Pathways to Low Carbon Resilience: Developing a Regulatory Mechanisms Toolkit for Nature-based Solutions in British Columbia's Municipalities

by

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Declaration of Committee

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Abstract

Nature-based Solutions (NbS) offer an opportunity for municipalities to address three planetary crises, namely pollution, climate change, and biodiversity loss (United Nations, n.d.), while also improving the health and equity of residents. For municipalities to mainstream the use of NbS, they will need to adopt regulatory mechanisms that facilitate and require NbS uptake. This study sought to support that effort by developing a toolkit of recommendations for the use of regulatory mechanisms, which were derived from a literature review and content analysis of key resources. The toolkit's utility was tested by applying it as an analytical framework in a case study of Port Moody, British Columbia, Canada, and conducting a workshop with the City's staff. The key findings of this study are that regulatory mechanisms can play an important role in advancing NbS in urban areas, although they will need to be tailored to the local context of the municipality.

Keywords: British Columbia; Bylaws; Low Carbon Resilience; Municipality; Nature-based Solutions; Regulatory Mechanisms

Dedication

This paper is dedicated to the more-than-human species who share our yards, streets, parks, forests, waters, skies, and homes.

Acknowledgements

First, I would like to thank my supervisors, Sean Markey and Alison Shaw. When I decided to make a major life change, you both affirmed for me, in our very first conversations, that I had chosen the right path. I appreciate your support throughout the development of and changes in the scope of this project, as well as your encouragement and enthusiasm as the pieces finally came together.

I am also grateful for the opportunity that I had to work with the Action on Climate Team throughout my studies. It was exciting and fulfilling to be able to contribute to resources that are relevant, timely, and useful for practitioners. I learned a lot from my fellow team members, who have such a rich knowledge of this field, and it was great to be a part of this team of positive changemakers.

I wish to express my gratitude to those who volunteered to be a part of this research. Thank you for taking the time to attend the workshop, as well as for sharing your insights and experiences. I learned a lot from all of you, and I hope that you also found this process and the toolkit's recommendations to be helpful for your work.

I also want to thank my family and friends for your help and encouragement over the past two years. You have been so supportive of my new path and have gone above and beyond to help me pursue it, including helping me pack up and move to another province. I especially want to thank my Mom, who has always been there for me when I need her and who offered advice, reassurance, and a patient ear during the intense weeks I spent writing this paper. And, of course, I could never forget my pets, who have kept me company during my long hours of research and writing: Kiwi, Leopold, and Eevee. They inspire me to speak for those who do not have a voice.

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List of Acronyms

ACT	Action on Climate Team
AR6	Sixth Assessment Report (by the Intergovernmental Panel on Climate Change)
IPCC	Intergovernmental Panel on Climate Change
NbS	Nature-based Solutions
NSI	Natural Solutions Initiative
SFU	Simon Fraser University
UN	United Nations

Chapter 1. Introduction

1.1. The Value of Nature-based Solutions in Cities

In the global struggle to mitigate and adapt to climate change, cities will play a pivotal role in our collective success or failure. In particular, cities produce around 70% of energy-related greenhouse gas emissions (United Nations [UN], 2019) despite only housing around 56% of the world's population (United Nations Human Settlements Programme [UNHSP], 2022). With the latter percentage expected to rise to 68% by 2050 (UNHSP, 2022), this raises serious concerns about a corresponding increase in emissions.

In addition to being major contributors to climate change, cities are also more vulnerable to its impacts (UN, 2019). These impacts include more frequent and severe weather events, which result in flooding and extreme heat (Intergovernmental Panel on Climate Change [IPCC], 2023b). In cities, these types of events have negative repercussions for both infrastructure and human health (IPCC, 2023b). As a result, cities must implement measures not only to reduce greenhouse gas emissions but also to increase resilience to extreme weather events.

In considering a path forward, the UN (n.d.) has asserted that climate change cannot be addressed in isolation. In particular, it is only one "part of an interlinked triple planetary crisis" which includes pollution and biodiversity loss (UN, n.d.). As such, these environmental threats must be "tackled together" in order to achieve a sustainable future (UN, n.d.). In a similar vein, the IPCC's Sixth Assessment Report (AR6; 2023b) has underscored the interdependency of humans and ecosystems as well as the role that ecosystems play as both carbon sinks and buffers against the impacts of climate change.

In recognition of this role, the AR6 highlights the effectiveness of using Ecosystem-based Adaptation approaches to moderate the impacts of climate change (IPCC, 2023b). As noted therein, these approaches are related to Nature-based Solutions (NbS; IPCC, 2023b), the latter of which are also being promoted by the Government of Canada (2024). NbS are "actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits" (Nature-based Solutions for supporting sustainable development, 2022).

Based on this definition, NbS must balance environmental, social, and economic considerations. As a result, this approach is particularly suited for complex socioecological systems, such as cities. As noted by Duffaut et al. (2022), the goal of NbS is to benefit both humans and the environment, rather than focusing on one or the other. In addition, many NbS that are targeted to one challenge area will have co-benefits for others (Jones & Doberstein, 2022; Raymond et al., 2017). As such, these measures appear to offer a way for cities to tackle climate change in tandem with pollution and biodiversity loss.

1.2. Project Scope

This research was conducted as part of ACT - Action on Climate Team's Natural Solutions Initiative (NSI). The goal of the NSI is to facilitate the uptake of NbS in communities (ACT, 2023b). In particular, the NSI aims to advance cohesive and systemic NbS by guiding practitioners from planning through to implementation.

For the implementation stage, this research project was initiated to examine how local governments in British Columbia can use regulatory mechanisms to support the uptake of NbS. As part of this project, I conducted a literature review and content analysis of key resources in order to develop a toolkit that provides recommendations for the use of regulatory mechanisms and other government powers: the NSI Regulatory Mechanisms Toolkit (Appendix A). I based the structure of the toolkit on the dimensions of NbS planning and practice that were described in the NSI Framework-for-Action (ACT, 2023b):

i) Three nested and interdependent NbS planning approaches: Ecosystem-based Management, Natural Asset Management, and Blue-Green Infrastructure Strategies.

ii) Four scales of NbS action: watershed, community, neighbourhood, and parcel.

iii) Five key areas for optimizing the values and benefits of NbS: climate action; biodiversity; sustainable service delivery; health, equity, and justice; and advancing Indigenous knowledges and rights wherever possible.

