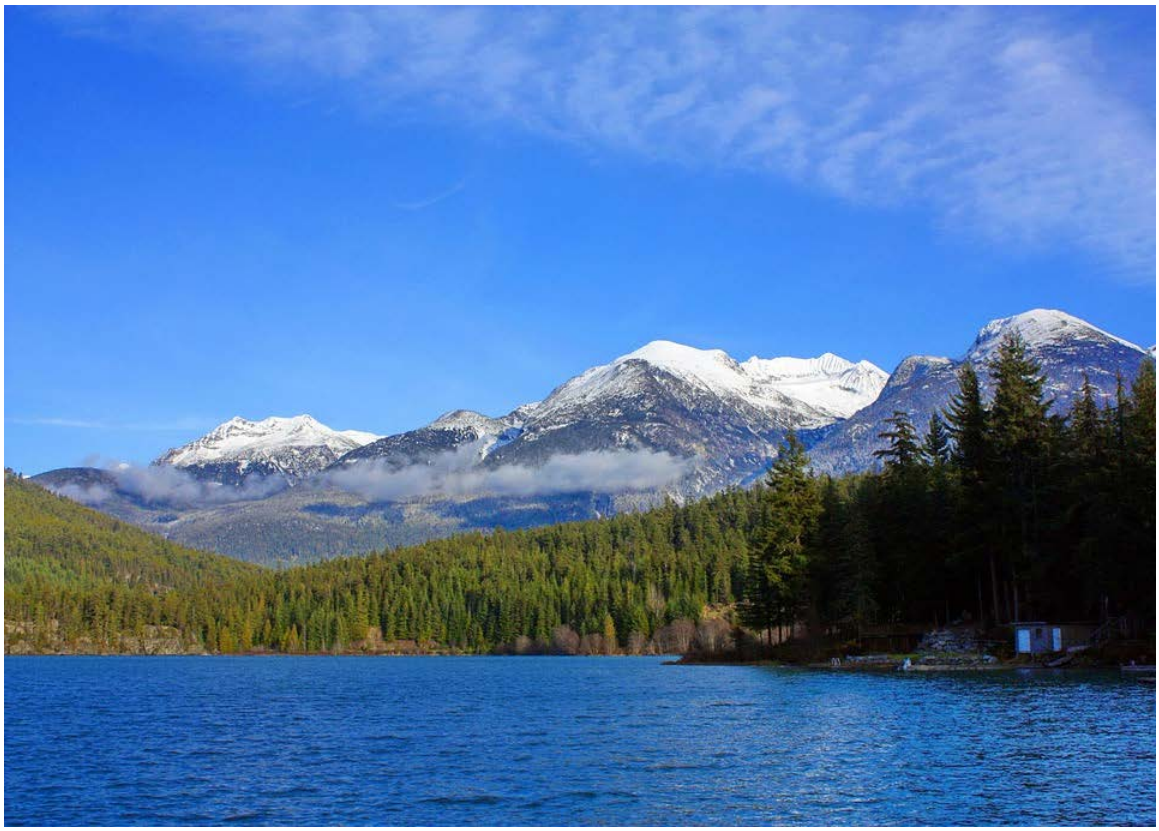
Green Infrastructure Innovations: Developing a Sustainable Community in Pemberton, B.C.



Skylar J. Kylstra

Master of Land and Water Systems Candidate, B.Sc. Global Resource Systems

Faculty of Land and Food Systems, University of British Columbia

August 2020

Created in partial fulfillment of the requirements for the Master of Land and Water Systems degree.

Table of Contents

Acknowledgements

I would like to extend my deep gratitude to my academic supervisor, Dr. Les Lavkulich for his invaluable guidance as I conducted my project. His sincerity, empathy, and immense knowledge have greatly inspired me. I would also like to thank him for his friendship and sense of humour.

Also, thank you to Robert J. Taylor, Michael Smits, Thomas A. Barr, and the rest of the Rt. Inc team for giving me the opportunity to design this project and contribute to sustainable housing solutions in Canada. I look forward to continuing to work with you all into the future to deliver 'The Shire'.

Thank you Dr. Maja Krzic and Chantel Chizen for providing me with summer internship opportunities that deepened my love for soil science. In addition, I would like to extend my thanks to the other UBC Faculty members and peers who have supported and believed in me in both my undergraduate and graduate studies, including Roxana Diaz, Adriana Laurent, and Dr. Sandra Brown. Thank you to British Columbia Council for International Cooperation, Roxana, and Les for providing me with the opportunity and resources to attend climate change and development conferences including ICSD2018 and COP25 that enriched my learning experience and passion for climate advocacy.

My sincere thanks also goes out to the rest of the MLWS family, including our program director Julie Wilson, our program assistant Megan Bingham, and our 2019/2020 cohort. Thank you all for your stimulating discussions, and for helping us all navigate the uncertainty brought on by this year's events.

Lastly, I would like to thank my friends and family for supporting me mentally and spiritually throughout this journey.

Executive Summary

Looking ahead, housing will continue to play a significant role in BC's economic and social development. Pressures on the housing supply resulting from population growth, urbanization, and the need to foster continued economic growth in the province will likely only escalate. In addition, Canadians face a growing number of environmental, public health, and social concerns, including the maintenance of water and air quality, biodiversity loss, and food insecurity. Many of these issues are partially a result of the lack of ecological context in how development has been implemented in the past. When one considers the full range of economic, social, and environmental forces bearing down on housing needs, it is clear that building more units without proper consideration of these forces is inadequate to respond to the challenges that communities and developers will face over the next decades.

There are many challenges in this problem space. The current housing supply is ageing or going to disrepair, public finances for housing programs are under pressure, and there are different views on priorities for housing investment and what is considered "sustainable." Green infrastructure (GI) offers an approach to development that can produce lower cost and more resilient systems. Furthermore, recognizing the role of green infrastructure in housing has a critical role to play in meeting the challenge of climate change adaptation, as well as other environmental and social issues.

This paper gives a comprehensive overview of green infrastructures as the "next generation" of development, using a "three-pillars of sustainability" approach to evaluate environmental, social, and economic benefits and considerations. Lastly, this paper overviews the planned Canada Mortgage and Housing Corporation Solutions Lab process to create a framework for GI delivery which will be piloted at the case study: 'The Shire of Pemberton', a proposed development in Pemberton, BC.

Introduction

Green Infrastructure, Sustainability, and Urban Resilience

Historically, there has often been very little ecological context in the way that new urban developments are implemented (Erkman, 1997). However, there is still a need to increase housing supply to address housing unaffordability within Canada (Petterson et al., 2017). In addition to housing unaffordability, urban areas today face a variety of ecological challenges, including air pollution, natural habitat and biodiversity loss, and urban flooding, which are further exacerbated by global climate change (Forest Research, 2010). As a result, the importance of sustainable urban development has risen as a response to these challenges, and the United Nations has identified "Sustainable Cities" as one of the 17 Sustainable Development Goals (United Nations, n.d). Green infrastructure offers a new approach to development that incorporates ecological and social values along with other land development objectives (Ranjha, 2016). With proper planning, incorporating green infrastructures into urban developments has the potential to solve a wide variety of problems that exist within the urban development context (US EPA, 2014).

From an engineering perspective, 'green infrastructure' (GI) refers to the integration of infrastructures such as bioswales, green roofs, and gardens (among others) to offer various environmental benefits, including improved stormwater management, improved flood resiliency, improved air quality, and mitigation of the urban "heat island" effect (US EPA, 2017) (Benedict et al., 2006) (Ranjha, 2016). The benefits provided may vary slightly among the different types of infrastructure. For instance, rooftop gardens can enhance community food security while also addressing watershed management challenges. In addition to the environmental benefits of GI, there are also potential economic and social benefits. GI has been shown to facilitate urban residents' connection to nature, increase life expectancy, lead to better mental and physical health outcomes, increase property values, and decrease utility costs (US EPA, 2017) (Ranjha, 2016).

Barriers to the adoption of GI include acceptance by developers and the public, zoning concerns, a perception of higher costs, skepticism about long-term performance, and unfamiliarity with maintenance requirements and costs (US EPA, 2019). There are challenges associated with incorporating GI into already-existing developments due to logistics and costs.

Many of these challenges are associated with perceptions, and can thus be tackled by learning from case studies where GI has been implemented, learning about design variations, and recognizing the potential of GI to add values beyond what traditional "grey" infrastructures offer (US EPA, 2019). Furthermore, many of the logistical concerns of GI are minor when they are applied to new developments and GI objectives are integrated into the planning stage.

It is also important to acknowledge that there is nuance in this space. Certainly, there are developers and members of the public that want to embrace GI innovations, but they may be concerned about the lack of standard protocols to select the best technologies, the lack of standard protocols for building codes and safety evaluation, and concerns that the technologies selected may become obsolete within only a few years (Taylor, personal communication, July 2020). However, these specific concerns appear to not yet be explored in detail within the scientific literature.

In summary, well-designed green infrastructures can be a valuable tool to help solve several problems faced in urban areas and increase the resilience of urban areas to climate change while providing additional social and economic benefits. Continued exploration of the opportunities for integrating both ecological and experiential objectives within development is needed for developers and planners to design new housing developments in a way that increases environmental sustainability while enhancing the economic and social benefits provided. Ultimately, the project will seek to answer the following question: How can we design a standardized framework that can be applied across Canada to create housing which sustainably balances community, shelter, food, energy, transportation, and land-use bylaws?

Objectives

The objectives of this project are to:

- Provide background on the socioeconomic drivers and environmental concerns associated with community housing development in Canada;
- Conduct a meta-analysis of the economic, social, and environmental opportunities and challenges associated with green infrastructure, assessing the relevance to the case study, a proposed development ("The Shire") in Pemberton, B.C;

- Discuss the Canada Mortgage and Housing Corporation Solutions Lab process that will be used to determine appropriate green technologies at the site of the case study; discuss how community consultation can offer a new approach to development, and;
- Provide recommendations to minimize the impact of development activities at the site of the case study, considering the biophysical conditions at the site.

Methods

The following discussion in this paper is based on a review and analysis of the relevant literature about the social, economic, and environmental concerns associated with land development, green infrastructures, and affordable housing in Canada. Recommendations are based on the literature review. In addition, the project includes a design for a Canada Mortgage and Housing Corporation Solution Lab which was created in collaboration with the RT Inc. Solutions Lab Core Project Team: namely Robert Taylor, Michael Smits, and Thomas Barr. The project has been conducted in coordination with RT Inc development managers, architects, and engineers to make sure recommendations are in line with their objectives. There will also also be opportunities throughout the Solutions Lab to consult with other professionals and experts in the fields of landscape architecture, biology/ecology, sociology/anthropology, city planning, and engineering throughout the entire process as the recommendations are developed (see Appendix for Project Partners).

The findings are synthesized in the following professional report and infographic which will be published on the MLWS website, and will later be showcased on a website that will be created in collaboration with AntiSocial Solutions to communicate the project (see Appendix for the Communications Materials and Strategy).

Meeting Housing Demand in Canada: Socioeconomic and Environmental Considerations

In Canada, there is a growing gap between incomes and housing prices, and many Canadians have to dedicate more than 30% of their income to housing (Refer to Figure 1) (Peterson et al., 2017). The issue of housing affordability has contributed to an estimated 235,000 Canadians experiencing homelessness in any given year, though the actual number is likely much higher

(Gaetz et al., 2016). However, this issue is not exclusive to large urban centres in Canada. For instance, in Pemberton, BC and surrounding areas (the site of the case study to be discussed), rent has increased by 68 percent in the past 10 years alone and there is a 2-year waitlist for non-market housing. (Village of Pemberton, 2019).

