbia Institute of Agrologists (BCIA) who has substantial experience in the following areas of practice: 1. Soil and land conservation, reclamation planning and management, 2. Soil and terrain classification mapping and land evaluation, and 3. Arable land evaluation, conservation and management (Agricultural Land Commission Act, 2017). The BCIA would be of assistance in referring the best person(s) to carry out such an assessment.

This report focuses on land-based food systems and terrestrial ecosystems. The marine aspect of Bowen Island's food system and the status of local marine ecosystems were not included in the scope of this study.

This report's overview of production systems and the economic viability of agricultural activities on the island is incomplete. However, the intent is to resume and refine this research pending the receipt of grant funding, which would enable further inquiry and data gathering, and more detailed actionable items.

List of Acronyms

ALC	Agricultural Land Commission
ALR	Agricultural Land Reserve
ALUI	Agricultural Land Use Inventory
BAA	Bowen Agriculture Alliance
BCIA	British Columbia Institute of Agrologists
BEC	Biogeoclimatic Ecosystem Classification
BGC	Biogeoclimatic
BIFS	Bowen Island Food Sovereignty
BIM	Bowen Island Municipality
CC	Capability Class
CLI	Canada Land Inventory
CWH	Coastal Western Hemlock
CWHdm	Coastal Western Hemlock Very Dry Maritime Subzone
CWHxm1	Coastal Western Hemlock Very Dry Maritime Subzone - Eastern Variant
CWHvm2	Coastal Western Hemlock Very Dry Maritime Subzone - Montane Variant
FAO	Food and Agricultural Organization of the United Nations
GHG	Greenhouse Gas
GIS	Geographical Information System
GVRD	Grand Vancouver Regional District
IC	Improved Capability
IPCC	Intergovernmental Panel on Climate Change
IPES	International Panel of Experts on Sustainable Food Systems
OCP	Official Community Plan
PCIC	Pacific Climate Impacts Consortium
RCP	Representative Concentration Pathway
SIFT	Soil Information Finder Tool

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Glossary

Agroecology

Agroecology is a transdisciplinary science combining the ecological, sociocultural, technological, economic and political dimensions of food systems from production to consumption. Agroecology supports a transition to a more sustainable food system. It applies ecological principles to agriculture, ensuring a regenerative use of natural resources and ecosystem services while addressing the need for food sovereignty. It represents an alternative food and farming paradigm standing in contrast to industrial agriculture and is rooted in rebuilding relationships between agriculture and the environment and between food systems and society. While the practices can be wide-ranging, agroecology is characterized by diversifying farms and farming landscapes, replacing chemical inputs with organic materials and processes, optimizing biodiversity, and stimulating interactions between different species. These practices are the main components of holistic strategies to build long-term soil fertility, healthy agro ecosystems, and secure and just livelihoods (IPES-Food n.d.). Farms that follow the principles of agroecology have been shown to remove carbon dioxide from the atmosphere by sequestering carbon in the soil and in long-lived biomass such as trees, thereby potentially reducing GHG emissions. Thus, agroecology can help to mitigate climate change (Agroecology Research Action n.d.).

> The following 10 Elements emanated from the FAO regional seminars on agroecology:
> - Diversity; synergies; efficiency; resilience; recycling; co-creation and sharing of knowledge (describing common characteristics of agroecological systems, foundational practices and innovation approaches)
> - Human and social values; culture and food traditions (context features)
> - Responsible governance, circular and solidarity economy (enabling environment)
>
> The 10 Elements of Agroecology are interlinked and interdependent. (FAO 2018)

Agroforestry

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals in some form of spatial arrangement or temporal sequence. In agroforestry systems, there are both ecological and economic interactions between the different components. Agroforestry can also be defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels. There are three main types of agroforestry systems:

Agrisilvicultural systems are a combination of crops and trees, such as occurs in alley cropping or home gardens.

Silvopastoral systems combine forestry and grazing of domesticated animals on pastures, rangelands or farms.

Agrosylvopastoral systems integrate three elements, namely trees, animals and crops, and are illustrated by home gardens involving animals as well as scattered trees on croplands used for grazing after harvests (FAO 2015).

Biochar

Biochar is a solid product obtained in pyrolysis of biomass. It is a carbon-rich and porous material, which can be used for a wide range of applications, among which soil improvement, remediation and pollution control take the most important roles. As a product, biochar differs from charcoal, which is produced at lower temperatures and considered as solid fuel, containing high quantity of volatile matter. Because of higher process temperatures, the chemical structure of biomass changes and content of hydrogen, nitrogen and oxygen in biochar is significantly decreased in relation to carbon. In contrary to charcoal, biochar is also not phytotoxic.

The biochar history traces back to an ancient methods of Amazon Indians used to change infertile, sandy soils into rich and sustainable fields, also noticed as distinctive dark-colored soils called *terra preta* or *terra preta de indio* (Indian black earth).
Biochar is mainly used in agriculture to enhance soil fertility, improve plant growth, and provide crop nutrition. As a result, it improves the overall farming productivity. It has also gained considerable attention in livestock farming as an animal feed. (Biogreen, n.d.)

Food Sovereignty

A broadly used definition of food sovereignty is the one offered by the global movement of La Via Campesina: "Food Sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems." Food sovereignty goes beyond food security in the sense that it not only addresses food access and distribution but also food justice and pays attention to who is growing the food and how it is being grown (Food Secure Canada 2015).

Living Soil

A soil composed of a diverse and healthy microbiome.

Microbiome

A community of microorganisms (such as bacteria, fungi, arthropods, nematodes, etc.) that inhabit a particular environment and especially the collection of microorganisms living in our soils and in or on the human body (Merriam Webster). A healthy and diverse microbiome can also be referred to as below-ground biodiversity.

Regenerative Agriculture

The term 'regenerative' refers to farm practices that regenerate rather than degenerate natural systems. In North America, the term is more widely used and accepted among producers and consumers than its counterpart agroecology defined above. Regenerative agriculture is a holistic land management practice that holds the potential of reversing climate change by rebuilding soil organic matter and restoring degraded soil biodiversity, resulting in carbon drawdown and improvement of the water cycle (Regeneration International, 2017).

Regenerative Livestock Grazing

Regenerative livestock grazing is one of the practices of regenerative agriculture. It refers to a grazing method for herbivores that improves soil function and increases organic matter in the soil. Soil function is mediated by microbes, which are dependent on plants for support. Plant management is therefore crucial to overall microbial population, and microbial community structure. Ways to achieve this focus on plant recovery time. Grasses benefit from short periods of grazing with very high stock densities (up to 1.5K lb/ha) and not allowing the animals to return until the grass has regrown. In the wild, the actions of ferocious predators are an important factor in achieving moving high-density herds.

This type of adaptive grazing is a form of biomimicry and promotes greater biodiversity, similar to what the bison and other large ruminants used to provide in terms of biological and environmental impact on the prairies. (Savory & Butterfield 2016).

Soil Regeneration

Soil regeneration is the objective of regenerative agriculture and consists in re-establishing a healthy and diverse microbiome, which contributes to the soil's ability to draw down and sequester atmospheric carbon while restoring nutrient balance and flow and increasing water retention.

Background

As the UN Intergovernmental Panel on Climate Change (IPCC) declared in 2014, climate change is already impacting our global food supply. Communities and governments at every scale – from towns to countries and even continents – are looking at how to prepare for uncertainty in their food systems.

"'The main way that most people will experience climate change is through the impact on food: the food they eat, the price they pay for it, and the availability and choice that they have,' said Tim Gore, head of food policy and climate change for Oxfam" (The Guardian, 2014).

Here on Bowen Island in British Columbia, Canada, we are not immune. We need to address the impending challenges and inevitable disruptions to food systems that such global changes bring. Anticipating these threats, Bowen Island Food Sovereignty (BIFS),[1] launched its 'Toward a Resilient Food System for Bowen Island' initiative in March 2019.

BIFS is one of several groups and many individuals that are concerned about food and climate and community resilience on Bowen Island. BIFS' aim has been to inspire the community's confidence by working together to figure out how to create a more resilient food system that serves all residents. The initiative relies upon the efforts of many people and has begun to identify strategies to be adopted and implemented by community groups, businesses, municipal government, and individuals.

The *Agrarian Analysis* constitutes an overview of natural resources, food production, and land use on Bowen Island. It should be used as a supporting document for future initiatives related to a local food system on Bowen Island. Between March and August 2019, BIFS simultaneously conducted an engagement process to assess attitudes and beliefs about the local food system, the results of which are published in their *Communication and Engagement Groundwork Report*.

Together, these two reports constitute the culmination of our groundwork, which will be presented to the community at a Climate Conversation in September 2019. They also form the foundation of the next phase of BIFS' work: to outline specific, achievable goals and timelines that are responsive to the needs and momentum of the community.

[1] C.f. glossary for a definition of food sovereignty

Introduction

An agrarian analysis assesses the status of both past and current agricultural activity in a contained geographic area. The aims of an agrarian analysis are first to characterize both the geographic area and the agricultural activities, and then to understand the reasons behind the evolution of such agricultural activities in the area of study.

Often, an agrarian analysis starts by defining the area of study and which components are important to consider. In this analysis, Bowen Island, BC, is the area of study, and this analysis is an integral part of a local initiative titled 'Toward a Resilient Food System for Bowen Island' led by Bowen Island Food Sovereignty.

This study presents the history of farming on Bowen Island, explaining the evolution of its agrarian landscape and qualifying its contemporary social, political, and biophysical characteristics. It also explores how the community can move toward a more resilient, local food system, acknowledging the climate change emergency declared by the Islands Trust Council in July 2019 and the 2050s projections for the Metro Vancouver area.

The third section of this report goes beyond the standard framework of an agrarian analysis to recommend opportunities for building food system resilience by identifying climate change mitigations and adaptations. Because complex systems change calls for a systematic and comprehensive approach, this report explores the related disciplines upon which a resilient local food system depends, namely, natural resource management and land use planning.

Methodology

This agrarian analysis has two objectives. The first is to provide more information on the social, political and biophysical characteristics of Bowen Island and the evolution of the island's approach towards agriculture. The second is to discuss how to enhance food system resilience on the island, and to present recommendations that stimulate dialogue and action, including the development of appropriate policies and bylaws.

To achieve these goals, the research phase of this work involved reviewing information on food systems and agriculture from reports, frameworks, action plans, community plans, academic studies, non-governmental organizations, and news organizations. Research included direct communication with representatives at various levels of government and ministries as well. This report presents a selection of information gathered during this phase. References are noted at the end of the report.

Simultaneously, members of Bowen Island Food Sovereignty engaged in participatory research that informed and engaged with the community at large and with stakeholders in the local food system on more specific points. The methodology for this participatory research is presented in *Toward a Resilient Food System for Bowen Island: Communication and Engagement Groundwork Report*.

The recommendations in the this report are based on the engagement with stakeholders and a literature review. To facilitate the implementation of recommendations, they have been formulated using the framework of the *Regional Food System Action Plan* developed for Metro Vancouver municipalities in 2016.

1. Context

1.1 Overview of Bowen Island

Bowen Island is situated in the mouth of Howe Sound, which was created approximately 10,000 years ago by receding glaciers that carved a network of fjords. The island is located in the greater Salish Sea and within the territories of the Squamish First Nations who called it 'Nexwlélexm' and sometimes referred to as "fast drumming ground," an allusion to the large population of deer and the noise they made when galloping through the forest. Bowen Island was a neutral meeting ground for indigenous peoples. Just like other areas of the Squamish territory, Bowen Island's lakes and shores offered an excellent source of seafood, and its forest abounded with game, roots, and berries. It was reported in the late 1700s that sea otters did not come to Howe Sound, but seals were an abundant source of meat, particularly on the rocks east of Bowen Island. In 1975, the British Columbia Archaeological Survey uncovered evidence of 10 sites on Bowen Island (Harbour publishing 2016), most likely used by the Squamish First Nations as summer camps. Early settlers also mentioned a village in Snug Cove called 'Qolelaqom' (Bowen Island Museum and Archives, n.d.).

Sko-Mish-Oath: the territory of the Squamish Indian People, 1937. Author: Major Matthews. Copyright: City of Vancouver

When Captain Narvaez sailed into Howe Sound in 1791, Bowen Island was named 'Isla de Apodaca.' It was officially renamed Bowen Island in 1859. The arrival of Captain Vancouver to the region in 1792 signaled the start of a transition from a place of hunting and gathering to a rural residential area where Europeans would live off the land (Bowen Island Museum and Archives, n.d.).

According to historical records, in the early 1900s, the permanent population of Bowen Island was 150. A ferry carrying vehicles was introduced into service in 1958, contributing to a steady population growth and inevitable shifts in lifestyles on the island. "The advent of the car ferry in 1958 brought these little industries to an end – sawmill, travelling store and pie shop folded when people could load up their cars in Vancouver and West Vancouver with everything they needed" (Bowen Island 1872-1972, 148-149).

BC Ferries vessel Cy Peck at Snug Cove, Bowen Island, 1962.

Between 1996 and 2016, the population of Bowen Island grew by almost 41%, from 2599 inhabitants to 3670. The 2016 Census reported that 90.5% were of European descent or origin and merely 7% constituted a visible minority. The 2016 Census also revealed that 56% of islanders in the labour force (15 and over) commuted to work most days of the week. Of this commuting population, 58% travelled daily or almost daily to a different municipality or district of the Metro Vancouver area.

Bowen Island became a municipality in 1999, joining the 20 other municipalities, one Electoral Area, and 11 First Nation communities that form the Metro Vancouver area today – the most densely populated regional district in BC. Bowen is the only island municipality within the jurisdiction of the Islands Trust.

Bowen Island's land area is 50 square kilometers and includes three mountains (Mt. Gardner, Mt. Apodaca, and Mt. Collins), two valleys, eight lakes, and 27 terrestrial ecosystems, 19 of which are classified as endangered or of special concern (see Appendix 3).

1.2 History of farming on Bowen Island

1.2.1 The Early Settlers

From 1874 to 1910, Crown land was made available to settlers who utilized a method called pre-emption. Among those who benefited from pre-emption by cultivating and building on Bowen Island were the following settlers: Joseph Mannion from Ireland; William Davies from Ontario; Wade Beach from Wisconsin; Dewitt Becker and his Swedish wife from Minnesota; Edward and Mary Galbraith who were second generation immigrants from Ireland; widow Caroline Susanna Grafton and her four children from London; Jacob and Sarah Dorman from London; and Matilda and William Flores from the Philippines. Once the land was established as productive, the Crown granted title for $1 to some of these early settlers.

The excerpt below from Bowen Island 1872-1972 by Irene Howard depicts the homesteaders' reality of those days.

> The settlers tried to make a living on the land. Orchards were planted and some fruit was shipped to Vancouver... The soil was thin and stony, except around Lake Killarney and Trout Lake where Herbert Smith, James Collins and Robert Green came at the turn of the century, replacing some of the first settlers, who had left the island by this time. But even here the farms were not much more than stump ranches, yielding hay for a cow or two, some fruits and vegetables and sometimes butter and eggs to sell to stores in Vancouver. Fred Billington Jr. describes the Isaac Miller farm his father shared in those years as "a total loss." Yet, the land did provide, and the sea as well. William Grafton recalled that in two days he and his brother once shot and sold thirteen deer and sixty-seven brace of blue grouse to a Vancouver firm. "…In Grafton Lake… I used to catch trout with the tail of another trout sticking out of his mouth."
>
> An official government report for 1902 is just as dramatic: in Howe Sound during the spawning season "the fish can…be literally raked out of the water…" There used to be sand bars in Snug Cove, and early settlers recall that herring a foot deep would sometimes be left behind on the sand bars when the tide went out. Salmon were abundant too and sold in Vancouver at four to eight cents a pound... The logging camps on the Island provided a living for some of the homesteaders, who might earn $1.75 or $2.00 a day as swamper, barker, saw filer or cook; perhaps $2.50 as skid road boss, teamster or faller. (Bowen Island 1872-1972, 37-39)

By 1887, William Davies had planted a five-acre orchard in Snug Cove. William and John Simpson, loggers from Port Moody, also planted an orchard and garden on the northwestern tip of the island. In 1892 and 1894, Mr. Davies made the observations compiled below.

> My stocks are graded. Sorrel is a noxious weed. The following are the best varieties of roots, grasses, fruits, etc. for this locality: - - Golden Wax Beans, Chili and Burbank Potatoes, Shorthorn Nanthus Carrots, Purple Top Swede, Red Wethersfield Onion, Egyptian Beet, Timothy Grass and Alsike Clover; Wealthy, Red Astrachan, Gloria Mundi, Rhode Island, Greening and Red and Yellow Bellflower Apples; Bartlett and Sheldon Pears; Yellow Egg; Washington Peach, Damson and Yellow Gage Plums; Royal Ann, Early Black and Yellow Spanish Cherries; and Alexander Peaches. The best breeds of stock for here are a cross between the Canadian French and the Clyde for horses; Cotswolds for wool and Berkshire Pigs. Last winter there was not much snow; there was not much rain, and there was the average amount of cold weather. Spring was late and not good for seeding. The summer was wet and dry to the extremes. The autumn was very rainy. Harvest weather was very favourable. There were two frosts in May, which killed the fruit crop. Crops were saved in good order but the yield was not good. … A very minute insect which infects

> fruit trees when in blossom and eats into the stalk, so causing the bloom in nearly formed fruit to fall. (Records from the Agriculture file at the Bowen Island Museum and Archives, n.d.)

By the turn of the century, Davies had established a general store to sell his apples, cherries, pears, plums and peaches, as well as local venison and grouse, soft drinks and cigars.

William Davies' store sat on the shore at Snug Cove, near the current location of the BC Ferries dock. (Copyright: Bowen Island Heritage Preservation Association)

Between 1910 and 1913, the Terminal Steamship Company acquired the land surrounding Killarney Lake as farmland, and it became Terminal Farm, which was developed to supply produce and dairy to the Terminal Hotel, the general store, and the ships. It was described as a large operation with barns, stables, slaughterhouse, greenhouses and silos. The area now known as “The Meadow” was a pasture for purebred Holstein cows and was cleared in 1903 by James Collins and Robert Green with the help of Japanese workmen.

The Union Steamship Company Farm (formerly Terminal Farm) known today as "The Meadow" in Crippen Park (Copyright: Bowen Island Museum and Archives)

> In those years, the farm flourished: cabbages and lettuces and carrots in the garden, and apples and cherries and pears and plums in the orchard; fields of hay and corn, potatoes and strawberries, thoroughbred horses in the stables, cows and sheep in the wooded meadows, goats on the rocky bluffs and ducks in the pond. (Bowen Island 1872-1972, 57)

By 1912, the Cowan family had established a twelve-acre farm at Seymour Bay and hired a farmer to help. The intent of Mr. Cowan was to create and support a self-sufficient community at Cowan's Point.

Three men loading a hay wagon at a Bowen Island farm. (Copyright: Bowen Island Museum and Archives)

His efforts paid off, and the community flourished, providing all the necessary services (post office, telephone service, commissariat) "and scenery besides." (Bowen Island 1872-1972, 62)

> Cowan was a farmer at heart and was a familiar figure riding about the island on his horse, visiting and comparing notes on livestock with John Lister, Jim Collins and other homesteaders. …'I have out there 15 ewes with 18 pretty little lambs which will be ready for the table by the time the tenants get there. The Japs [sic] are skilled in killing and dressing. They are putting in a fairly good garden so that vegetables will be there in plenty.' Every aspect of the farm claimed his attention – Pete and his eleven hens and the black currant bushes no less than his purebred Ayrshires. He has a hundred schemes. He would raise turkeys.… He would raise pheasants and made inquiries for a supply of pheasants and pheasant eggs. He would have a stump-puller, an anti-cow kicker, and a milking machine.…In 1934 at the age of 76, the year before his death, he was still farming. (Bowen Island 1872-1972, 63)

In those days, commuters to and from Vancouver would use his launch every day.

"If the big plans of the real estate people had been fulfilled, the face of Bowen Island would have been drastically changed by the end of the decade. But hard times came, and then the war" (Bowen Island 1872-1972, 133).

By 1922, the Terminal Steamship Company had become the Union Steamship Company, which decided to acquire Davies Orchard to expand and build 20 cottages. Long-term renters were allowed, and they could have gardens and annual garden contests. Islander Marion Moore recalls delivering milk to the cottages and admiring the lovely rock garden in front of Mrs. Hewitt's house, which was on the slopes above what is now known as "The Boardwalk." The Union Steamship Company also purchased the orchard that the Podavin family had planted in Deep Bay in the 1880s.

Aerial view of Deep Bay and Collins Farm (Copyright: Bowen Island Museum and Archives)

1.2.2 Heritage Farms of Bowen Island

In 1993, the Greater Vancouver Regional District bought the large area of land around Snug Cove and Killarney Lake, including the Davies' orchard. This whole area was turned into Crippen Park in 1994. The absence of a budget to maintain the cottages motivated the GVRD's decision to remove them. The Bowen Heritage Society acted to protect some of the orchard cottages, believing that they represented Bowen's history and therefore deserved conservation and restoration.

Today, a few historic Bowen Island farms remain. The descriptions below are based on excerpts from several sources[2].

Endswell Farm (Mt. Gardner Road) – Agricultural Land Reserve

In 1955, the owners of Endswell Farm, Wallace and Ethel Wilson, donated their property to UBC as a writers' retreat. That same year, Buck and Nicolette McIntosh showed interest in purchasing the acreage, so the Wilsons arranged for the McIntoshes to have first right of refusal if UBC were to sell the property. This arrangement saved the acreage from being logged in 1964 when UBC had financial difficulties.
In order to generate revenue and be eligible for farm status with attendant property tax deduction, the McIntoshes applied for a license for 499 laying hens[3]. With 250 hens to start, the flock was doubled in order to make their business model viable and keep up with demand in Vancouver (to compensate for lack of demand on Bowen Island). In 1971, Patrick Buchanan moved into the farmhouse built in 1912 and worked with Nicolette for the following 35 years. Maintaining farm status for a 150-acre property when only one quarter of an acre was in production became hard to justify. The next attempt at viability involved diversifying with grazing livestock, which required clearing and draining the property's swamp and felling trees. A series of unsuccessful trials with cattle breeding and pig raising steered them toward sheep breeding in 2002. They successively tried different breeds, with Border Leicester, Suffolk, and Texel proving to be the best suited for Bowen's land and climate. They also cultivated hay to feed their animals.

[2] Sources: the 2014 Bowen Phone Book, "Farming on Bowen – The Legacy" by Nancy Leonard, Bowen Island 1872-1972 by Irene Howard, from original records from the Agriculture file of the Museum and archive of Bowen Island, Bowen Island Journal, Life in the Salish Sea (Blog Post Oct 4th, 2008)
[3] in order to comply with the quota system

Endswell Farm's float in the Bowfest parade: "All is Well at Endswell," 1979 – Copyright: Bowen Island Museum and Archives.

In 2008, Patrick and his wife Donna moved to their own farm, and the following year Rosie Montgomery and her family took over management of the farm, which Rosie likes to call "a beautiful, blissful bit of England." They operate it as Home Farm Gardens with a farm gate market and weekly presence at the Farmers' Market. Nicolette McIntosh passed away in June 2019.

Collins Farm (Collins Farm Road)

In 1906, James Collins committed to removing stumps, roots and stones on a 167-acre piece of land to fulfill the requirements of the pre-emption contract. James had no machinery and could only resort to manpower and horsepower.

Jim and Roy Collins (1930-1950) (Copyright: Bowen Island Museum and Archives)

With his farming experience from the Isle of Arran in Scotland, Jim bought cows (purebred Guernsey) and chickens (Leghorn and Rhode Island Red) once he had returned from serving in the First World War. Cow manure progressively enriched the soil, and dairy products were delivered to on-island customers by some of his seven children. Jim delivered milk and eggs with a horse cart to larger customers in Snug Cove. Milk was the main dairy product available in the summer and fall, but with a winter population of only 150 people, cream was turned into butter to accommodate a smaller customer base.

The family had a half-acre vegetable garden and cultivated various root vegetables and very popular sweet corn in August. Vegetables and apples were stored in a root cellar for winter consumption. Later on, Jim planted an orchard (apples, pears, cherries, peaches), which remains today as a heritage orchard. Hay, oats, and Mangel beets were cultivated as animal feed. Farm visitors could enjoy cream scones, bread, butter and buttermilk. Before the Livestock Act implemented the Pound District Regulations, Collins cows' grazing area spanned from Killarney Lake to the Union Steam Ship Company property in the Cove. Each cow had a bell so that Jim's daughters Jean and Marion could locate them and bring them home at night.

The 1940s and 50s saw a decline of farm activities. In the 1960s, the closure of the Union Steam Ship Company contributed further to the scaling down of the Collins' farm activities and marked Jim and Irene's retirement. By the time Jim passed away in 1974, his 167-acre property had been subdivided, and seven large lots had been assigned to each of his children. In the 1980s, further subdivision led to the creation of the Collins Farm Strata. Two of their daughters, Jean Jamieson and Marion Moore (both in their late nineties when this report was published in August 2019), preserved ownership of their garden through a Community Supported Agriculture program where volunteers maintain the garden and share the harvest with Jean and Marion. The original farmhouse still stands today and is rented out to tenants.

Buchanans' Farm (Adams Road) – Agricultural Land Reserve
The Buchanans' farm was previously owned by the Listers and called Sunnyside Farm or the Lister Farm. John and Sarah Lister purchased the 63-acre farm in 1926 and raised a herd of Guernsey cows, which typically grazed on cleared pasture land on the southwest and east sides of Grafton Lake.

Cows in a field on a Bowen Island farm. (Copyright: Bowen Island Museum and Archives)

The Listers supplied milk and eggs to their neighbours and main customer, the Union Steam Ship Company. Hay was also cultivated to feed horses and cows. The cowherd was sold when John's health declined, and a flock of 499 chickens was acquired for egg production. The Listers also cultivated produce, tree fruits and berries, and Sarah is remembered as an excellent shot, dispatching the hawks that pursued her chickens.