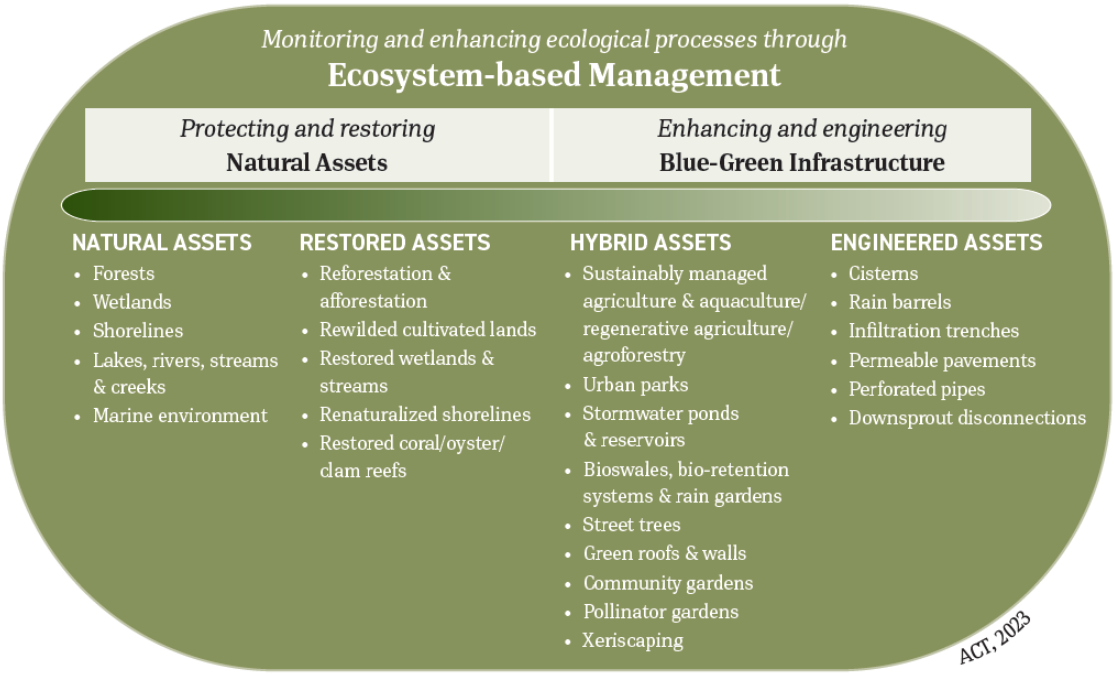

Figure 1.1. Three nested NbS approaches for adaptively managing watershed health and resilience

Source: ACT, 2023b. Reproduced with permission.

Although there are four scales of NbS action in the NSI Framework-for-Action (ACT, 2023b), the toolkit only addresses the scales at which regulatory mechanisms are adopted: community and watershed. With respect to the NSI's key areas, the toolkit includes four of the key areas: climate action; biodiversity; sustainable service delivery; and health, equity, and justice. Since the toolkit is focused on legal mechanisms within the colonial system, it was beyond the scope of this project to consider how Indigenous knowledges or governance systems could inform the use of these mechanisms for implementing NbS.

After the toolkit was developed, I used it as an analytical framework to examine the use of regulatory mechanisms in the City of Port Moody, British Columbia. In particular, I evaluated whether the City's existing mechanisms aligned with the toolkit's recommendations, explored opportunities for amending these mechanisms to improve their alignment, and identified which mechanisms the City was not currently utilizing. Then, I conducted a workshop with staff members from the City in order to solicit feedback on the toolkit as well as to explore opportunities for and barriers to using these regulatory mechanisms to support NbS.

The purpose of this research was to investigate the following questions:

1. How can municipalities in British Columbia use regulatory mechanisms most effectively in order to facilitate the uptake of NbS?

2. What are the potential challenges and barriers to using these mechanisms?

Chapter 2. Literature Review

2.1. The Role of Regulatory Mechanisms in the Implementation of Nature-based Solutions

As cities and other municipalities work to address the environmental crises facing our planet, NbS present a key opportunity for sustainable and meaningful action. As such, it is important to identify both avenues for and obstacles to implementing NbS in municipalities. In one study on this subject, Duffaut et al. (2022) found that regulations can play a pivotal role in the success of NbS projects in urban areas. In particular, the authors concluded that regulations can both support and obstruct the use of NbS. On the first point, they noted that regulations can make NbS mandatory and therefore expand their use in municipalities. On the second point, they indicated that existing regulations, which were not drafted with NbS in mind, may constrain or prevent the use of NbS. As such, there are two sides to this issue, both of which must be addressed in order to advance NbS in urban areas.

First, municipalities can use regulations to mainstream NbS by ensuring that they are considered in all planning processes (Wamsler et al., 2020b). More specifically, they can incorporate measures that facilitate or require the protection and/or use of NbS in community plans, bylaws, and other regulatory mechanisms (Duffaut et al., 2022; Dushkova & Haase, 2020; Wamsler et al., 2020b; van der Jagt et al., 2023). These mechanisms can regulate “the planning, design and management of urban [NbS]” (van der Jagt et al., 2023, p. 7). By enshrining requirements for NbS in plans and regulations, municipalities can secure funding for these projects in their budgets (Hölscher et al., 2023) and increase the likelihood that they will be maintained through political changes (Duffaut et al., 2022). As such, embedding NbS considerations in regulations can both increase their uptake and safeguard their long-term use.

Second, municipalities may need to review and amend their existing regulations in order to remove barriers to NbS. In particular, municipal bylaws are likely to contain “conditions and restrictions [that were] designed for traditional grey infrastructure (Voskamp et al., 2021, p. 6). As a result, these restrictions may obstruct the development and implementation of NbS projects (Voskamp et al., 2021). In addition, municipal plans and zoning bylaws may fail to leave space for NbS on properties (Duffaut et al., 2022), a problem exacerbated by the fact that NbS require more space than grey infrastructure (Bogdzevič, 2023). These issues can become even more complicated when municipalities must coordinate their actions with other governments,

such as when maintaining a network of NbS that spans jurisdictional boundaries (Zuniga-Teran et al., 2020). As a result, it is critical that municipalities identify and modify those regulatory provisions that may impede the implementation of NbS.

To develop a regulatory environment that supports NbS, municipalities will therefore need both to adopt new regulations and to amend their existing ones in order to mainstream NbS considerations. However, they may face challenges with respect to finding information about how to achieve these goals (Voskamp et al., 2021). In particular, municipalities' administrative staff may lack knowledge about legal instruments that affect the use of NbS (Kabisch et al., 2016). To address this and other knowledge gaps, one study found there is a demand amongst municipal officers for tools to enhance NbS uptake (Voskamp et al., 2021). In a review of 44 existing NbS tools, the authors found that the majority of the tools address technical expertise rather than institutional challenges, such as planning processes and regulations. More specifically, they noted that multiple studies have highlighted a lack of "regulatory and legal frameworks" for NbS (Voskamp et al., 2021, p. 6). As such, there is a clear need for tools that can guide practitioners through the development of regulatory mechanisms to advance the uptake of NbS.