To address the housing crisis the Government of Canada and the Canada Mortgage and Housing Corporation have rolled out the 'National Housing Strategy' (NHS): a 55 billion dollar plan to revitalize Canadian Housing over the next 10 years (CMHC, 2019). The goals of the NHS include building 100,000 new community housing units, removing 530,000 families from housing need, renewing and repairing 300,000 community housing units, and reducing chronic homelessness by at least 50% (CMHC, 2019).

However, simply building more units will not solve the housing crisis, because housing is tied up with other social issues including food security, health concerns of urban residents, environmental issues, climate and energy concerns, and systemic injustices in our society. The implementation of community housing must be integrated with these issues that are so intrinsically linked together to achieve sustainable development (Refer to Table 1).

The Federal Government is the main body that finances affordable housing projects in Canada (Peterson et al., 2017). Therefore, it may be argued that these housing projects should serve the public interest and go-above-and-beyond housing provision. Because healthy ecosystems and people are at the core of sustainable and resilient economies and a transition to a Green Economy, land developers should be supported and encouraged to protect environmental services (Refer to Figure 2).

According to classical economics, land (along with capital and labour) is one of the main factors of production that is essential for economic growth and development. Land is an essential input for housing and food production, and thus some level of land-use change is often required for continued economic growth and development, and in this case, to address the issue of housing supply. However, land-use change and development do not come without socioeconomic and environmental concerns. For context, a brief overview of the socioeconomic drivers and environmental concerns of urbanization and housing development in Canada are outlined in the next following sections of this paper.

Affordable Housing: In Canada, housing is considered affordable if the household's shelter

costs equal 30% or less of a household's income. (Petterson et al., 2017).

Figure 1: What is affordable housing?

Green Economy: [An economy] that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

Figure 2: Definition of Green Economy. Source: UNEP, 2010

Sustainable Development Encompasses:		
Society 	**Environment** 	**Economy** 
● Welfare ● Equal opportunity and equity ● Social cohesion ● Peace and justice ● Health and wellbeing	● Consumption of resources and energy ● Risks ● Rate of change and baseline (i.e. climate change) ● Natural and cultural landscape ● Biodiversity and ecosystem services	● Economic growth ● Efficiency and competitiveness ● Industry and innovation ● Responsible production / consumption ● Employment and good livelihoods ● International trade

Table 1: What is sustainable development? Source for table content: (United Nations, n.d.)

Socioeconomic Drivers

The provision of social or affordable housing has proven difficult for governments and nonprofits due to several reasons, including rising land prices, limited funding, and an increasing gap between the wealth of the general population and market housing prices (Peterson, 2017). Another factor influencing land availability and affordability for development is land-use regulations. These regulations can be put in place for good reasons, such as for the protection of environmental services. However, land-use regulations that aim to curb land development can potentially contribute to rising housing prices, make housing less affordable for middle- and low-income households, and disrupt the function of market forces (Petterson, 2017) (Wu, 2008). Therefore, land use regulations may seek a balance between public interest and private property rights.

Environmental Impacts

Watershed Health and Impervious Areas

Urbanization and development have a serious impact on the number of impervious areas through sealing of the soil surface with buildings or soil compaction from heavy machinery as a result of development. Furthermore, greywater infrastructures can lead to a decline in the quantity and quality of water due to ecosystem degradation (UNEP, 2014). High impervious area negatively impacts watershed quality by leading to higher amounts of pollutants and runoff entering lakes and streams (Refer to Figure 3) (Davis, 2005; Wang and others, 2001; Williamson, 1993). Furthermore, when water is unable to infiltrate and drain out there is increased flood potential, which is already a rising concern due to climate change (US EPA, 2003).

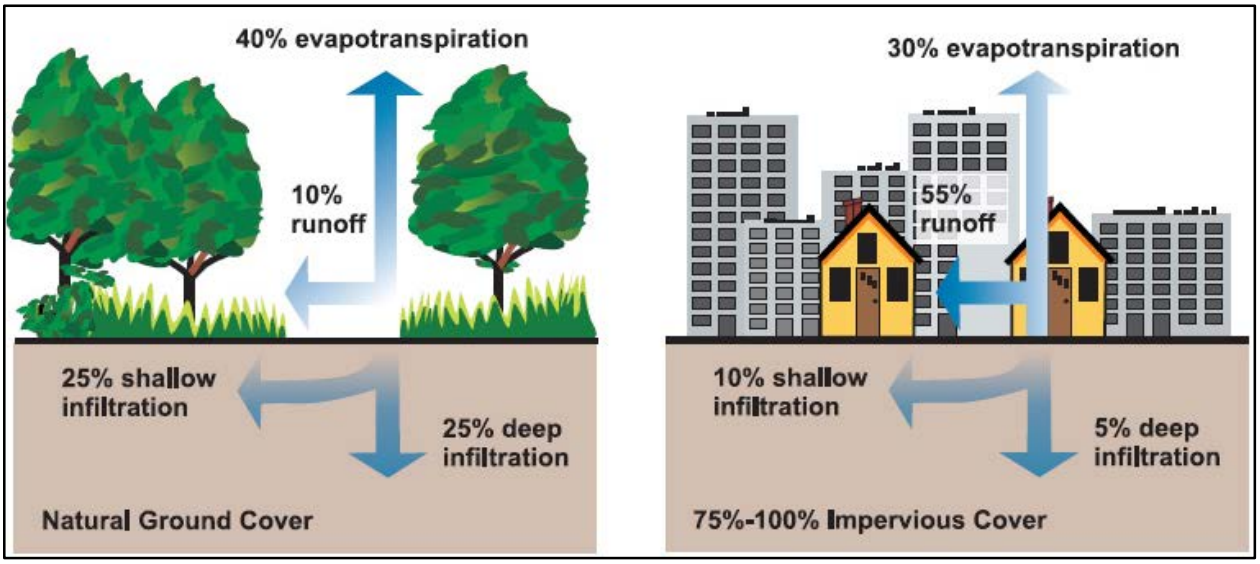


Figure 3: Illustration of the relationship between impervious surfaces and stormwater runoff. Source: US EPA, 2003 Wikimedia Commons

Biodiversity

Currently, biodiversity is being lost at unprecedented rates in all regions of the world (refer to Figure 4) (UN CBD, 2018). For decades, scientists have known that inappropriate development is one of the leading causes of land, water, and atmospheric degradation. This is contributing to the extinction of a broad range of organisms on Earth (US National Research Council, 1992) (UN CBD, 2018). Because the loss of organisms is irreversible, the potential impact on human life and the process of evolution is incredibly profound. Humans depend on biodiversity

immensely; we depend on plants, animals, fungi and microbes for food, fibre, and medicine, and living organisms play a large role in regulating the Earth's biogeochemical cycles and providing resilience to climate change (US NRC, 1992) (UN CBD, 2018). From the perspective of the urban environment, healthy ecosystems support the freshwater supplies that urban residents rely on for consumption and energy production. They also provide natural solutions for runoff and watershed management, regulating temperature, and natural disaster resilience (UN CBD, 2018). Moving forward, it is clear that strategies must be implemented to ensure sustainable development in the future to safeguard the biodiversity which we depend on.

Biodiversity: The variability among living organisms from all sources (i.e. diversity between species, within species, and ecosystems). The diversity of life on Earth.

Figure 4: What is biodiversity? (CBD, 2018).

Environment and Human Health

Human health and wellbeing is a significant challenge to address in the face of continued urbanization. Urban residents may face reduced access to outdoor/green spaces, inadequate transport, and reduced opportunities for physical activity (WHO, 2020). As a result, urban residents may be at increased risk of mortality and morbidity and lower well-being (Krefis et al., 2018). Human health challenges in urban environments are often linked to heightened environmental stressors such as heat stress, air pollution, carbon emission, and environmental noise, as well as socio-economic disparities (Krefis et at., 2018). The influence of the built environment on public health is particularly apparent concerning chronic diseases such as chronic respiratory disease, obesity, cancer, and neurological disorders (Perdue et al., 2003) (Yuchi et al, 2020). The destruction of natural habitat also leads to the increased risk of disease transmission from wildlife to humans, which can potentially wreak havoc on human health, the economy, and global security, as has been seen with the recent and ongoing COVID-19 crisis (WWF, 2020).

These issues can be addressed through better education about these issues on an individual level, intervention by social movements, intervention by environmental laws, and intervention by urban planning and environmental design elements including green infrastructures (Krefis et al., 2018). Increased vegetation and green spaces in urban areas can

also help to reduce negative health impacts associated with poor air quality, water quality, and environmental sound pollution (Yuchi et al., 2020). There are a number of studies that link urban green spaces to positive outcomes such as greater social cohesion and public health (Jennings and Bamkole, 2019). To give an example with respect to neurological disorders, a study conducted in Ontario found that increased exposure to urban green spaces was associated with a reduced risk of dementia and stroke among adults aged 55 to 85 (Paul et al., 2020). Taking this into consideration, it is clear that developers have the opportunity and the ability to create built environments that facilitate healthy behaviours and create the conditions for health.

Summary

Socioeconomic Impacts	Environmental Impacts
● Conversions of land can reduce green spaces and environmental amenities for local residents. ● Soil erosion, salinization, desertification, and other associated impacts can reduce the ability of the land to be productive for agriculture and forestry in the future. ● Urban development can encroach on a community's identity and culture (i.e. gentrification). ● Urban development contributes to air and water pollution which is a concern for public health.	● Urban development as conventionally implemented leads to air pollution, water pollution, urban runoff, and higher flood risk. ● Habitat fragmentation and destruction are the leading causes of biodiversity loss and species extinctions. ● The development of previously undeveloped land contributes to further land-use change which exacerbates the greenhouse effect and global climate change.

Table 2: Summary of socioeconomic and environmental concerns associated with land conversion and development.

Green Infrastructure Applications and Housing Sustainability - Society, Environment, and Economy

Green infrastructures and technologies can provide a wide variety of social, financial, and environmental benefits to both developers and consumers. In fact, GI can potentially solve many of the issues associated with traditional forms of development that were discussed previously. This allows developments to serve a greater public interest than simply the provision of housing, and on a large scale could potentially lead to government cost-savings on watershed management, water treatment, and public health spending.

There are many different kinds of green infrastructures and sustainable technologies that developers could potentially choose from, as summarized in Table 3. Options range from small in scale and relatively low maintenance, such as rain gardens, to fairly sophisticated feats of engineering which require specialized knowledge to maintain, such as rooftop greenhouses. Different infrastructures offer differing benefits, and common GI options are categorized into those GI interventions appropriate for various watershed management scenarios in Table 4.

From a social standpoint, GI in urban environments can holistically connect people back to nature. Furthermore, green technologies can provide human health benefits while enabling people to exercise, grow food, and recreate locally, creating social cohesion (Jennings and Bamkole, 2019) (Veen et al., 2016). From an environmental standpoint, GI offers many potential benefits including better watershed management, climate mitigation and biodiversity enhancement, and aesthetics (UNEP, 2014) (refer to Figure 5).

Infrastructure selection decisions are invariably financial and therefore a business case must be made to allow for their adoption. Many green infrastructures require specialized engineers to install and design which can inhibit their adoption. However, many options are relatively low-maintenance once installed (i.e. rain gardens). It is also logistically more straightforward to implement these technologies at new developments rather than retrofitting already-existing developments, due to labour and cost. However, it is important to acknowledge that site factors such as land value, availability of space, and environmental conditions (soil, slope, etc.), can make costs variable (WEF, 2015).