In 1958, the Buchanans purchased the Lister Farm and there raised their six children: Diane, Mike, Patrick, Cathy, Keith and Chris. The farm was later split among the children, who have preserved the farming legacy on their respective properties: Diane's acreage is called "Holly Gully," Cathy's is "The Garden to Cottage," Chris' is "Sunnystein," and Patrick's is "Highlands Farm." Patrick and his wife Donna live in the original Lister farmhouse.

Ravenhill Farm (Carter Road) - Agricultural Land Reserve
Before Carol Robb and Peter Frinton bought the farm in 1972, it was owned by Albert (a.k.a. "the Egg Man") and Kate Carter. Albert and Kate raised between 1500 and 2000 leghorn chickens and delivered eggs to the Union Steam Ship Company. They also planted an orchard in the 1920s. When Carol and Peter took ownership, they dedicated a lot of time to the garden and chickens. They started all their perennials and vegetable plants from seed. In the 1970s, they brought in a purebred Karakul ram, a Romney ewe, and Nubian goats and developed their animal husbandry skills. Carol cleaned, carded, spun and dyed the wool and made clothes. She also made yogurt and cheese from goat's milk. They pressed apple juice and made soap from on-island pig fat. Over the years, storms took down most of the fruit trees – about ten are still standing. Carol reports that they have grown too large to prune and act mostly as wildlife habitat.

Arbutus Bay Farm (Arbutus Bay Lane)
Kirsty Johnstone and her brother Alastair have maintained the agricultural activity of the Cowan farm on the Southern tip of the island that their grandfather acquired before the First World War. The original farm and orchard was near holes 1 and 9 of the current golf course, and down to Seymour Bay. It had many fruit trees, old English variety berry plants, cow and horse barns, a chicken coop, an orchard and a vegetable garden. The Arbutus Bay Farm appeared later on, in a different location than their grandparents' farm. Kirsty and Alastair still raise sheep, chickens and lambs, and also grow garlic.

Meadowbrook Corner Farm (Grafton Road) - Agricultural Land Reserve
John and Elaine McLeod moved from Argyle, Manitoba, where they farmed for 17 years, to Bowen Island in 1980. Two years later, they established Meadowbrook corner nursery, a full-service, family-operated retail garden centre. In 1995, they started growing and selling echinacea and established Bowen Island Botanicals Ltd., a vertically integrated farm growing 17 acres of certified organic herbs, processing and marketing echinacea and other medicinal herbal tinctures. Alastair Johnstone, who grew up on Arbutus Bay Farm, now owns Meadowbrook Corner. He is planning to open a cidery in the near future and sell some of the other products growing on site.

As for orchards, the remnants of five historic ones can be found at Davies' Orchard, Collins Farm, the Dorman family property on Hummingbird Lane, at King Edward Bay, and on private lots scattered around Deep Bay that were part of the Podavin family's property.[4]

[4] There may be other historic farm operations on Bowen Island, but if so, they did not come to light during this research phase within the time allotted

1.3 Evolution of Farmland in Metro Vancouver

Metro Vancouver refers to the City of Vancouver and the metropolitan area that surrounds it. The region has a total population of 2,463,431, spans 2,700 square kilometers, and is composed of 21 municipalities, one Electoral Area, and 11 First Nation communities. (Statistics Canada, 2016)

During the last BC Land Summit (May 2019), research associates Polasub and Robert of the Institute for Sustainable Food Systems at Kwantlen Polytechnic University (KPU) presented on the evolution of farmland in Metro Vancouver with a talk titled “Beyond protection: trends in farmland price, valuation and policy for productive agricultural land." The findings of this talk relevant to this section are presented below.

As demonstrated by Polasub and Robert, the main challenge of Metro Vancouver’s farmland is its desirability for development and other activities generating higher financial gains than food production. The social and ecological benefits of cultivated farmland are not easily measurable and therefore do not get the credit they deserve.

In the past, pressures from developers have led to agricultural land being converted to non-agricultural uses (industrial, commercial, residential) and therefore being lost for agricultural purposes. This trend will continue unless the right policies to not only protect but also to revitalize farming are implemented and enforced. Additionally, topsoil is a non-renewable resource being threatened by any non-agricultural use of farmland.

The selling price of ALR land in Metro Vancouver has been increasing steadily since 2013 and is now extremely high. The high price per acre of non-agricultural land has an immediate repercussion on the price of agricultural land, even when the intended use is not for development.

The figure below shows the evolution of farmland prices in BC over the past ten years.

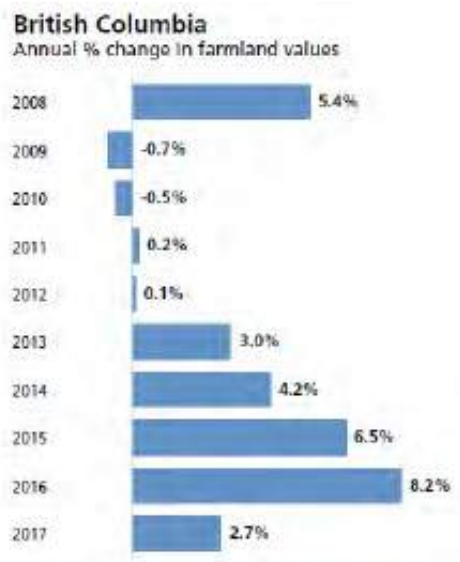

Figure 1: Annual farmland prices increase in BC
Source: Farm Credit Canada, 2018

Farmland prices in the Southwest BC region and the Okanagan were reported to be the highest in the country, with an estimated dollar value per acre of $89,314 for Southwest BC and $91,978 for

the Okanagan. In the agricultural municipalities of Metro Vancouver[5] specifically, the discrepancy between the assessment price and the sale price of ALR has considerably increased in the past five years, as shown in the figure below.

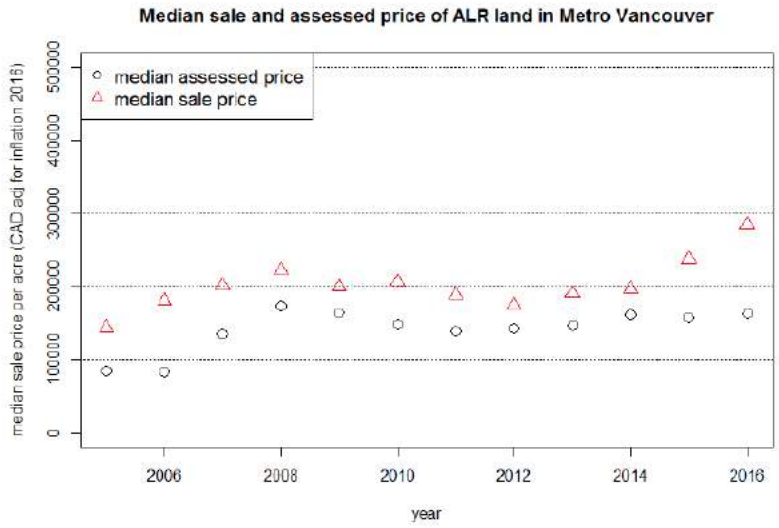

Figure 2: Median sale and assessed price of ALR land in Metro Vancouver, excerpted from the presentation "Beyond protection: trends in farmland price, valuation and policy for productive agricultural land" presented at the 2019 BC Land Summit by the associate researchers of the Institute for Sustainable Food Systems at Kwantlen Polytechnic University. (Polasub & Robert 2019)

According to Polasub and Robert, the sale prices of 26% of ALR parcels were five times higher than their assessed value. In 2018, eight hectares of ALR were sold for $9.2 million, more than 100 times the assessed value. The parcels most subject to sale at the highest prices are the smallest ones (under 2 acres) that are close to a major highway, without farm class tax status and farm class status history. The highest selling price of ALR property is reported to be in Richmond.

The main drivers of high sale prices are competing economic interests (residential, commercial, and industrial), land speculation, and fiscal policies (reduced property tax rate with farm class tax status, 50% school exemption, and tax exemption for building construction). About 74% of ALR parcels in Metro Vancouver are less than 10 acres, an attractive size for developers.

[5] Delta, Maple Ridge, Pitt Meadows, Richmond, Surrey and Township of Langley.

Speculative marketing of farmland, excerpted from the presentation, "Beyond protection: trends in farmland price, valuation and policy for productive agricultural land" presented at the 2019 BC Land Summit by the associate researchers of the Institute for Sustainable Food Systems at Kwantlen Polytechnic University. (Polasub and Robert 2019) (Photo credit: Richard Croft)

Interest from developers and their ability to bid the price of ALR parcels higher than farmers can afford makes the intended farm use of farmland less likely. As a result, acquiring ALR land in Metro Vancouver has become much less accessible for farmers. In an area where the average annual net farm receipts are $56,000 (Statistics Canada, Census of Agriculture, 2016) and where labour and other operating expenses are high, prohibitive mortgage payments can easily lead to negative net incomes, a serious barrier to entry for aspiring farmers or farmers wanting to expand their surface of arable land.

According to the BC Ministry of Agriculture, 67% of the ALR in Metro Vancouver is registered under the non-farm use category. Of this non-farm use, 49% is residential. Although the ALR protects farmland from development, the high price of farmland parcels in Metro Vancouver results in underutilization and non-farm uses, and effectively removes them from the active agricultural base.

Polasub and Robert support policies outlined by Tatebe et al. aimed at increasing the use of farmland with four distinct outcomes:

- Increase farmers' ability to access farmland
- Reduce non-farm use of farmland
- Raise farm incomes and improve farm viability
- Increase availability and transparency of farmland ownership data

The table below summarizes the fiscal and regulatory policies recommended.

	Increase farms' ability to access farmland	**Reduce non-farm use of farmland**	**Raise farm incomes and improve farm viability**	**Increase availability and transparency of farmland ownership data**
Fiscal policy		Farm property tax relief (reform)		
Fiscal policy		Conversion tax (for non-agricultural use)		
Regulatory policies	Farmland ownership restriction	Lease regulation (tenant farmer security)	Agricultural enterprise zones	Tracking and reporting: ownership and beneficial use
Source: Tatebe et al., 2018. Protection is not enough: policy precedents to increase the agricultural use of British Columbia's farmland, Institute for Sustainable Food Systems, KPU				

Table 1: Policy recommendation to increase the use of farmland

Further details on each policy can be found in the White Paper, "Protection is not enough, policy precedents to increase the agricultural use of British Columbia's farmland" (Tatebe et al 2018).

1.4 Overview of the Southwest BC Bioregion

The Southwest BC region includes Metro Vancouver, the Fraser Valley, Squamish-Lillooet, Sunshine Coast, Powell River Regional Districts, and traditional territories of the Coast Salish Peoples. The Institute of Sustainable Food Systems of Kwantlen Polytechnic University (KPU)

defines it as a bioregion with similar land use patterns, natural resources management and ecosystems. As such, the bioregion is an appropriate scale for assessing and planning food systems.

In its report, *The Future of our Food System*, KPU's Institute reports that the Southwest BC bioregion has 165,000 hectares of arable land on both Agricultural Land Reserve and Crown land. Sixty-one percent of the surface of arable land was estimated to be cultivated in 2011 for both domestic and export markets. The Southwest BC bioregion has a favourable climate for producing a variety of crops (field and greenhouse), including potatoes, berries and animal products (poultry, eggs and dairy).

In their report, the Institute took a close look at food self-reliance in the bioregion. They define food self-reliance as the proportion of the diet[6] that can be satisfied by locally produced foods. Based on this definition, the Southwest BC bioregion is only 40% food self-reliant. If imported animal feed were not available, total dietary self-reliance would be only 12%. Analyzed by category, self-reliance in vegetable production is significant (35%) but low for fruit production (3%) due to diets that include tropical and subtropical fruits. Self-reliance in grains, legumes, fats and oils is very low (1%) and self-reliance in animal products is high (87% dairy, 82% eggs, 100% poultry) except for red meat (10%). It was explained in the report that the high dependence on imported livestock feed renders the self-reliance rating for animal products less accurate (Institute for Sustainable Food Systems, Kwantlen Polytechnic University, 2016).

2050 Projections

The population of Southwest BC is projected to reach 4.3 million by the 2050s, an increase of about 60% above 2011 numbers. Given that an estimated 0.5 hectare of arable land is needed to feed one person following the average Canadian diet, such growth is a problem. Current estimates show that if population increases as predicted and the available surface of arable land remains constant, there will be less arable land available per capita, or only 0.04 hectare per capita.

According to Professor Rees from the Department of Environment and Resource Planning at UBC, "by 2050, more than half of the world's population is expected to rely on food from other countries (...) assuming that importing food from other countries is still a reliable and viable option" (Rees 2018). Reliance on food imports is a primary indicator of the lack of food self-reliance.

Under the best-case scenarios of optimized production on arable land and a transition to a more plant-based diet, Southwest BC would only reach 57% food self-reliance by 2050 because of the increase in population. The region would thus remain dependent on food imports and therefore vulnerable to disruptions in the supply chain. Under the "business as usual" scenario, food self-reliance would drop to 28% according to researchers at KPU.

To understand how serious the situation is, it is important to grasp that these figures do not factor in climate disruptions and their consequences to agricultural production and food self-reliance. The evidence of climate change and population pressures make clear the need to take steps to increase food self-reliance. Specific measures in the bioregion should include optimization of arable land (i.e. increased production on the same surface), support to small-scale operations for a

[6] Defined as the satisfying average Canadian food preferences and the previous Canada's Food Guide recommendations.

diversified agrarian landscape and economically viable agri-food sector, and the adoption of different agricultural practices that are less dependent on fossil fuels and generate fewer greenhouse gas emissions.

One wonders if KPU's assessment and indicators of food self-reliance (based on local food produced then divided on a per person basis) are useful for emergency planning. When planning for post-disturbance recovery, looking to maintain or restore food security (and food sovereignty) may be more appropriate when assessing food system resilience and its indicators. While the research associates at KPU recognize that there may be limitations with self-reliance indicators, they are also right to point out that food security is not comprehensively measurable.

Part 3 of this report offers a more in-depth discussion of food system resilience and what its indicators may be on Bowen Island.

1.5 Regulatory Frameworks

Bowen Island is unique in that it is both a municipality in Metro Vancouver and a member of the Islands Trust. While the Municipality of Bowen Island supports the Metro Vancouver Growth Strategy, the island remains excluded from the area designated as "urban containment" (Bowen Island Official Community Plan, 2010).

Agriculture on Bowen Island is regulated at several levels of government: federal, provincial, and municipal. The federal government and the province of British Columbia share a mandate to promote agriculture and health. The legislative body in charge of a ruling depends on the circumstances. For example, the municipal government will address a zoning regulation while a farmland preservation act is overseen at the provincial level and takes precedence over local bylaws and policies.

Finding the appropriate agriculture-specific legislation that governs Bowen Island land use and production involves understanding the mandates of different jurisdictions. Here's where to look:
Municipal: Bowen Island Municipality's Official Community Plan (OCP) under Agricultural Land Use Management.
Regional: Islands Trust Policy Statement under "Stewardship of Resources" and Metro Vancouver's Regional Growth Plan 2040, the 2016-2020 Metro Vancouver Food Action Plan, and waste management bylaws.
Provincial: Agriculture Land Commission and the Ministry of Agriculture primarily but not exclusively.

Since agriculture is intricately linked to natural resources, land use, and waste management, the Ministry of Environment and Climate Change Strategy, the Ministry of Forests, Land, Natural Resource Operations and Rural Development, and Fisheries and Ocean Canada are among the authorities responsible for oversight of agricultural activities.

A recent example of provincial agricultural regulation is the BC Code of Practice for Agricultural Environmental Management issued on February 28, 2019 to replace the Agricultural Waste Control Regulation. It regulates a wide range of agricultural practices, from diversion of compost leachate to liquid manure storage and animal burial.

Other Federal and Provincial provisions that may restrict Bowen Island Municipality's powers related to agriculture and land use management include but are not limited to:
- Agricultural Land Commission Act
- Environmental Management Act
- Integrated Pest Management Act
- Land Title Act and Regulations – Subdivision
- Public Health Act
- Species at Risk Act (Federal)
- Strata Property Act and regulations – Buildings and Bare Land
- Watershed, Aquifer and Streams Protection Act
- Wildlife Act (Bowen Island OCP, 2010)

Vancouver Coastal Health, the Ministry of Health, the Canadian Food Inspection Agency, and Health Canada are other agencies with regulations that ensure food safety and protect human health.

As of July 2019, Bowen Island was granted Rural Status by the Ministry of Forests, Land, Natural Resource Operations and Rural Development, which recognizes that Bowen Island has characteristics qualifying it as "remote." Such a designation carries with it additional legislative remedies and funding.

Appendices 1-A and 1-B present excerpts of the Bowen Island Official Community Plan. Both excerpts support the Regional Food Action Plan 2016 (Metro Vancouver), a framework for developing a sustainable, local food system.

Because the Agricultural Land Commission Act and the Farm Practices Protection Act are two major policies impacting agricultural operations in British Columbia, they are described in some detail below.

1.5.1 Agricultural Land Commission Act

The Agricultural Land Commission (ALC) is a provincial tribunal created in 1973 with the mandate to protect the province's existing farmland and to encourage keeping it in production. More specifically, the purposes of the Agricultural Land Commission, as set out in Section 6 of the Agricultural Land Commission Act, are

a) To preserve agricultural land;
b) To encourage farming in collaboration with other communities of interest; and
c) To encourage local governments, First Nations, the government, and its agents to enable and accommodate farm use of agricultural land and uses compatible with agriculture in their plans, bylaws, and policies.

When the ALC was formed, nearly 6,000 hectares of prime agricultural land was being lost annually to development and other non-farm uses. The Agricultural Land Reserve (ALR) was created to stem these losses and is still recognized today as a provincially governed land use zone that is protected from urbanization. The ALR defines where agriculture should remain the priority use and where residential, industrial, and commercial uses should be regulated. The ALR includes Crown land and privately held land throughout the province.

The ALC Act and ALR Regulations are legislative frameworks that govern the administration and operation of BC's agricultural land preservation program. According to the Ministry of Agriculture, approximately 5% of BC's total land base is within the ALR and only 1% is prime agricultural land (class 1-3), suitable for the broadest range of crops.

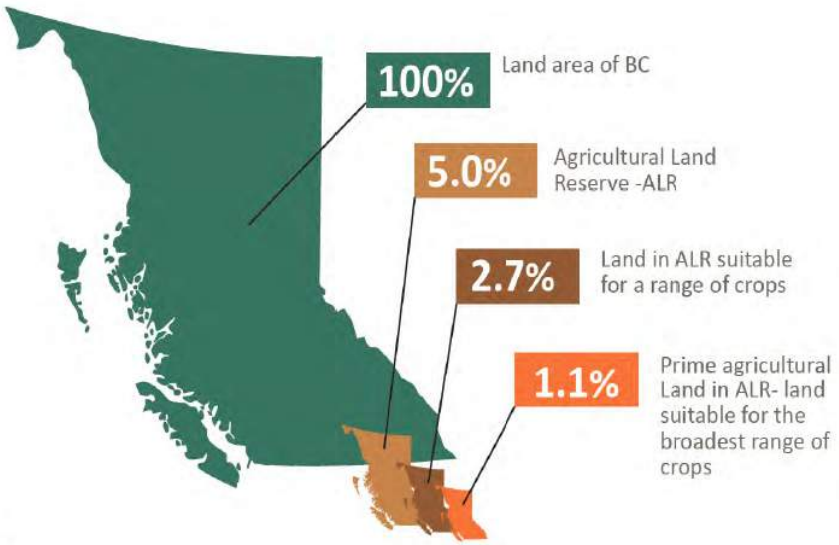

Figure 3: Agricultural Land Reserve in British Columbia (Copyright: Agricultural Land Commission)

While the implementation of the ALR was successful in preventing urban sprawl on agricultural land, it did not encourage farming and did not prevent unauthorized land use and non-permitted additional dwellings.

One of the reasons that the ALR is underutilized in high-density, peri-urban regions such as Metro Vancouver is that market value of land in the ALR is not based on its agricultural use but on its potential value for residential, industrial, or commercial uses. As a result, farmland has become unaffordable, deterring entrant farmers and adversely impacting the profitability and viability of commercial farm operations. In 2011, only 49% of Metro Vancouver's ALR was actively farmed (Mullinix et al., 2018).

2018 ALR Land Pressures (Copyright: Agricultural Land Commission)

In an effort to revitalize the ALR, legislative changes were made to the ALC Amendment Act. In February 2019, the ALR Use Regulation was approved, and Bill 52 came into effect.
Significant changes to the ALR include:
- Elimination of two-zone system by reinstating one zone for all ALR land in B.C. so that all land in the ALR benefits from the same strong protections.
- Prohibition of "mega-homes" (max. allowable floor area 500 square meters) and non-adhering residential use.
- Authorization of additional residences for farm use only.
- Prohibited filling of land[7].
- Required Notice of Intent to fill or remove soil.
- Required application to construct right-of-way.
- Recognition of lawful production of cannabis as farm-use if a) produced out in the field, b) inside a structure with a base entirely of soil, or c) inside a structure constructed before July 13, 2018.

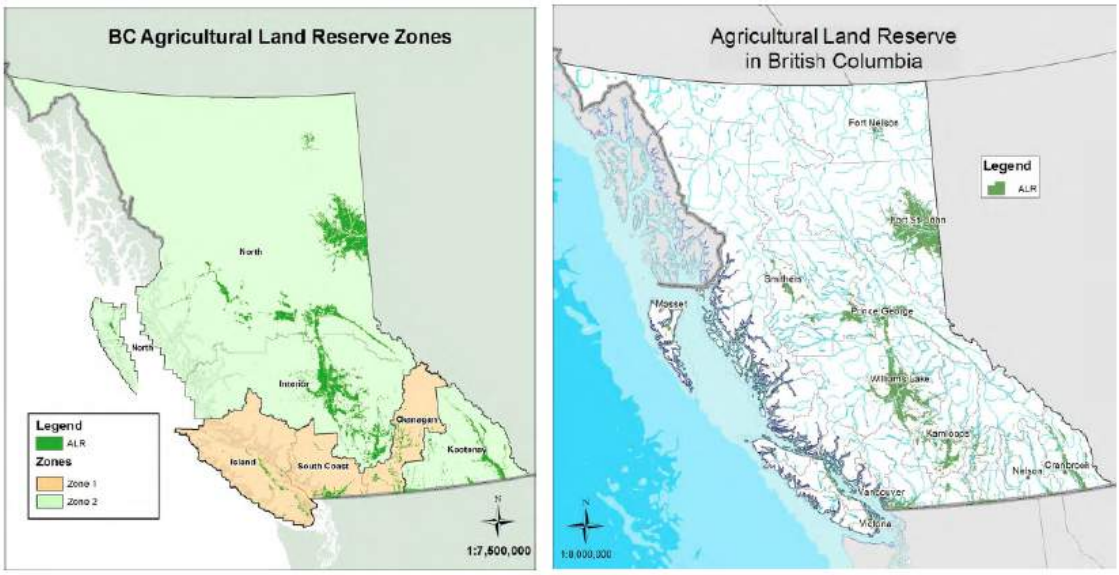

Figure 4: Bill 52: Return to a single ALR
Source: ALC https://www.alc.gov.bc.ca/alc/content/alc-act-alr-regulation/the-alc-act-and-alr-regulations

The Agricultural Land Commission Amendment Act, Bill 15, is expected to take effect by the end of 2019. It would legislate:
- Agriculture-focused decision-making criteria for applications to remove or add ALR land that will prioritize a) size, integrity, and continuity of the ALR, and b) the use of the ALR for farm use.
- Landowners would no longer be authorized to submit exclusion applications.
- Stricter conditions would go into effect for reconsideration of applications.

[7] Subject to exemptions for small volumes, cranberry berms, farm structure or principal residence, flood plain dikes, dikes, irrigation, livestock watering, maintenance of existing farm road, soil amendment, conduction of soil research or testing

1.5.2 Farming Practices Protection Act

The Farming Practices Protection Act is also referred to as the "Right to Farm" Act. For any farm operation conducted on the ALR, or in a licensed aquaculture area, the Farming Practices Protection Act applies and protects farmers from liabilities related to nuisances such as odour, noise, dust, or other disturbances. It also protects farmers from a local government's nuisance bylaws and from lawsuits brought by nearby residents. The right to farm requires that a farm operation use 'normal farm practices,' and that the operation doesn't contravene other legislation (Environmental Management Act, Integrated Pest Management Act, and Public Health Act) or any land use regulation.

'Normal farm practices' is defined within the act as activities that comply with the following standards:
- Proper and accepted customs and standards as established and followed by similar farm businesses under similar circumstances.
- Any standards prescribed by the Lieutenant Governor in Council.

However, it is important to note that any agricultural activity outside the ALR or licensed aquaculture area is not protected under the Farming Practices Protection Act.

2. Landscape Reading and Agricultural Profile

2.1 Agricultural Land Reserve on Bowen Island

When the ALR was created in 1973, the Department of Agriculture was tasked to map out all agricultural land in the province. A Vancouver Sun article from August 1973 captures the dispute between Greater Vancouver Regional District (GVRD) chairman and some Bowen Island landowners who were not in favour of establishing an ALR on Bowen Island, arguing that there was no suitable arable land on the island.

18*** The VANCOUVER SUN: Sat., Aug. 25, 1973

Bowen good for farming? GVRD wants gov't to rule

By PAUL MUSGROVE
Sun Staff Reporter

BOWEN ISLAND — The Greater Vancouver Regional District will ask the department of agriculture to establish whether there is agricultural land here.

GVRD chairman Allan Kelly told The Vancouver Sun he doubts any of the island should be designated agricultural reserve land.

He made the remark Friday following a public information meeting attended by about 30 persons.

Before the meeting Kelly and members of the staff and planning committee of the regional district made a tour of areas of the island.

"Based on what we saw today (on the tour) we are going to the people who made the original survey and ask 'did you properly survey the land?'" Kelly said.

"Did they in fact just look at the land, see a few cows and say this is good farmland?"

He said that if the agriculture department could not establish that there is usable farmland on the island, the GVRD would recommend that no reserve be established.

"We can make that recommendation, but the government doesn't necessarily have to follow through. It can still designate reserve land," Kelly said.

Several residents who would be affected by the proposed reservation of part of Bowen Island for agriculture emphatically stated they did not consider their land useful for that purpose.

Mrs. Dorothy Proudlock said she and her husband have tried unsuccessfully to farm their land.