2.2. The Legislative Authority of Municipalities in British Columbia, Canada

In British Columbia, Canada, municipalities are incorporated by the provincial government pursuant to section 3 of the *Local Government Act*, RSBC 2015, c 1. As set out in section 7 of the *Community Charter*, SBC 2003, c 26, "the purposes of a municipality include … (b) providing for services, laws and other matters for community benefit, (c) providing for stewardship of the public assets of its community, and (d) fostering the economic, social and environmental well-being of its community." The municipal services referenced in section 7(b) can include sewer, water, roads, and recreational areas (Government of British Columbia, 2022). The public assets referenced in section 7(c) can include both the infrastructure required to provide those services (e.g., storm sewers) as well as natural assets (e.g., parks) (Government of British Columbia, 2023a; Government of British Columbia 2023b).

In order to foster environmental well-being in their communities, as set out in section 7(d), municipalities have legislative authority to regulate specific matters with respect to the local environment. These matters include, but are not limited to, emissions, tree protection, and

stormwater management (s. 8 of the *Community Charter*; s. 523 of the *Local Government Act*). For other specified matters, municipalities share jurisdiction with the provincial government and thus require an agreement to enact bylaws with respect to that area (e.g., environmental protection) (s. 9 of the *Community Charter*). In all matters, municipal bylaws must be consistent with any relevant provincial (s. 10 of the *Community Charter*) and federal (ss. 91 and 92 of *The Constitution Act*, 1867, 30 & 31 Vict, c 3) legislation, such as the *Riparian Areas Protection Regulation*, BC Reg 178/2019, and the *Migratory Birds Convention Act*, 1994, SC 1994, c 22.

When it comes to environmental regulation, British Columbia's municipalities have various tools at their disposal, including environmental development permit areas, zoning bylaws, regulatory bylaws, and building permits (Curran & Gray, 2021). Using these tools, municipalities can facilitate and even require the use of NbS within their boundaries. For example, municipalities can protect natural assets by prohibiting development in sensitive areas, or they can require developers to install blue-green infrastructure (Curran & Gray, 2021). Municipalities can also coordinate action across jurisdictional boundaries through mechanisms such as Regional Growth Strategies and Watershed Plans (Curran & Gray, 2021). By enshrining NbS considerations in regulatory mechanisms, British Columbia's municipalities can ensure that nature becomes a systemic component of all urban planning and development.

2.3. The Natural Solutions Initiative's Key Areas for Optimizing Nature-based Solutions

NbS can provide benefits in multiple areas, including biodiversity, cultural value, pollutant removal, recreational activities, water security, energy security, noise reduction, climate change mitigation and/or adaptation, and positive effects for human health (Bratman et al, 2012, as cited in Bayulken et al., 2021; Drever et al., 2021; Enzi et al., 2017; Epelde et al., 2022; Hayes et al., 2022; Jones & Doberstein, 2022; Raymond et al., 2017). When an NbS project provides multiple benefits simultaneously, which is common, they are referred to as 'co-benefits' (Raymond et al., 2017).

In order to capture these benefits, the NSI identified five key areas for optimizing the values and benefits of NbS: climate action; biodiversity; sustainable service delivery; health, equity, and justice; and advancing Indigenous knowledges and rights wherever possible (ACT, 2023b). As set out in the Introduction, it was beyond the scope of this project to consider the fifth key area, Indigenous knowledges and rights, due to the colonial nature of the Canadian

legal system. The following sub-sections will outline how NbS and related municipal actions can advance each of the other four key areas.

2.3.1. Climate Action

Climate action includes both mitigation of and adaptation to climate change (ACT, 2023b). Mitigation involves reducing greenhouse gas emissions or enhancing sinks that remove greenhouse gases from the atmosphere (IPCC, 2023a). Adaptation involves moderating the harmful impacts of climate change, such as extreme weather events (IPCC, 2023a). Different types of NbS can contribute to mitigation, adaptation, or even both at the same time (Epelde et al., 2022).

Mitigation

NbS can mitigate climate change by protecting or creating carbon sinks, which absorb greenhouse gases from the atmosphere (United Nations, n.d.). In considering the various types of NbS, around two-thirds of their mitigation potential comes from “protecting, managing, and restoring forests” (United Nations, n.d.). As such, municipalities can contribute to mitigation by protecting treed areas and limiting the amount of land that is cleared for urban expansion. In addition, municipalities can expand their urban canopy cover to increase carbon storage within their boundaries (Drever et al., 2021; Teo et al., 2021).

In one study of 7,595 cities across the globe, Teo et al. (2021) calculated that approximately 17.6% of urban areas are available for reforestation. For this analysis, the authors only included land that had grass and shrub cover; they excluded land with other vegetation, no vegetation, or unsuitable land uses (eg. golf courses). In Canada, Drever et al. (2021) estimated that by increasing urban canopy cover in cities from the current average of 24% to 36%, approximately 0.2 Tg CO2e would be removed from the atmosphere each year by 2030. As nursery stocks are developed and trees grow larger, the annual carbon uptake would increase to eight times that amount by 2050.

If the carbon storage capacity of soils is considered, the mitigation potential of NbS is even higher. In a study by Epelde et al. (2022), the implementation of five NbS (trees, green roofs, orchard-gardens, soil with herbaceous vegetation, and grass parks) was projected to increase carbon storage in soils by 50%. In an alternative scenario, where the NbS were even

more abundant and covered a larger area, that projection increased to 130%. The authors noted that the majority of storage was provided by soils and, to a lesser extent, by vegetation.

When managed in specific ways, agricultural land can also be used to increase carbon storage in soils (Bamière et al., 2021). These management approaches include no-tillage farming, conversion to grasslands, and agroforestry (Bamière et al., 2021). As such, municipalities can further contribute to mitigation efforts by preventing development on agricultural land.

Other mitigation measures that municipalities can pursue include reducing emissions from both transportation and energy consumption (United Nations Framework Convention on Climate Change [UNFCCC] Secretariat, n.d.). To reduce emissions from transportation, municipalities can adopt development forms that reduce residents' vehicle kilometers traveled (when implemented with careful planning), such as compact development, mixed-use/nodal development, and transit-oriented development (Elldér, 2020; Park et al., 2018; Tian et al., 2020). To reduce emissions from energy consumption, municipalities can require energy-efficient development or impose regulations to promote energy conservation (Curran & Gray, 2021; Government of British Columbia, 2014). Thus, through a combination of NbS requirements and other regulatory measures, municipalities can contribute significantly to the global effort to mitigate climate change.

Adaptation

As a result of more frequent and intense weather events, municipalities will increasingly be subjected to hazards such as droughts, wildfires, floods, and extreme heat (IPCC, 2023b). With respect to floods, these events will become more common due to both sea level rise, which may cause coastal flooding, and heavy rainfall events, which may cause pluvial flooding and surface runoff (Hobbie & Grimm, 2020). In municipalities, flooding is exacerbated by extensive impervious land cover, which prevents water from infiltrating into soil (Hobbie & Grimm, 2020). As a result, this leads to higher levels of surface runoff (Hobbie & Grimm, 2020), which can damage city infrastructure (IPCC, 2023b).