While GI can be perceived as being more costly than grey infrastructures there are often options that are comparable in cost to the grey infrastructure options (Sheils, 2013). However, highly manicured green infrastructures (i.e. those in high-profile locations) that require more intensive design and maintenance may lead to higher costs (WEF, 2015). Through proper planning, maintenance costs can be reduced, such as avoiding installing porous pavements in areas with a high amount of leaf litter (WEF, 2015). In fact, many studies show that GI and low-impact development interventions cost significantly less to maintain over the long term when compared to traditionally engineered infrastructures (Shiels, 2013). Other ways to make a business case for GI includes integration of GI into the planning process (as opposed to retrofits), utilizing economies of scale, and taking advantage of incentive programs (WEF, 2015). These strategies not only make GI implementation more feasible, but will allow for infrastructure

delivery in an efficient manner, and raise awareness to nurture investments in GI that will enhance population well-being and protect the environment.

Due to a lack of awareness of GI benefits and co-benefits (e.g. carbon sequestration, health benefits, improvements in biodiversity, etc.), and perceived difficulties in valuing them in financial and economic analyses, GI benefits and co-benefits are frequently neglected in investment decisions (Figure 6) (UNEP, 2014). Economic valuation of GI benefits and co-benefits for watershed management is another tool that can help to place GI on a more equal footing with grey infrastructure options, allowing decision-makers to adequately weigh economic tradeoffs of the different options in their decision-making (UNEP, 2014). Economic benefits of GI include: cost-effective stormwater management, increased energy efficiency and reduced energy costs, reduced flooding and flood-related damage costs, and protecting the public health from illness-related costs.

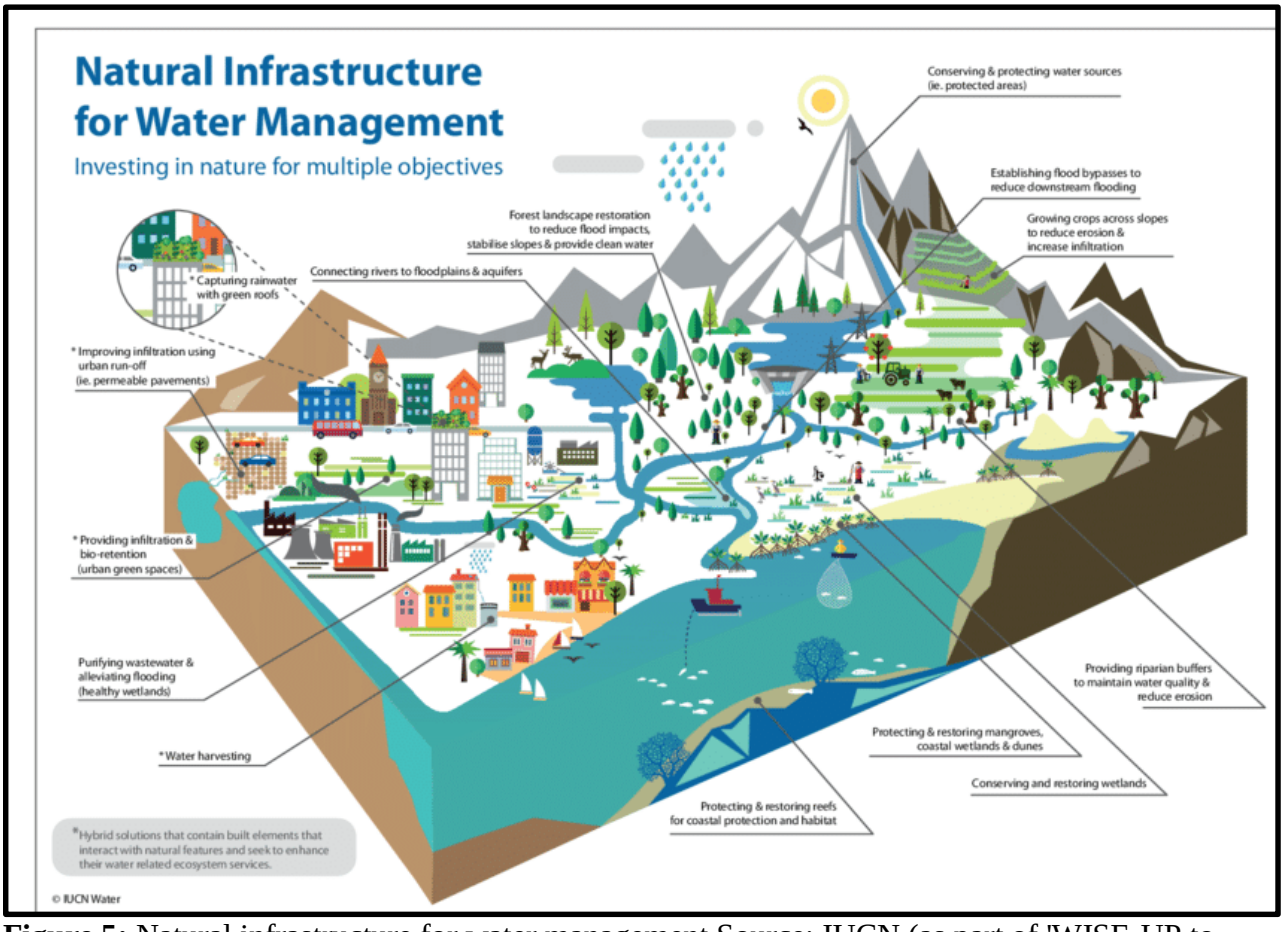


Figure 5: Natural infrastructure for water management Source: IUCN (as part of 'WISE-UP to Climate' project). See http://www.iucn.org/theme/water/our-work/wise-climate

Infrastructure Type	Description	Possible Benefits	Considerations
Green Infrastructures and Technologies			
Bioswales/Rain Gardens 	Channels that are designed to concentrate, contain, and drain stormwater runoff while removing debris and contaminants (Utah State University Extension, 2019).	• *Biodiversity* - Can provide habitat for small organisms such as frogs. • Aesthetically pleasing • *Watershed Health* - Filters and slows stormwater runoff • Relatively low maintenance (i.e. can choose plants that don't need irrigation in the summer).	• May only be suitable in places with coarser-textured soils. • There may need to be occasional maintenance of the system (i.e. weed removal).
Rainwater Harvesting 	A type of system where raindrops are collected and stored for future use. There is a great variety of different designs and scales.	• *Flexibility* - Can be integrated with other systems (i.e. rain gardens, rooftop greenhouses, etc). Many different designs and scales of the systems. • Rainwater can be stored and put to good use. Reduces the demand for treated water for irrigation during the summer months. Also leads to cost savings on water bills.	• Without further treatment, water is not potable. • Depending on weather and the storage capacity it may not meet all the irrigation/non-potable water needs of a site.
Rooftop Greenhouse 	"Greenhouses located on the roof of the buildings that usually produce food using soil-less culture systems" (Pons et al., 2015).	• *Insulation benefits* - cost savings on heating and cooling. • *Food Systems* - Can add to the local food system. Reduces food transport, packaging, waste (Pons et al., 2015). • Increase the green areas in urban environments (Pons et al., 2015). • Can be integrated with other infrastructures such as solar and rainwater collection → energy, water, and CO2 flow can be integrated through the building.	• *Maintenance* - Will the work be community-led or outsourced? High amount of maintenance and knowledge required to operate. • *Energy* - how will the energy be generated? • *Water* - Where will the water come from?
Rooftop Garden / Green Roof 	Garden or vegetation planted on the flat roof of a building.	• *Food* -Can potentially grow food crops. • Aesthetically pleasing. • Increases green areas in the city. • *Climate* - Carbon sequestration. • Insulation. • Comparable lifespan to traditional roofs. • Mitigation of the urban "heat island" effect.	• May require specialized knowledge to maintain and install. •
Permeable Pavement 	"Permeable pavement is a porous urban surface which catches precipitation and surface runoff, storing it in the reservoir while slowly allowing it to infiltrate into the soil below" (USGS, n.d.).	• *Watershed Health* - Can reduce the amount of pollutants and the volume of runoff (Houle et al., 2009). • Establish a more natural hydrologic balance (USGS, n.d.)	• *Durability* - will permeable pavement last as long as traditional pavement? • *Water quality* - how much pollutant reduction can be expected?
Greenway	A strip of land set aside in an urban area for recreational use (i.e. biking, walking,	• *Health* - Provides people with the opportunity to exercise locally outside. • Encourages carbon-free modes of transportation such as biking, running, and	• Not often designed to increase environmental benefits; can be "afterthoughts" in the

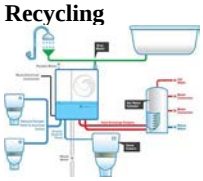
	running) and/or environmental protection. Generally located in old converted transportation (i.e. railroad) corridors.	walking. • *Biodiversity* - Provides continuous belts of habitat for wildlife. • Can incorporate elements such as constructed wetlands to filter stormwater runoff from roads and provide habitat and climate mitigation benefits. • *Food* - Can include community gardens to allow for people to grow food locally and create community.	planning process. • Maintenance and installation cost are usually paid for by the city. • May compete with other land uses (i.e. roads for cars).
Urban Woodlands 	Woodland within the boundary of a city; can encompass larger tree- or shrub-covered areas down to individual street trees (Forest Research, 2020).	• *Biodiversity* - Can create habitat coordinators and prevent forest fragmentation. • Give the opportunity for people to interact with local wildlife. • *Climate* - Carbon sequestration and climate mitigation. • *Water and Soil* - Flood and erosion prevention. (Forest Research, 2020)	• Competes with other land uses; other land uses may generate higher economic value. • Forests in urban areas can contribute to wildfire risk if improperly managed.
Other Sustainable Infrastructures			
Solar Panels 	Devices used to absorb the sun's rays and convert the energy into electricity or heat. Usually installed on rooftops.	• Provides locally sourced, cheap, renewable energy. • Supports the transition to a carbon-neutral economy.	• *Design considerations* - roof slope, water drainage from rooftops, the weight of panels, etc need to be taken into account.
Grey Water Recycling 	Systems that collect and store greywater (i.e. wastewater from sinks, showers, bathtubs, and washing machines) and put it to some kind of beneficial use (i.e. irrigation).	• Reduces water demand/extraction and can address water scarcity. • Consumers pay less for water because they make use of water which they already paid for. • Can reduce wastewater entering the sewage/treatment system.	• Water from kitchens generally can't be recycled due to high amounts of grease and organic matter. • *Scalability* - Difficult to scale up. • Limited uses of water without further treatment. • Regulatory concerns.

Table 3: A summary of various common green infrastructures.

Watershed Management Issue	Green Infrastructure Option
Water Supply Regulation	• Re/aforestation or forest conservation • Riparian buffers • Wetlands restoration/conservation • Constructing wetlands • Water Harvesting • Green Spaces

	• Permeable pavements
Water Purification	• Re/aforestation or forest conservation • Riparian buffers • Wetlands restoration/conservation • Constructing wetlands • Green Spaces • Permeable pavements
Erosion Control	• Re/aforestation or forest conservation • Riparian buffers
Biological Control	• Re/aforestation or forest conservation • Riparian buffers • Wetlands restoration/conservation • Constructing wetlands
Water Temperature Control	• Re/aforestation or forest conservation • Riparian buffers • Wetlands restoration/conservation • Constructing wetlands • Green spaces (i.e. gardens)
Riverine Flood Control	• Re/aforestation or forest conservation • Riparian buffers • Wetlands restoration/conservation • Constructing wetlands • Establishing flood bypasses
Coastal Flood Protection	• Coastal marshes/dunes • Protecting/restoring mangroves (if applicable) • Protecting/restoring reef or oyster habitat (if applicable)
Urban Stormwater Runoff	• Green Roof • Green Space • Water Harvesting • Permeable Pavement

Table 4: Green Infrastructure interventions for various watershed management scenarios. Adapted from UNEP Green Infrastructure Guide for Watershed Management 2014.