She described her soil and that of her neighbors as rocky and sandy, unfit for crops.

"I've had the soil analysed and it proved to be very poor quality."

Mrs. Betty Knight said she had raised a better garden in the middle of Vancouver than she could raise on her island property.

"We have a few horses for breeding and for riding, and we have to bring in all our feed," she said.

Mrs. Munro Davies said she and her husband have some 40 acres of land that cannot be successfully farmed.

"You'd starve to death," she said.

Excerpt from the Vancouver Sun, August 1973

Surveyors from the Department of Agriculture thought otherwise and did include 182 hectares on Bowen Island in the ALR as shown by Schedule C of the OCP bylaw 282 presented in Appendix 2, where the ALR is designated in purple.

2.2 Agricultural Land Use Inventory

An Agricultural Land Use Inventory (ALUI) is used to assess agricultural activities in a given area. It helps inform decision-making about how to best manage agricultural land to support and strengthen farming in the future. The data from this inventory is typically used to determine the percentage of land under production within the ALR or the percentage of land available for

production. Comparing ALUIs from different years also provides details as to how the land use of an agricultural area has evolved. The data for an ALUI is collected by parcel in two ways: the land cover (biophysical material at the surface of the earth) and land use (how people use the land). According to the ALUI methodology, a parcel could have numerous land covers and be assigned up to two land uses.

2011 ALUI report

In the summer of 2011, the BC Ministry of Agriculture conducted an ALUI of all nine municipalities of North Metro Vancouver (Anmore, Belcarra, Bowen Island, Burnaby, Coquitlam, New Westminster, North Vancouver (District), Port Coquitlam and Vancouver). The map below shows the surveyed areas of this Land Use Inventory.

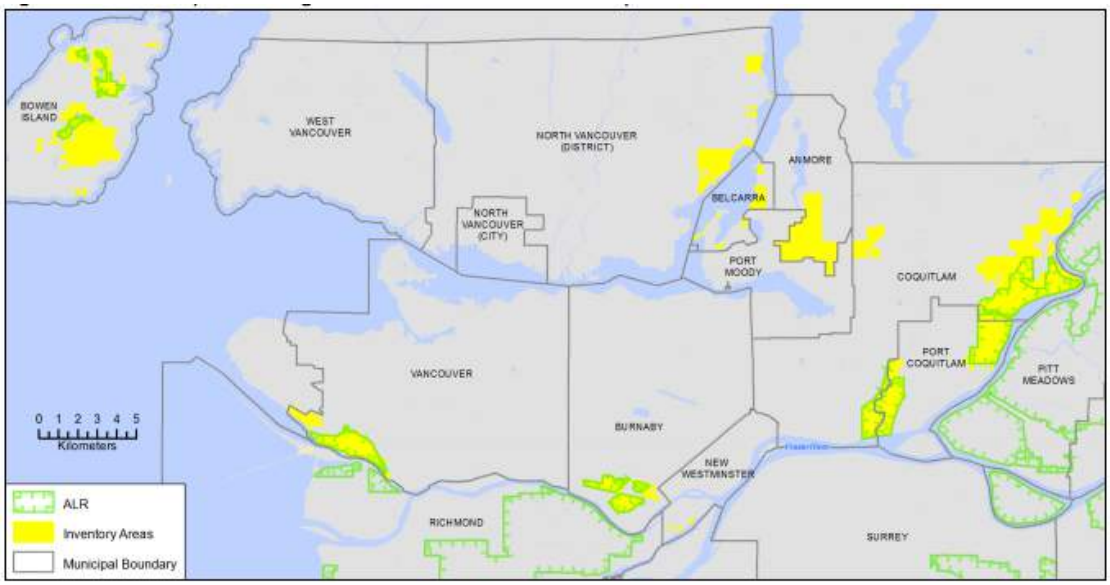

Figure 5: Inventory area and Agricultural Land Reserve location map. North Metro Vancouver Land Use Inventory report (2011)

Bowen Island's inventory area included 918 hectares on 49 parcels, 182 hectares of which were in the ALR. In the 2011 ALUI inventory of land cover and land use on Bowen Island, the Ministry determined that:

- Of the 182 hectares, only 17 hectares (9%) was actively farmed (field crops, farm infrastructure, greenhouses).
- 95 hectares (52%) were unavailable for farming due to land use (e.g. parks and protected areas, etc.) or land cover (e.g. wetlands, non-farm residential use, etc.)
- 45 hectares (25%) had limited potential for agriculture due to physical limitations (mostly topography and bedrock)
- 4 hectares (2%) were not surveyed and not considered to be available for farming.
- 20 hectares (11%) of the ALR is available and has the potential to be farmed. (North Metro Vancouver, 2011).

Of the 918 hectares of surveyed area, 34 hectares were cultivated land (29 Ha of pastures, 2 Ha of vegetables, less than 1 Ha of tree fruits, less than 1 Ha of grapes, and less than 1 Ha of Christmas trees. Additionally, 19 livestock activities were recorded (7 sheep/lamb/goat activities, 4 equine activities, 3 poultry activities, 2 unknown activities, and 1 beef, 1 swine, and 1 rabbit activity). All livestock activities are "non-intensive" and "small" or "very small" scale.

The table below, excerpted from the report, summarizes the status of the surveyed area on Bowen Island in 2011.

Bowen Island

Table 22. Status of the land base with respect to farming on Bowen Island

Land status		ALR		Outside ALR (ha)	Total area (ha)	% inventory area
		In ALR (ha)	% ALR Area			
Actively farmed	Cultivated field crops	16	9 %	11	27	3 %
	Farm infrastructure	1	<1 %	< 1	2	<1 %
	Greenhouses	< 1	<1 %	< 1	< 1	<1 %
ACTIVELY FARMED		17	9 %	12	29	3 %
Anthropogenic areas supporting farming	Transportation	< 1	<1 %	< 1	< 1	<1 %
	Residential footprint	< 1	<1 %	< 1	< 1	<1 %
SUPPORTING FARMING		< 1	<1 %	< 1	< 1	<1 %
Unavailable for farming due to existing land use	Protected area / park / reserve	89	49 %	511	600	65 %
	Recreation & leisure	1	<1 %	< 1	2	<1 %
	Residential	< 1	<1 %	< 1	< 1	<1 %
Unavailable for farming due to existing land cover	Wetlands	3	1 %	2	5	<1 %
	Residential footprint	1	<1 %	< 1	2	<1 %
	Waterbodies	< 1	<1 %	2	3	<1 %
	Built up - Other	< 1	<1 %	< 1	< 1	<1 %
	Transportation	< 1	<1 %	< 1	< 1	<1 %
UNAVAILABLE FOR FARMING		95	52 %	517	612	67 %
Site limitations	Topography &/or soils	45	25 %	200	245	27 %
	Drainage	-	-	< 1	< 1	<1 %
LIMITED POTENTIAL FOR FARMING		45	25 %	200	246	27 %
Available & with potential for farming	Natural & Semi-natural - Vegetation	14	7 %	6	19	2 %
	Unmaintained field crops	3	2 %	3	6	<1 %
	Anthropogenic - Managed vegetation	2	1 %	< 1	3	<1 %
	Anthropogenic - Non Built or Bare	2	<1 %	< 1	2	<1 %
	Natural pasture	-	-	1	1	<1 %
AVAILABLE & WITH POTENTIAL FOR FARMING		20	11 %	11	31	3 %
TOTAL		178	98 %	740	918	100 %
Not surveyed	Rights-of-way	4	2 %			
SUBTOTAL		4	2 %			
TOTAL		182	100 %			

Table 2: Land Status of the surveyed area on Bowen Island. Land Use Inventory report, North Metro Vancouver, 2011.

2016 ALUI update

In 2016, the Ministry of Agriculture updated the ALUI for Bowen Island. The land that was being farmed decreased over that five-year period. Of the 917 hectares surveyed, 172 hectares were in the ALR. It is possible that 10 hectares were not surveyed, explaining the discrepancy between 2011 totals (182) and 2016 totals (172 hectares). The 2016 update reveals that:

- Of the 172 hectares, 15 hectares (8%) were actively farmed, as opposed to 20 hectares in 2011.
- Of these 15 cultivated hectares, 83% were cultivated with field crops and 16% were farm infrastructures.
- 157 hectares (92%) was not used for farming, as opposed to 150 hectares in 2011.
- 10 hectares were anthropologically modified, as opposed to 8 hectares in 2011.
- If the protected areas still represent 95 hectares and the areas determined to have limited potential for agriculture are still 45 hectares, then 22 hectares were available for farming in 2016, a 2 hectare increase from 2011.

Of the entire 917 hectares surveyed (inside and outside of the ALR), 27 hectares are now actively farmed, as opposed to 34 hectares in 2011, representing a 26% decrease in farmed area. Of the 27

actively farmed hectares, 22 hectares were cultivated: 18.7 ha. of pastures, 2 ha of vegetables, 1.2 ha of nursery, and 3 ha of berries. Livestock activity was not reported but can be observed.

The next Agricultural Land Use Inventory update is anticipated in 2021.

2.3 Biophysical Characteristics of Bowen Island

2.3.1 Climate

Bowen Island, like the rest of Howe Sound, is situated in the southern part of the Georgia Depression Ecoprovince. The southern part of this region has the greatest annual amount of sunshine in British Columbia, and its temperatures are moderated by the ocean around Howe Sound and the Strait of Georgia. Known for its relatively dry summers and moist, mild winters, the southern part of the Georgia Depression Ecoprovince is noted as having moisture deficits during the summer (Madrone Environmental Consulting Services Ltd., 2009).

UBC's Centre for Forest Conservation Genetics (Department of Forest and Conservation Sciences) provides an interactive platform for accessing visualization and climate data, giving a more detailed picture of Bowen Island's changing climate. Below is a selection of climate variables for Bowen Island (Cates Hill) extracted from the ClimateBC_Map and accessible online.

While the table provides informative data, the interactive ClimateBC_Map tool was designed to calculate future climate variables for a specific location in BC by using historical weather station data and global circulation models (GCM) for regional prediction (Centre for Forest Conservation Genetics n.d.). The variables below should therefore be compared to various GCM projections to analyze how each of them will evolve and what impact it may have on the community and on the agricultural activity of various locations on the island.

Bowen Island (Cates Hill)			
Latitude	49.383	Longitude	(123.345)
Elevation (m)	44		
Annual variables - 2018			
MAT			11.3
MAP			1573
MSP			280
DD>5			2484
CMD			307
RH			79
Seasonal variables - 2018			
Tmax_summer			22.6
DD>5_spring			543
PPT_summer			88
CMD_winter			0
CMD_spring			87
CMD_summer			220
CMD_autumn			0
MAT: Mean annual temperature (°C)			
MAP: Mean annual precipitation (mm)			
MSP: May to September precipitation (mm)			
DD>5: Degree Days above 5°C (growing degree days)			
PPT: Precipitation (mm)			
CMD: Hargreaves Climate Moisture Deficit (mm): means of understanding the annual cycle of hydrologic surplus and deficit.			
RH: mean annual relative humidity (%)			
Tmax_sm: Summer mean maximum temperature (°C)			
Source: http://www.climatewna.com/ClimateBC_Map.aspx			

Table 3: Climate variables of Bowen Island (Cates Hill) in 2018.

2.3.2 Ecosystems

The climate, soil, terrain type, and range of elevations on Bowen Island produce a variety of vegetation and ecosystem types.

2.3.2.a Ecoregion and Biogeoclimatic Ecosystem Classification

As mentioned previously, an important aspect of climate on Bowen Island is its summer moisture deficit, which affects the terrestrial ecology of the island (Madrone Environmental consulting, 2009). The Biogeoclimatic Ecosystem Classification (BEC) system developed in the 1960s by faculty in UBC's Botany Department is now used province-wide to define forested and non-forested ecosystems such as wetlands, riparian areas, grasslands, alpine tundra, and parklands. Combined data on vegetation communities, the effects of climate, and soil surveys has resulted in the establishment of 14 biogeoclimatic (BGC) zones in British Columbia. The zones are shown in the figure below. Each zone is divided into subzones or units with specific, identifying characteristics.

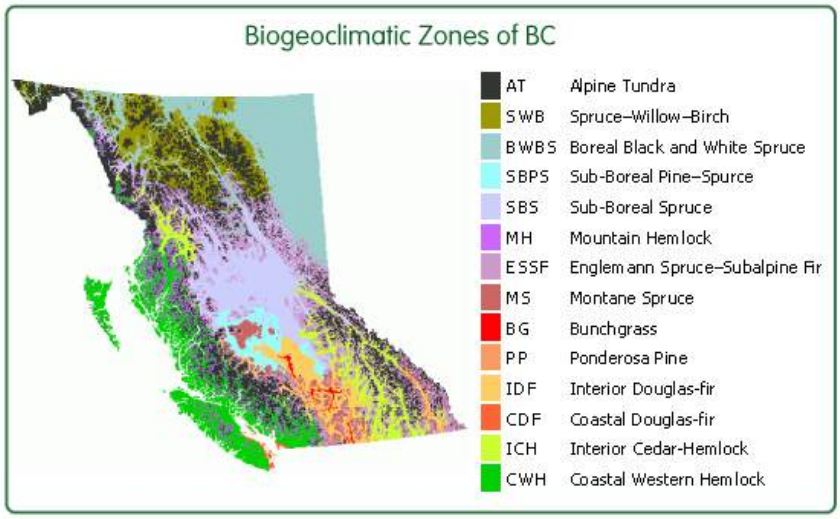

Figure 6: About BEC and BGC units - Centre for Forest Conservation Genetics
Source: UBC department of forestry, Centre for Forest Conservation Genetics

Bowen Island is located within the Coastal Western Hemlock (CWH) biogeoclimatic zone. Its dominant BGC units are CWH Dry Maritime Subzone (CWHdm), CWH Very Dry Maritime Subzone, Eastern Variant (CWHxm1) and a very small proportion of CWH Very Wet Maritime Subzone, and Montane Variant (CWHvm2), as represented in the map below (Islands Trust Conservancy 2005).

Figure 7: Biogeoclimatic Subzones of the CWH of Bowen Island. Madrone Environmental Consulting, 2009.

The primary ecosystem for each of these biogeoclimatic subzones (or communities) is described in Appendix 3.

2.3.2.b Sensitive Ecosystems and species at risk

Bowen Island's Coastal Western Hemlock BGC and the species it hosts are threatened primarily by invasive species, intensifying dry spells caused by climate change, and land conversion and ecosystem fragmentation (Islands Trust Fund 2018). Bowen Island's BGC has therefore been included in the Coastal Douglas-fir and Associated Ecosystems Conservation Partnership, an alliance intended to ensure the ecological integrity of the Strait of Georgia and Howe Sound littorals[8] through research and education. The Coastal Douglas-fir is one of the rarest BGC zones in BC. Of the 20 ecosystem subzones (or communities) presented in Appendix 3, seven are red listed (meaning extirpated, endangered or threatened), and seven are blue listed (meaning vulnerable and particularly sensitive to human activity). 70% of the ecosystem subzones on Bowen Island are, in fact, either vulnerable or endangered.

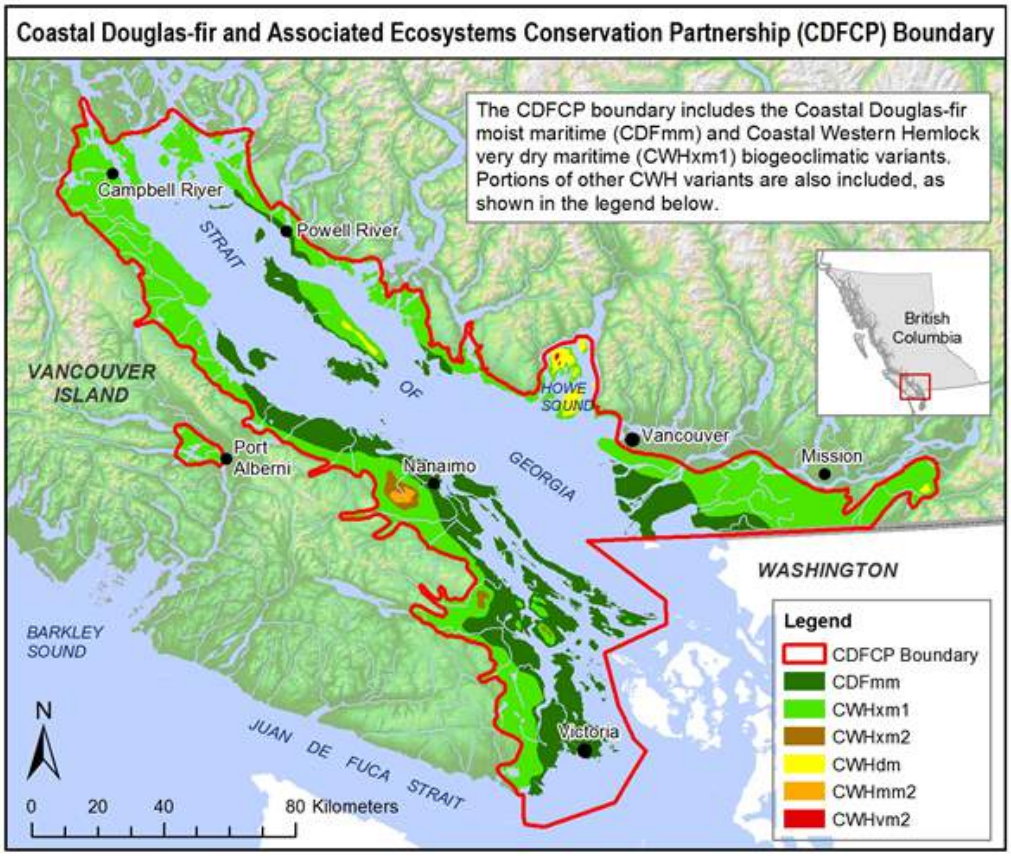

Figure 8: Coastal Douglas Fir and Associated Ecosystems Conservation Partnership Boundary

As of March 31, 2019, 14.5% (734 hectares) of Bowen Island Local Trust area was protected. As a point of reference, the average for all the islands of the Islands Trust is 18%. Protected areas on Bowen are summarized in the table below and comprise parks (Apodaca Provincial Park, Crippen Regional Park, Bowen Island Municipal Park, Quarry Community Park); nature reserves (Singing Woods, Fairy Fen, David Otter); Bowen Island Ecological Reserve; as well as watershed lands, heritage forests lands, and conservation covenants (Islands Trust Conservancy 2019; Islands Trust Fund n.d.).

[8] Littorals are the shore zones between the high tide and low tide points

Protected Areas Distribution (March 2017):

Type of Protected Area	Area (hectares)	Area as % of Island Municipality
Conservation Covenant (Conservancy held)	2.1	<0.1
Ecological Reserve	395.1	7.8
Nature Reserve	30.4	0.6
Park – Municipal	76.3	1.5
Park – Provincial	9.5	0.2
Park – Regional	220.4	4.4
TOTAL	**734.8**	**14.5**

Table 4: Protected Areas Distribution, Islands Trust Conservation Plan 2018-2027
Source: Islands Trust Conservancy 2019

As a member of the Islands Trust, Bowen Island complies with the mandate of the Islands Trust Conservancy to "preserve and protect" species, habitat and overall ecosystem health. In doing so, Bowen Island agrees to keep land conversion to human use under the 30-40% threshold to maintain ecosystem health. Land converted to human use on Bowen Island is currently under 15% (Islands Trust Conservancy 2019).

Nonetheless, the Lower Mainland has felt the pressure of development and surging population growth for decades, resulting in the fragmentation and degradation of terrestrial ecosystems. Anthropogenic pressures combined with a warming climate have pushed a high proportion of ecosystems into the "sensitive" classification. Sensitive ecosystems are defined as biologically diverse and a vital part of the landscape. They regulate climate, clean water, generate and clean soils, recycle nutrients and pollinate crops (Islands Trust Conservancy, 2005).

Bowen Island's sensitive terrestrial ecosystems cover its entire surface of 5,053 hectares. However, only 20% of this surface is under protection (see figure below). Bowen Island has no protected marine areas and no Rockfish Conservation Areas in its waters (Islands Trust Fund, 2018).

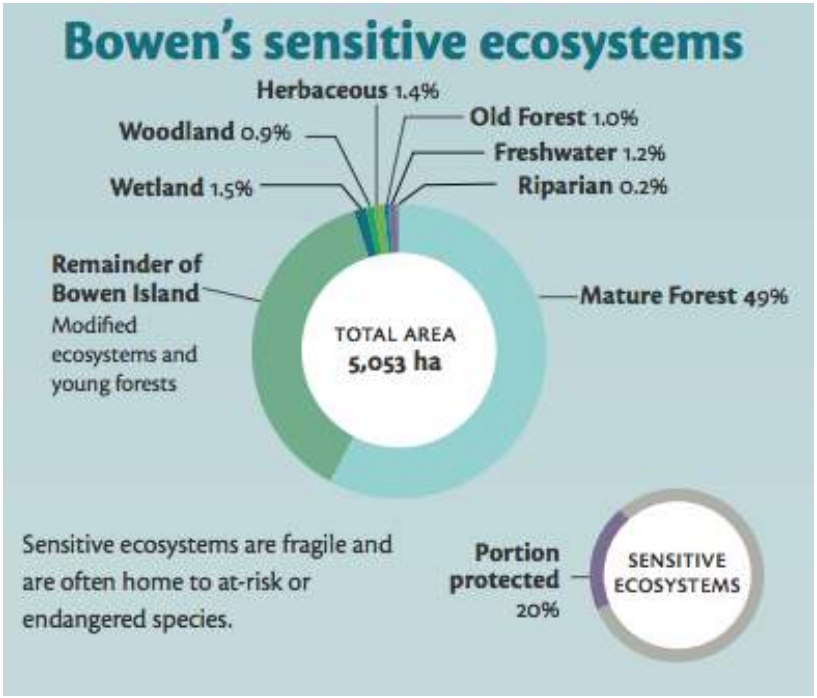

Figure 9: Conservation status of Bowen Island, Islands Trust Conservancy.

In September 2017, the Federal Government mapped Bowen Island as a critical habitat for the Marbled Murrelet (*Brachyramphus marmoratus*), a small seabird from the North Pacific. The B.C. Conservation Data Centre recorded sightings of the Blue Dasher (*Pachydiplax longipennis*) and the Great Blue Heron (*Ardea herodias fannini*) on Bowen Island, both of which are listed on the province's blue list of special concerns (Islands Trust Fund 2018). The Northern Red-legged Frog (*Rana aurora*), the Band-tailed Pigeon (*Patagioenas fasciata*) and Hutton's Vireo (*Vireo huttoni*) have also been observed on the island, all blue-listed by the province. There may be other red and blue listed species on Bowen Island not reported here.

2.3.2.c Invasive species

According to the Invasive Species Council of Metro Vancouver, invasive species are those that occur outside their natural range and can have significant ecological, social and/or economic impacts once established.

Invasive species in Canada include at least 27% of all vascular plants, 181 insects, 24 birds, 26 mammals, 2 reptiles, 4 amphibians, several fungi and molluscs, and 55 freshwater fish (Invasive Species Council of BC 2016). Invasive species disturb established ecosystem communities and can be serious nuisances to the agricultural and forestry industries. They represent the second biggest threat to biodiversity and native ecosystems after habitat loss and are an even greater threat than pollution, harvest, and disease combined.

In the agricultural sector, invasive species can infest rangelands, reduce forage, and compete with desired species for space and resources. Additionally, some invasive species can be toxic to livestock (Invasive Species Council of BC 2016). Controlling and monitoring them has a cost, which could increase in the coming years if global warming, as predicted, promotes their proliferation.

The Invasive Species Council of Metro Vancouver offers educational, technical, and support services for invasive species identification and control. The Council identifies the main invasive animal species on Bowen Island as the Eastern Grey Squirrel (*Sciurus carolinensis*). And although there hasn't been any clear evidence of sightings on Bowen Island, the American Bullfrog (*Lithobates catesbeianus* or *Rana catesbeiana*) was reported in other locations of Metro Vancouver. One could argue that black rats (*Rattus rattus*), striped skunks (*Mephitis mephitis*), minks (*Neovison vison*) and, to a lesser extent, racoons (*Procyon lotor*) have become prevalent invasive species as well. As for the Columbian black-tailed deer (*Odocoileus hemionus columbianus*), the proliferation of this species presents a certain negative impact on agriculture and gardening, but they are native to Bowen Island.

The Invasive Alien Plant Program (IAPP) is a web-based mapping and reporting tool provided by the Ministry of Forests, Lands, and Natural Resource Operations and Rural Development to develop and deliver effective invasive plant management programs throughout British Columbia. For Bowen Island, this mapping tool reports the presence of ten invasive plant species, listed in the table below.

Map Label	Common Name	Latin Name	Genus	Species	Sighting
BO*	Bohemian knotweed*	*Fallopia x bohemicum*	FALL	BOH	1
CT*	Canada thistle*	*Cirsium arvense*	CIRS	ARV	2
EI	English ivy	*Hedera helix*	HEDE	HEL	1
GH	Giant hogweed	*Heracleum mantegazzianum*	HERA	MAN	1
GO	Gorse	*Ulex europaeus*	ULEX	EUR	1
HB	Annual hawksbeard	*Crepis tectorum*	CREP	TEC	1
HO*	English holly*	*Ilex aquifolium*	ILEX	AQU	14
JK*	Japanese knotweed*	*Fallopia japonica*	FALL	JAP	12
OH	Orange hawkweed	*Hieracium aurantiacum*	HIER	AUR	1
SB	Scotch broom	*Cytisus scoparius*	CYTI	SCO	2

Source: Invasive Plant
Map Label Legend
Invasive Plant Map Label Legend
https://www.for.gov.bc.ca/hra/publications/invasive_plants/iapp_training/Map_Label_legend.pdf
Map:
https://maps.gov.bc.ca/ess/hm/iapp/
*: Priority plants identified by the Invasive Species Council of Metro Vancouver

Table 5: Invasive Plants sighted on Bowen Island

Of these ten reported species, four are listed as priority plants to control: the Japanese and Bohemian knotweeds, Canada thistle, and English holly (Invasive Species Council of Metro Vancouver, 2017). The two most concentrated sighting zones are Fairy Fen Nature Reserve and the Snug Cove/Crippen Park area. Other sightings are scattered across the island.