To address these risks, NbS can be used to restore natural hydrological cycles by enhancing water infiltration and retention in soils and reservoirs, thus reducing surface runoff and the load on drainage systems (Bayulken et al., 2021; Krauze & Wagner, 2019; Qi et al., 2020). The types of NbS that can reduce flooding include trees, bioswales, ponds, rain gardens,

green roofs, permeable pavements, parks, and the addition of soil and herbaceous vegetation to yards (Emilsson & Sang, 2017; Epelde et al., 2022; Qi et al., 2020). In considering the potential contribution of these measures, Epelde et al. (2022) found that a combination of multiple NbS could reduce flooding in one area by an average of 0.1-0.2 meters (based on projected flooding of 0.5 meters).

In an ideal situation, natural processes would be restored on a watershed scale (Haase, 2017). For example, rivers could be reconnected to their historical floodplains. However, space is limited in most municipalities, so their NbS options might be restricted to smaller-scale interventions like street trees or bioswales. Nevertheless, these types of measures can still help to reduce the risk of flooding in urban areas (Emilsson & Sang, 2017; Epelde et al., 2022).

With respect to extreme heat events, municipalities are vulnerable to the urban heat island effect, whereby urban areas become warmer than their surroundings (Health Canada, 2020). The factors that contribute to this effect include the high capacity of building materials to store heat, the aerodynamic resistance of buildings to heat dissipation, and the waste heat generated by energy use in buildings and vehicles (Zhao et al., 2014, as cited in Hobbie & Grimm, 2020). Urban heat islands pose a hazard to human health and have already caused mortalities across the globe, especially among vulnerable populations (Health Canada, 2020).

Similar to the issue of flooding, various types of NbS can also be employed to reduce the severity of extreme heat events, such as urban trees, green walls, green roofs, and green spaces (Emilsson & Sang, 2017; Hayes et al., 2022). These measures reduce ambient temperatures by providing shade and preventing solar radiation from reaching buildings and the ground (Dardir & Berardi, 2021, as cited in Hayes et al., 2022). In addition, their vegetative components provide cooling through evapotranspiration (Hayes et al., 2022).

In one study, a 10% increase in canopy cover reduced temperatures in municipalities by 3-4 degrees (Elmqvist et al., 2015, as cited in Bayulken et al., 2021). In another study, green roofs reduced excess heat by 48-75% when compared to black roofs (Heusinger et al., 2018, as cited in Bayulken et al., 2021). In addition, the cooling effect of green roofs can extend for multiple floors in the building; it is not restricted to the level beneath the roof (Arenghi et al., 2021, as cited in Hayes et al., 2022).

In a comparison of four NbS measures (green roofs, street trees, enhanced vegetation in urban parks, and de-sealing parking areas), Cortinovis et al. (2022) found that a combination of

the first three measures provided the greatest amount of heat reduction. This is in line with Bayulken et al.'s (2021) conclusion that municipalities should build a network of urban forests, including both parks and green roofs, in order to mitigate heat most effectively. Interestingly, Cortinovis et al. (2022) also found that combining all four measures would provide the greatest reduction in surface runoff. As such, municipalities can utilize NbS to adapt to multiple climate hazards at the same time.

2.3.2. Biodiversity

NbS can provide various benefits for more-than-human species, including with respect to biomass, connectivity, species diversity, habitat quality, ecosystem functioning, and population dynamics (ACT, 2023b; Key et al., 2022). In a review of 109 NbS interventions, Key et al. (2022) found that 72% of the interventions reported positive outcomes for ecosystem health. Interestingly, 75% of those interventions "also reported positive outcomes for climate change adaptation" (Key et al., 2022, p. 17), which reinforces the multifunctionality of NbS (Raymond et al., 2017). In terms of specific outcomes, Key et al. (2022) found that 25 NbS interventions increased species richness (which most of the studies only measured for plants) by an average of 67%. As such, NbS offer an important tool for municipalities in the global struggle to halt and reverse biodiversity loss.

However, practitioners must be cautious when planning NbS projects because they can also have negative impacts on biodiversity (Key et al., 2022; Seddon et al., 2020). For example, afforestation that replaces non-forest ecosystems or creates non-native monocultures will negatively impact biodiversity (Key et al., 2022; Seddon et al., 2020). Similarly, community-based forestry may negatively impact biodiversity by introducing invasive species, which can threaten native species and ecosystem functioning (Paolucci et al, 2013 and USEPA, 2016, as cited in Key et al., 2022). As a result, municipalities must consider the potential impacts of NbS projects on local ecosystems.

In particular, NbS "need to be designed with ecological principles in mind" (Clement, 2022, p. 36) and a focus on supporting native species and ecological processes. In addition, most urban NbS will need to be actively managed on an ongoing basis in order to ensure the survival of their living components amidst the pressures of an urban environment (Clement, 2022). For example, street trees are subject to multiple stressors, including pollutants (e.g. de-icing salt), soil compaction in tree pits (which limits drainage and gas exchange), and limited soil

volumes (due to tarmac, pipes, wires, and other infrastructure) (Knapp & MacIvor, 2023). As such, both the planning and implementation of NbS will shape their impacts on biodiversity.

In urban areas, the types of NbS that can support biodiversity include parks, wetlands, meadows, rain gardens, street trees, pollinator gardens, green walls, green roofs, floating habitats, vernal pools, nesting sites, urban orchard-gardens, and grass car parks (Clement, 2022; Epelde et al., 2022; Knapp & MacIvor, 2023; Wildlife Habitat Council, 2020). In one study, implementing five types of NbS (woody species, green roofs, urban orchard-gardens, soil and herbaceous vegetation in yards, and grass car parks) was projected to increase biodiversity in a city neighbourhood by 46% in a 'feasible' scenario and by 108% in an 'expanded' scenario (Epelde et al., 2022). These findings highlight the benefits of NbS for biodiversity in urban settings, as municipalities can both create new habitats and protect/enhance existing ones (Clement, 2022; Knapp & MacIvor, 2023).

To improve the quality of habitats within their jurisdictions, municipalities can plant native vegetation, increase vegetation cover/understorey volume, provide structural diversity, and engage in ecologically-oriented management of green spaces (Clement, 2022; Knapp & MacIvor, 2023; Threlfall et al., 2017). They can also enhance ecosystem connectivity, which allows species to migrate more easily, by creating corridors or patches that connect a network of NbS to large natural areas (Filazzola et al., 2019). Other options include implementing buffer areas around key habitat features (Filazzola et al., 2019) and providing mechanisms for species to cross roadways, such as overpasses or tunnels (Vasiliev, 2022). In these ways, municipalities can ensure that more-than-human species have the opportunity to co-exist with human residents.