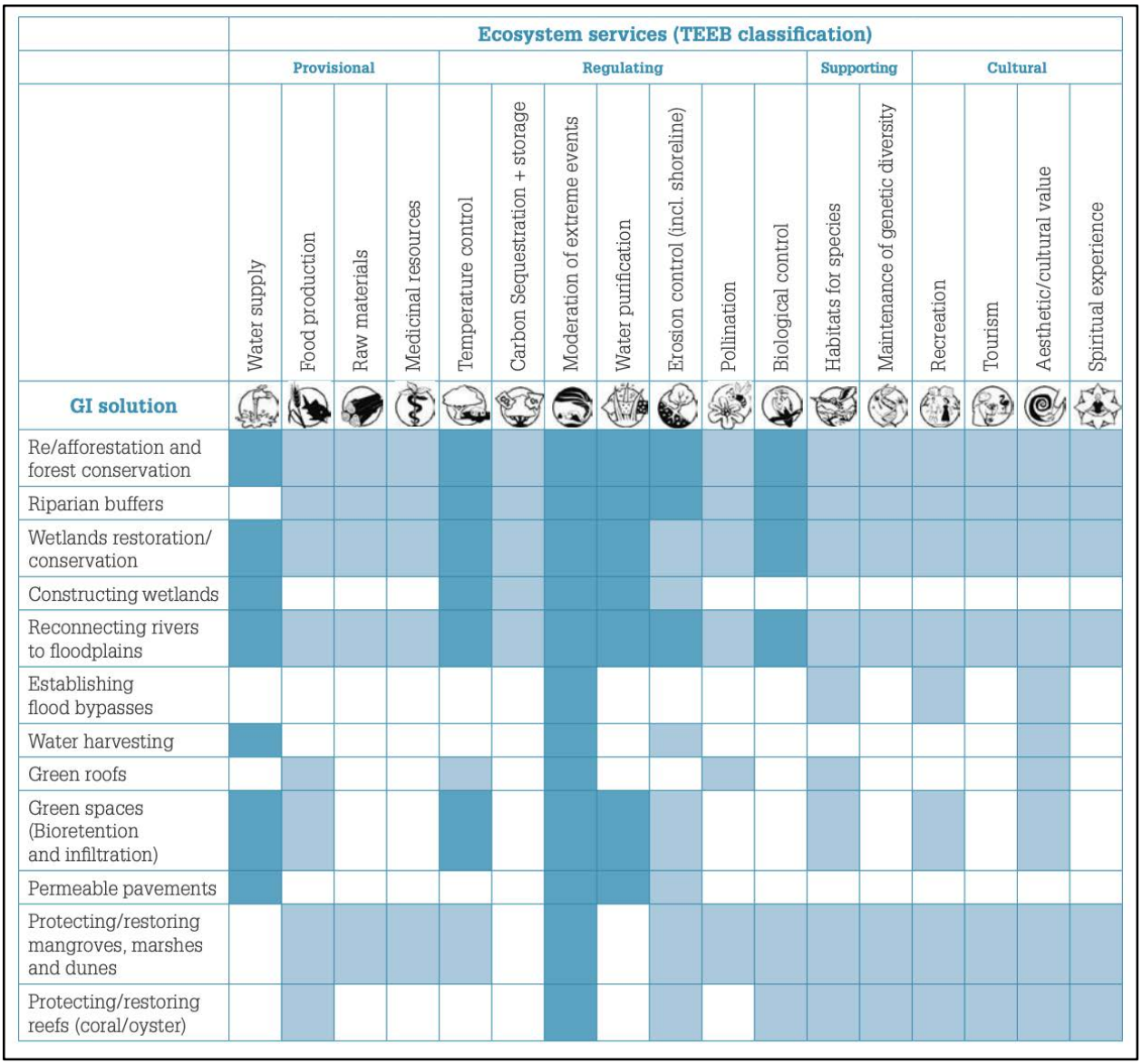


Figure 6: Ecosystem services provided by GI interventions. Image Source: UNEP 2014

Case Study: Pemberton, BC

Overview

'The Shire of Pemberton' is a proposed affordable housing retirement development in Pemberton British Columbia. The developers (Rt Inc.) will be delivering the development in collaboration with the Canada Mortgage and Housing Corporation (CMHC). The vision of the project is to "provide the highest quality care and sustainable socio-economic ecosystems for ageing Canadians through design-build technology" (Taylor, 2018). Rt Inc. has identified environmental

sustainability as one of the main objectives of the project and aims to reduce the environmental impact of the development through resource conservation, on-site energy generation, and the incorporation of various green infrastructures on the site. Possible opportunities include rainwater harvesting, rooftop gardens, and green roofs, but the specifics and feasibility of the GI delivery on the site have yet to be explored in detail. Therefore, managers at Rt Inc. have sought opportunities to collaborate with various groups including government bodies, communities, and professionals from various disciplines to explore opportunities for GI delivery at 'The Shire' in a way that aligns with their objectives and values.

Site Characteristics

The proposed development site is a roughly 300-acre (120 hectares) undeveloped property located in Pemberton, BC. The target-region is in the Squamish-Lillooet Regional District (SLRD) located 55 minutes outside of Whistler. BC and 2.5 hours outside of Vancouver, BC (refer to Figure 7). SLRD is a local government federation consisting of four member municipalities (District of Lillooet, Village of Pemberton, Resort Municipality of Whistler, District of Squamish) and four unincorporated rural Electoral Areas (A, B, C, D), found within the traditional territories of the Líl'wat, Squamish and St'at'imc Nations. Pemberton receives 940 mm of precipitation annually with most of the precipitation occurring between November and March (Pemberton District Chamber, 2020). Pemberton has warm summers and freezing winters with peak temperatures up to 32 degrees C in July and minimum temperatures of -11 degrees C occurring in January (Pemberton District Chamber, 2020). The development will create approximately 187-200 units of affordable housing for ageing Canadians (one of the National Housing Strategy priority populations).

Pemberton is one of the fastest-growing municipalities in BC, growing by over 6% per year between 2011 and 2016, compared to the provincial annual growth rate of about 1% per year. Part of this growth is due to the Whistler Blackcomb Resort and surrounding areas following the 2010 Olympics (Statistics Canada, 2016). As a result, there is high pressure on the housing supply and rents have increased as much as 68% between 2007/2008 and 2017/2018 (Refer to Figure 8) (Village of Pemberton, 2019).

The site of the proposed development is a 387-acre area (160 hectares) which comprises two adjacent properties (refer to Figure 9). The site is located 30 minutes outside the village of

Pemberton. The property has 1.25 km of Lillooet River frontage, as well as a creek with water rights; engineers working on the project have identified these as potential sources of freshwater (refer to Figure 10). 200 acres (80 hectares) of the property are in farmland (historically used for hay and cattle grazing but currently fallow), and the other ~187 acres (75 hectares) of the property are currently undeveloped but potentially suitable for development. According to the knowledge of RT Inc., the municipal government is currently pursuing the process of rezoning to allow for housing development.

Figure 7: Map of the Squamish-Lillooet Regional District in British Columbia, Canada. Photo: https://www.slrd.bc.ca/about-us/slrd-member-municipalities/village-pemberton

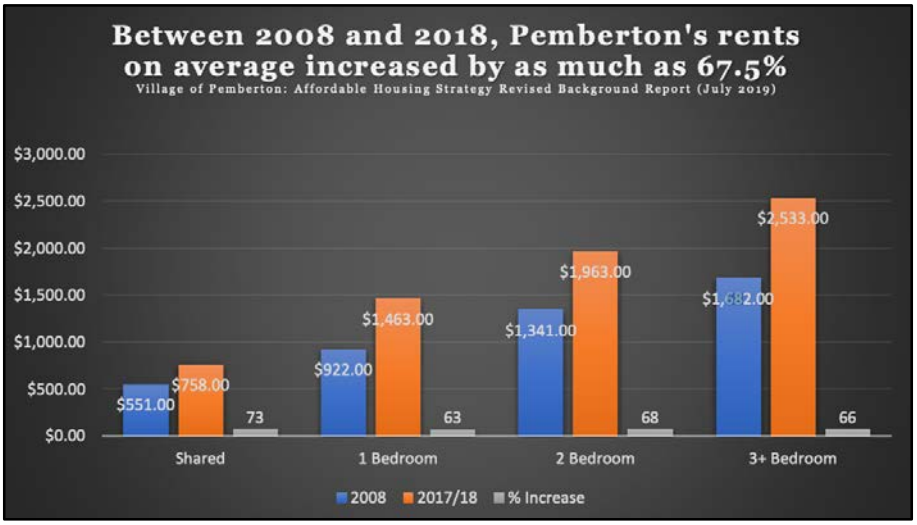


Figure 8: Rents in Pemberton, BC 2008 vs 2018. Source: Village of Pemberton, 2019

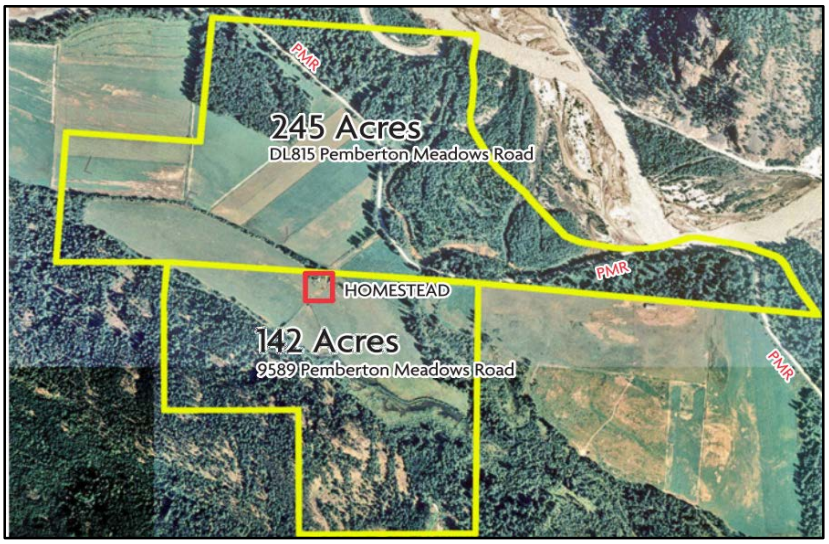


Figure 9: Aerial image showing the proposed development site located just outside of Pemberton, BC. Image: Frank Ingham Real Estate

Figure 10: Lillooet River frontage at the proposed development site. Image: Frank Ingham Real Estate.

Site-Specific Concerns

Impact on Agriculture

The compaction and sealing of the soil surface as a result of development activities have a profound impact on the health of soil resources, and consequently, food security. This is because development, in addition to the loss of agricultural land, leads to soil erosion, salinization, and degradation. This reduces the quality of the land and thus future agricultural productivity (Lubowski et al., 2006). The impact of development on food systems is a particularly important consideration for this case study due to the proximity to farms and the situation of the site within an agricultural community. There are several potential impacts on agricultural production associated with urbanization and the conversion of farmland to development. One major concern is agricultural runoff, which is the leading source of nonpoint pollution in both inland and coastal

environments globally (Wu, 2008). Because there are in fact farms nearby the Pemberton site, the risk of agricultural runoff is already high, and impervious surfaces at the development could potentially lead to higher amounts of agricultural runoff running into streams (Wu, 2008). Green infrastructures, along with the maintenance of healthy riparian buffer zones (discussed below) can help to prevent agricultural and stormwater runoff from ending up in the Lillooet River and other nearby streams.