However, the IAPP mapping tool doesn't always include data for private or municipal land, which is a major limitation, and which suggests that more invasive species could be present on Bowen Island, unreported and uncontrolled.

2.3.2.d Impact of Agriculture on Natural Resources and Ecosystems

While the plant and animal species listed above (as well as other predators and pests) can adversely affect agricultural activities, it is important to acknowledge the obverse, that certain agricultural practices can negatively impact native wildlife. Maintaining biodiversity and contributing to the preservation of ecosystem communities should remain a priority for any agricultural activity.

To reduce the negative impacts on natural resources and surrounding ecosystems, the BC Ministry of Agriculture adopted a Code of Practice for Agricultural Environmental Management in 2019. This new legislation sets standards for agricultural operations, including waste management (composting, contaminated runoff, leachate, and solids), air contaminants, water management and wastewater treatment, soil testing, and nutrient management.

Recent research[9] demonstrates that agricultural practices that follow organic, biodynamic, agro ecological[10] and/or agroforestry[11] practices tend to have lesser negative impact on natural resources and ecosystems, and in principle aim for:
-Atmospheric carbon sequestration in the soil
-Improving water retention through soil health and below ground biodiversity
-Reducing levels of pollutants
-Increasing the population of pollinators
-Mitigating the weed population
-Increasing above ground biodiversity through riparian buffers, shelterbelts, hedgerows

The picture below illustrates a coffee plantation in Latin America using agroforestry principles.

A coffee plantation using Agroforestry principles. Copyright: CIRAD.fr

[9] IPES-Food (2016), Inra, Cirad (2016), Rodale Institute (2018)
[10] cf. glossary
[11] cf. glossary

2.3.3 Hydrology

2.3.3. a Freshwater Availability and Future Capacity on Bowen Island

According to the Province, most of BC's drinking water comes from surface water, from small streams to large reservoirs. Watersheds play an important role in protecting surface water quality and quantity for communities (Ministry of Environment, Community watersheds). There are twelve watersheds on Bowen Island. Half of the households are served by a Municipal water system (Bowen Island Municipality, 2019) relying both on surface and groundwater. The rest are supplied by private or communal water systems, or private wells that rely exclusively on groundwater.

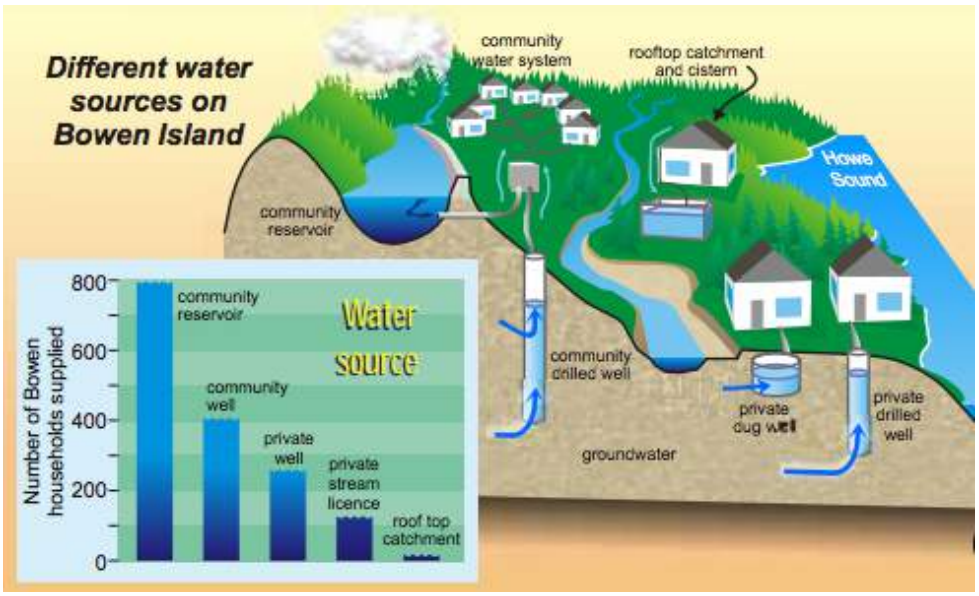

Figure 10: Different Water sources on Bowen Island. Bowen Island Municipality, 2005

When it comes to irrigation water for agriculture, supply can be either from surface water or groundwater. Considering the longer, drier, hotter summers of the past two years (2017, 2018) combined with the pressure to build more housing, groundwater supply is already becoming a concern on some parts of the island. Unless a comprehensive water catchment program is undertaken, pressure on groundwater supply will most likely intensify.

2.3.3.b Aquifer, Water Storage and Groundwater Capacity

One of the characteristics of the islands in the Islands Trust is their limited water storage and groundwater capacity. Despite abundant rainfall during the winter season, it is estimated that a very small proportion of rainwater infiltrates to deep groundwater storage. Most rainwater infiltrates as shallow groundwater, which returns to the surface as springs and flows back to the ocean (Bowen Island Municipality, 2005). Despite the surface of forested land on Bowen Island with its ability to retain water through root systems, water storage is far from optimal and heavily used aquifers cannot replenish fully over time. Housing developments and any activity requiring land clearing further affects aquifers' replenishment.

An aquifer is a geological formation defined as an underground layer of broken rock, gravel, sand or silt that contains groundwater that can be brought to the surface through a water well.

The classification of aquifers is often the first step to assess groundwater availability and quality as well as future water capacity (Ministry of Environment and Climate Change Strategy, n.d.). Bowen Island has seven aquifers, five are fractured rock and two are sand and gravel, as table 6 displays.

Aquifer	Descriptive location	Material	Litho stratigraphic unit	Subtype	Vulnerability	Size (km2)	Productivity	Demand
743	BI - Grafton Lake Valley	Sand and Gravel	Fluvial and glacio-fluvial deposits	4b- Confined sand and gravel - glacial	Moderate	0.3	Moderate	Moderate
744	BI - SW	Sand and Gravel	Fluvial and glacio-fluvial deposits	4b- Confined sand and gravel - glacial	Moderate	0.2	Moderate	High
745	BI - North	Bedrock	Lower Jurassic to Middle Jurassic Bowen Island Group	6b - Fractured crystalline bedrock	High	10.4	Low	Moderate
746	BI - Central	Bedrock	Lower to Middle Jurassic	6b - Fractured crystalline bedrock	Moderate	14.9	Low	Moderate
747	BI - South and SE	Bedrock	Lower Jurassic to Middle Jurassic Bowen Island Group	6b - Fractured crystalline bedrock	Moderate	15.1	Low	Low
748	BI - West	Bedrock	Lower Jurassic to Middle Jurassic Bowen Island Group	6b - Fractured crystalline bedrock	Moderate	5.8	Moderate	Moderate
749	BI - SW	Bedrock	Lower Jurassic to Middle Jurassic Bowen Island Group	6b - Fractured crystalline bedrock	Moderate	4.1	Moderate	High

Year of mapping 2006

Groundwater Level Data:
https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=b53cb0bf3f6848e79d66ffd09b74f00d
GWELLS:
https://apps.nrs.gov.bc.ca/gwells/aquifers/?search=745&resources__section__code=
Aquifers Subtype Code description:
https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/groundwater-wells-aquifers/understanding-aquifers/aquifer-subtype-code-description

Aquifer classes description:
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/science-data/aquifer_maps_guide.pdf

Table 6: Aquifer classification for Bowen Island

The classification of these seven aquifers shows that their productivity is moderate to low while their vulnerability is high to moderate. As for demand, it varies from low to moderate to high. The level of productivity of an aquifer refers to the abundance of the resource. Its level of vulnerability refers to a contaminant that is introduced at the land surface and is directly related to water quality degradation. Its level of demand refers to the reliance on the resource for supply (Ministry of Water, Land and Air Protection, 2002)

Tactics that would allow optimizing aquifer recharge and water storage include: preserving forested uplands and valley slopes (and developed root systems able to retain water), increasing the amount of topsoil with a rich microbiome, and creating infiltration ponds where excess water could accumulate (Bowen Island Municipality, 2005).

As Bowen's population continues to expand and land is cleared and developed, the demand for natural resources such as surface water and groundwater will inevitably increase and will undoubtedly require best management practices. The figure below shows the correlation between housing development, aquifer recharge and the atmospheric water cycle.

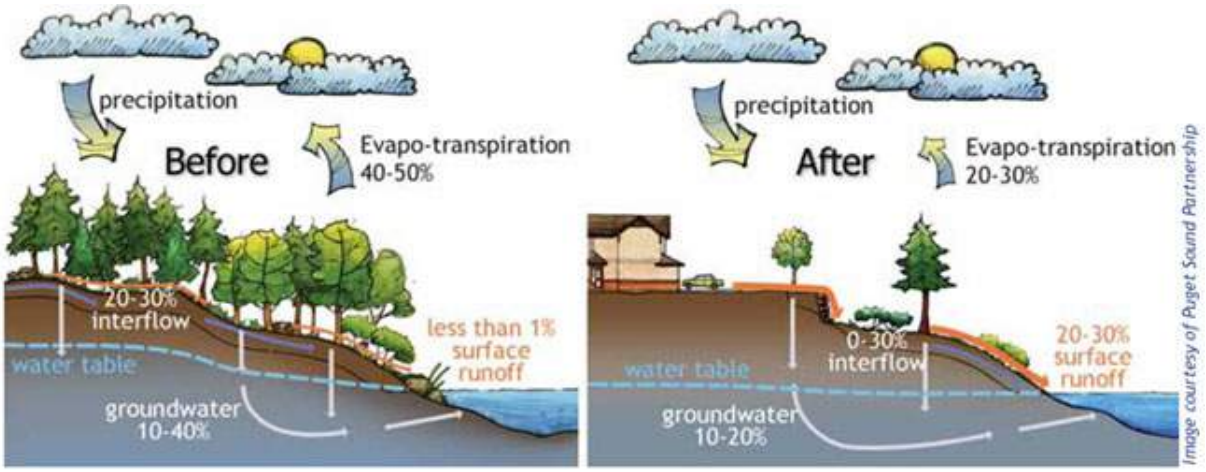

Figure 11: Correlation between housing development and groundwater capacity
Source: A hydrologic Perspective on Climate, Resource Development, and Watershed Condition, Rex, 2016.

Note that the year of mapping for Bowen's aquifers was 2006, 13 years before this report was published. However, Bowen Island's population increased by 10% between 2006 and 2016 (BC Stats, 2012 and Statistics Canada, 2017). Assessing the stress level of each aquifer, based on productivity, vulnerability and demand would be required. The BC Aquifer Stress Tool method is currently not applicable to Bowen Island due to a lack of data. It is, however, a promising resource for land use planning in the future.

Both figures below present a geographical representation of Bowen Island's seven aquifers and wells. The data available does not specify the depth of the wells.

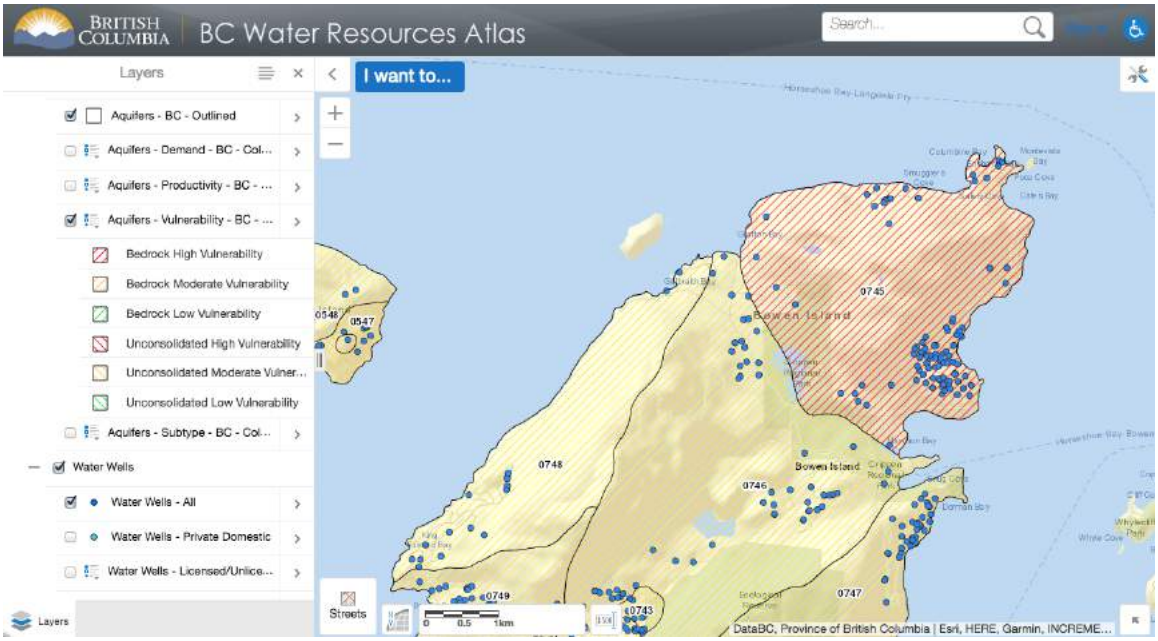

Figure 12: Aquifer vulnerability classification and water wells (all) for the Northern part of Bowen Island: http://maps.gov.bc.ca/ess/hm/wrbc/

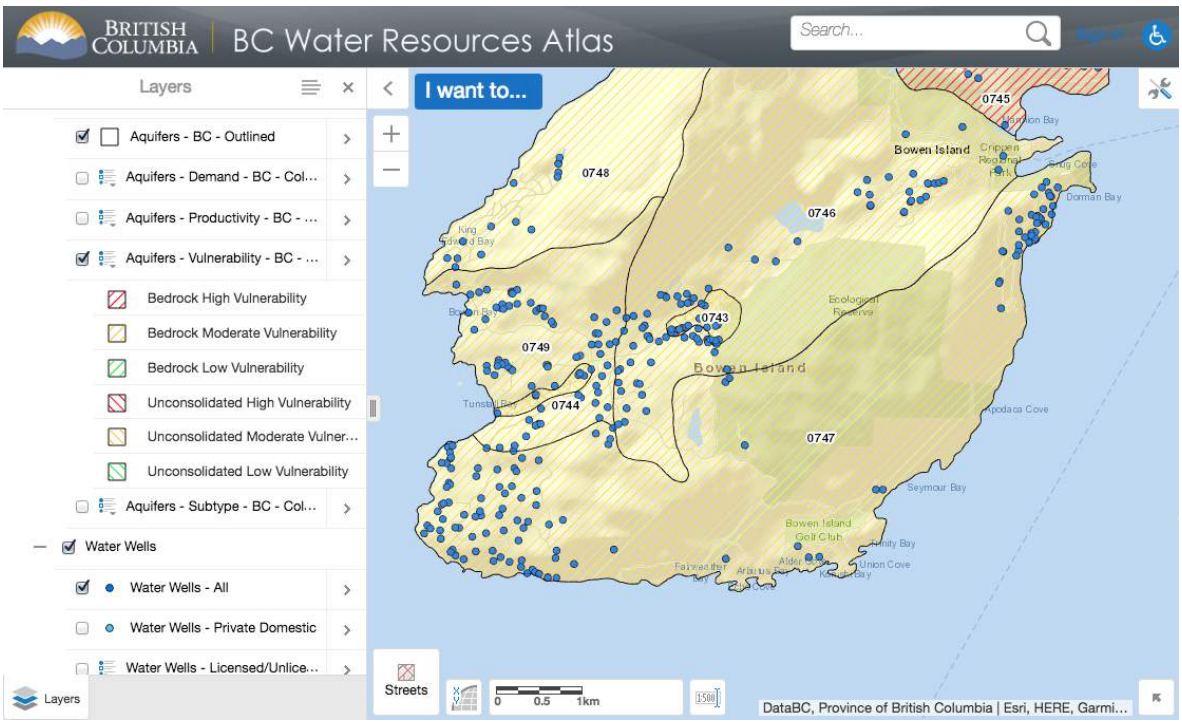

Figure 13: Aquifer vulnerability classification and water wells (all) for the Southern part of Bowen Island: http://maps.gov.bc.ca/ess/hm/wrbc/

2.3.4 Geology and Pedology

2.3.4.a Bedrock Geology

Bowen's geological formation is dated to the Jurassic and composed of volcanic, sedimentary, and intrusive (igneous) rocks.

The lower to middle Jurassic volcanic and sedimentary formation is referred to as the Bowen Island Group (coded JBi). It is characterized by an association of tuffaceous sandstone,

tuffaceous siltstone, argillite, and graphitic siltstone with minor interbedded carbonate, lapilli tuff, and andesite flows and sills.

The late Jurassic intrusive rocks formation is predominantly granodiorite (coded LJqd) and quartz dioritic on the southern end (Geoscience BC, 2013)

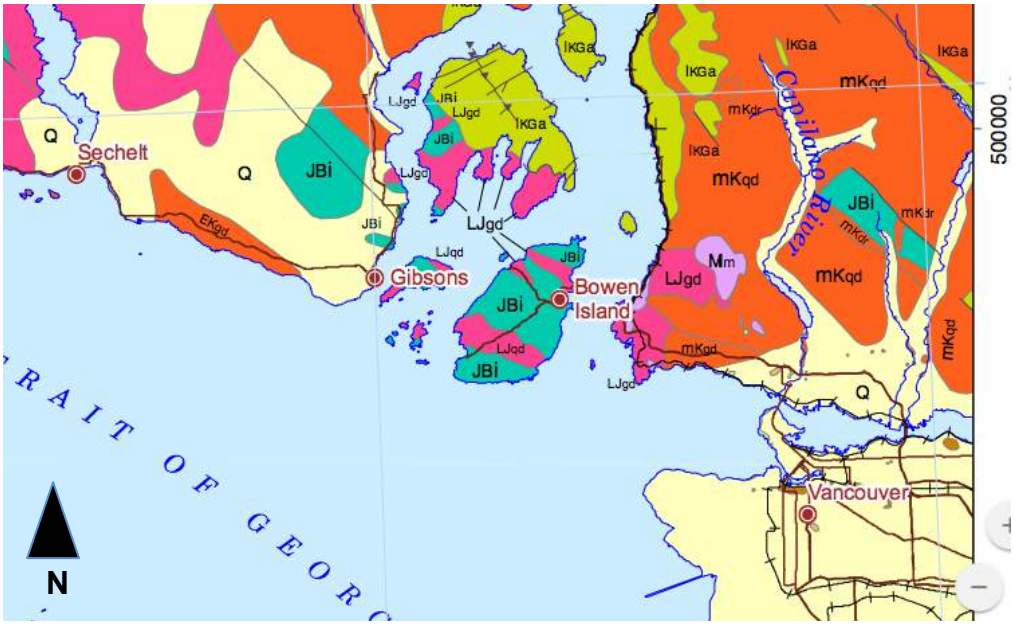

Figure 14: Geology of Bowen Island
Source: Northern Vancouver Island Project – Geoscience BC

2.3.4.b Surficial Geology and Soil Landscapes

Soil and terrain types are influenced by glaciation events, erosion, deposition and topography. The surficial geology of the island is a combination of exposed bedrock and deposits of colluvial (clay to boulders) and fluvial (gravel and sand) origins. The shorelines tend to have much thinner and scattered deposits of marine origin. Soils landscapes are derived from the components of the surficial geology, including the physical and chemical weathering of the exposed bedrock.

As per the System of Classification for Canada, the dominant soil orders on Bowen Island are Podzolic. Gleysolic and organic soils are also present, to a much lesser extent. Podzolic soils have been formed under perhumid to humid soil climates. They are characterized by good drainage and a coarse texture. The most typical vegetation growing on this soil order is coniferous forest. It is the accumulation of organic matter, iron and aluminum that distinguishes Podzolic soils.

The most common Great Group is the Humo-Ferric Podzol, which is characteristic of the east side of Vancouver Island. Humo-Ferric Podzols have developed from glacial moraine derived from granodiorite bedrock. The vegetation cover is Douglas-fir, western hemlock and western red cedar with a dense ground cover of salal.

Humic Gleysol is another observed Great Group on Bowen Island, characterized by a thick accumulation of organic matter and no clay accumulation. Gleysolic soils are saturated with water for long periods of the year. The lack of oxygen prevents any decomposition from aerobic microorganisms.

Finally, organic soils are composed mainly of organic matter and have developed under highly saturated conditions (low temperatures and lack of oxygen), which prevents the production of humus. Humisols and Folisols are the two observed Great Groups. Humisols are saturated and well decomposed, whereas Folisols are rarely saturated forest debris over thin mineral layers or rocks (Government of Canada, 1986).

2.3.4.c Soil Survey Classification

This soil survey is based on data extracted from the British Columbia Soil Information Finder Tool (SIFT). The soil survey map for Bowen Island is composed of 59 survey units (or polygons)[12] presented in the figure below. The dominant soil types are BOSE (BO), BURWELL (BW), CANNELL (CE), JUDSON (JN), KENWORTHY (KW), MURRAYVILLE (MY), ROSS (RS) and SUNSHINE (SS). A soil type is defined by its texture, drainage, horizons, parent material, landform, classification, degree of development and other factors, which determine soil management techniques. The profile of these dominant soils is native and undisturbed by agriculture. Apart from JUDSON and ROSS, they are all composed of mineral particles. JUDSON and ROSS are composed of organic particles (Government of Canada, Soils of British Columbia).

Figure 15: Soil Survey Map for Bowen Island. Source: SIFT, 2018
NB: the area highlighted in green represent the Agricultural Land Reserve.

A detailed description of soil types is presented in appendix 4.

[12] Excluding Hutt Island

2.3.5 Agricultural Capability of Bowen Island Soils

The descriptions of the soil landscapes and of the soil survey are prerequisites for determining the land capability for agriculture. Based on an assessment of climate and soil attributes, the Canada Land Inventory (CLI) developed the Agricultural Capability Rating System to define classes and subclasses of land capability for agriculture. The term capability describes the agricultural potential based on the land, its soils and related limitations. The seven classes indicate the degree of limitation imposed by the mineral soil in its use for mechanized agriculture.

- Class 1 to 3 is referred to as prime agricultural land with no to moderate limitations in use for crops and moderate to special conservation practices.
- Class 4 to 6 is referred to as secondary with severe to very severe limitations, restricting use for crops and for which improvement practices are feasible to not feasible.
- Class 7 refers to land and soil with no capacity for arable culture or permanent pasture.

However, contrary examples exist where farm operations manage to be successful in class 7. This demonstrates that the rating system is a useful tool but not an absolute predictor of capability. Depending on the crop and farming methods, a parcel deemed inappropriate for agriculture can be improved and made productive.

The eighteen subclasses indicate types of limitations that individually, or in combination with others, affect agricultural land use (such as excess water, stoniness, salinity, and topography, among others) and provide information as to how to improve the agricultural capability of a given polygon (Government of Canada 2013).

Each polygon on the Agricultural Capability map has a Capability Class Label (or CC Label) and an Improved Capability Class Label (or IC Label). The CC Label describes the components and their respective soil class and subclass. The IC label describes how the polygon can be improved if the limitations are removed or alleviated (British Columbia Soil Information Finder Tool 2018).

A comparison between CC and IC labels reveals ways to alleviate the limitations, assuming that improvements are physically and economically feasible. Additionally, management input recommendations from the Soil Management Handbook for the Lower Fraser Valley are based on the dominant soil landscape.

For example, the CC Label 7:3AT~3:4APT means that 70% of this polygon is of class 4 limited by aridity and topography and 30% of it is class 4 limited by aridity, stoniness and topography. The IC Label of this polygon is 7:2TA~3:3PTA, meaning that 70% of class 3 can be improved to class 2 and the 30% of class 4 can be improved to class 3 with proper irrigation.

Based on this methodology, the tables below present a detailed description for each of Bowen Island's polygons.

Polygon identifiable name	CC Label	IC Label	Main limitations (Sub class)	Limitation alleviation, management inputs recommendations	Number of polygons
Adams Rd (MY)	4:4TA~3:3AT~3:5TPA	**4:4T~3:2TA~3:5T**	Aridity, Topography, Stoniness	Irrigation, stone removal	1
Bowen Bay (SS)	7:4AT~3:4APT	**7:3TA~3:3PTA**	Aridity, Topography, Stoniness	Irrigation, stone removal, increase nutrient holding capacity, organic matter incorporation,	1
Crippen/Killarney (MY)	7:3AT~3:4APT	**7:2TA~3:3PTA**	Aridity, Topography, Stoniness	Irrigation	1
Crippen/Mannion (MY)	6:3AT~4:4AP	**6:2TA~4:3PAT**	Aridity, Topography, Stoniness	Irrigation	1
Crippen/Meadow (RS)	5W	**3W**	Excess water	Drainage, crop rotation, cover cropping, tillage best practice (appropriate to clay soils), sub soiling to fragment cemented layers	1
Galbraith Bay (BO)	5:4APT~3:4AT~2:7RT	**5:4TPA~3:3TA~2:7RT**	Aridity, Topography, Consolidated Bedrock, Stoniness	Stone removal, Irrigation System, Increase of nutrient holding capacity, sub soiling to fragment cemented layers	1
Golf Course (SS)	7:4A~3:4AP	**7:2AT~3:3APT**	Aridity, Topography, Stoniness	Irrigation, stone removal, increase nutrient holding capacity, organic matter incorporation,	1
Grafton Creek/Home Farm (MY)	6:3AT~4:4A	**6:3AT~4:3TA**	Aridity, Topography	Irrigation	1
Grafton Lake South (RS)	5WI	**3W**	Excess water	Drainage, crop rotation, cover cropping, tillage best practice (appropriate to clay soils), sub soiling to fragment cemented layers	1
Legion/Lower Ocean View Dr. (BO)	6:4AP~4:4WP	**6:3PAT~4:3PWA**	Aridity, Stoniness, Water Excess, Topography	Irrigation, stone removal, drainage	1

1

Polygon identifiable name	CC Label	IC Label	Main limitations (Sub class)	Limitation alleviation, management inputs recommendations	Number of polygons
NA	7:5PAT~3:7RT	7:5TPA~3:7RT	Aridity, Topography, Consolidated Bedrock, Stoniness	Irrigation, stone removal	1
NA	6:5PTA~4:7RT	6:5TP~4:7RT	Aridity, Topography, Consolidated Bedrock, Stoniness	Irrigation, stone removal	2
NA	5:5TPA~5:7RT	5:5TP~5:7RT	Aridity, Topography, Consolidated Bedrock, Stoniness	Irrigation, stone removal	1
NA	5:5PAT~5:7RT	5:7RT~3:5TPA~2:4PAT	Aridity, Topography, Consolidated Bedrock, Stoniness	Irrigation, stone removal	1
NA	5:5PAT~3:5WP~2:7RT	5:5PAT~3:4PWA~2:7RT	Aridity, Topography, Consolidated Bedrock, Stoniness	Irrigation, stone removal, drainage	1
NA	6:4APT~4:5TAP	6:4TPA~4:5TPA	Aridity, Topography, Stoniness	Irrigation, stone removal	1
NA	6:4TA~2:4TPA~2:5TAP	6:4T~2:4TPA~2:5T	Aridity, Topography, Stoniness	Irrigation, stone removal	1
NA	4:4TA~4:5TAP~2:7RT	4:4T~4:5T~2:7RT	Aridity, Topography, Consolidated Bedrock, Stoniness	Irrigation, stone removal	1
NA	O6WI	O4W	Excess water, Inundation by streams or lakes	Drainage, cover cropping, crop rotation	1
NA	7RT		Consolidated Bedrock, Topography	No alleviation possible	26
NA	7T		Topography	No alleviation possible	1
Source: British Columbia Soil Information Finder Tool (SIFT). SIFT compiles data and reports from the Government of Canada and the Province of British Columbia and is managed by the Ministry of Environment. https://governmentofbc.maps.arcgis.com/apps/MapSeries/index.html?appid=cc25e43525c5471ca7b13d639bbcd7aa&bcgovtm=CSMLS					

Table 7: Agricultural Capability of each polygon of Bowen Island.