In addition to their benefits for species, NbS that support higher biodiversity are also more resilient to environmental changes (Seddon et al., 2020). Conversely, "low-diversity systems are much more susceptible to stressors and disturbances" (Knapp & MacIvor, 2023, p. 89). For example, if municipalities plant a diversity of tree species, this will provide a buffer against tree loss from pests, pathogens, and extreme weather (Knapp & MacIvor, 2023). As the impacts of climate change become more severe, it will be increasingly important that NbS are implemented with a diverse composition of plant species in order to enhance their survival.

Other measures that municipalities can implement to support biodiversity include employing compact development, maintaining large lot sizes in rural areas, and preventing

development on brownfield sites and agricultural land. Compact development can preserve natural areas both within and outside of the municipality and thus has been positively linked to biodiversity, with the benefits being especially apparent for urban-sensitive species (Sushinsky et al., 2013; Villaseñor et al., 2017). Conversely, maintaining large lot sizes in rural areas can also protect natural areas and sensitive species by decreasing the intensity of development in those areas (Curran & Gray, 2021; Merenlender et al., 1998). Similarly, brownfield sites can "have high ecological value" and are positively linked to landscape-scale biodiversity (Macgregor et al., 2022, p. 1). Finally, agricultural land can support biodiversity when it is managed sustainably (e.g., low intensity farming, agroforestry) (Curran & Gray, 2021; Gonthier et al., 2014; Udawatta et al., 2019). As such, municipalities can contribute to averting the biodiversity crisis through the use of NbS alongside other measures that protect natural and semi-natural areas.

2.3.3. Sustainable Service Delivery

NbS that address the NSI key area of sustainable service delivery include measures that enhance ecosystem services and/or reduce municipalities' costs related to the construction, operation, or maintenance of services and infrastructure (ACT, 2023b). For the first element of this key area, municipalities rely on a variety of ecosystem services to support their human populations, including recreational opportunities, water purification, water supply, food production, air quality regulation, temperature regulation, and the prevention of erosion, floods, and other hazards (Somarakis et al., 2019, as cited in La Notte & Zulian, 2022). NbS can provide these types of services by managing, protecting, restoring, and enhancing ecological processes in natural and semi-natural systems (La Notte & Zulian, 2022).

In section 2.3.1, various types of NbS were described that can enhance water infiltration in soils and reduce surface runoff in urban areas. In one study, a combination of four types of NbS (green roofs, street trees, enhanced vegetation in urban parks, and de-sealing parking areas) was projected to provide the greatest reduction in surface runoff (Cortinovis et al., 2022). In addition to advancing climate change adaptation by reducing the risk of flooding, these NbS provide ecosystem services related to water filtration and groundwater recharge (Haase, 2017; La Notte & Zulian, 2022; Qi et al., 2020). Further, these measures also improve municipalities' stormwater management, which reduces the load on drainage systems and thus the costs of maintaining grey infrastructure (Bayulken et al., 2021; Krauze & Wagner, 2019; Qi et al., 2020).

Similarly, section 2.3.1 also reviewed different types of NbS that can reduce the urban heat island effect through temperature regulation. Once again, in addition to contributing to climate change adaptation, this ecosystem service also provides benefits to municipalities with respect to energy consumption (Enzi et al., 2017; La Notte & Zulian, 2022). In particular, these measures will reduce the amount of energy required for heating and cooling buildings (Enzi et al., 2017; La Notte & Zulian, 2022). As a result, NbS can decrease the load on a municipality's electrical grid and also reduce energy costs.

With respect to some of the other ecosystem services that benefit municipalities, NbS can provide recreational opportunities, air purification, and food production in urban areas. For the first service, the types of NbS that support recreation include gardens, parks, and urban forests (La Notte & Zulian, 2022). These NbS offer areas for people to walk, do gardening, play sports, and go for picnics (La Notte & Zulian, 2022). The second service, air purification, will be provided by any NbS that includes vegetation, such as street trees, green roofs, and green walls (La Notte & Zulian, 2022). Finally, for food production, municipalities can implement NbS such as urban gardens and orchards (La Notte & Zulian, 2022). In addition, they can support pollinator species with wildflower meadows (Bretzel et al., 2016). As such, municipalities have a range of NbS options for providing ecosystem services to residents.

In order to maximize the benefits of NbS with respect to sustainable service delivery, larger municipalities will need to develop and actively manage a network of NbS that connects to natural areas outside of the city (Krauze & Wagner, 2019). This is because NbS in densely populated areas will experience greater pressures and thus will have lower resiliency to disturbances than those in suburban areas (Krauze & Wagner, 2019). By creating a network of NbS that connects areas with high natural capital to areas with low natural capital, resilient NbS at the municipality's outskirts can support ecosystem functioning at its core (Krauze & Wagner, 2019).

Other measures that municipalities can adopt to support sustainable service delivery include compact development, transit-oriented development, and preventing development on agricultural land. If the first two development forms are employed for the purpose of reducing urban sprawl, this will also reduce the need for a municipality to expand its infrastructure and service networks (e.g., sewer, electricity, and transit). With respect to preventing development on agricultural land, this can secure local food production for the municipality. Thus,

municipalities can utilize NbS and other measures to provide sustainable services to their residents.

2.3.4. Health, Equity, and Justice

In considering the final NSI key area addressed in this study, NbS can support healthy populations, equitable outcomes, and justice within communities (ACT, 2023b). For the first of these benefits, NbS can improve both the mental and physical health of urban residents (Bratman et al, 2012, as cited in Bayulken et al., 2021; Kolokotsa et al., 2020). With respect to mental health, access to green and blue spaces is correlated with reduced symptoms of stress, higher self-reports of happiness, less reliance on medications, lower rates of depression, and improvements for mood, cognitive functioning, self-esteem, and children's behavioural development (Bratman et al, 2012, as cited in Bayulken et al., 2021; Braubach et al., 2017; Kolokotsa et al., 2020). In addition, NbS that reduce noise pollution, such as green roofs and walls (Enzi et al., 2017), can also reduce stress-related symptoms (Kolokotsa et al., 2020). As such, these findings illustrate that NbS can improve both people's self-perceptions as well as physiological indicators of mental health.

With respect to physical health, NbS provide benefits related to physical activity, birth outcomes, and other aspects of human health (Kolokotsa et al., 2020). In particular, access to green spaces is correlated with lower blood pressure, higher probability of meeting physical activity guidelines, and lower rates of cardiovascular risk factors, diabetes mellitus, and obesity (Bratman et al, 2012, as cited in Bayulken et al., 2021; Kolokotsa et al., 2020). Further, NbS that reduce air pollution also reduce the risk of preterm birth, respiratory disease mortality, and hospitalization for heart disease or stroke (Kolokotsa et al., 2020). Finally, NbS that reduce ambient temperatures are associated with lower mortality during urban heat events (Kolokotsa et al., 2020). As such, NbS have clear benefits for the health of urban residents.