From a social standpoint, unchecked development in agricultural communities can potentially lead to a loss of community identity, conflicts and vandalism between farmers and non-farm neighbours and loss of cooperation and information sharing between neighbouring farms (Wu, 2008). However, there are some potential socioeconomic benefits to farmers resulting from urbanization, including better access to markets, new customers, and receiving higher prices for their goods (Wu, 2008). Conflicts between farmers and developers can potentially be reduced by including farmers in the community consultation process and raising public awareness about the importance of farming in their community.

Riparian Zones and Biodiversity

Because the property sits on the Lillooet River, strategies must be implemented to minimize the impact of development on the river ecology and water health. The Lillooet River is home to several species of fish including steelhead, trout, char, and various species of salmon; these fish also support fishing tourism in the area (District of Lillooet, 2020). In addition to providing food and recreation, rivers provide environmental services, including the provision of water for drinking, cooling, and irrigation, flood protection, and cultural and aesthetic value (Böck et al., 2018).

To minimize the impact of development on the river, care should be taken to maintain Riparian Zones of 30 metres at a minimum (or higher if required by municipal bylaws). Riparian buffer zones may provide stability to river banks, water flow, and water quality without sacrificing too much of the land base (Refer to Figures 11 and 12). Because the property is adjacent to an agricultural community, the riparian zone may mitigate the impact of agricultural practices on biodiversity.

Riparian Buffer: The area between an upland zone and river shoreline is characterized by a variety of trees, shrubs, and large woody debris.

Figure 11: What is a riparian buffer? (Cowichan Lake and River Stewardship Society, 2015).

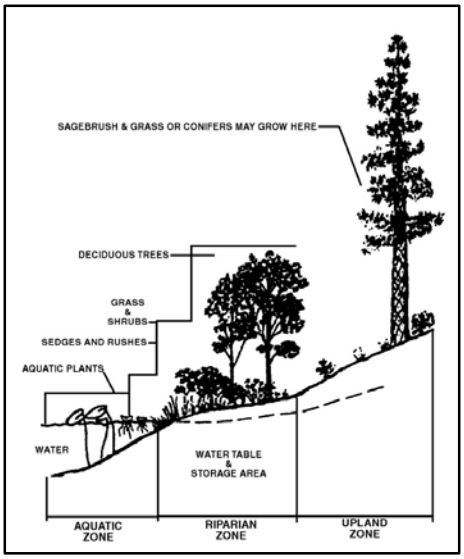


Figure 12: Riparian zone defined. Source: Cowichan Lake and River Stewardship Society (March 2015). http://www.cowichan-lake-stewards.ca/Riparian%20Zone%20Regulation.htm#Riparian

Next Steps: CMHC Solutions Lab

The Government of Canada provides up to $250,000 CAD of funding through the Canada Mortgage and Housing Corporation for developers to create solutions to the housing crisis in Canada (see Appendix 2 for the budget submitted to the CMHC). The Solutions Lab is an opportunity for developers to create a solution (i.e. a technology, a process, etc) to a housing problem that aligns with at least one of the National Housing Strategies 'Priority Areas'. These priority areas include (1) Housing For Those In Greatest Need, (2) Community Housing Sustainability, (3) Indigenous Housing, (4) Northern Housing, (5) Sustainable Housing and Communities, and (6) Balanced Supply of Housing (CMHC, 2020). The priority area for the Solution Lab being conducted at the site of the case study is 'Sustainable Housing and Communities' as this is the priority area most relevant to environmental sustainability and green infrastructures. The National Housing Strategy defines sustainable housing as housing that is "environmentally friendly, socially inclusive, and financially secure for builders and operators" (CMHC, 2020). This approach to sustainability is known as the "three pillars" approach to sustainability, which incorporates environmental, social, and economic objectives (Figure 13). This approach to sustainability is beneficial because theoretically, a given system is more resilient when these objectives are balanced.

By conducting the Lab, the team aims to break down knowledge barriers and the lack of standardization that prevents the adoption of GI by developers in the first place. The ultimate goal is to create a standardized framework for sustainable technology and service delivery for housing developers which sustainably balances energy, housing, transportation, environmental services, and land-use bylaws. This framework will be piloted at The Shire.

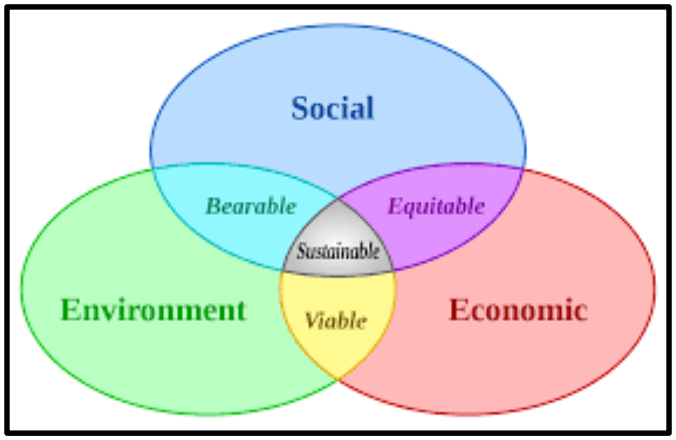


Figure 13: The three pillars of sustainability. Image: Wikipedia Commons

Methods[1]

This project attempts to move away from typical processes of development by including community members and other stakeholders in the design and selection of green infrastructures at the site. The Solutions Lab utilizes a community-centred innovation approach with a multidisciplinary team of 4-5 core-team members (called TEAM), including Young-Professionals (YPs), complemented throughout the process with community members and/or other vital stakeholders. When needed, TEAM is expanded with other YPs with specific skills for a relevant phase. The experience, insight and needs of subject-experts and other stakeholders are included in the process. By including the community through consultation 'The Shire' will achieve more sustainable outcomes, and the amenities and services offered will bring optimal benefits to the community. (See appendix 1 for a full list of team members and project partners).

This approach has had success across cultures and economies. Studies show that human decision making is not rational. Deeply embedded perspectives and experiences influence our

[1] Note that Robert Taylor, Thomas Barr, and Michel Smits contributed to the methods of the 'The Shire of Pemberton' Solution Lab.

future thinking abilities. It's harder to get seasoned talents to think out-of-the-box (unintentionally) than outside talents. Working with purpose-driven and neutral talents who aren't part of the 'system' or (local) 'problem-space' enables an organic challenge of long-held assumptions (Davison, 2009) (Preskill and Jones, 2009).

The approach's key success is its ability to tackle complexity deep in the social and behavioural roots. Elements that are not easily quantifiable yet vital to the long term success of proposed solutions. Putting the voices of the community and future generations is central to the process. While we develop new concepts in line with our described goal, we take a holistic approach by building capacity and strengthening the community's and stakeholders' overall innovation power. This provides long term compounded impact for today's and future generations, plus increases scalability to other regions.

As we go through each step, we train and empower the TEAM + community to:

1. Increase awareness around common-ground;
2. Inspire community and stakeholders;
3. Increase the adoption rate of proposed solutions; AND
4. Develop new leaders with entrepreneurial mindsets who:
    a. Drive solutions and holistic vision forward and
    b. Help increase the community's overall innovation power.

The Solutions Lab will follow the Dutch Design Deltas (D3), developed by Studio. WHY, which is a Solutions Lab consulting agency whose methods have been pre-approved by the Canada Mortgage and Housing Corporation. D3 is based on Design Thinking, Lean Startup—including hypotheses testing and Agile frameworks—complemented with trend watching and exploration outside of the problem space's domain and industry. It looks at the local situation through a global lens, utilizing, when needed, Metamorphany's network of 4000+ global innovators' and changemakers' specialized in leveraging new technologies and approaches (Smits, 2019).

The process is non-linear and iterative. Each step begins and ends with WHY. The next step is always informed by learnings from the previous. TEAM, stakeholders and community leaders receive masterclasses each phase. D3 consists of 3 steps, called Deltas, each divided into 3 phases, and one "Phase Zero" warm-up workshop:

- 0) WARM-UP:

    - Before D3, commitment, funding, and accountability are confirmed. TEAM members are recruited and selected. Scoping interviews with the project team and stakeholders produces a document describing the challenge and the starting point.
- 1st Delta: WAKE UP—“Context Design”—with phases UNDERSTAND, EXPLORE, DEFINE.
    - TEAM unravels context, puts the challenge in the right perspective of community, stakeholders and end-users. TEAM focuses on underlying issues through iterative information collection. Needs, frictions and insights are identified, analyzed and reframed into future scenarios. Opportunities are generated by exploring and identifying promising technologies/trends/concepts. This delta ends with a defined problem-solution fit.
- 2nd Delta: STARTUP—“Concept Design”—with phases CREATE, EXPERIMENT, POSITION.
    - Aimed at designing solutions from perspectives obtained during Delta1. Concepts and models are tested with real end-users. Delta2 ends with a validated balanced product-market fit. TEAM pitches perspectives, solutions, business model, a roadmap to a judging panel and stakeholders from municipal to federal levels including media.
- Final Delta: SCALE-UP—“Business Design”
    - Accelerating the formation and scaling of the organization that will ‘market’ the new solution. This requires its own Sprint process. Deltas 1+2 end where CMHC’s process also ends.

Solutions Lab Key Milestones and Activities

Phase	Team Responsibilities	Milestones and Activities	Deliverables	Outcome
0 - WARM-UP	Solutions Lab "Simulation" of the entire process with core TEAM; identification of	Scoping; Confirming project; Planning process; Lab logistics: stakeholders, experts, panels; Finalizing TEAM	Draft project agreement, governance structure, critical chain	Project team; Project engagement + commitment
DELTA-1: CONTEXT DESIGN				
1 - UNDERSTAND	Explores objectives, scenarios, scopes, constraints; asks Why-What-Who questions; creates an overview of problem space. Reformulates challenge if needed.	Kick-off training, including team-building; Strategy workshop; Interviews; Masterclasses	Final project agreement, governance structure, critical chain; Social Media and Website	TEAM trained on D3 method; Shared understanding & expectations; Cohesive team
2 - EXPLORE	Creates deep context by exploring trends, technologies, experts, stakeholders; Empathizes with end-users by immersing (experience what they experience), engaging (interact) + observing to discover hidden wants, needs, goals, desires + frustrations; determines opportunities, research strategies, frictions	Workshops (Discovery+ Explore); Interviews	Empathy and Stakeholder maps; Trends and Technology canvas; V/Blog	New insights + needs from various perspectives; Solution directions further inspired by Community- inclusion.
3- DEFINE	Define future scenarios to generate ideas. Findings from phase 1+2 unpacked, shared, synthesized and refined. Problem statement reframed.	Define workshop	Reframed problem statement(s) incl. Moonshot How Might We's? + Probing What if's; V/Blog: new insights, needs + frictions. etc.	EXPLORE- Insights enhanced with deeper WHY?; Inspired with 10x-thinking
DELTA-2: CONCEPT DESIGN				
4 - CREATE	The process's creative peak. Based on Delta1 outcomes, risks are determined, ideas generated and developed into concrete concepts and pre-prototypes.	Masterclasses (Concept-development/-refining ..., Prototyping)	V/Blog ideas+findings; Panel-ready concepts; website/media; Validation plan	Enhanced insight through the panel; Trained participants in 'opportunity discovery', 'solution development'...; 100s ideas; 4-6 concepts for validation; Prototypes

5 - EXPERIMENT	Reviews concepts, refines them, enhances prototypes; tests with end-users; processes feedback into renewed concepts; repeats the process until optimal solution fit is reached	Qualitative Panel tests; Concept-Improvement workshop; best-concept decision	Validated concepts; test log	Risk mitigation by end-user testing; Best concept picked for Mini New Business Case (MNBC)
6 - POSITION	Defining solution position statement, business model + pitch. When holistic + sustainable solution fit is achieved LAB ENDS; next is Delta3: Business Design (out of scope here)	Write MNBC; Scaling and Pitching masterclass; Pitching solution	Pitches, MNBC + roadmap; New qualitative insight start issue.	Lab completed; Concrete sustainable solution; created further awareness and opportunities; the collaboration between parties strengthened, new leaders empowered.