The majority of the island's 27 polygons belong to Class 7, with topography and consolidated bedrock as limitations (7RT rating). The CC Label identifies these polygons as highly inappropriate for arable land or pasture and the limitations cannot be removed. However, ten

polygons already belong to prime agricultural land (class 2 or 3) or could be upgraded to that category if their respective limitations were removed or alleviated.

Independently of soil type, the most common soil improvements for agriculture are stone removal, increasing nutrient content and organic matter by adding quality compost (animal or green manure), installing an adequate irrigation system, installing drainage pipes where the water table is high, and creating a terrace system (with a preliminary evaluation for each site).
The ten polygons of prime agricultural land are presented at the top of Table 7, with identifiable location names. They are also localized on the map below with a purple pin.

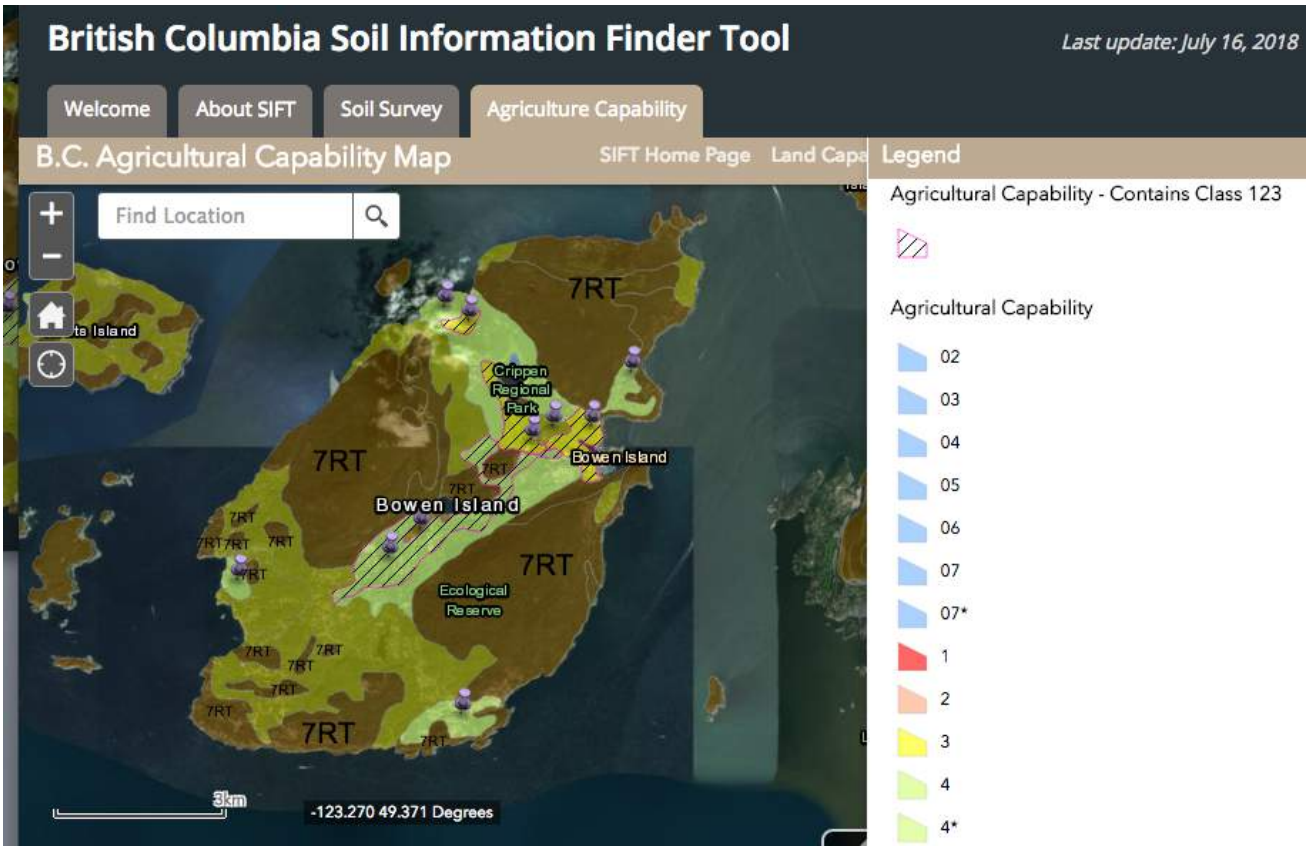

Figure 16: Agricultural capability map for Bowen Island. Source: SIF, 2018

This map does not co-locate Bowen Island's ALR. While some of the ALR is on the prime agricultural land identified by the Agricultural Capability Map, there are significant variances. A minimal surface of the ALR is not on prime agricultural land. A much more significant surface of prime agricultural land is excluded from the ALR. This total surface has not been estimated and would require further GIS mapping.

It is important to note that the Agriculture Land Capability Rating System assumes that soil management and agricultural practices rely on mechanized methods and that performing irrigation systems can be implemented. While the Agricultural Capability identification is helpful for identifying the polygons (or areas) of Bowen Island to prioritize for agricultural production, this analysis does not mean that other polygons cannot be considered for non-mechanized agricultural production, including production that would not necessarily rely on elaborate irrigation methods. It is, however, recommended to consult an experienced professional agrologist before undertaking agricultural activity in the polygons of class 7 where topography and exposed bedrock are the main limitations.

2.3.6 Agricultural Suitability

For the Agricultural Land Commission, "suitability" refers to the types of crops or farm products that can be produced on the land based on its capability. While the Agricultural Capability identifies soil-related limitations, Agricultural Suitability considers other possible limitations such as marketing avenues, logistics, post-harvest infrastructure, type of land ownership, skills required, access to capital and loans, and overall economic viability of a specific crop or farm product.

Agricultural Capability findings may not be as relevant to decision-making if the land is not for "soil bound use." For reference, soil bound use refers to any crop or animal product that relies on the soil on site to be grown or raised. Examples of non-soil bound use would include an intensive livestock operation or a hydroponic greenhouse.

For a specific area, and depending on the crop or farm product, an Agricultural Suitability Assessment combines the findings of the Agricultural Capability with the likelihood of mitigating soil limitations, and with the other limitations listed above. The final decision on land use should acknowledge the potential negative impacts on local or regional agricultural production capacity and existing neighbouring land use. It should also consider possible conflicts with residential neighbourhoods (Vast Resource Solutions 2016).

An in-depth analysis of these socio-economic factors, including market research and an environmental and ecological impact assessment, are important steps in the decision-making process.

Considering the multiple levels of analysis and relative complexity, it would not be reasonable to extrapolate the agricultural suitability of the polygons of prime agricultural land on Bowen Island. A professional agrologist with experience in soil survey and analysis and arable land evaluation would be able to make recommendations on the agricultural suitability of a given area or set of polygons.

2.4 Climate Projections and Consequences

"Globally, the impacts of climate change will be profound, and are already evident. Not surprisingly, coastal areas such as Bowen Island are particularly vulnerable to the effects of climate change." (Bowen Island Municipality, OCP 2010)

In March 2019, the Islands Trust Council declared a climate change emergency, joining Vancouver, the Capital Regional District, Los Angeles, London and other regional and local governments worldwide. This declaration acts as a commitment to add climate change mitigation, resilience, and adaptation policies into the Islands Trust Policy Statement amendment project (Islands Trust Council, 2019).

2.4.1 Global Risk Report 2019

The World Economic Forum released its 2019 Global Risk Report in January 2019 with some striking statements, such as this one: “Of all risks, it is in relation to the environment that the world is most clearly sleepwalking into catastrophe” (WEF Global Risk Report 2019).

The graph below estimates the most likely and the most impactful environmental (coded in green) and societal (coded in orange) risks related to the climate emergency that we are facing, including extreme weather events, failure of climate change mitigation and adaptation, natural disasters, biodiversity loss, and ecosystem collapse. The most likely and impactful societal risk is the multiplication of water crises.

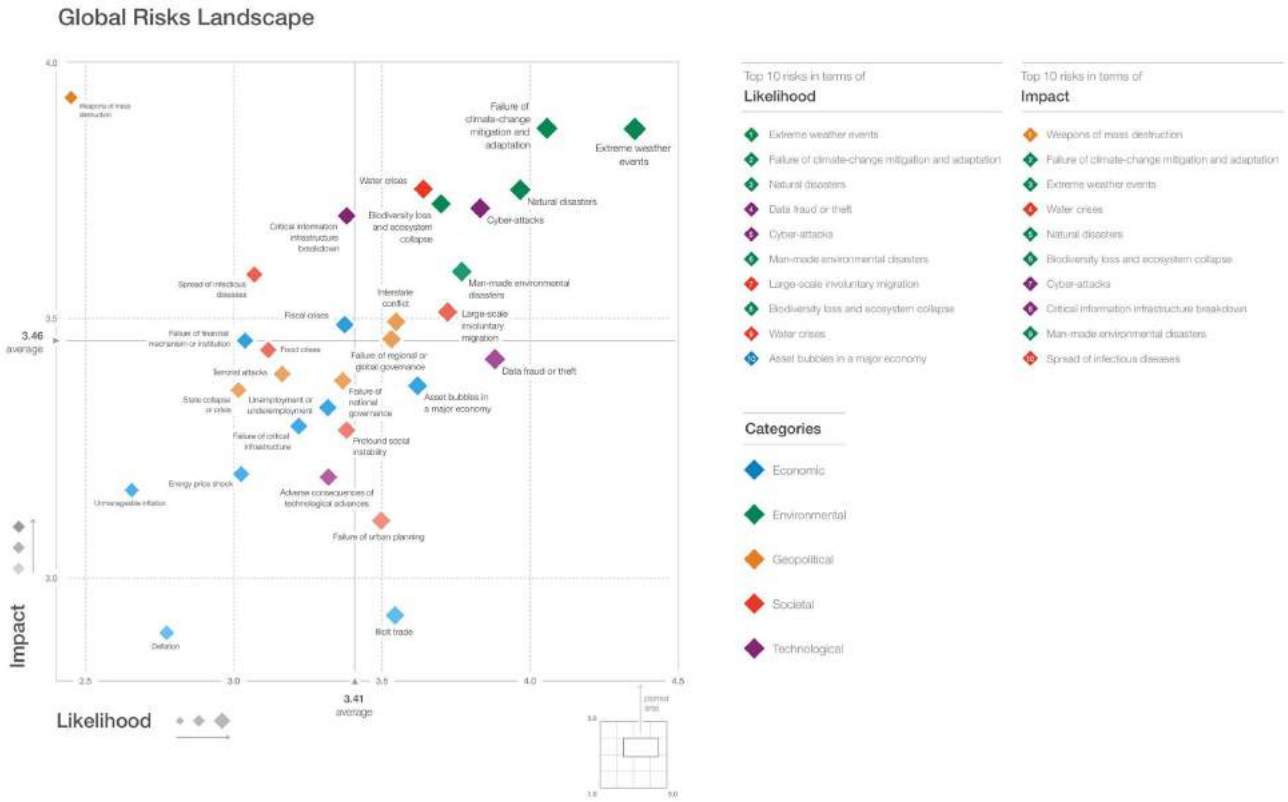

Figure 17: Global Risks Landscape. Source: World Economic Forum, Global Risk Report 2019

The Risk Trend Interconnectedness projections from the same report clearly reveal the environmental and societal risks ascribed to our changing climate, such as food and water disruptions.

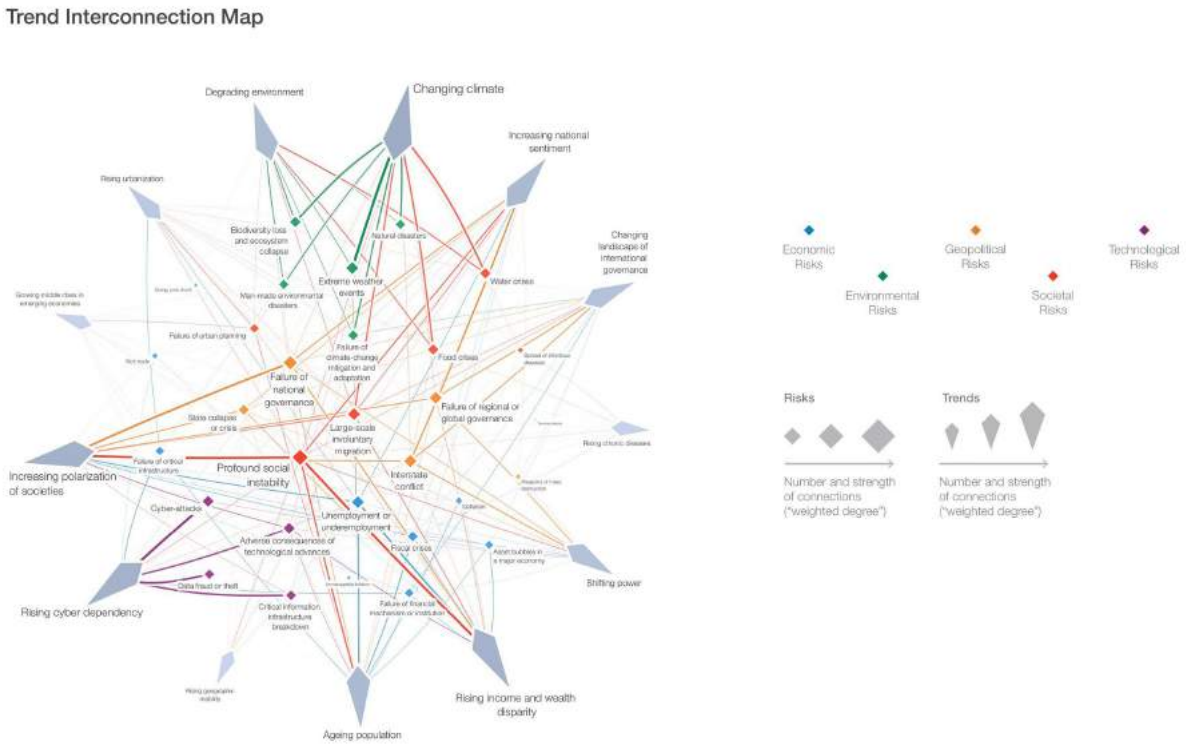

Figure 18: Trend Interconnection Map. Source: World Economic Forum, Global Risk Report 2019

2.4.2 Climate Projections Modelling

General Circulation Models are the most elaborate tool for simulating the consequences of greenhouse gas (GHG)[13] concentrations on our climate and its indicators (IPCC, n.d.). The simulations of trajectories of GHG emissions are correlated with political will and socio-economic factors. The 5th Intergovernmental Panel on Climate Change (IPCC) distinguishes these trajectories and long-term GHG concentration levels in four Representative Concentration Pathways (or RCPs) as a basis for climate predictions and projections.

RCPs describe climate outcomes of anthropogenic GHG emissions from all sources. The number associated with a given RCP indicates the change in radiative forcing by the end of the 21st century and is expressed in W/m2 (Canada's Changing climate Report 2019). Our current trajectory is classified as RCP8.5, a "high emissions scenario" pathway. It is referred to as "business as usual," and shows the consequences if no policies are implemented quickly and if emissions and resulting concentrations do not decrease.

RCP4.5 and RCP6 reflect "medium emissions scenario" pathways, where emissions are about half that of the RCP8.5 pathway. RCP2.6 is the "low emissions scenario" pathway and the only one that will ensure global warming remains below 2°C above pre-industrial temperatures. This is the goal agreed upon by the signatory countries at the Paris Agreement in 2015. This scenario requires CO_2 emissions to be reduced to near zero before the end of the century.

The figure below is a common representation of RCPs.

[13] A non-exhaustive list of the main Greenhouse Gases includes carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons. GHGs potencies vary; N_2O is 28 times more potent than CO_2 for instance.

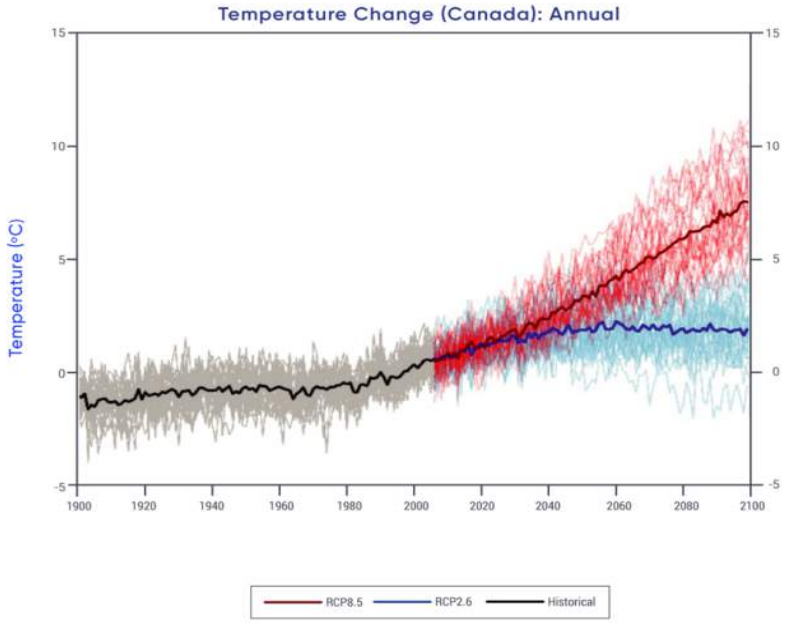

Figure 19: Temperature change projections in Canada depending on the high (RCP8.5 - red) or low (RCP2.6 – blue) emissions and radiative forcing (W/m2). Source: CCCR 2019

In all cases, CO_2 (carbon dioxide) is the largest contributor to the historical and projected RCP modelling followed by CH_4 (methane) and N_2O (nitrous oxide). Future changes in anthropogenic CO_2 emissions (through emissions and land-use changes) will determine the most likely RCP scenario (CCCR, 2019).

The diagrams below present correlations between GHG emissions and GHG concentrations, and RCP climate projection scenarios.

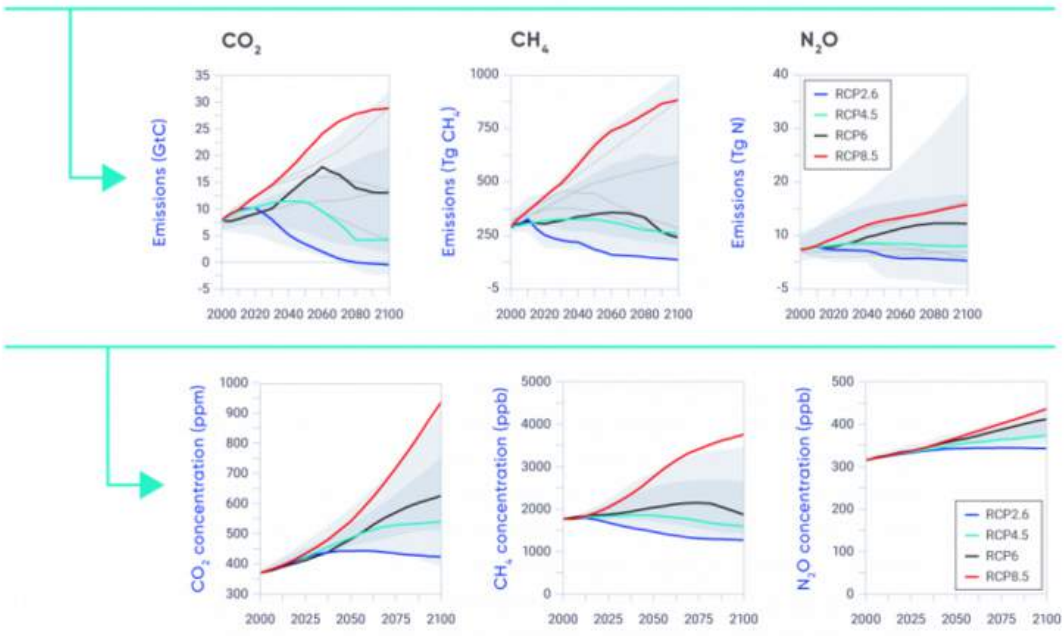

Figure 20: Correlation between GHG emissions and GHG concentrations and RCP scenario Source: CCCR 2019

2.4.3 From Global to Regional Climate Models

The climate projections presented above rely on global system models. Downscaling from global to regional (for example, focusing on western northern America) would provide a higher degree of detail. The downside of downscaling is uncertainty and reduced reliability of data and projections. To this day, local and regional impact studies based on the global projections remain the most reliable approach. However, the UBC Centre for Forest Conservation Genetics' ClimateBC Map is an interactive tool offering climate projection scenarios for different RCPs and for a very localized area.

2.4.4 Climate Projections for Metro Vancouver and Consequences

In June 2016, Metro Vancouver, in collaboration with the Pacific Climate Impacts Consortium (PCIC), released a report, *Climate Projections for Metro Vancouver* (Metro Vancouver 2016). Beyond confirming an average temperature increase of 1.7°C by the 2050s (2040-2069), the report offers projections on specific indicators of temperature and precipitation to support a municipal adaptation plan.

As shown in the table below, the projections for Metro Vancouver are

- In the summer, warmer temperatures, a significant increase of growing degree days[14] and longer dry spells[15].
- In the winter (and shoulder seasons), more precipitation, significantly less heating degree days[16], more frost-free days.

Not shown in the table below, but included in the projections, are more intense extreme events, such as winter storms.

[14] Growing degree-days measure heat accumulation required by cultivated plants and other crops. Any day with an average temperature above 5°C is a growing degree-day.

[15] Dry spells represent the longer stretch of dry days in a year, or the number of consecutive days where daily precipitation is less than 1mm.

[16] Heating degree-days is a derived variable that can be useful for indicating energy demand (i.e. the need to heat homes, etc.)

Summary of Climate Change for Greater Vancouver in the 2050s

Climate Variable	Season	Projected Change from 1961-1990 Baseline	
		Ensemble Median	Range (10th to 90th percentile)
Mean Temperature (°C)	Annual	+1.7 °C	+1.0 °C to +2.5 °C
Precipitation (%)	Annual	+7%	-2% to +11%
	Summer	-15%	-25% to +3%
	Winter	+6%	-4% to +15%
Snowfall* (%)	Winter	-36%	-56% to -19%
	Spring	-56%	-73% to -17%
Growing Degree Days* (degree days)	Annual	+415 degree days	+250 to +609 degree days
Heating Degree Days* (degree days)	Annual	-589 degree days	-853 to -360 degree days
Frost-Free Days* (days)	Annual	+22 days	+14 to +33 days

The table above shows projected changes in average (mean) temperature, precipitation and several derived climate variables from the baseline historical period (1961-1990) to the **2050s** for the **Greater Vancouver** region. The ensemble median is a mid-point value, chosen from a PCIC standard set of Global Climate Model (GCM) projections (see the 'Notes' tab for more information). The range values represent the lowest and highest results within the set. Please note that this summary table does not reflect the 'Season' choice made under the 'Region & Time' tab. However, this setting does affect results obtained under each variable tab.

* These values are derived from temperature and precipitation. Please select the appropriate variable tab for more information.

Table 8: Summary of Climate Change for Greater Vancouver in the 2050s, annual averages
Source: Pacific Climate Impacts Consortium 2012.

The next section, extracted from the Climate Projections for Metro Vancouver, offers more detail on selected indicators relevant to this report.

2.4.5 Focus on Key Indicators

2.4.5.a Precipitation Indicators

Dry Spells
A dry spell represents the longer of either a stretch of dry days in a year or the number of consecutive days when daily precipitation is less than 1 mm. This indicator reflects times of the year when reservoirs are not recharged by rainfall. It is an annual average and does not reflect extreme droughts. Dry spells in Metro Vancouver are expected to extend from 21 days to 26 days by the 2050s, a 24% increase.

Five-day Max Precipitation
Five-day maximum precipitation describes the largest amount of rain that falls over a period of five consecutive days in the year. This indicator shows how extreme precipitation will change over time. The total annual precipitation is expected to increase by 5% by the 2050s but models show that the increase will be concentrated into the wettest days, i.e. winter. As a result, the amount of rain in the wettest 5-day period will increase by 12% by the 2050s.

1-in-20 Wettest Day
The 1-in-20 wettest day is the day so wet that there is only a one-in-twenty chance (or 5% chance) in any year that a one-day rainfall event of this magnitude will occur. This indicator shows the extreme one-day storm events. The projected 1-in-20 wettest day will increase by 36% in lower elevations by the 2050s, meaning that extreme storms and related flooding will be 36%

more likely to happen. The projections for this indicator also seem to suggest that these extreme storms will happen more frequently.