In considering the role of NbS with respect to equity and justice in communities, "research shows that environmental injustice related to differential access to healthy urban environments is a global concern" (Borelli et al., 2022, p. 213). In particular, neighbourhoods with a larger proportion of minorities or lower socioeconomic position tend to have a higher exposure to environmentally-related health threats, such as air pollution (Su et al., 2011). In addition, some residents face barriers to accessing green spaces due to their race, age, gender, disability, or socioeconomic status (Borelli et al., 2022). More specifically, the populations that

tend to have less access to green spaces include immigrants, minorities, elderly individuals, disabled individuals, and those with lower socioeconomic statuses (Borelli et al., 2022; Kabisch & van den Bosch, 2017). As such, the distribution of environmental hazards and benefits in many municipalities is currently inequitable.

NbS have the potential either to improve or worsen conditions for vulnerable and marginalized populations (Borelli et al., 2022; Kabisch & van den Bosch, 2017). In particular, municipalities can design and implement NbS in a way that facilitates access to green spaces and reduces the distance that residents must travel to reach them (Borelli et al., 2022; Kabisch & van den Bosch, 2017). However, studies have shown that municipalities tend to invest in NbS primarily in wealthier areas, which exacerbates the inequitable distribution of their benefits (Dai, 2011, and Wen et al., 2013, as cited in Borelli et al., 2022). When municipalities do install NbS in low-income neighbourhoods, there is also a risk of negative impacts on residents due to gentrification (Kabisch & van den Bosch, 2017). In particular, NbS can increase the attractiveness of an area, which may drive up prices and thus displace low-income residents (Kabisch & van den Bosch, 2017). As such, it is critical that municipalities plan and implement NbS with the specific goal of increasing equity and reducing injustice in the community.

Other measures that municipalities can implement to improve equity and justice include affordable housing, enhanced food security, and mixed-use/nodal development. In particular, affordable housing and enhanced food security will benefit low-income and vulnerable populations. With respect to mixed-use/nodal development, this form of development can increase residents' access to services by reducing the distance they must travel to access those services (Zhou et al., 2018). Thus, municipalities can implement NbS and other measures to improve public health, social equity, and environmental justice in communities.

Chapter 3. Methods

3.1. Developing the Toolkit

3.1.1. Recommendations

To explore how regulatory mechanisms and other government powers can support the adoption of NbS in communities, I developed a toolkit of 159 recommendations with the title "NSI Regulatory Mechanisms Toolkit" (Appendix A). I generated the majority of these recommendations by conducting a content analysis of seven resources that address the issue of environmental regulation by local governments. These resources were chosen due to their focus on regulatory mechanisms, natural assets, and blue-green infrastructure, and they are listed in the References section of the toolkit. All of the resources are in the nature of toolkits or guidelines for local governments, with one being published by the Government of British Columbia, one by Metro Vancouver, one by the Union of BC Municipalities, and the remainder by non-government organizations. I also drew additional recommendations from a literature review with respect to the use of NbS and other tools that address the NSI key areas in urban areas.

My review of the seven resources focused on four of the NSI's key areas: climate action; biodiversity; sustainable service delivery; and health, equity, and justice. In particular, I evaluated whether each recommendation in the resources would advance any of these four key areas, and, if so, I included that recommendation in the toolkit. To determine whether a recommendation advanced a key area, I considered whether it fit within the definition of the key area, as set out in Appendix A of the toolkit. These definitions also include an explanation of how various measures are related to each key area.

As a result of focusing on the NSI's key areas rather than specifically on NbS, some of the toolkit's recommendations are not related to NbS. I included these recommendations in the toolkit in order to provide alternative or complementary options for advancing the NSI key areas, so practitioners can evaluate synergies and trade-offs between them.

During my review, I also looked for connections between recommendations in the various resources. When it seemed appropriate to do so, I combined complementary concepts into one recommendation in the toolkit.

3.1.2. Organization and Coding

I organized the recommendations in the toolkit into two scales of action: watershed and community. These categories are based on the two scales of NbS action in the NSI Framework-for-Action (ACT, 2023b) at which regulatory mechanisms are adopted. At the watershed scale, the toolkit outlines mechanisms that fall within provincial jurisdiction (e.g., Agricultural Land Reserve) or require coordination between multiple governments (e.g., Regional Growth Strategy). The community scale contains mechanisms that can be used by a local government within its own jurisdiction (e.g., Zoning Bylaw).

When assembling the toolkit, I grouped some of the regulatory mechanisms into common sections, such as the mechanisms related to zoning that are listed as sub-subsections within section 2.2 and the different types of regulatory bylaws in section 2.3. Similarly, section 2.1, which pertains to Official Community Plans, includes sub-sections for environmentally sensitive areas and development permit areas because these types of areas are designated in Official Community Plans.

For each regulatory mechanism, the toolkit provides one or more recommendations for how the mechanism can be used to advance NbS and/or to support one or more of the NSI key areas. These recommendations are mostly complementary, but some present different alternatives or priorities for practitioners to consider.

For the majority of the recommendations, I identified which of the NSI key areas and NbS approaches (or, in many cases, which combination of them) is addressed by that recommendation. As set out in section 3.1.1., the definitions of the NSI key areas are provided in Appendix A of the toolkit. If the recommendation does not address an NSI key area or an NbS approach, I indicated this with the abbreviation for ‘not applicable’: N/A. During this process, I sought input from other ACT team members on the coding of recommendations with respect to both the applicable NSI key area and NbS approach.

Within each scale, I ordered the mechanisms based on the number of recommendations for the mechanism (highest to lowest) as well as the number of key areas addressed by the mechanism (highest to lowest). If two mechanisms had the same number of recommendations, I placed the mechanism with the higher number of key areas first. This ordering is not intended to reflect the value or utility of the mechanisms.

Finally, there are three additional Appendices (B through D) in the toolkit, which provide more detailed recommendations with respect to three types of regulatory mechanisms: Environmental Development Permit Areas, Marine Development Permit Areas, and Tree Protection Bylaws. In particular, Appendices B and C set out recommended conditions for development permits issued in these types of Development Permit Areas. Appendix D provides recommended sections/requirements to include in a Tree Protection Bylaw.

3.2. Applying the Toolkit as an Analytical Framework

3.2.1. Case Study Approach

In order to evaluate the utility of the toolkit, it was tested in two stages. In the first stage, I applied it as an analytical framework for a case study that focused on the City of Port Moody, in British Columbia, Canada. I chose the case study methodology because it allows for a "detailed and intensive analysis of a single case" (Bryman & Bell, 2019). Using this methodology, a researcher can collect in-depth data that may be unique in terms of the time and place of collection (Bryman & Bell, 2019).