Table 5: Milestones and activities planned for the Rt. Inc Solutions Lab.

First Nations Engagement

Although the main beneficiary demographic for 'The Shire' are ageing Canadians, by partnering with First Nation communities, the development process can be more inclusive and address housing pain points for all. The Lil'wat Indigenous Community of Pemberton, the main location of the housing project, has been consulted and identified as a partner in this endeavour. The community's biggest concern in light of the recent COVID-19 response, according to representative Shannon Didier, is to place focus in the immediate future on food security and making sure that the community has access to the food they need as individuals and families increasingly self-isolate for protection.

The collaborative process will apply to the First Nation's subsidiary housing needs to address concerns such as food security, education in urban farming as well as skill training in the sustainable community housing development process. It is the hope that consulting with the Lil'wat Indigenous Community of Pemberton for discussions on challenges they face—concerning land and food systems—will help the team devise a comprehensive, inclusive, and diverse approach to addressing upstream solutions to housing for all.

Potential Risks and Mitigation Strategy

Due to the COVID-19 crisis, there were processing delays and as a result, the schedule of the Solutions Lab was delayed from a May 2020 start to a September 2020 start. Additionally, many

of the in-person meetings will need to be conducted remotely over Microsoft Teams to maintain social-distancing and eliminate non-essential travel as per public health guidelines. Each of the phases of the Lab will also inevitably depend on the availability of the TEAM, stakeholders, and other partners.

Because this will be an innovative approach to development, there may be risks to the success of the project. In such a complex problem space, facilitating connections between housing developers, sustainable land and water practitioners, policymakers, First Nations, and other stakeholders has historically proven to be challenging and time-consuming. Following the iterative creative solution-finding process of a Solution Lab can help to keep the focus on the common ground objectives of such a diverse group of stakeholders and strengthen collaboration. To prepare for potential risks, a mitigation strategy has been created, detailed below:

Risk:	Mitigation Strategy:
Communication could fall apart between different parties/stakeholders.	Bring in neutral parties to facilitate meetings and communication between disagreeing parties.
Going over budget.	The applicant has researched the budget thoroughly before application. Additionally, a discretionary fund will be set aside by the applicant to allow for items unaccounted for in the budget.
The objectives of the lab cannot be reached within the timeframe.	From the planning of the Solutions Lab, the timelines are made clear and all parties are held accountable for their responsibilities. Additionally, there will be weekly scheduled check-ins between the core team members, and deliverables and follow-up throughout the process. There will be substitutes/alternative team members who are readily available to contribute to the project should other members be unavailable to meet their commitments; other sources of expertise will also be identified. The objective outlined in the lab will continue to be reviewed and revised well past the duration of the lab itself as the lab is the first step and a fraction of the overall project scope of the Shire. It presents an opportunity to continue to refine the objective as a long term strategy.
The team is not diverse enough to provide the necessary perspectives to achieve the stated outcome.	The project team is currently composed of people working in multiple disciplines including engineers, academics, real estate, social and economic organizations, and government. In addition, contact has been made with local indigenous groups. The team is a mix of people from various backgrounds including age groups and genders. There are also other methods of realizing diversity such as consultation with interest groups through surveying and communication with those outside of the project team and "traditional" Industries.

Table 6: Risk and mitigation strategy for the Solutions Lab.

Expected Outcomes

It is expected that the methods and findings of the Lab will be promoted and adopted by developers and communities across Canada. This will be achieved through a combination of the promotion of the findings by the CMHC and RT. Inc's own social media strategy (see Appendix 3). And beyond, 'The Shire' will serve as a pilot of green infrastructure technologies and raise awareness of these technologies within the greater populace. Furthermore, by including young professionals, community members, we can empower the next generation of developers and decision-makers to utilize the principles of sustainable development. The Solutions Lab, the RT Inc. team is also pursuing funding through the CMHC Demonstrations competition (similar to the Solutions Lab) to further illustrate the link between green infrastructures and human health benefits.

There are several tools that the project team could potentially utilize and refer to in order to create the decision framework. These tools include existing models and tools for the valuation of GI benefit, which include (but are not limited to):

- The Green Value Calculator:
    - The Center for Neighbourhood Technology (CNT) (USA) has developed the Green Value Calculator to compare performance, costs and benefits of Green Infrastructure, and Low Impact Development interventions for stormwater management. By entering various indicators and data, the Green Value Calculator can be used to compare the benefits of a number of GI, such as green roofs, tree cover and rain gardens. Link to Green Value Calculator: http://greenvalues.cnt.org/calculator/calculator.php
- The Green Infrastructure Valuation Toolkit:
    - The Natural Economy Northwest programme (UK), has a valuation framework for assessing the potential economic and wider returns from investment in GI and various other environmental improvements. A prototype Green Infrastructure Valuation Toolkit was made available to the public in 2011 and includes a comprehensive user's guide and a set of tools that can be used for assessing the value of green assets for various benefits or projects. The Toolkit also includes three case studies and presents results from applying the toolkit. Link to the resources under Green Infrastructure Valuation Toolkit:

http://www.greeninfrastructurenw.co.uk/html/index.php?page=projects&GreenInfrastructureValuationToolkit=true

- i-Tree Vue
    - The i-tree Vue software comprises several tools that enable the user to analyze available land cover data and estimate land cover, including tree canopy and some of the ecosystem services provided by urban trees. The effects of tree planting scenarios on the possible benefits can also be modelled. The tool can be relevant in assessing impacts of proposed GI on delivery of related ecosystem services and co-benefits (basic scenarios can be modelled for carbon storage and sequestration, pollution removal). Another version, called i-Tree Hydro is also available, which can be used in watersheds to model the impacts of changes in tree and impervious cover characteristics on streamflow and water quality. I-Tree Vue link: http://www.itreetools.org/hydro/index.php
- Health Economic Assessment Tool (HEAT):
    - The HEAT tool was designed by the World Health Organization (WHO) Regional Office for Europe and helps to estimate the economic savings resulting from reductions in mortality as a consequence of regular cycling and/or walking. It can be used to assess the economic value of potential GI co-benefits (e.g. green spaces). The tool is designed with default parameters relevant for Europe, but these can be adapted to fit different contexts by using data appropriate for other locations. Link to the tool, methodology and user guide: http://www.heatwalkingcycling.org/

Lastly, as a contingency for receiving funding to conduct the Solutions Lab, the National Housing Strategy has a number of outcomes that are expected to be fulfilled through the findings of the Solutions Lab. These expectations and the explanation of how the Solutions Lab will meet them are outlined in Table 7.

NHS Expected Outcome	How Expected Outcome is Met
Homelessness is reduced year over year	SLRD has felt housing pressure for a while, with a current 2-year wait for non-market housing. Average rents have increased by 68% in 10 years. Developing a prototype will

	provide 187-200 units over the phased 2-3 year duration of the project, reducing homelessness. Scaling it nationally will have a similar impact.
Housing is affordable and in good condition.	The process will be applied to develop affordable housing based on 80% of Average Market Rent (AMR) and costs no more than 30% of Area Median Income (AMI). Housing will be new, in good condition, and developed in accordance with municipal building codes.
Affordable housing promotes social and economic inclusion for individuals and families.	Socio-economic indicators used to measure inclusion are: a) *Disposable income* - affordability increases disposable income with less spent on rent. This lifts marginalized individuals/families out of poverty b) *Fiscal responsibility*- affordability allows productive management of finances in the best interest of individuals/families. c) *Social responsibility*- affordability allows diverse groups of people from mixed-income, socio-ethnic backgrounds to build an inclusive community based on individual duties and cumulative performances to maintain accountability.
Housing outcomes in Canada's territories are improved yearly.	Scalability of the framework to other regions in Canada will accelerate the approval process for more sustainable community development in many different scenarios.
Housing needs of indigenous groups are identified and improved.	Although the main beneficiaries are ageing Canadians, by partnering with first nation communities, we will form an inclusive process addressing housing solutions for all. This will apply to their subsidiary needs like food security, as well as skill training in sustainable community development.
Affordable housing contributes to environmental sustainability	Incorporating green infrastructures and sustainable measures will lead to enhanced environmental benefits by mitigating impacts of land development on watershed; protection of biodiversity + natural ecology; generating clean energy; reducing carbon footprint; reducing energy consumption.
NHS contributes to Canadian economic growth	Proposed housing model will: boost the local construction supply industry; create food and energy systems; increase transportation networks; build multiple revenue streams to meet fiscal responsibilities; provide jobs, and reduce unemployment.
Partnerships are built, strengthened + mobilized to achieve better outcomes	A diverse + inclusive collaboration of multiple stakeholders including first nations; more women for a rich perspective; seniors citizens; non-traditional industry experts; academic institutions; government representatives; Young professionals.
Collaboration across the federal government results in holistic responses to housing problems	Partnership with CMHC, team members with federal NHS experience, and local authorities align with all levels of government to address the common denominators that exacerbate housing. In addition, partnerships are forged and strengthened between the local and federal government, housing developers, local First Nations, land and water practitioners, and community residents.

Table 7: Summary of National Housing Strategy expected outcome and how this will be achieved through 'The Shire' Solutions Lab Process.

Summary

- The need for affordable housing is continuing to grow as the gap widens between incomes and housing costs. However, housing development can compete for other land uses such as

food production and habitat for wildlife. In addition, there are environmental and human health concerns associated with the traditional ways housing developments and urban areas are implemented.

- Community housing and higher density housing are increasing around the world for several reasons such as better access to healthcare and affordability concerns. As a result, new developments must increasingly prioritize access to outdoor spaces for people to recreate and exercise locally and create conditions for health in urban environments.
- Furthermore, housing affordability is intrinsically linked with other social issues such as food security. New community housing development should seek to address these challenges in addition to building more units to offer holistic solutions.
- There are several infrastructure interventions called “green infrastructures” that can be applied at developments which have been shown to mitigate environmental and human health impacts of urban environments while delivering social and economic benefits. However, there is a need for wider adoption and implementation of these technologies within Canada to achieve the benefits provided on a larger scale.
- ‘The Shire of Pemberton’ is a proposed affordable housing development for seniors to be built in Pemberton, BC to be delivered by Rt. Inc in collaboration with the Canada Mortgage and Housing Corporation. To minimize the impacts of development, Rt Inc. will be conducting a CMHC Solutions Lab to create a framework for green infrastructure delivery using a community-centred approach. Infrastructure options include rooftop gardens, greenhouses, rain gardens, etc.

Recommendations

- Generally, when it is determined that land-use changes are needed to meet housing needs in a community, technologies such as low-impact development, stormwater management, and green infrastructures should be explored and deployed at development sites to yield benefits while minimizing harm to the natural integrity of the land.
- Consultation with a variety of stakeholders when choosing green technologies and services can potentially lead to better social, economic, and environmental outcomes; relevant

stakeholders include local residents and farmers, government officials, First Nations, and the target market (end users).