2.4.5.b Summer Temperatures Indicators

The projections of the average summer daytime high temperatures suggest Metro Vancouver would be warmer than present San Diego by the 2050s. The indicators provide more details on how summers will be hotter, longer and drier.

The figure below illustrates the projected increase of temperature in summer months.

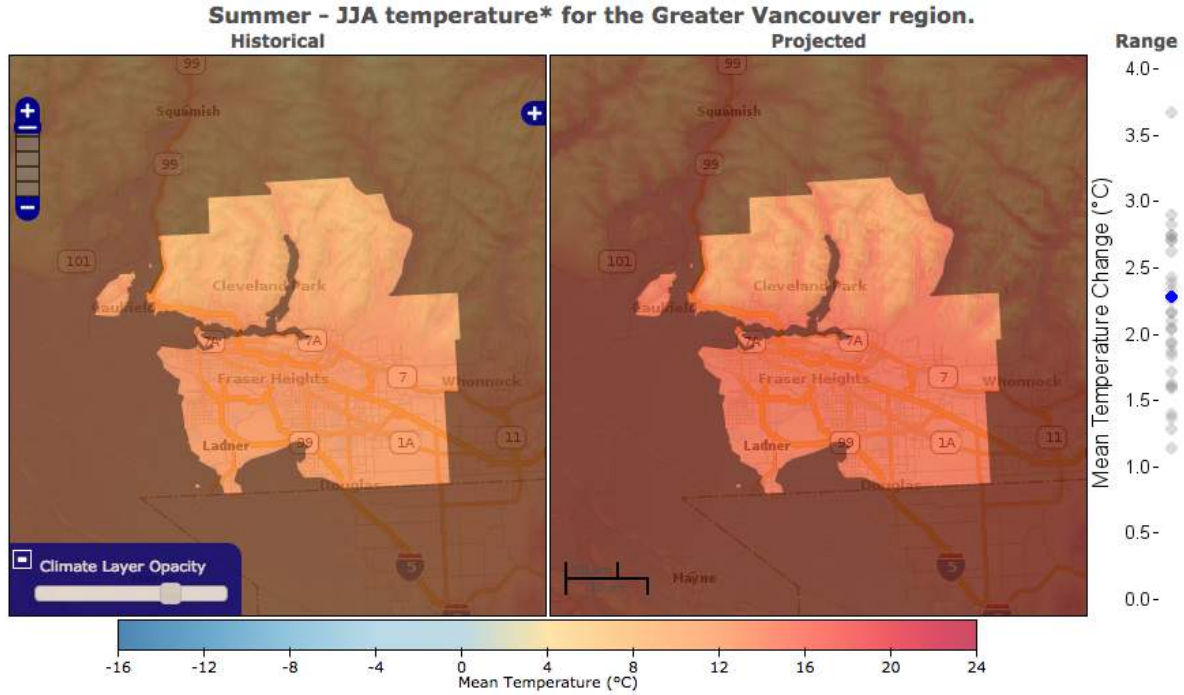

Figure 21: Projected summer temperatures in Metro Vancouver in the 2050s
Source: Pacific Climate Impacts Consortium 2012

Heat Days
Heat days refer to the number of days where the daytime temperature exceeds 30°C. This indicator reveals "heat zones" where some plant varieties experience physiological stress. The projected increase for heat days is 600%, from an average of 2 days in the past to 14 days in the 2050s.

Growing Season Length
The growing season length is an annual measure that counts the number of days between the first span of at least 6 days with a daily average temperature greater than 5°C, and the first span after July 1 of 6 days with a temperature less than 5°C. It indicates the length of the growing season for agriculture, for typical cultivated plants, and other crops in the Metro Vancouver region. In lower elevations where most agricultural activities currently take place on Bowen Island, the increase of the growing season length is projected to be 18%, from 252 days in the past to 297 days in the 2050s.

Growing degree-days

Growing degree-days measure heat accumulation required by cultivated plants and other crops. Any day with an average temperature above 5°C is a growing degree-day. The value of growing degree is the difference between the average temperature and the 5°C. For example, if the average temperature is 11°C, the value of growing degree for that day is 6. Annual growing degree days are accumulated this way for each day of the year and then summed. This indicator reflects opportunities for agriculture, but also for invasive species to thrive. By the 2050s, we can expect 44% more growing degree-days in lower elevations (increase from 2122 growing degree days in the past to 3051 days), as illustrated in the figure below.

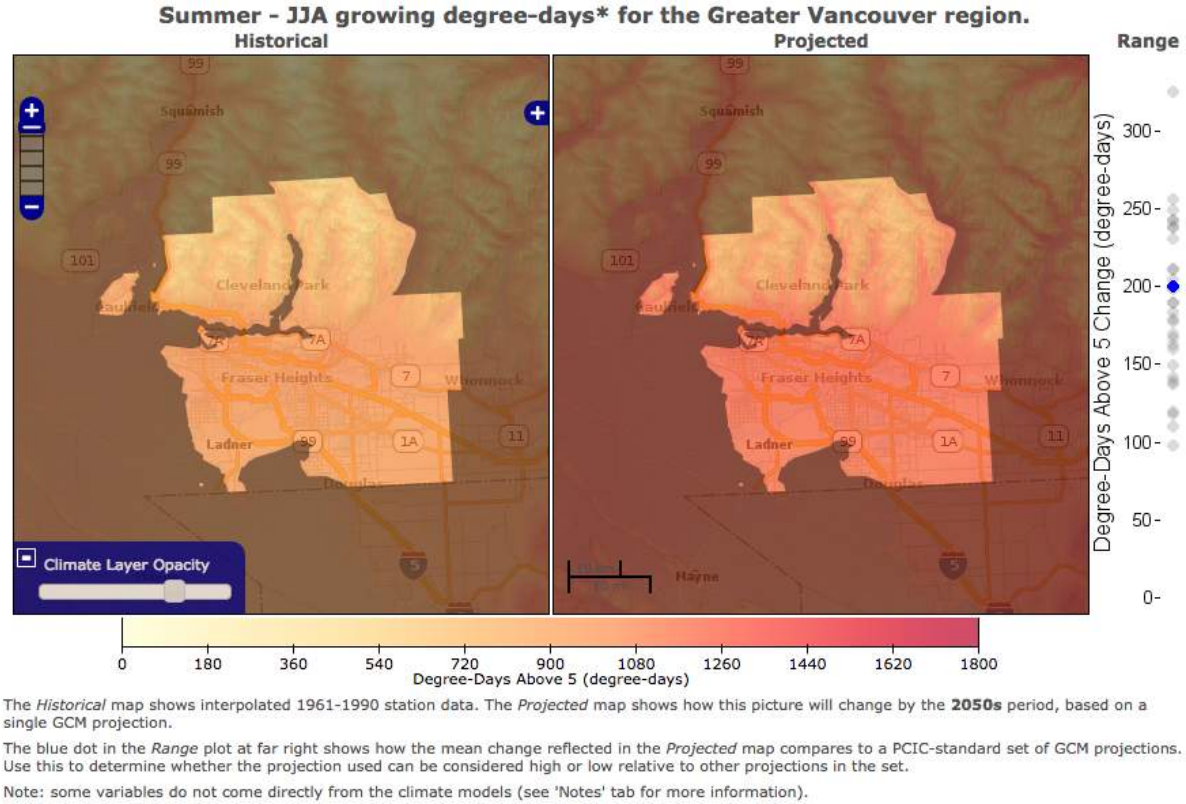

Figure 22: Projections of Summer Growing Degree Days for the Greater Vancouver region in the 2050s
Source: Pacific Climate Impacts Consortium

2.4.5.c Winter Temperatures Indicators

Future climate projections suggest our region will see warmer winter months. A frost day refers to the number of days where the minimum daily temperature stays below 0°C. This indicator is useful to determining the suitability of growing certain crops in a given area. It is also useful when predicting how pests and invasive species may develop and disturb existing ecosystems.

By the 2050s, the number of frost days for lower elevations is projected to be only 11, a 72% decrease. An almost frost-free winter is particularly favourable to the emergence and development of pests and invasive species, possibly detrimental to ecosystems and cultivated crops.

The projections for this set of indicators demonstrate hotter, drier, longer summers as well as warmer and wetter winters (and possibly springs and falls), punctuated with more frequent and more extreme weather events, such as droughts, floods and wildfires.

According to the BC Agriculture Climate Action program, the projections for Bowen Island are expected to be very similar to the other municipalities of Metro Vancouver. However, most islands in the Island Trust, Bowen Island included, are expected to experience even drier conditions, with a varying severity based on water storage, ground water capacity, and aquifer recharge ability.

2.4.6 Impacts of Climate Change and Adaptation Needs

As an integral part of their Plan2Adapt program, the Pacific Climate Impacts Consortium presents how certain sectors will be affected by the impacts of climate change presented above. The table below is an extrapolation of the list presented on their website.

Impacts	Affected sectors
Increase in hot and dry conditions	Agriculture, land use planning, fisheries
Increase in temperature	Agriculture, forestry
Reduced water supply	Agriculture, biodiversity, land use planning, fisheries
Waterlogged soil (after a storm)	Agriculture, land use planning
Sea level rise /storm surge	Agriculture, land use planning
Possible change in productivity	Agriculture
Possible flooding	Hydrology, infrastructure, agriculture
Longer dry season	Agriculture, forestry, hydrology
Shift in hydrologic regime classification	Biodiversity, hydrology
High intensity precipitation	Biodiversity

Table 9: Potential impacts for greater Vancouver in the 2050s (adapted). Source: Pacific Climat Action Consortium 2012

If these projections for the 2050s are accurate, agriculture and ecosystems (biodiversity) will be negatively affected and adaptation management plans will need to be implemented, particularly around water use and storage.

Ecosystems and Biodiversity
Increase of temperatures and dry spells will put pressure on our local terrestrial and aquatic ecosystems and the diversity of the species they host. Some species will thrive while others will decline. The Coastal Western Hemlock Dry and Very Dry biogeoclimatic subzones (CWHdm and CWHxm1), dominant on Bowen Island, are already showing clear signs of hydric stress across the island. As presented previously, 70% of the ecosystem communities are already of significant concern, threatened or endangered. According to the projections, it is very likely that this proportion will increase, and that tree, bush, and plant mortality will become more common, representing a higher vulnerability to wildfire propagation in the 2050s. Dry spells in the summer, combined with extreme and erratic rainfall in the winter (and possibly spring and fall), will affect soil moisture and drainage, worsening the consequences of droughts (if water retention is poorer) and of potential flooding.

Adapting for Resilient Agriculture
Projected climate changes will have important consequences on the quantity, quality, and diversity of food production and on the livelihood of the agricultural sector.

In terms of opportunities, the local growing season will be extended. Some crops could be cultivated year-round, and the range of suitable cultivated crops will evolve, possibly diversify. Warmer winters also mean lower costs of heating for greenhouse operations. Such changes will require research and support to help the farming and gardening community on Bowen Island to transition adequately and take advantage of these opportunities.

In terms of challenges, longer dry spells and more hot days is indicative of more potential pressure on water supply, with possible competition between consumption and irrigation. This threat points to the need for resources and guidance on water management (water supply, storage and drainage) but also highlights the importance of pest and invasive species management and best practices for natural resource management such as water, soil, and biodiversity.

Similarly, dry spells in the summer combined with extreme and erratic rainfall in the winter (and possibly spring and fall), will have serious consequences on soil structure and drainage and its agricultural capacity.

The *Climate Change Adaptation Programming* report (BC Agriculture Climate Action Initiative 2018) presents some of the successful actions implemented across the province. This program is available to all farming communities in BC willing to develop adaptation strategies for farm-level and community-level resilience.

Preparing Agriculture for Extreme Weather Events
The increased variability, frequency and severity of storms, droughts, wildfires, and flooding also requires proactive planning to address the intensifying impacts of climate change emergencies, to reduce vulnerabilities, and to improve speed recovery. The project on 'Adapting BC Horticulture through Protected-Crop Research and Demonstration' (Climate Action Initiative, UBC Faculty of Land and Food Systems 2018) in the Lower Mainland and the Cariboo is designed to help the agricultural sector adapt and anticipate projected climate disruptions.

- Drought and wildfires

Longer dry spells and more hot days are indicative of more frequent droughts and higher probability of wildfires. Risks and vulnerabilities for farms to both drought and wildfires need to be addressed. Implementing adequate measures of preparedness and mitigation should not be the exclusive responsibility of each farming operation. Different levels of governments should be involved in offering resources and technical support.

- Storm surges and flooding

The single day max precipitation and 1-in-20 wettest days indicators reflect more frequent extreme rainfall events in the winter (and potentially spring and fall). Increased rainfall will have consequences on coastal flooding[17], spring freshets, soil drainage, and soil productivity, all of which threaten cultivated land and the number of workable days in the field. On Bowen Island, most of the prime agricultural land is located in valley bottoms, a geographical zone that is prone to flooding and waterlogged soils. Implementing a water catchment in the upper parts of a given

[17] Coastal flooding describes the combined impact of sea level rise and storm surges (Climate Action Initiative, 2018)

watershed and at the farm-level, as well as having a water drainage plan at the farm-level, are preventive measures requiring resources and technical support from different levels of government. Ensuring that the upper part of the watershed remains untouched forest is also fundamental.

The Climate Adaptation Initiative offers information and recommendations for proper drainage in their study, *Improving On-Farm Drainage Management to Reduce the Impacts of Climate Change in Delta, BC* (Climate Action Initiative 2017). The agricultural lands of Bowen and Delta are not comparable. However, getting a better understanding of the initiatives in Delta and other agricultural municipalities in Metro Vancouver, the Gulf Islands, and the Sunshine Coast could provide useful insights for Bowen Island.

3. Production System, Economic Viability, and Food System Resilience

As demonstrated previously, Bowen Island has a rich history of farming dating back to the nineteenth century. At that time, the majority of permanent residents had a vegetable garden and an orchard. The most successful homesteaders managed to sell their production surplus to neighbours, the Union Steamship Company, or to the City of Vancouver. Times have changed, along with population density and the demographics of Bowen Island residents.

The groundwork research conducted by the Bowen Island Food Sovereignty (BIFS) group in the spring/summer of 2019[18] produced an overview of current agricultural characteristics on Bowen Island by surveying what is being grown and what the island's growers and gardeners are experiencing. The engagement tools used by BIFS during this inquiry included an online survey open to the community at large, a facilitated stakeholder workshop, and a series of one-on-one interviews with two natural resources professionals and experienced gardeners and farmers.

The information collected during this groundwork phase is presented in the report, *Toward a Resilient Food System for Bowen Island: Communication and Engagement Groundwork* (Bowen Island Food Sovereignty September 2019). While this report provides rich qualitative information, including verbatim quotes, it is neither exhaustive nor statistically representative of the island's approximately 3,700 residents. Time and budget constrained the scope of the groundwork's duration and reach, making the data collected indicative but not representative. A more in-depth, quantitative study would be required to gather reliable data about what is being produced each year and in what quantities.

3.1 Production System and Economic Viability

In the brief from the Ministry of Agriculture, the 2016 Agriculture Census for Bowen Island was amalgamated with other Metro Vancouver municipalities. This makes it impossible to clearly delineate the number of farms on the island, average farm size, details on farmland use, and which farms have written succession plans and other characteristics.

According to the 2019 BC Assessment, there are 22 Residential ALR properties and 8 Residential Farm properties on Bowen Island. Based on the information provided by a Bowen Island Municipality planner in April 2019, there are 18 properties assessed as having Farm Status whose farmers sell part of their agricultural production.

Additionally, it is important to note that Farmers' Market vendors are not required by the Bowen Island municipality to obtain business licenses. Therefore, individuals whose only retail food enterprise is selling at the Farmer's Market would not be licensed and their agricultural production would not be counted in official records kept by the Municipality. This implies that the number of individuals selling part of their agricultural production is greater than the official records of the Bowen Island Municipality would indicate.
Appendix 5 lists Bowen Island farms and gardens selling part of their production. The marketing avenues for local agricultural production include the Farmers' Market from May to October, the

[18] Simultaneously to the writing of this report

Ruddy Potato Whole Foods Store, and farm gate stands. One experienced farmer interviewed said that the most profitable avenue was selling directly to restaurants.

The variety of crops being grown on the island is quite representative of what grows well in Southwest British Columbia. The table below is a compilation of information shared by interviewees and respondents to the online survey.

Animal products	Broilers, eggs, lamb, meat birds (chicken, turkey), pork, wool
Berries	Boysenberries, blueberries, currants, gooseberries, mulberries, raspberries, Saskatoon berries, strawberries, tay berries
Fruit trees	Apples, cherries, figs, kiwis, persimmons, pears, peaches, plums
Nut trees	Chestnut, hazelnut, walnut
Roots	Beets, garlic, onions, potatoes, radishes, sweet potatoes, carrots
Vegetables & Fruits	Brassicas, beans, herbs, rhubarb, greens, squash (winter and summer), cucumbers & tomatoes
Other	Cider, Christmas trees, edible flowers, honey, seeds

Table 10: Crops grown, livestock raised, and products manufactured on Bowen Island in 2019

Tomatoes, carrots (small rainbow carrots especially), lettuces, garlic and eggs were identified as easy to sell by experienced growers/gardeners interviewed. Broilers and eggs were mentioned as easy to sell and profitable. However, local meat production and inspection regulations restrict the operation of an abattoir and meat processing on Bowen Island. This requires that the slaughter of animals and meat processing be done in the Fraser Valley, an added transportation expense, which discourages raising livestock on the island. Several interviewees confirmed that they would have more animals if the regulations imposed on production and processing were eased.

There are other factors making agricultural production difficult on Bowen Island, some being related to the biophysical constraints, others to the profitability of agricultural activities.

Biophysical constraints refer to agricultural capability of the land on Bowen Island as well as limited water supply during the growing season and the proliferation of invasive species and pests. As presented previously, agricultural capability on Bowen Island faces important limitations, topography, stoniness and lack of prime land (class 1-3) being the major ones. Alleviating or removing such limitations is possible but costly and time-consuming. Similarly, water supply limitations are not irreversible but would require water collection and storage infrastructure, which come at a cost and require technical assistance. As for invasive species and pests, there is currently no island-wide program addressing this constraint.

As for profitability, Bowen Island is perceived as a challenging place to engage in agricultural activity. Some of the growers/gardeners interviewed reported that producing food seems to be getting harder. Some contrasted Bowen Island to other Gulf Islands, which they viewed as having much more association with agriculture.

All growers/gardeners interviewed work other jobs in order to sustain their agricultural activity. As it is everywhere else in Southwest BC, the cost of living and cost of land inside or outside of the ALR are very high on Bowen Island. It is difficult to generate the revenue necessary to cover the operational costs of farming and mortgage payments, let alone an income above expenses. There is currently no land-sharing program on Bowen Island to encourage aspiring farmers. Offering uncultivated farmland for sharing is one way to lower barriers to entry-level farmers.

Such an arrangement might also help landowners if they can produce enough to secure farm status and thus a tax benefit.

Several of the growers/gardeners mentioned that regulations (such as local meat production and inspection regulations) on Bowen Island were particularly costly and onerous, which appears to be yet another significant constraint.

The most visible commercial farm operation on Bowen Island has identified several limitations that prevent it from flourishing: lack of suitable infrastructure, lack of accommodation for farm workers, and having only a short-term lease for the land under cultivation.

There are, however, a number of possible improvements that would contribute to the economic viability of commercial operations on the island. They are explored in the recommendation section of this report.

3.2 Food System Resilience on Bowen Island

3.2.1 Definition of Food System Resilience

The concept of resilience has been used in many disciplines and in ecology and natural resource management especially (Bonnor 2019). Resilience can be described as the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC 2012).

Applied to food systems, resilience can be understood as "the capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances" (Tendall et al. 2015). Hence, food system resilience is one component of food security over time and despite disturbances as represented by the figure below.

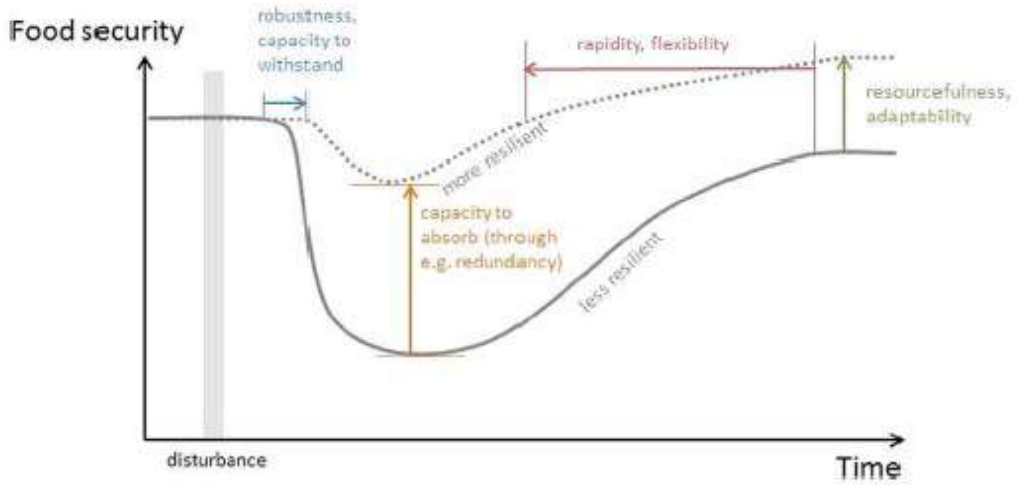

Figure 23: Relationship between food security and food system resilience. Source: Bonnor 2019)

In other words, a resilient food system is a well-functioning food system, resulting in food security: ensuring food is accessible and available to all people at all times (Biehl et al. 2017).

However, resilience changes over time and has several interconnected dimensions: social, economic, ecological, technical, and organizational. Social resilience refers to connectedness, to the existence of strong relationships that engender mutual support during times of disturbance, and the ability to recover quickly and collectively. Economic resilience refers to the capacity to avoid or limit financial losses caused by or related to the disturbance (Bonnor 2019). Ecological resilience is the capacity of ecosystems to withstand disturbances without changing basic processes and structures (Holling 1973). Technical resilience is the ability of infrastructure to perform after a disturbance (Bruneau et al. 2003). Organizational resilience is the capacity to maintain decision-making and management abilities during and after the disturbance as well as the ability to display flexibility of governance after the disturbance (Bruneau et al. 2003; Smith & Lawrence 2018).

To address resilience in a food system threatened by climate change poses particular challenges and requires proactive attention in each dimension. Specifically, a resilient food system requires conserving and restoring the natural resources and biodiversity it relies on; minimizing GHG emissions; managing solid and liquid waste; optimizing cultivation on available land without disturbing adjacent ecosystems; ensuring the economic viability of food operations (production, processing, storage and distribution); and ensuring that the shortest and closest food supply chains are reliable and robust.

Some key characteristics of a resilient food system are diversity (of production, income and sometimes practices); a dynamic local food economy with employment creation; farmland preservation and revitalization; a vibrant community where individuals are connected and have access to healthy food choices; stewardship of land and resources; and affordable farm-worker housing. These characteristics are also representative of a place-based food system that is designed for resilience (Kwantlen Polytechnic University 2018).

Exploring the dimensions of resilience inevitably leads to a contemplation of vulnerability. In fact, vulnerability is defined as a function of exposure, sensitivity, and resilience to a disturbance (Lengnick 2015; Prosperi 2016). Exposure is defined by the characteristics and magnitude of the disturbance, and sensitivity is the degree to which the system is affected by the disturbance (City of Vancouver 2012). Resilience, exposure, and sensitivity will determine the overall response of a system to the disturbance. As described by the United Nations, the conditions determined by the physical, social, economic, and environmental characteristics of the food system and interacting systems, influence the susceptibility of the system to the impacts of the disturbance (United Nations 2017).

In the context of our climate change emergency, with its concomitant pressure on land and natural resources, it appears that addressing food system resilience is a necessity. Given the distinct vulnerabilities of island communities due to their relative isolation and reliance on the mainland, developing a mitigation and adaptation strategy is critical. In conjunction with longer term planning, it would make sense that food system resilience or, at the very least, food security, be included in the scope of the island's emergency and preparedness plan.

3.2.2 Indicators of Food System Resilience

From this definition of food system resilience emerges a set of food system resilience indicators: food sovereignty, natural resource stewardship, arable land use management, waste management, and economic viability. Each of these indicators represents an adaptation or mitigation measure

that addresses the climate change emergency. These are priority indicators, but others could be added to address specific needs and conditions on Bowen Island.

Food Sovereignty

Food sovereignty and food security are sometimes used interchangeably when they are, in fact, distinct. A broadly used definition of food sovereignty is offered by the global movement of La Via Campesina: "Food Sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems."

Food sovereignty goes beyond food security in the sense that it not only addresses food access and distribution but also food justice. Food sovereignty also pays attention to who is growing the food and how it is being grown. In 2007, the International Forum for Food Sovereignty in Nyéléni, Mali developed six pillars, foundations of the concept of Food Sovereignty (Food Secure Canada).

Members of the Indigenous Circle developed a seventh pillar during the People's Food Policy process (Food Secure Canada 2015). The seven pillars of food sovereignty encourage more food production at a local scale as well as community building, contributing to social resilience. The seven pillars offer guidance in the spirit of social cohesion. While not all pillars are actionable, they provide a framework for environmental stewardship and social cohesion. Because food sovereignty is a comprehensive ideal, it makes sense that these principles be embedded in a resilient food system. The pillars are presented in the table below.

1. Focuses on food for people	Puts people's need for food at the centre of policies Insists that food is more than just a commodity
2. Builds knowledge and skills	Builds on traditional knowledge Uses research to support and pass this knowledge to future generations Rejects technologies that undermine or contaminate local food systems
3. Works with Nature	Optimizes the contributions of ecosystems Improves resilience
4. Values food providers	Supports sustainable livelihoods Respects the work of all food providers
5. Localizes food systems	Reduces distance between food providers and consumers Rejects dumping and inappropriate food aid Resists dependency on remote and unaccountable corporations
6. Puts control locally	Places control in the hands of local food providers Recognizes the need to inhabit and to share territories Rejects the privatization of natural resources
7. Food is sacred	Recognizes that food is a gift of life, and not to be squandered Asserts that food cannot be commodified

Table 11: The 7 pillars of Food Sovereignty. Source: Food Secure Canada 2015

Natural Resource Stewardship

Another indicator of food system resilience is the ability to preserve and restore those natural resources that a food system depends upon and/or has an impact on. Conserving water, collecting and storing rainwater, and protecting groundwater are ecological resilience measures that will likely be instituted in the near future given climate projections for the islands in the Islands Trust.