As such, the data collected from using the toolkit as an analytical framework (Appendix B) is not generalizable to other areas (Bryman & Bell, 2019). It only provides a snapshot of one municipality's regulatory mechanisms at the time of the study. This analysis was conducted in order to provide recommendations to the City as well as material for a workshop with the City's staff, the latter of which is described in section 3.3. below.

3.2.2. Study Site

The City of Port Moody was selected for this study because it is one of ACT's partner organizations for the NSI. This partnership arose from an existing relationship between ACT and the City, as ACT had also worked collaboratively with the City on a previous project. In particular, from 2018-2021, ACT engaged in a co-creation process with the City to develop a low carbon resilience planning process, which culminated in the City's Climate Action Plan (ACT, 2023a). In around 2023, the City began developing a Natural Asset Management Strategy, and ACT was invited to provide guidance about how to incorporate NbS considerations into that strategy. Building on that process, the present research project was

conducted collaboratively with the City in order to provide tailored recommendations with respect to advancing NbS through regulatory mechanisms.

The City of Port Moody is a member municipality of Metro Vancouver, which is "a federation of 21 municipalities, one electoral area, and one treaty First Nation" (Metro Vancouver, n.d.). The City is located in the Lower Mainland region of British Columbia, which is along the southwest coast of the province. The area occupied by the City includes "the ancestral and unceded homelands of the kʷikʷəƛ̓əm (Kwikwetlem), səlilwətaɬ (Tsleil-Waututh), xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), q̓ic̓əy̓ (Katzie), qʼʷaːn̓ ƛ̓ənˀ (Kwantlen), qiqéyt (Qayqayt), and Stó:lō (Sto:lo) Peoples" (City of Port Moody, n.d.-b).

The City is located at the edge of the Burrard Inlet. The terrain within the City includes hills, streams, rivers, ravines, forests, and shoreline areas (City of Port Moody, 2023). The City's forests are part of the Coastal Western Hemlock zone of British Columbia's Biogeoclimatic Ecosystem Classification system (City of Port Moody, 2023). The City's watercourses include fish-bearing and non-fish-bearing rivers and streams, and there are also two salmon hatcheries in the City (City of Port Moody, n.d.-c).

In 2021, the City had a population of 33,535 people (Statistics Canada, 2023). The City's population has remained relatively stable since the previous census in 2016, when the population was 33,551 people (Statistics Canada, 2023). The City's Council consists of one mayor and six councillors, who are elected every four years (City of Port Moody, n.d.-a).

3.2.3. Analysis of the City's Documents

For my analysis, I examined to what extent the City of Port Moody's regulatory mechanisms aligned with the recommendations in the toolkit. In particular, I reviewed each of the City's documents (based on what was available on the City's website in the spring and summer of 2023) that reflected one or more of the regulatory mechanisms in the community scale section of the toolkit (e.g., Zoning Bylaw). I did not review the City's regulatory mechanisms that correspond with the watershed scale of the toolkit because those mechanisms require coordination with the province or other municipalities, and my intention was to provide recommendations about mechanisms within the City's sole jurisdiction. To record my findings, I developed an analytical table that was organized around each of the City's relevant documents (Appendix B).

For each type of mechanism, I identified any provisions in the City document that gave effect to the toolkit's recommendations for that mechanism, in whole or in part. If the provision only gave partial effect to the toolkit's recommendation, I made note of this gap and, where appropriate, suggested ways that the provision could be amended to fill the gap. If I was unable to determine whether the recommendation had been fully captured by the City's existing work, I either stated this limitation or made note of any outstanding questions that I had on the subject. Finally, if I could not find any provision that gave effect to a recommendation, I stated this as well. All of my notes, questions, and statements were identified using italicized font.

The purpose of this analysis was not to measure or evaluate the City's performance but to provide tailored recommendations to the City and to test the utility of the toolkit. In particular, the analytical table was intended to offer suggestions for how the City could advance NbS considerations and the NSI key areas, a topic that was of interest to the cross-departmental team. The table also provided a focus for discussion at the workshop, such that staff were able to offer feedback on the toolkit's usefulness and relevance for the City.

3.3. Workshop with City Staff

3.3.1. Workshop Approach

For the second stage of evaluating the utility of the toolkit, the ACT team conducted a workshop with staff in the City of Port Moody. This methodology was chosen because it allows researchers to collect data while also providing an opportunity for participants "to achieve something related to their own interests" (Ørngreen & Levinsen, 2017). In particular, both the researchers and the participants expect some kind of outcome, such as the generation of new ideas or insights (Ørngreen & Levinsen, 2017). As such, this approach is ideal for collaborative projects like the one in the present study. In this case, the workshop provided an opportunity for City staff to explore and evaluate ideas for advancing NbS in their community, and those discussions generated both insights with respect to my second research question as well as suggestions for how to refine the toolkit.

The workshop methodology is best suited to small groups, so everyone has an opportunity to speak (Ørngreen & Levinsen, 2017). This is important because workshops are intended to spark creativity and openness through active participation (Ørngreen & Levinsen, 2017). In addition, the structure of workshops can vary from prescribed to open formats, the

latter of which allows both participants and researchers to shape the process (Ørngreen & Levinsen, 2017). In the present study, there were ten workshop participants, and the ACT team used an open format that involved both a World Café and a group discussion, the details of which are set out in section 3.3.2. below.

Although the workshop was centered around the analytical table described in section 3.2, the data from which is not generalizable due to the specificity of a case study approach, the findings from the workshop are not subject to the same limitation. In particular, the themes and insights that emerged from the workshop, including with respect to opportunities and challenges for using regulatory mechanisms to support NbS, could be relevant to other municipalities that share similar circumstances to Port Moody. In addition, the ACT team will be evaluating these findings in order to consider ways that the toolkit can be amended prior to publishing it.

3.3.2. Workshop Structure

The workshop was conducted on November 17, 2023, and the participants were ten staff members from the City of Port Moody's cross-departmental team. Three ACT team members (including myself) were present to act as facilitators. My analysis of the City's documents, as described in section 3.2.3. above, was provided to the City's team in advance of the workshop. At the workshop, we reviewed multiple sections of this analytical table with participants in order to solicit feedback on the toolkit, explore opportunities for implementing the toolkit's recommendations in the City, and identify barriers to their implementation. We made a recording of those periods of the workshop during which participants were answering questions.

In the workshop, we began with a World Café activity that focused on three types of bylaws: Tree Protection Bylaws, Subdivision & Development Servicing Bylaws, and Zoning Bylaws. We asked participants to self-select the bylaw of greatest interest to them and to review the relevant section of the analytical table. Based on this self-selection, the participants were divided into three groups: one for each bylaw. One ACT team member was a facilitator for each group and guided the group's discussion around the following questions:

1. Which recommendations are most valuable?

2. What are any challenges or barriers to implementing them?

Midway through the World Café, the participants were invited to move to a different group if they wished to do so, but all of the participants chose to remain with their current topic. At the end of the World Café, the participants returned to their original seats, and the group as a whole was asked to answer the following questions:

1. Are there any recommendations that surprised you, or that you think should be used more?

2. What did you learn?

After this discussion, the ACT team members provided the group a list of the other topics in the analytical table, and we asked them to choose which topic they would like to discuss next. For each topic that was chosen by the group, we displayed the relevant portion of the analytical table for the participants to review and discuss. For this activity, we allowed the conversation to flow naturally rather than using structured questions.