- Because the property of the case study is currently undeveloped, environmental impacts associated with watershed health and biodiversity are of particular concern for developing the land due to the destruction of habitat and sealing of the soil surface with buildings. Therefore, Rt Inc. will consider installing infrastructures such as rainwater collection and bioswales which mitigate these impacts.
- In addition, Rt Inc. will consider leaving ample green spaces which can further mitigate environmental impacts while providing an area for residents to recreate and exercise. The importance of accessible green spaces is particularly relevant to the case study because seniors may have more difficulty travelling and moving around than others. Urban green spaces are also correlated with a decreased risk of negative health outcomes such as dementia and stroke among older Canadians.
- Riparian buffer zones should also be maintained along the Lillooet River as per provincial and municipal guidelines and bylaws to mitigate the risk of agricultural and stormwater runoff and provide protection from extreme weather events.
- Due to COVID-19, a survey of the soil and environmental conditions of the site was unable to be conducted due to travel restrictions. A thorough survey of the site conditions (i.e. soil type, topographic conditions, etc) should be done to determine which infrastructures would be feasible and provide optimal benefits at the site.
- Rt. Inc will continue to seek community consultation for green infrastructure and technology delivery at the 'Shire of Pemberton'. The developers will pay particular attention to the potential use of rooftop greenhouses and community gardens at the site which can provide benefits including rainwater harvesting, heat insulation, and food security. These options may also align with the agrarian culture of the Pemberton Community and the food security priorities of the local First Nations.

The Solutions Lab will only be one piece of the whole multi-year project of building and delivering 'The Shire'. However, it is perhaps one of the most important steps of this project because it kick-starts the creative problem-solving and design-build process. In addition, the process allows Rt. Inc to build partnerships with the local government, First Nations, and the community to collaboratively address housing sustainability.

Ensuring long-term sustainability, housing affordability, and the accessibility of homes in good condition is not solved by simply building more units. Especially in regions where besides housing, other important challenges such as food security and addressing climate change and biodiversity loss are equally challenging concerns to consider when making decisions that carry possible long term impact. So, it is more important today than ever before to seek holistic solutions. Furthermore, due to the COVID-19 crisis, governments and businesses must embrace principles of sustainable development to kickstart a wider transformation towards an economic model that values nature as the foundation for a healthy and prosperous society.

It is important to acknowledge that housing development interventions are not the only way to solve these problems, and that funding must also be made available for health, education, and social welfare services for low-income Canadians and those at risk of homelessness. However, GI gives a unique and feasible opportunity to address several social and environmental issues in a coherent manner. By supporting developers to implement green infrastructures at new developments, the Canada Mortgage and Housing Corporation and the Canadian Government can support a transition towards more sustainable and healthier housing for all.

References

Benedict, Mark & McMahon, Edward & Fund, The & Bergen, Lydia. (2006). Green Infrastructure: Linking Landscapes and Communities. Bibliovault OAI Repository, the University of Chicago Press. 22.

Böck K., Polt R., Schülting L. (2018) Ecosystem Services in River Landscapes. In: Schmutz S., Sendzimir J. (eds) Riverine Ecosystem Management. Aquatic Ecology Series, vol 8. Springer, Cham

Canada Mortgage and Housing Corporation. (2019). A Stronger National Housing Strategy. Retrieved from: https://www.cmhc-schl.gc.ca/en/media-newsroom/news-releases/2019/stronger-national-housing-strategy#:~:text=The%20Government%20of%20Canada%20is,units%20and%20reduce%20chronic%20homelessness

Canada Mortgage and Housing Corporation. (2020). National Housing Strategy: Priority Areas for Action. Retrieved from: https://www.cmhc-schl.gc.ca/en/nhs/guidepage-strategy/priority-areas-for-action

Cowichan Lake and River Stewardship Society. (March 2015). Riparian Zone and Regulations. Retrieved from http://www.cowichan-lake-stewards.ca/Riparian%20Zone%20Regulation.htm#Riparian

Davis, A.P., 2005, Green engineering principles promote low-impact development: Environmental Science and Technology, A-pages, v. 39, no. 16, p. 338A–344A.

Davison, M. L. (2009). The challenges we face managing those external (and internal) consultants! Paper presented at PMI® Global Congress 2009—North America, Orlando, FL. Newtown Square, PA: Project Management Institute.

District of Lillooet. (2020). Outdoor Activities: Fishing. Retrieved from http://www.lillooetbc.ca/Recreation-Activities/Outdoor-Activities/Fishing.aspx

Erkman, S. (1997). Industrial ecology: An historical view. *Journal of Cleaner Production*, *5*(1), 1–10. https://doi.org/https://doi.org/10.1016/S0959-6526(97)00003-6

Forest Research (2010). Benefits of green infrastructure. Report by Forest Research, Contract no. WC0807, Farnham, UK

Forest Research. (2020). Benefits of Green Space: Woodland. Retrieved from https://www.forestresearch.gov.uk/tools-and-resources/urban-regeneration-and-greenspace-partnership/greenspace-in-practice/benefits-of-greenspace/woodland/#:~:text=Urban%20woodland%20can%20be%20defined,between%20urban%20and%20rural%20areas.

Gaetz, S. Dej, E., Richter, T., and Redman, M. (2016). *The State of Homelessness in Canada 2016*. The Canadian Observatory on Homelessness. Retrieved from https://homelesshub.ca/sites/default/files/SOHC16_final_20Oct2016.pdf

Houle, K., Roseen, R., Ballestero, T., Briggs, J., and Houle, J., (2009), Examinations of Pervious Concrete and Porous Asphalt Pavements Performance for Stormwater Management in Northern Climates: World Environmental and Water Resources Congress 2009: p. 1–18.

Jennings V, Bamkole O. The Relationship between Social Cohesion and Urban Green Space: An Avenue for Health Promotion. Int J Environ Res Public Health. 2019;16(3):452. Published 2019 Feb 4. doi:10.3390/ijerph16030452

Krefis, A., Augustin, M., Schlünzen, K., Oßenbrügge, J., & Augustin, J. (2018). How Does the Urban Environment Affect Health and Well-Being? A Systematic Review. Urban Science, 2(1), 21. doi:10.3390/urbansci2010021

Lubowski, R.N., Vesterby, M., Bucholtz, S., Baez, A., and Roberts, M.J. (2006). Major uses of land in the United States, 2002. Economic Information Bulletin No. (EIB–14).

National Research Council (US). (1992). Panel on Biodiversity Research Priorities. Conserving Biodiversity: A Research Agenda for Development Agencies. Washington (DC): National Academies Press (US. 1, Biodiversity and Development. Available from: https://www.ncbi.nlm.nih.gov/books/NBK234666/

Paul, L. A., Hystad, P., Burnett, R. T., Kwong, J. C., Crouse, D. L., van Donkelaar, A., Tu, K., Lavigne, E., Copes, R., Martin, R. V., & Chen, H. (2020). Urban green space and the risks of dementia and stroke. Environmental research, 186, 109520. https://doi.org/10.1016/j.envres.2020.109520

Pemberton District Chamber. (2020). Pemberton Climate. Retrieved from https://www.pembertonchamber.com/pemberton/area/climate/

Perdue, W. C., Stone, L. A., & Gostin, L. O. (2003). The built environment and its relationship to the public's health: the legal framework. American journal of public health, 93(9), 1390–1394. https://doi.org/10.2105/ajph.93.9.1390

Petterson, S. (2017). *Investing in affordable housing : BC, canada, and the world* Centre for Social Innovation and Impact Investing, Sauder School of Business, UBC.

Pons, O., Nadal, A., Sanyé-Mengual, E., Llorach-Massana, P., Cuerva, E., Sanjuan-Delmàs, D., Muñoz, P., Oliver-Solà, J., Planas, C., & Rovira, M. R. (2015). Roofs of the Future: Rooftop Greenhouses to Improve Buildings Metabolism. Procedia Engineering, 123, 441–448. https://doi.org/https://doi.org/10.1016/j.proeng.2015.10.084

Preskill, H., and Jones, N. (2009). A Practical Guide for Engaging Stakeholders in Developing Evaluation Questions. Retrieved from http://www.pointk.org/resources/files/rwj.stakeholders.final.1.pdf

Ranjha, S. (2016). Green infrastructure: planning for a sustainable and resilient urban environment. Retrieved from https://sustainabledevelopment.un.org/content/documents/95599_Ranjha_Green%20infrastructure_planning%20for%20sustainable%20and%20resilient%20urban%20environment.pdf

Roseen, R., Ballestero, T., Houle, J., Briggs, J., and Houle, K., 2012, Water Quality and Hydrologic Performance of a Porous Asphalt Pavement as a Storm-Water Treatment Strategy in a Cold Climate: Journal of Environmental Engineering, vol. 138, no. 1, p. 81–89.

Shiels, M. (2013). The Cost of Green Infrastructure as Convergence of Political Leadership, Architecture and Engineering: Cheaper than We Thought. Retrieved from https://thefield.asla.org/2013/12/09/the-cost-of-green-infrastructure/

Smits, Michael. (January, 2019). Solving the global housing affordability crisis: a next-generation approach. Retrieved from https://www.metamorphany.org/News-blogs/YDI-Program-housing-affordability-crisis-Canada-190130.html

Statistics Canada. (2016). Census of Canada 2016. Retrieved from https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/index-eng.cfm

Taylor, Robert J. (2018). The Shire of Pemberton. Retrieved from file:///Users/skylarkylstra/Downloads/The%20Shire-%20Pemberton,%20BC.edited.pdf

Utah State University Extension. (2019). Water Quality: Rain Gardens and Bioswales. Retrieved from https://extension.usu.edu/waterquality/urbanstormwater/green-infrastructure/rain-gardens-and-bioswales

United Nations Convention on Biodiversity. (April 2018). Biodiversity at the Heart of Sustainable Development: Input to the 2018 High-Level Political Forum on Sustainable Development. Retrieved from https://sustainabledevelopment.un.org/content/documents/18277CBD_input_to_2018_HLPF.pdf

United Nations. (n.d.). The sustainable development agenda. Retrieved from https://www.un.org/sustainabledevelopment/development-agenda/#:~:text=Sustainable%20development%20has%20been%20defined,to%20meet%20their%20own%20needs.

United Nations. (n.d.). Goal 11: Make cities inclusive, safe, resilient, and sustainable. Retrieved from https://www.un.org/sustainabledevelopment/cities/

United Nations Environment Programme. (2014). Green infrastructure guide for watershed management. Retrieved from https://www.iucn.org/downloads/green_infrastructure_guide.pdf

United States Environmental Protection Agency. (2017). Healthy benefits of green infrastructure in communities. Retrieved from https://www.epa.gov/sites/production/files/2017-11/documents/greeninfrastructure_healthy_communities_factsheet.pdf

United States Environmental Protection Agency. (2014). Enhancing sustainable communities with green infrastructure. Retrieved from https://www.epa.gov/sites/production/files/2016-08/documents/green-infrastructure.pdf

United States Environmental Protection Agency. (May 13, 2019). Overcoming Barriers to Green Infrastructure. Retrieved from https://www.epa.gov/green-infrastructure/overcoming-barriers-green-infrastructure

U.S. Environmental Protection Agency, Washington, D.C. (February 2003). "Protecting Water Quality from Urban Runoff." Document No. EPA 841-F-03-003

USGS. (n.d.). Evaluating the potential benefits of permeable pavement on the quantity and quality of stormwater runoff. Retrieved from https://www.usgs.gov/science/evaluating-potential-benefits-permeable-pavement-quantity-and-quality-stormwater-runoff?qt-science_center_objects=0#qt-science_center_objects

Village of Pemberton. (July, 2019). Affordable Housing Strategy - Revised Background Report. Retrieved from https://www.pemberton.ca/public/download/files/92518

Veen, E. J., Bock, B. B., Van den Berg, W., Visser, A. J., & Wiskerke, J. S. C. (2016). Community gardening and social cohesion: different designs, different motivations. Local Environment, 21(10), 1271–1287. https://doi.org/10.1080/13549839.2015.1101433

Wang, L., Lyons, J., Kanehl, P., and Bannerman, R., 2001, Impacts of urbanization on stream habitat and fish across multiple spatial scales: Environmental Management, v. 28, no. 2, p. 255–266.