Soil is another crucial natural resource needing attention on Bowen Island. Quality soil is not abundant on the island, but soil regeneration can be achieved over time by incorporating compost obtained through an aerobic method and integrating a rich microbiome[19] that will catalyze the delivery of nutrients to cultivated crops. Regenerative systems are optimal for water retention and the sequestration of atmospheric carbon. Biochar[20] is another method of soil regeneration worth considering.

Biodiversity refers to a diversified and healthy population of plants, animals, and microorganisms both above and below ground. Biodiversity is essential for supporting the resilience of ecosystems. Microbes, grazing animals, and forests play a fundamental role in our food system. Pollinators are the most well-known example of a 'biodiversity service.' It has been demonstrated that plants that depend on pollination make up 35% of global crop production volume (New York Times 2016).

Other natural resources, such as forested land, which covers 50% of the island (Islands Trust Conservancy 2018), deserve consideration and preservation. Trees represent formidable carbon sinks and offer favourable services when adjacent to arable land, such as windbreak, soil fertilization, and water retention.

[19] cf. glossary
[20] cf. glossary

Arable Land Use Management
Land use management is and will increasingly be pressured by increases in population and the consequences of climate change. Arable land use management needs careful planning before implementing appropriate mitigation or adaptation measures to avoid any negative impact on natural resources or competition with forest cover of the island.

As mentioned previously, one pillar of food sovereignty is a localized food system. Applied to Bowen Island, a localized food system would mean an increase in on-island food production to reduce dependence on imports from the mainland. In terms of land use management, increased food production often means expansion of arable land, which could be achieved one of two ways. The most logical one would be to revitalize Bowen Island's existing or previously farmed land, inside and outside of the Agricultural Land Reserve. Another possibility is to allow for clearing of land in order to create space for crops and livestock. The first option is the least disruptive. The latter could result in ecosystem degradation and competition for natural resources and should be discouraged.

While the expansion of food production onto existing or past farmland is the less disruptive option, it is important to note that some farmland is currently forested and is delivering important ecosystem services to the adjacent cultivated areas.

The least damaging approach to arable land use management would be to optimize the existing farmland surface and increase yields per hectare using sustainable methods. Agroecology, regenerative agriculture, and agroforestry are considered "best practices" among current agro-environmental approaches.

If the population of Bowen Island were to increase as per 2050 projections, the expansion of farmland needed for local food production to maintain a constant caloric intake per capita would depend on islanders' diets and agricultural methods. A higher share of animal products in the diet and lower crop yields would require a larger surface of farmland. This would not be compatible with the biophysical constraints of farmland on Bowen Island.

Green Waste Management
Green waste refers to food scraps and yard trimmings, also called "organic waste," which is collected weekly by Bowen Waste Management, Ltd.

Since the inception of the weekly municipal pick up of organic waste, the quantity of material collected and shipped to the mainland has increased significantly. In 2018, 540 metric tonnes of food scraps and yard trimmings were exported to Sea to Sky Soils in Pemberton, BC.

Greenhouse Gas (GHG) emissions produced in the transportation of waste disposal are high. Removal of green waste from the island includes trucking and ferry transport and, additionally, necessitates the importation of compost and topsoil from the mainland for gardens on the island. This, of course, produces more GHG emissions, especially in the spring when landscaping companies are busiest. Ironically, some of these imported soil products come from Sea to Sky Soils, the very company that receives shipped waste from Bowen Island.

A closed loop for green waste produced on Bowen Island would not only reduce GHG emissions, a mitigation measure addressing the climate change emergency, but would also recycle biomass and nutrients into on-island compost, making it less expensive and more accessible for islanders.

Accessible, island-made compost might even be an incentive for people to increase food production.

Turning local waste into a natural resource (topsoil) contributes to food sovereignty and is another indicator of food system resilience. It is important to note that in July 2019, the Bowen Island Municipality issued a request for proposals (RFP) for an on-island composting feasibility study.

Operating a composting facility is more complex than it would seem, requiring comprehensive and careful planning, including clear terms of reference and ongoing administration. Several prerequisites, such as the regulation of pesticide and herbicide use, which otherwise can contaminate yard trimmings, need to be established. In order to ensure that the end product is of good, consistent quality and is safe in food production, such contaminants must be isolated from the compost production cycle. For anaerobic technologies, methane and other potent GHG emissions produced as a by-product should ideally be captured and converted into a renewable energy source.

Economic Viability

Achieving and maintaining food system resilience requires a healthy, local food economy. Measures of a robust economic system include an assessment of the profitability of food production, processing, and distribution enterprises, including efficient marketing and sufficient demand. Receptivity and support from the community and local government would increase the prospect of economic viability.

To create food system resilience requires securing land access, establishing agriculture as a component of rural development, and having commitment to food production as an element of community economic development.

To generate a satisfactory annual income over the course of a six-month growing season (May-October) can be challenging and will become riskier as climatic patterns become less predictable. Diversification of agricultural activity and investment in infrastructure are needed to extend the local season and spread revenue generation throughout the year. Such measures would improve economic viability and financial security.

Developing mechanisms to support succession planning of farmland ownership and/or to facilitate inter-generational transfer of skills would also contribute to food system resilience by securing the next generation of agricultural growers and gardeners. A final, yet equally important aspect of economic viability, is the availability of affordable accommodations for farm and food business workers, without which a local food economy cannot thrive.

3.2.3 Opportunities for Enhanced Food System Resilience on Bowen Island

There are very few positive aspects to the climate change emergency that we are facing. Re-invigorating and rethinking our approach to food systems could, however, be one.

The prospect of Bowen Island's population growth is a significant factor, reinforcing the need to strengthen our local food system and reduce our reliance on imported foods. Optimizing the existing arable land that is or once was in production and offering guidance on best agricultural practices and environmental stewardship should be a priority if we want to move towards food system resilience on Bowen Island.

Implementing solutions that meet the priority indicators of food system resilience for Bowen Island will require a substantial commitment. While a green waste management program is making some progress, other indicators will require more research, more community education, more stakeholder engagement, and, most likely, the involvement of local government to move forward. Additionally, implementing appropriate and long-term support mechanisms will require funding.

The following section presents recommendations for the next steps towards food system resilience on Bowen Island.

4. Recommendations

Despite its rich farming history, contemporary Bowen Island is not widely viewed as a community that celebrates agriculture and local food. In fact, most of the historic farms on the island are unknown to the most recent residents. Outreach and educational efforts exist but remain insufficient and not widely supported. There are clear social, political, biophysical, and marketing limitations that prevent agricultural activity from being viable on the island, let alone profitable. However, adopting best agricultural practices and supporting a stronger local food system present a very promising pathway towards building community resilience mechanisms for dealing with the climate change emergency that is intensifying.

Will Bowen Island, as a municipality and as a community, rise to the challenge and identify ways to reduce its GHG emissions and sequester atmospheric carbon while building a more resilient food system for all?

The recommendations below are meant to inspire action. Many of the proposed approaches will require further research and discussion to determine whether or not they are applicable to Bowen Island and whether or not the community supports them.

This section is organized according to the framework of the Metro Vancouver Food Action Plan (appendix 1-B) and integrates the existing objectives and policies of Bowen Island's Official Community Plan (OCP). Other frameworks or policies from other jurisdictions or levels of government in Canada have been included when relevant. In 2016, several municipalities, Bowen Island excluded, endorsed the Metro Vancouver Food Action Plan. Three of the five Food Action Plan goals are presented here as opportunities for action.

Goal 1: Increase Capacity to Produce Food Close to Home

1.1 Protect [and revitalize] agricultural land for food production

To paraphrase the title of a recent white paper by the Institute for Sustainable Food Systems at Kwantlen Polytechnic University, "protection is not enough." Protecting BC's farmland is important but has to be done in conjunction with the revitalization of its use. Of the 172 hectares of Agricultural Land Reserve (ALR) on Bowen Island, only 15 hectares were actively farmed. Another 12 hectares was farmed outside of the ALR in the surveyed area (Ministry of Agriculture, 2016). Almost half of the surface of ALR on Bowen Island is within Crippen Park, under the jurisdiction of Metro Vancouver and zoned as 'unavailable for farming due to existing land use.'

Meanwhile, Objective 88 of the OCP intends "to encourage Metro Vancouver Parks to plan and implement active farming uses for ALR lands in Crippen Regional Park, subject to the environmental policies of this OCP, as demonstration farming, allotments or recreational gardening if compatible with park values."

When considering how to protect and potentially revitalize farming on the ALR in Crippen Park, the Federal Agricultural Park framework of Rouge National Urban Park of Parks Canada (Ontario) offers some valuable insights about how to reconcile recreational and agricultural uses of a protected park. Rouge National Urban Park contains large tracts of fertile Class 1 farmland and is the first federally protected area in Canada to protect agriculture as well as nature and cultural heritage. Although Parks Canada doesn't have a tradition of supporting agriculture, the

federal institution was progressive enough to see value in protecting farmland, celebrating a farming heritage and keeping it active for the benefit of Ontarians (Parks Canada, 2019).

Additionally, funding and support from the Metro Vancouver Regional Parks Committee could help to preserve the legacy of the Island's most iconic heritage orchard, namely Davies Orchard. Working with the Bowen Island Heritage Society to rehabilitate the orchard would be a step in the right direction. Given the visibility and central location of the orchard to islanders and visitors alike, an educational, perennial and pollinator garden would act as an educational tool for the Bowen Island community and Metro Vancouver residents visiting the island.

The passage of bills 52 and 15 is reinforcing the protection of the ALR and updating the definition of which activities qualify as farm use. Bill 52 also authorizes ALR owners to build an additional residence, as long as it is for farm use. Since accommodation for farm workers was identified during BIFS' groundwork research as a significant limitation to agricultural activities on Bowen Island, guidance and support from the municipality to ALR owners would be appropriate, as land use and zoning falls under municipal jurisdiction.

The municipality could invite ALR owners to a dialogue about protection and revitalization of the ALR and present information about recent amendments to the Agricultural Land Commission (ALC) Act (Bills 15 and 52). The ALC is sometimes associated with restrictive and costly regulations and the rejection of landowners' applications. Informing ALR owners about the updated regulations, liaising with ALC planners, and having a municipal planner support landowners' efforts to protect and revitalize the ALR could result in support for and expansion of agricultural production, eventually increasing its economic viability (goals 1.2 and 2.4 - see appendix 1-B).

The ALC anticipates that all local governments will have made substantial progress on updating their bylaws by February 22, 2020, to ensure consistency with the ALC Act, the ALR General Regulation, and the ALR Use Regulation. ALC regional planners can offer guidance for drafting bylaws (ALC 2019). As per S. 46 of the ALC Act, "a local government in respect of its bylaws and a first nation government in respect of its laws must ensure consistency with this Act, the regulations and the orders of the commission."

Finally, further research is needed to get a better understanding of why most ALR parcels on Bowen Island are not actively farmed. In the instance of ALR owners being in favour of agricultural activity on their land but unable to take care of the land themselves, the option of farmland trusts could be explored. Farmland trusts are organizations that acquire and maintain land for farming. Land is typically acquired by way of gift or direct purchase and protected with instruments such as covenants or conservation easements, which restrict land use activities to preserve farming capacity (Tatebe et al. 2018). The Foodland Cooperative of BC works with community groups and donors to facilitate putting land into trust for food production (Foodland Cooperative of BC, n.d.).

The Islands Trust has successfully implemented conservation covenants to protect land or a specified amenity in relation to the land. It is not clear at this point if the ALR qualifies under this conservation mechanism. Inquiring with the Islands Trust Conservancy would help to clarify this point. In any case, it appears to be an efficient mechanism to ensure the protection of farmland, especially for heritage farms that have been on Bowen Island since the nineteenth century.

1.2 Enable expansion of agricultural production

The Official Community Plan addresses expansion of agricultural production in Objective 83 and Policy 213. The intention of Objective 83 is "to promote sustainable active farming on lands with agricultural potential and to protect the resources necessary for such agricultural activity for purposes of domestic food production; preservation of open space and rural atmosphere; contribution to a sense of community on Bowen." The municipality's authority for acquiring and protecting land for agriculture is codified in Policy 213, which includes "the establishment of agriculture zoning regulations on lands suitable for productive agriculture;" and the "acquisition of lands for the community" (2010).

Because of the value of Davies Orchard to Bowen Island's agricultural heritage, including it in Crippen Park's ALR would afford it protected status. Such inclusion would make it eligible for rehabilitation projects such as those mentioned in section 1.1 of Part 4 (Recommendations) of the current document, encouraging high visibility agricultural production.

The soil survey and the agricultural capability rating system revealed that a significant surface of agricultural land (formed of various parcels or portions of parcels) with good agricultural capability is excluded from the ALR. The next step would be to contract a professional agrologist with experience in soil survey and analysis, arable land evaluation, and GIS mapping, to verify the information provided by the provincial database. Then, starting with the data presented in this report, (s)he can estimate the total surface having good agricultural capability. Depending on the findings, this surface should technically be included in the ALR, which would be a decision that the landowners owning this surface would make.

Finally, encouraging agricultural activities may require guidance from a non-profit organization or volunteer group of knowledgeable food gardeners. With the Bowen Island population projected to keep rising, newcomers may have an interest in producing food in their backyards but may not know how or where to start. Having a dedicated and visible group of volunteers offering support would encourage more agricultural production, improve food production literacy and skills, and enhance access to healthy food.

1.4 Invest in a new generation of food producers

A land-matching program similar to the one implemented throughout BC by the Young Agrarians would encourage aspiring farmers to produce food on Bowen Island. The Young Agrarians BC Land Matching Program provides land matching and business support services to individuals looking for land to farm, as well as landowners interested in finding someone to revitalize their parcel of ALR. This program addresses the significant barrier to land access in the province and invests in the next generation of local food producers (Young Agrarians 2019). One of the Young Agrarian land matchers for Metro Vancouver would likely be available to provide more information on this program and help determine whether or not it is applicable to Bowen Island.

Additionally, offering guidance to ALR owners willing to write a succession plan to non-family members would likely act in favour of the next generation of food producers on Bowen Island.

Goal 2: Improve the Financial Viability of the Food Sector

Within the context of interviewing island food producers, it was learned that all local agricultural operators required another source of income to maintain their agricultural activity. Clearly, working to improve the financial viability of the food sector should be an island priority.

2.1 Increase capacity to process, warehouse and distribute local foods

Objective 85 of the OCP states the intention "to provide for the supporting infrastructure necessary to maintain and strengthen the agricultural economy."

The barriers to raising livestock and increasing farm revenues presented earlier in this report reflect the need to increase the capacity to process, warehouse, and distribute meat and animal products on the island. Other islands of the Islands Trust have explored the option of a mobile abattoir that would travel from island to island. Such a service would not only drastically reduce the operational costs of meat processing but would also lower livestock stress.

As of July 2019, Bowen Island was granted Rural Status, which may change the set of regulations pertaining to local meat production, inspection, and processing. Offering Bowen-raised and Bowen-processed meat would improve the economic viability of raising livestock on the island and would benefit the island's food system resilience.

However, the prospect of an increased livestock population requires cautious planning. An excessive increase could have negative impacts on land use and cause groundwater contamination due to phosphorus and nitrogen runoff and leaching from livestock manure. Regenerative livestock grazing[21] should be prioritized, as it isn't intensive and presents climate change mitigation and adaptation measures such as atmospheric carbon sequestration and soil regeneration.

There are examples of cooperative or sponsored infrastructure components that would support local production, such as season-extending greenhouses, root cellars for the storage of root crops, a commercial kitchen for food processing to extend the shelf life of produce, and farm worker housing, as previously mentioned.

2.2 Include local foods in the purchasing policies of large public institutions

Rather than focusing on public institutions, a more impactful measure would be to involve the Community Economic Development Officer hired by the municipality in spring 2019 in facilitating interactions between restaurateurs/food retailers and food producers to create farm-to-table and farm-to-store synergies. The two examples below illustrate this recommendation.

Example 1: Restaurant A could commit to purchasing X kilos of salad greens from farm B from June to September and Y kilos of butternut squash from farm C from September to December at a fixed price covering sustainable costs of production making the transactions viable for farm B and C as well as restaurant A.
Example 2: After a cost analysis and purchasing plan for Restaurant D, explore with farm E if they could supply Z kilos of cured garlic throughout the year for $x/lb.

[21] C.f. glossary

2.3 Increase direct marketing opportunities for locally produced food

The OCP already addresses some direct marketing opportunities in Policy 214 which includes "permitting roadside stands for farm gate sales of agricultural products," and "encouraging home-based businesses that produce value-added products from locally produced agricultural products."

While encouraging these marketing approaches may benefit the sales of some locally produced products, increasing farm-stand businesses could be viewed as competition for the summer Farmers' Market.

Agritourism is a direct marketing approach that can help to diversify agricultural activity and supplement agricultural income. Agritourism is defined as the "business [open to the public] of establishing farms as travel destinations for educational and recreational purposes" and as any "farming-related experiences enjoyed on a farm or other agricultural setting for entertainment or educational purposes" (Rutgers University, n.d.).

Examples of agritourism include long-table dinners, u-pick sales, farm tours, wine tasting, etc. In 2014, Gabriola Island proposed an amendment to its Land Use Bylaw to support agritourism initiatives: "Where agriculture is permitted, agritourism would be a permitted accessory use on any farm with farm status …" and "on lots larger than 4.0 hectares with farm status, seasonal agritourism accommodation is permitted up to a maximum of four sleeping units (campsites and/or bedrooms in the principal residence)" (Gabriola Island proposed LUB amendment, 2014).

Given that Bowen Island is viewed as a recreational destination by visitors from Metro Vancouver, a similar land use designation could become a driver of community economic development. Agritourism could contribute to the economic viability of the agricultural and food sector and could strengthen the rural identity of Bowen Island. However, a prerequisite would be to clearly define which activities qualify as agritourism on Bowen Island and to analyze how such activities could contribute to the sector's economic viability. The process of defining such activities should involve stakeholders in Bowen Island's food system (producers, retailers, processors, etc.).

2.4 Further develop value chains within the food sector and 2.5 Review government policies and programs to ensure they enable the expansion of the local food sector

Researchers at the Institute for Sustainable Food System of Kwantlen Polytechnic University (KPU) have determined that agricultural "enterprise zones" represent an efficient land use policy that help to raise farm incomes and improve farm viability (Tatebe et al 2018). They are described as a zoning option for agricultural enterprises on commercial and industrial lands, outside of the ALR, in close proximity to farmland and farms that provide local producers with better access to essential agricultural services (Curran & Stobbe 2010). By increasing access to processing and post-harvest infrastructure, such enterprises allow smaller, independent producers to add value or better preserve products, potentially commanding higher prices (Mullinix et al. 2016; Grando & Ortolany 2015).

The City of Pitt Meadows has established an Agricultural Farm Industrial Zone with the intent of enhancing the economic viability of agriculture and the diversification of the agricultural industry in the region (City of Pitt Meadows 2017). On Bowen Island, the Garden Centre and Meadowbrook Corner on Grafton Road are currently zoned as Rural Commercial 1 ALR parcels.

Goal 5: A Food System Consistent with Ecological Health

5.1 Protect and enhance ecosystem goods and services

Bowen Island's OCP Policy 25 stipulates that "the Municipality will encourage the production of biochar from land clearings." While this is a positive sign and acknowledgment of the importance of building soil health, it is not enough. As demonstrated in the surficial geology section of this report, topsoil is among the scarcest of natural resources on Bowen Island. Yet islanders have relied on it (and on imported soil) to grow food since the late nineteen hundreds.

Raising awareness that topsoil is as essential as water is needed. A more developed policy would do much to promote living soils with a rich microbiome (sometimes referred to as belowground biodiversity). Living soil is able to catalyze nutrient flows, sequester atmospheric carbon and enhance water retention (Scientific American 2019). Giving life back to soil is a critical, concrete step needed to effectively counter the climate change emergency.

Another initiative that could further this goal is making a wood chipper available. To be able to borrow or rent a chipper for a small fee would encourage islanders to upcycle land clearing and garden waste into a valuable resource for gardeners and landscapers, as shown in the picture below.

Upcycling of land clearing wood into wood chips to increase water retention (picture taken on the West side of Bowen Island)

5.2 Reduce waste in the food system

As explained in the municipality's request for proposals (RFP) issued in July 2019, composting is one of the most effective ways to reduce food system and garden waste. The RFP seeks proposals for a feasibility study for an on-island composting facility. Other support is needed to bolster islanders' home composting efforts.

Whether at a commercial or backyard scale, composting should be an island-wide priority for recycling biomass and nutrients into a natural resource to enrich Bowen Island's soils, to lower GHG emissions related to exporting of waste and importing of soil, to sequester atmospheric carbon, and to increase water retention.

Commercial composting should be approached with care and requires qualified research about the health and ecological risks of pesticides and GMOs in the end product. In addition to choosing the right technology, a proficient professional should assess the system to ensure that it wouldn't produce negative effects, such as GHG emissions as a byproduct. Quality standards for the system should be high, with regenerative properties of the soil product and waste reduction valued equally.

For home composting, further education and guidance for islanders of all generations (starting at school) would benefit the island as a whole.

Finally, collaborating with food businesses on island and encouraging them to transition from plastic to recyclable packaging, as the Ruddy Potato and General Store are doing, would greatly contribute to the reduction of single-use packaging waste.

5.3 Facilitate adoption of environmentally sustainable practices

Policies 217 and 219 of the OCP both aim at facilitating the adoption of environmentally sustainable practices. Policy 217 addresses rainwater harvesting for irrigation which represents the most obvious sustainable practice, given climate projections and drought conditions reported the last several years in the Gulf Islands and southern British Columbia.

In addition to encouraging water conservation, collection, and storage, policies should include financial incentives to support homeowners (and builders) who invest in the installation and maintenance of such systems.

The Policy 219 statement that "production methods that maintain soil quality and minimize impacts on adjacent lands and the environment are encouraged" is vague. Further elaboration on what is meant by soil quality and by minimizing impacts could be drawn from this report. Encouraging methods of soil regeneration that result in carbon sequestration and increased water retention is a proactive and timely response to the Islands Trust Council's declaration of a climate emergency in March 2019.

5.4 Prepare for the impact of climate change

The previous measures presented for Goal 5 all contribute towards mitigation and adaptation of the climate change emergency. However, to ensure the successful implementation of such measures, agriculture and the food system must be recognized as an integral component of climate action, community resilience, and self-reliance as described in the 2019 Island Plan.

OCP Objective 15 intends "to establish the importance of climate change-related concepts of energy consumption, energy security, GHG emissions, carbon cycling, and local food production in land and site planning, building and transportation." And, policy 26 recognizes "the importance of forested lands in their role to remove and sequester carbon dioxide from the atmosphere."

Again, a more detailed and proactive approach needs to be aligned with the Islands Trust declaration of climate change emergency. Bowen Island needs a specific framework for mitigation, adaptation, and resilience of its food system. Forming a select task force of natural resource professionals to offer guidance on best agricultural environmental practices, on natural resource preservation and regeneration, and on pest and invasive species management practices is needed.

The biophysical limitations of Bowen Island make a small-scale, intensive agricultural model most appropriate. Within the context of a climate emergency, with projections of warmer temperatures, more severe weather events, and more pressure and competition for natural resources, small-scale intensive agricultural models will be more flexible and adaptable to unpredictable circumstances. While smaller size seems to be a disadvantage in the current industrial agricultural model, the flexibility of smaller enterprises will be a strength when it comes to adapting to climate disruptions and transforming the food systems. That is, provided that the proper adaptations and resilience mechanisms are implemented.

One of the most significant climate change mitigation measures available here is the maintenance of the Island's forest cover. Forests represent a potential for tension between the objectives of food security and climate change stabilization. If there is increased competition for land between agricultural and forestry uses, other disciplines can be consulted for ways to navigate any apparent conflicts. Agroecology, and more specifically agroforestry,[22] could offer appropriate options for averting conflict, since they simultaneously work towards the objectives of food security and climate change stabilization (i.e. carbon sequestration, protection of the forest cover, soil regeneration, water retention, belowground biodiversity) (Le Mouël et al 2018).

More generally, the potential for agroecological practices to address the climate change emergency need to be acknowledged, communicated, and promoted by the Municipality.

Agroecology is a trans-disciplinary science, combining the ecological, sociocultural, technological, economic and political dimensions of food systems, from production to consumption. Agroecology supports the transition to a more sustainable food system. It applies ecological principles to agriculture, ensures a regenerative use of natural resources and ecosystem services while addressing the need for food sovereignty.

Agroecology represents an alternative food and farming paradigm, standing in contrast to industrial agriculture. Agroecology is rooted in rebuilding relationships between agriculture and the environment, and between food systems and society. While the practices can be wide-ranging, agroecology is characterized by diversifying farms and farming landscapes, replacing chemical inputs with organic materials and processes, optimizing biodiversity, and stimulating interactions between different species. These practices are part of holistic strategies to build long-term soil fertility, healthy agroecosystems, and secure and just livelihoods. (IPES Food n.d.)

Farms that follow the principles of agroecology have been shown to remove carbon dioxide from the atmosphere by sequestering carbon in the soil and in long-lived biomass such as trees. It may also reduce GHG emissions. Thus, agroecology can help to mitigate climate change. (Agroecology Research Action n.d.)

[22] C.f. glossary

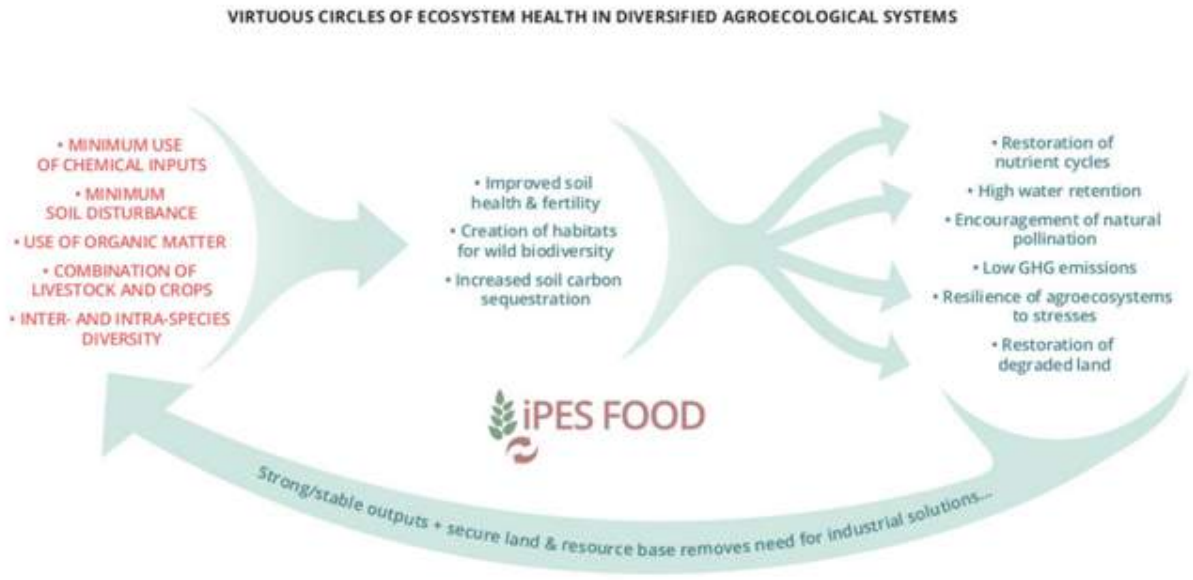

Figure 24: Virtuous circles of ecosystem health in diversified agroecological systems. Source: IPES Food

Final Recommendations

As stated by the Metro Vancouver Regional Food Action Plan in 2016, there are a wide range of food-related policies, plans and programs being implemented by local governments, yet these initiatives are often not labeled as such. In addition to the agriculture plans, food strategies, and food charters prepared by municipalities, actions in support of a food system approach have emerged from a broad range of other policy tools such as Official Community Plans, zoning bylaws and development permit area guidelines. There are also supportive actions embedded in Local Area Plans, Park Plans, Climate Action Plans, Environmental and Social Sustainability Strategies, and Healthy Built Environment initiatives.

While municipalities are responding to the growing interest in local food issues by using available tools and resources, a more strategic, integrated, long-term approach that includes dedicated staff, funding, and partnerships are needed. This conclusion also applies to Bowen Island, which, as demonstrated in this section, already has objectives and policies in its OCP, formed a dynamic Environmental and Climate Action Advisory Committee, issued a Parks Plan in the summer of 2018, has become an active member of the Islands Trust Fund, and succeeded in achieving Rural Status in July 2019, all creating a favourable context for climate action by implementing a sustainable, local food system.

Along with the previous recommendations, this conclusion identifies the many ways in which implementing a sustainable local food system produces climate change mitigation and adaptation, strengthens community resilience, and drives community economic development. Ensuring that community planning and the adoption of food systems policies are integrated and coordinated with land use and natural resource management is paramount in a context of climate change emergency.

On August 7, 2019, as this report was being finalized, news outlets reported on the release of an IPCC Special Report on climate change, desertification, land degradation, sustainable land

management, food security, and greenhouse gas fluxes in terrestrial ecosystems. One particular recommendation stood out in the Summary for Policymakers:

> Acknowledging co-benefits and trade-offs when designing land and food policies can overcome barriers to implementation (medium confidence). Strengthened multilevel, hybrid and cross-sectoral governance, as well as policies developed and adopted in an iterative, coherent, adaptive and flexible manner can maximise co-benefits and minimise trade-offs, given that land management decisions are made from farm level to national scales, and both climate and land policies often range across multiple sectors, departments and agencies (high confidence). (IPCC 2019)

This recommendation illustrates how critical it is to associate land use and food systems when designing successful policies and bylaws for climate mitigation and adaptation.

Finally, the Rural Economic Summit for communities of the Islands Trust will take place in the fall of 2019. How to place agriculture and food systems at the centre of community economic development strategies? How to create synergies and build momentum around food system resilience to benefit all island communities?

Further recommendations applicable to food system resilience are presented in *Toward a Resilient Food System for Bowen Island: Communication and Engagement Groundwork Report.*

Conclusion

One could wonder, why did we ever start farming in the first place? It is, after all, a legitimate yet uncommon question. The origins of farming and agriculture, and questions around our food supply such as where our food comes from, who grew it, and in what circumstances, are not everybody's preoccupations. As a modern civilization, we tend to take food for granted. It is presented to us as abundant, and we are reassured that modern technology and artificial intelligence will maintain this abundance and even manage to – one day – solve the persistent problem of world hunger.

In the meantime, we have never been so disconnected from our food: free trade agreements keep increasing the number of kilometers between the source of our food and our plate. Going back to the initial question – "Why did we ever start farming in the first place?" – while research scientists do not provide any firm evidence, they offer enlightening hypotheses. The first hypothesis posits that abundance and easy access to food supply are conducive to crop domestication to make food sources even more accessible in terms of distance and quantity. The second hypothesis refers to domestication as a consequence of over-exploitation of resources and/or a changing climate affecting food sources, in which case agriculture may have been an adaptation measure to guarantee a reliable food source. Researchers, backed by archaeological studies, tend to lean towards the second hypothesis (Weitzel 2019). So, if we, as a species, indeed started farming due to over population and over-exploitation of resources, what does that imply for our modern times and for Bowen Island?

Despite its arable land, Bowen Island is not suited for farming according to an established, industrial agriculture model. Its social, political, biophysical, and marketing characteristics make it very challenging for an agricultural operation to be viable or profitable, leaving its residents vulnerable and dependent on the mainland for their food supply. To assume that we can secure our food needs from distant lands and rely on remote farmers and farmworkers also assumes that they do what we cannot, which is to maintain and work their farmland[23]. One day, this may no longer be the case. Either they will no longer be able to supply food as before, or we will realize that we can maintain and work the land to grow food closer to home.

While it is reassuring to see that the concept of resilience is both a core value and a strategic commitment in the Bowen Island Municipality's 2019 Island Plan, efforts will be required to apply this commitment to Bowen Island's food system. Beyond presenting the historical and biophysical characteristics of the agrarian landscape of Bowen Island, this analysis offers a set of food system resilience indicators that are specific to the island, as well as recommendations to address and improve each of them.

There are very few positive aspects to the climate change emergency that we are facing. Reinvigorating and rethinking our approach to food systems could, however, be one. Enabling the development of a thriving local food system can deliver efficient climate change mitigation and adaptation measures. Supporting islanders' initiatives to grow healthy and diversified food and food products, to preserve and restore critical natural resources such as water, soil and biodiversity, and to revitalize Bowen Island's farmland through agroecological practices and community support represents a pathway for collective empowerment both to lower GHG emissions and to face the intensifying and unpredictable consequences of the climate change

[23] Regional District of Central Kootenay Agriculture Plan, 2011

emergency. There is more work to be done on each indicator of food system resilience for Bowen Island, collaboratively.

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Appendix 1–A: Regulatory Framework relevant to farming and sustainable food systems, excerpt from the Bowen Island Official Community Plan

The Official Community Plan (OCP) acts as a municipal "constitution", particularly in relation to land use management. As a municipality of the Islands Trust, BIM adheres to the Islands Trust Act and Policy Statement. The OCP update intends to take into account how local, regional and global changes (such as climate change) affect our island community, and to acknowledge significant societal shifts with more emphasis on food security (among others).

OCP objectives relevant to food system sustainability: 1. To preserve and protect the unique amenities and natural environment of Bowen Island for the benefit of Bowen Island residents and, generally, for residents of British Columbia. 3. To provide environmental stewardship strategies, to be followed by residents and visitors alike, that recognize societal responsibilities, as well as the rights of property owners. 4. To minimize Bowen Island's contribution to global climate change. 5. To establish a land use pattern, which places a high priority on environmental and social factors. 6. To manage growth in a way that is conditioned by the natural environment and respects social and economic diversity

Agricultural Land Use Management (section 3.7)		**Climate Change Mitigation (section 2.5)**
Objective 80: to encourage commercial and domestic agriculture in suitable locations, and to encourage local food production	**Policy 213**: establishment of agriculture zoning regulations on lands suitable for productive agriculture; (…) acquisition of lands for the community	**Objective 13:** to consider the impacts of, and upon, climate change as a central factor in community planning and land use management
Objective. 83: to promote sustainable active farming on lands with agricultural potential and to protect the resources necessary for such agricultural activity for: purposes of domestic food production; preservation of open space and rural atmosphere; contribution to a sense of community on Bowen	**Policy 214**: permitting roadside stands for farm gate sales of agricultural products, (…) encouraging home based businesses that produce value added products from locally produced agricultural products	**Objective 14:** to secure the capacity and resilience of ecological systems by protecting natural landscapes, especially those rich in biomass to maintain air and water quality, so they can continue to sequester carbon dioxide (CO2) and help mitigate the impacts of climate change and storm events. **Policy 25:** The Municipality will encourage the production of Biochar from land clearings.
Objective 85: to provide for the supporting infrastructure necessary to maintain and strengthen the agricultural economy	**Policy 215**: Organic farming or regenerative methods are encouraged through development of low impact farming. Operators of farms will be encouraged to avoid the use of pesticides and herbicides. If used, pesticides and herbicides will be applied in a manner that minimizes damage to adjoining and drainage areas.	**Objective 15:** to establish the importance of climate change-related concepts of energy consumption, energy security, GHG emissions, carbon cycling, and local food production in land and site planning, building and transportation. **Policy 26:** recognize the importance of forested lands in their role to remove and sequester carbon dioxide from the atmosphere
Objective 88: to encourage Metro Vancouver Parks to plan and implement active farming uses for ALR lands in Crippen Regional Park, subject to the environmental policies of this OCP, as demonstration farming, allotments or recreational gardening if compatible with park values.	**Policy 217**: rainwater harvesting	
Objective 89: Islands Trust Policy Statement Policy 4.1.9.: "Local trust committees and island municipalities shall, in their official community plans and regulatory bylaws, address the use of Crown lands for agricultural leases."	**Policy 218**: soil removal/deposit **policy 219**: production methods that maintain soil quality and minimize impacts on adjacent lands and the environment are encouraged.	

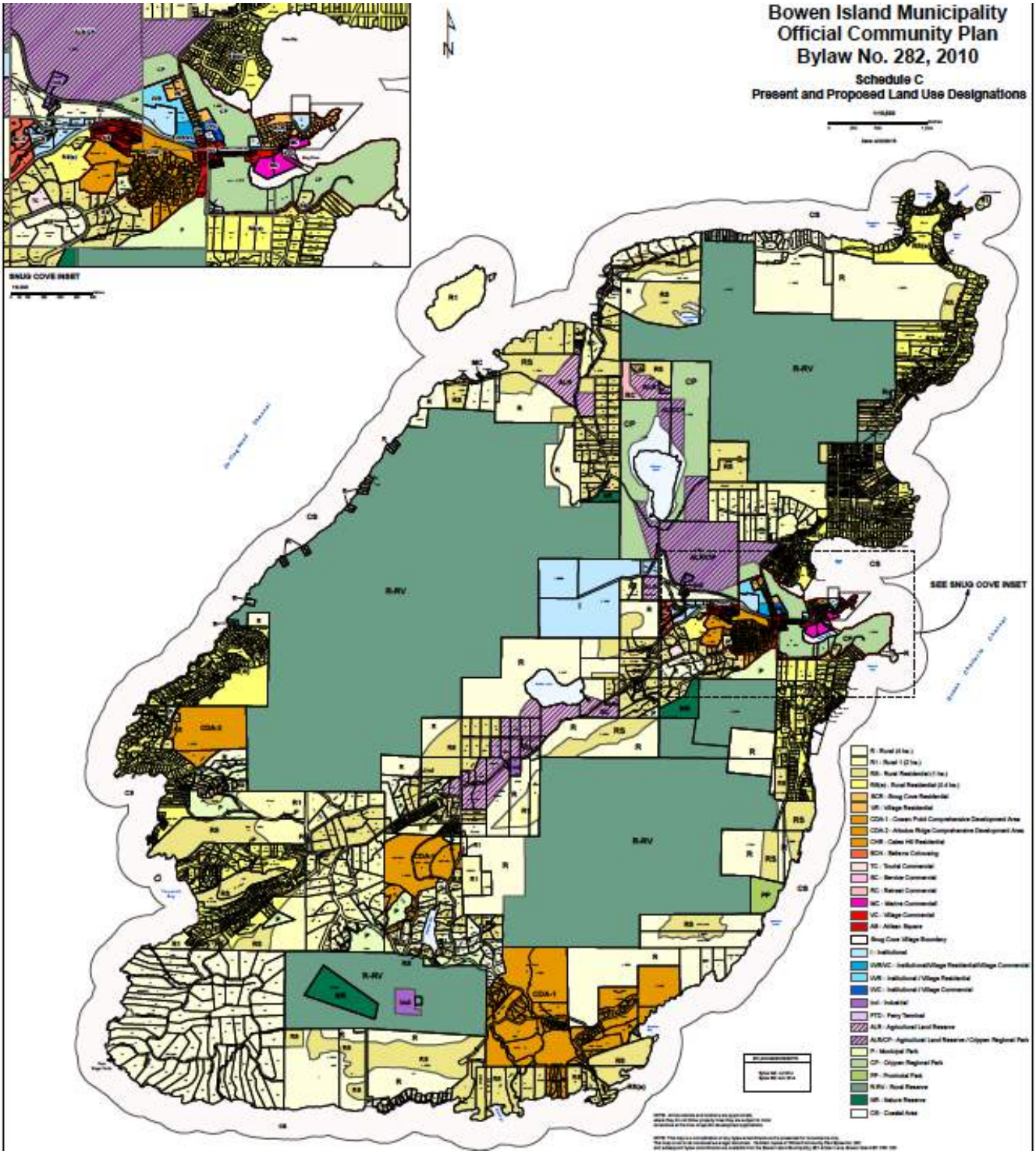
Appendix 1–B: Regulatory Framework relevant to farming and sustainable food systems, excerpt of the Metro Vancouver Regional Food Action Plan 2016

"The Action Plan acknowledges a distinctive role for local governments in the Metro Vancouver region while recognizing that each local government has unique characteristics and circumstances and therefore addresses agriculture and food issues in its own way."

When the GVRD Board adopted the Regional Food System Strategy in 2011, it requested an accompanying implementation plan. This Regional Food System Action Plan fulfills the GVRD Board directive. The vision for the plan was to create "a sustainable, resilient and healthy food system that will contribute to the well-being of all residents and the economic prosperity of the region while conserving our ecological legacy."

Metro Vancouver Regional Food System Action Plan 2016-2020 A collaborative approach through which municipalities can jointly advance a sustainable, resilient and healthy regional food system. This action plan presents 160 actions and 18 collaborative actions aiming at building capacity with civil society. Not endorsed by the Bowen Island Municipality.	
Goal 1: Increase Capacity to Produce Food Close to Home	1.1 - Protect agricultural land for food production 1.2 - Restore fish habitat and protect sustainable sources of seafood 1.3 - Enable expansion of agricultural production 1.4 - Invest in a new generation of food producers 1.5 - Expand commercial food production in urban areas
Goal 2: Improve the Financial Viability of the Food Sector	2.1 - Increase capacity to process, warehouse and distribute local foods 2.2 - Include local foods in the purchasing policies of large public institutions 2.3 - Increase direct marketing opportunities for local foods 2.4 - Further develop value chains within the food sector 2.5 - Review government policies and programs to ensure they enable the expansion of the local food sector
Goal 3: People make healthy and sustainable food choices	3.1 - Enable residents to make healthy food choices 3.2 - Communicate how food choices support sustainability 3.3 - Enhance food literacy and skills in school 3.4 - Celebrate the taste of local foods
Goal 4: Everyone has access to healthy, culturally diverse and affordable food	4.1 - Improve access to nutritious food among vulnerable groups 4.2 - Encourage urban agriculture 4.3 - Enable non-profit organizations to recover nutritious food
Goal 5: A food system consistent with ecological health	5.1 - Protect and enhance ecosystem goods and services 5.2 - Reduce waste in the food system 5.3 - Facilitate adoption of environmentally sustainable practices 5.4 - Prepare for the impact of climate change

Appendix 2: Map XY: Schedule C from the OCP bylaw 282: Present and Proposed Land Use Designations, 2010



Appendix 3: Terrestrial Ecosystem Map Codes and Site Unit Names

Map Code	Site Unit Name
CWHxm1 - Forested (Coastal Western Hemlock Very Dry Maritime Subzone, Eastern Variant)	
CS	Western red cedar - Slough sedge
CW	Black cottonwood - Willow
DC	Douglas-fir - Lodgepole pine - Cladina
DF	Douglas-fir - Sword fern
DS	Douglas-fir - Western hemlock - Salal
HD	Western hemlock - Western red cedar - Deer fern
HK	Western hemlock - Douglas-fir - Oregon beaked moss
RB	Western red cedar - Salmonberry
RC	Western red cedar - Sitka spruce - Skunk cabbage
RF	Western red cedar - Foamflower
RS	Western red cedar - Sword Fern
RT	Western red cedar - Black twinberry
SS	Sitka spruce - Salmonberry
CWHdm - Forested (Coastal Western Hemlock Dry Maritime Subzone)	
CD	Black cottonwood - Red osier dogwood
DC	Douglas-fir - Shorepine - Cladina
DF	Douglas-fir - Sword fern
DS	Douglas-fir - Western hemlock - Salal
HD	Western hemlock - Western red cedar - Deer fern
HM	Western hemlock - Flat moss
LS	Shorepine - Sphagnum
RC	Western red cedar - Sitka spruce - Skunk cabbage
RF	Western red cedar - Foamflower
RS	Western red cedar - Sword Fern
CWHdm - Non-forested (Coastal Western Hemlock Dry Maritime Subzone)	
SC	Cladina - Wallace's selaginella
Wb50	Labrador tea - Bog laurel - Peat-moss bog
Wf50	Narrow-leaved cotton-grass - Peat moss fern
Wf52	Sweet gale - Sitka sedge fen

Source: Terrestrial Ecosystem Map Codes and Site Unit Names for Bowen Island
Source for the red and blue listings: BC Species and Ecosystems Explorer – Ministry of Environment

Appendix 4: Soil Survey and classification

BOSE (BO) soils have developed on coarse-textured, gravelly and stony deposits, which have only limited value for agriculture. Water and nutrient-holding capacities are low, drainage is generally good to rapid, the soils are rapidly pervious, and the water table is present in the soil during an unspecified period. Coarse fragments content is moderate to excessive with a high proportion of cobbles, stones and boulders. The dominant soil limitations are excessive stoniness, which severely limits their use for agriculture. Variability of the stone content makes management difficult. Topography is variable with most slopes being less than 5% and a small area of sloping lands with gradients up to 30%. This varying topography limits agricultural use significantly. Water and nutrient-holding capacities are low. Some soils have a sixth layer of duric horizon[24], which limit plant roots growth and water penetration.

JUDSON (JN) Soils are partially to well decomposed organic material between 0.4 and 2m in depth overlying moderately fine-textures mineral deposits. The organic material is mainly derived from decomposed wetland vegetation. Drainage is poor and water and nutrient-holding capacities are high. Their decomposition and subsidence will be accelerated by drainage and cultivation. Water is always present in the soil and plant roots growth is not restricted. The dominant soil limitations are a very poor drainage and naturally infertile and acidic nature. The bulk density of the soil is low. The root zone is restricted where the depth of the organic layer is reduced to less than 40cm due to subsidence.

MURRAYVILLE (MY) Soils have developed in coarse, stone-free material, usually between 50 and 150cm thick, over moderately fine to fine-textured deposits. Slopes are generally less than 5% although there is some hilly topography. Drainage ranges from imperfect to moderately poor and a perched water table develops over the clayey material in the winter. Hence, water is present in the soil during an unspecified period. Plant roots growth is not restricted. The dominant soil limitations are low water and nutrient-holding capacities, as well as restricted drainage.

ROSS (RS) Soils have developed on a deltaic material. They are poorly drained, and slowly pervious, with a groundwater table near the surface during part of the year. Surface ponding is prevalent in the winter. Soils are moderately fine to fine-textured, are moderately fertile, and have a high water and nutrient-holding capacities. At depths below 50cm, sand is common. The dominant soil limitations are very poor drainage and high clay content.

SUNSHINE (SS) soils have developed in deep, coarse-textured material with the stone content varying from few stones to very stony. Drainage is good to rapid and the soils are rapidly pervious. Water and nutrient-holding capacities are low. Topography is variable with most slopes being less than 5% and a small area of sloping lands with gradients up to 30%. Water is not present at any time. Plant roots growth is not restricted. The dominant soil limitations are low water and nutrient holding capacities with low nutrient supplying ability, some areas with excessive stoniness, and very steep slopes in some small areas.

[24] A soil horizon is a layer of mineral or organic soil material approximately parallel to the land surface that has characteristics altered by processes of soil formation.
A duric horizon is a mineral, strongly cemented horizon, which occurs commonly at a depth of 40-80cm from the mineral surface. Excerpted from Canadian System of Soil Classification, 3rd edition, 2013, Soil horizons and other layers (Chapter 2)

BURWELL (BW) and CANNELL (CE) and KENWORTHY (KW) soils descriptions are not available.

The table below presents distinguishing characteristics of each dominant soil:

Number of polygons	Dominant soil name	Texture	Drainage	Coarse fragment (%)	Mode of deposition	Development	Plant roots growth restrictions
16	BOSE	Loamy Sand	Moderately well	41	Marine	Duric Humo Ferric Podzol	Limited by sixth layer (duric horizon)
1	BURWELL	Sandy Loam	Imperfectly	27	Morainal till	Duric Humo Ferric Podzol	Limited by sixth layer (duric horizon)
27	CANNELL	Loam	Well	20	Colluvial	Orthic Humo-Ferric Podzol	Limited by fifth layer (consolidated bedrock)
1	JUDSON	NA (organic)	Very poorly	2	Fen peat	Terric Humisol	None
3	KENWORTHY	Sandy Loam	Well	30	Colluvial	Orthic Humo-Ferric Podzol	None
6	MURRAYVILLE	Loam	Imperfectly	0	Fluvial	Gleyed Humo-Ferric Podzol	None
2	ROSS	Silt Loam	Very poorly	6	Fluvial	Rego Humic Gleysol	None
2	SUNSHINE	Sandy Loam	Well	0	Glaciofluvial	Orthic Humo-Ferric Podzol	None
1	UNDIFFERENTIATED BEDROCK	NA	NA	NA	NA	NA	NA

Source: British Columbia Soil Information Finder Tool (SIFT). SIFT compiles data and reports from the Government of Canada and the Province of British Columbia and is managed by the Ministry of Environment.
https://governmentofbc.maps.arcgis.com/apps/MapSeries/index.html?appid=cc25e43525c5471ca7b13d639bbcd7aa&bcgovtm=CSMLS

Table 12: Soil Survey Classification for Bowen Island

Appendix 5: Updated list of Farmers' Market vendors (producers and gardeners) and farm gate sales

Farmers' Market vendors

Bowen Island Herb Salts
Herb Salts, smoked salts, blackberry sugar, mulling spices
All herbs, fruits and berries in our blends are grown on Bowen Island - chemical free.
Smoked salts are smoked using clippings from our fruit trees.
Lisa and Bernie
bowenislandherbsalts@gmail.com
www.bowenislandherbsalts.com

David Griffiths
Beets, cucumbers, eggs, garlic, lettuce, radishes, tomatoes, zucchini
Using organic practices.
griffithsdavid@gmail.com

Forest Brooks Farm
Apples, Bedding plants, garlic using
Using organic practices.
Jayeson Hendyrson and Kim Brooks
330 Forest Ridge Road
forestbrooks@me.com
Kim@hempcrete.ca

Grafton Gardens
Farmers Market
A food-growing project in service and heart. Building community relationships to food sharing. Contributions based on abilities and interests. No experience in food growing necessary. All ages welcome.
graftoncollective@gmail.com

Home Farm Gardens Ltd.
Organic Vegetables, meats, wool
Long table dinners several times throughout the summer months.
Rosie Montgomery
rosie@homefarm.ca
604-947-6995
www.homefarm.ca

Old Tree
Fruit leathers and preserves
Organic, local, heritage
Sarah Haxby
604-947-9952

VanBerckel Garden
Fruits and produce using organically grown practices
Aubin VanBerckel
aubinvb@gmail.com
609 Cates Hill Road

Farm Gate Sales

Alderwood Farm
Apples, pears, raspberries and other fresh produce, eggs, pies and homemade healthy foods
Accommodation available
Jules De Groot
604.947.9434
1351 Adams Road
www.alderwoodfarm.com

Arbutus Bay Farm
Sheep, chickens, garlic, lamb, eggs, roasting chickens
Kirsty Johnstone and Alastair Johnstone
kirstycjohnstone@gmail.com
604-947-9504 to arrange pick up.
953 Arbutus Bay Lane

Buchanan's Farm
Eggs, Pickles, Pies, Rhubarb
1148 Grafton Rd.
Patrick and Dona Buchanan
604-947-9752

Little Song Farm
Beets, eggs, cucumbers, herbs, salad greens (arugula, lettuce, kale), squash, zucchini
Using organic practices
Charmaine Heffelfeizer
604-947-9533

Home Farm Gardens Ltd.
Organic Vegetables, meats, wool
Long table dinners several times throughout the summer months.
Rosie Montgomery
rosie@homefarm.ca
604-947-6995
www.homefarm.ca

MacDonald's Farm
Turkeys, pork, pumpkins, Christmas trees, McDonald's Farm seed - local organic seed
Carolyn McDonald
mcdfarm@shaw.ca
604-947-2517

VanBerckel Garden
Fruits and produce using organically grown practices
Aubin VanBerckel
aubinvb@gmail.com
609 Cates Hill Road