Water Environment Federation. (2015). Stormwater Report: The Real Cost of Green Infrastructure. Retrieved from https://stormwater.wef.org/2015/12/real-cost-green-infrastructure/#:~:text=Highly%20manicured%20green%20infrastructure%20%E2%80%94%20often,highway%20median%2C%E2%80%9D%20Potts%20said.

Williamson, R. B., 1993, Urban runoff data book: a manual for the preliminary evaluation of urban stormwater impacts on water quality. Water Quality Centre, Ecosystems Division, National Institute of Water and Atmospheric Research

World Health Organization. (2020). Health effects of urban environments. Retrieved from https://www.euro.who.int/en/health-topics/environment-and-health/Housing-and-health/activities/health-effects-of-urban-environments

Wu, JunJie. (2008). Land Use Changes: Economic, Social and Environmental Impacts. Retrieved from http://www.choicesmagazine.org/UserFiles/file/article_49.pdf

Yuchi, W., Sbihi, H., Davies, H., Tamburic, L., & Brauer, M. (2020). Road proximity, air pollution, noise, green space and neurologic disease incidence: a population-based cohort study. Environmental Health, 19(1), 8. https://doi.org/10.1186/s12940-020-0565-4

Appendix 1: Research Team and Project Partners

Core Team

Skylar Kylstra, Project Manager

Organization: UBC Masters in Land & Water Systems

Role in Project: Project Manager and Researcher

Expertise and Experience:

- Land and Water Resource Evaluation
- Academic knowledge related to the fields of urban watershed management and food systems

Dr. Les Lavkulich, Academic Supervisor

Organization: University of British Columbia Faculty of Land and Food Systems

Role in Project: Skylar Kylstra Masters research supervisor

Expertise and Experience:

- Land, water and food systems expertise
- Consultation and direction

Robert Taylor, Professional Collaborator

Organization: RT Design-Build Inc.

Role in Project: Housing Research and Innovation

Expertise and Experience:

- Socio-economics
- Merit review process for NHS research and innovation, vetting viable and sustainable housing solutions for Canadians
- Real Estate Development
- Building Technology

Thomas A. Barr, Team Member

Organization: Atlas Projects

Role in Project: Energy Systems Specialist

Expertise and Experience: Mechanical, Electrical, Energy Integration Specialist. Focused on selecting the appropriate solution using the appropriate technologies. Fifteen years, design, building and project managing clean tech innovative projects in the residential, commercial and community development markets.

Michael Smits, Team Member

Organization: Metamorphany

Role in Project: Solutions Lab Consultant

Expertise and Experience: Certified innovation coach and solutions lab consultant with global working & living experience; From executive positions and entrepreneurship in IT, Finance, Marketing and Telecom in Europe, Australia and North America to leading humanitarian and human rights programs in countries affected by fragility, conflict and violence, including working with Indigenous populations and leading large-scale development programs that entailed the construction of housing, schools, hospitals and road infrastructure in challenging terrains. Facilitates the lab process and brings a global lens. Michael and his teams have been vetted by CMHC and Federal and Provincial Ministries in the EU, among others, as an authoritative Solution Lab Provider.

Project Partners

In addition, we will be able to consult with the following project partners and stakeholders who have already agreed to provide input throughout the process:

Shannon Didier

Lil'wat First Nations Community

- Identifying sustainable community development pain points from First Nations
- Collaboration on long-term food security for First Nations community
- Cultural/traditional considerations for a holistic outcome

Chee Ying Ho

Organization: Centre for Sustainability Whistler

- Inspire and facilitate effective conversations and planning for a better world.
- Engagement and Facilitation
- Creative process design experts.

Kevin Healy

Organization: Creus Engineering Ltd

- Provides civil engineering design requirements
- Solutions for developers and public clients
- Land development in the Pemberton area
- Environmental tests, assessments and reports

Trish Mitchell

Organization: Squamish Lillooet Regional District

- Building and planning assistance
- Rezoning requirements and bylaws
- Pemberton Valley Transit system
- Grid electric services to lot
- Road accessibility

Scott Mackay

Organization: AntiSocial Solutions

An innovative digital branding and marketing agency helping companies expand their online presence worldwide by offering a wide range of services including:

- Social media strategy
- Photo and video production
- Website development
- Branding
- Copywriting
- Publishing

Derek Graves

Organization: Pemberton Lions Club

Seniors organization

- The Pemberton Lions Club is a part of Lions Clubs International, a network of volunteers who work together to answer the needs that challenge communities
- Seniors network and outreach

Hossein Bizhanfard

P. Eng LEED Mechanical and Plumbing Systems

- Sustainable system schematics
- Low Impact Development (LID) strategies

Niekia Botham

Organization: Sea-to-Sky Solar

- Renewable Energy System installations

- Solar PV system consultations
- Clean energy generation

Vivian Chen

Organization: HSBC Canada

- CFO
- Business Banking Relationship Manager
- Economic consultant
- Quantitative analysis
- Financial advisor

Pedro Martine Cabrian

Building Engineering and Architectural Technician

- Architectural schematics for Housing/Shelter
- Accessibility for disabilities
- Site planning

Yared Afework

Organization: Alair Homes Vancouver

- Custom Residential Design-Builders
- LEED Certification
- Construction Project Management
- Elevators and accessibility designation
- Architectural design
- Passive Haus

Kerry Batt

Organization: Engels and Volkers - Real Estate

- Underutilized land search and identification
- Real estate assessments and reports
- Amenities and lot services
- Appraisal and negotiation
- Acquisition facilitation

Appendix 2: Solutions Lab Budget

4.1 Total Project Costs – (Note regarding the Timing – please indicate the expected expenditures in the Quarter it will occur for the associated activity)

Phase (align with Section 2.5)	Total cost of activities ($K)	Total request from CMHC by quarter						Total Cost request from CMHC	Description of costs (e.g.; recipient of funding, labour, capital costs, services, etc.)
		Q2 2020-2021 (July to September)	Q3 2020-2021 (October to December)	Q4 2020-2021 (January to March)	Q1 2021-2022 (April to June)	Q2 2021-2022 (July to September)	Q3 2021-2022 (October to December)		
Phase 1	$13,300.90	$13,300.90						$13,300.90	Prep, Project planning,consultant fees (CF)
Phase 2	$48,441.48	$36,967.51						$36,967.51	per diems (PD), CF, workshops (WS), research...
Phase 3	$64,723.38	$38,497.16						$38,497.16	PD, CF, WS, Masterclasses (MS) growth-hacking...
Phase 4	$20,226.06	$12,030.36						$12,030.36	PD, CF, MS + WS, research + interviews, logistics.
Phase 5	$141,582.39	$36,091.09	$48,121.44					$84,212.53	PD, CF, MS + WS, end-user testing, research, logistics
Phase 6	$64,723.38		$38,497.16					$38,497.16	PD, CF, MS + WS, prototyping, marketi experimenting, rese
Phase 7	$44,497.32		$26,466.80					$26,466.80	PD, CF, MS + WS, event planning, logistics, marketing
Total Project Costs	$397,494.91	$136,887.02	$113,085.40	$0.00	$0.00	$0.00	$0.00	$249,972.42	

4.2 Proposed Funding Contributions – CMHC, Applicant and Partners

Contributions ($K)	Cash	In-Kind **	Total	Activity and Purpose *
Requested from CMHC *	$249,972.42		$249,972.42	
Applicant		$102,000.00	$102,000.00	
Partner 1		$10,000.00	$10,000.00	UBC in-kind contribution
Partner 2		$10,312.50	$10,312.50	Atlas Projects Inc. In-Kind expertise
Partner 3		$10,210.00	$10,210.00	Metamorphany In-Kind expertise
Partner 4		$15,000.00	$15,000.00	Metamorphany In-Kind expertise
Total Contributions **	$249,972.42	$147,522.50	$397,494.92	
% Total Cash from CMHC	100.00		62.89	

Budget submitted to the Canada Mortgage and Housing Corporation for the proposed Solutions Lab. Note: UBC in-kind contribution refers to the savings of using free bookable meeting spaces on campus as opposed to paying to rent a meeting space (however, this is unlikely to be utilized anyways due to COVID-19 and the fact that the lab date was postponed until September).

Appendix 3: Communications Materials and Strategy

Knowledge Products:

A Professional Report, Infographic, Website, Branding and marketing/communication strategy/roadmap, Blog, Press releases

Knowledge Sharing (Overview):

The process of the Solutions Lab will allow for knowledge-sharing and storytelling between various groups including academics, seniors, community members, developers, and policymakers. There is also an opportunity to share this process via vlogging and documentation throughout the process which can be open source and shared with CMHC and others.

I will be conducting work within the Solutions Lab as an extension of my Major Project for the degree of Master of Land and Water Systems at UBC. As part of the Project, a Professional Report will be written which will be published on the UBC M.L.W.S. website, and could also potentially be adjusted and submitted to relevant academic journals. I will also be giving a presentation of the project to the M.L.W.S. cohort and Faculty of interest at UBC in the fields of land and water management, engineering, and landscape architecture (among others). In addition, an infographic will be created to be published with the professional report on the MLWS site. The professional report that is created will also be shared via social media such as Linkedin.

There is also the intention to present the findings from the Solutions Lab in the form of a pitch to relevant stakeholders including government officials, community members, First Nations, and real estate development; RT Design-Build Inc. has already been pursuing these kinds of connections. This pitch could be advertised to local news channels, or alternatively could be filmed and shared by the project team.

Because the Solutions Lab is just one piece of The Shire project, the knowledge will continue to be shared throughout the process of conducting that particular project and through other channels such as the CMHC demonstrations.

CMHC will also be able to assist with knowledge-dissemination to raise awareness of the created framework with developers, building associations, communities, and other parties across the country.

Anti-Social Solutions Partnership

To market the project, the team has partnered with AntiSocial Solutions, a Canadian expert in innovative digital branding, marketing and community building that will provide services including social media strategy, photo and video production, website development, media buying, branding, copywriting, and consulting. We will take an integrated approach, meaning that the insights, lessons learned and solutions developed will be turned into various creative knowledge products, which we'll share through a variety of channels, using multiple media. Think: (social) media posts, professional reports, website, blogs, press releases, etc.

It'll be an antisocial(media) marketing approach. We're not just seeking to disseminate our findings, learnings, and solutions using social and digital media and/or the physical channels of our partners and local, provincial and federal Government organizations. The aim is to build and exponentially grow a community & crowd around the wider purpose of The Shire; take people, organizations and partners on the journey with us; create ambassadors and believers among our target group, which include academics, community members, developers, policymakers and government representatives, but also seniors, changemakers, sustainability advocates, etc. Part of the Lab's results will be an even more in-depth marketing/branding/communication strategy than the phased plan we have already outlined together with AntiSocial. We have purposefully determined a phased sharing of our knowledge gained, lessons learned and solutions developed—to build it, craft it around each stage of the Lab and the new findings as they arise.

A summary of the starting plan we have put together with the professionals is as follows:

1. **PHASE 1: 1st HALF**
    a. Simple Branding: Creating simple, but definitive guidelines for any digital or print content being developed for The Shire moving forward— the interim branding that represents the Shire in a polished and cohesive way from the beginning until the final Brand is confirmed through engagement.

b. Small (Brochure) Website Development: Build the basic website that is required at this early stage, with information about the project, team, timeline, and blog that follow these brand standards.

2. **PHASE 2: 2nd HALF**
    a. Social Media & Paid Advertising Strategy & Management Social Media Strategists will put together a customized plan for launching the brand and social media, including platforms, content, marketing pillars, tonality. The entire plan on how to run the social media program or advertising campaign is developed.
    b. Content Production: A team of producers, designer, animators can create virtually any kind of digital or live action content we might want to create. Copywriting/Editing, Blog Writing, Graphic Design, Motion Graphics, Videography, Photography.