For a final discussion at the end of the workshop, we asked the participants to answer the following questions:

1. Do you have any feedback on the design and functionality of the framework?

2. Did you find the framework useful for supporting the implementation of NbS?

After the workshop, I listened to and summarized the recordings. I identified themes, comments that answered the questions posed during the workshop, and ideas that went beyond the recommendations in the toolkit.

Chapter 4. Findings

4.1. Evaluation of the Toolkit

The toolkit contains 159 recommendations. Upon reviewing the coding of these recommendations based on the NSI key areas, I found that approximately 76% of the recommendations address biodiversity, 48% address sustainable service delivery, 25% address climate action, and 11% address health, equity, and justice. These results are summarized in Table 1.1.

Table 4.1. NSI Key Areas Addressed by the Toolkit's Recommendations

NSI Key Area	Number of Recommendations that Address the Key Area
Climate Action	39
Biodiversity	121
Sustainable Service Delivery	76
Health, Equity, and Justice	17

I also found variation in the number of recommendations for each mechanism as well as the number of NSI key areas that are addressed by each mechanism. These results are summarized in Table 1.2. As can be seen, 15 out of 20 categories of regulatory mechanisms had recommendations that addressed two or more NSI key areas. Only Official Community Plans, Zoning Bylaws, and Amenity Density Bonuses had recommendations that addressed all four of the NSI key areas.

Table 4.2. Number of Recommendations for, and NSI Key Areas Addressed by, Each Regulatory Mechanism

Regulatory Mechanism	Number of Recommendations	Number of NSI Key Areas Addressed
Regional Growth Strategy/Regional Conservation Strategy	12	3
Agricultural Land Reserve	1	3
Watershed Plan (Integrated Stormwater Management Plan)	1	2
Official Community Plan	47	4
Zoning Bylaws	30	4
Regulatory Bylaws	16	3
Conservation Covenants	12	2
Subdivision and Servicing Bylaws	11	3
Amenity Density Bonuses	5	4
Tax Incentives/Lower Development Cost Charges	4	3
Property Tax Exemptions, Freezes, Credits, & Support	4	2
Riparian Areas Protection	3	2
Land Acquisition	3	1
Building Permits	3	1
Important Bird and Biodiversity Area/Key Biodiversity Area	2	1
Impact Assessments	1	3
Parcel Taxes	1	2
Statutory Right-of-way/Public Utility Easement	1	2
Bare Land Strata	1	1
Conservation Fund	1	1

4.2. Findings from the Workshop

Based on my review of the recordings from the workshop, I have organized my findings into the following sections: common themes that emerged during discussions, challenges and barriers to implementing the toolkit's recommendations, additional ideas that expanded upon the toolkit's recommendations, and feedback on the toolkit's form and content.

4.2.1. Common Themes

Two common themes emerged from the discussions that took place in the workshop: the importance of protecting natural assets in communities and the advantages of keeping some requirements outside of bylaws.

Protection of Natural Assets

For the first theme, multiple participants talked about the value of the natural environment for the City of Port Moody. Participant 1 expressed it in the following way: “What makes Port Moody so special is that we have all these beautiful natural areas.” Similarly, Participant 3 noted that, “Port Moody has really high biodiversity values”, in contrast to other cities. The participants discussed the importance of preserving trees and other habitat features in order to support species and the integrity of natural areas. If those areas are not protected, one participant expressed concern about the potential for reaching tipping points that would negatively affect biodiversity.

Participant 3 also spoke about the importance of nature for human health. In particular, they noted that nature affects both mental health and physical health. As they described it, “People kind of intuitively know that they like having…green space.” As a result, they said that people will pay more to live in neighbourhoods with more green infrastructure and natural assets.

For specific types of natural assets, participants focused on the benefits that are provided by urban trees, including shade, carbon storage, slope stability, and erosion control. With respect to shade, participants noted that trees reduce ambient temperatures and thus can reduce energy consumption in adjacent buildings. Alternatively, when trees are removed during development, one participant noted that adjacent buildings will require air conditioning.

Finally, participants also discussed the cost of restoring green infrastructure or natural assets that have been removed or damaged during development. One participant noted that other cities are engaging in restoration work because they recognize the benefits that nature provides, but restoration is very expensive. As such, they asserted that it is better to preserve valuable areas from the outset rather than spend money to restore them.

Requirements Outside of Bylaws

For the second theme, multiple participants discussed the benefits of keeping some requirements outside of bylaws. For example, the City’s Subdivision and Development Services Bylaw (the “Subdivision Bylaw”) does not contain regulations for minimum soil volumes for tree roots nor setbacks for tree planting from utilities and infrastructure. Instead, the City has a technical standard that sets out these requirements for new developments.

As another example, one participant indicated that rather than regulating stormwater design in a bylaw, the City will be issuing a manual that contains technical design outcomes, criteria, and performance measures for infrastructure. The participant explained that the overarching bylaw will designate different levels of service and then delegate authority to the General Manager to approve the schedules to the bylaw. That way, the General Manager and technical staff will control how the designated levels of service can be achieved.

The primary reason that participants gave for establishing requirements in these types of documents, rather than in bylaws, was that it provides greater flexibility. In particular, staff are able to modify these documents more easily and frequently because they do not have to ask Council to pass a bylaw amendment. This approach not only speeds up the process for changing requirements but also reduces the volume of items that staff must ask Council to approve.

In terms of when to use this approach, one participant noted that it is particularly useful in areas that are evolving quickly, such as best practices for landscaping, green infrastructure, and stormwater management. In addition, all of the examples that participants provided for these types of requirements were related to technical standards and criteria. On that subject, multiple participants expressed agreement that specific and technical pieces should be addressed at the staff and management level (rather than by Council).

4.2.2. Challenges and Barriers

When participants were asked if there were any challenges or barriers to implementing the recommendations in the toolkit, four themes emerged from their answers: opposition from developers or the public (and ways to mitigate that opposition), conflicting/competing priorities or laws, NbS constraints in single family zoning areas, and challenges faced in the local context of the City.

Opposition from Developers or the Public and Ways to Mitigate Opposition

For the first theme, participants expressed concern about the potential opposition that the City might face from developers or the general public if they tried to implement some of the toolkit's recommendations or other measures to support NbS. For example, participants anticipated that the City may experience difficulty with developers if they implemented the toolkit's recommendation to adopt a low-impact development design and policy manual. Since

the City is currently developing a Green Infrastructure Strategy, the participants indicated that developers might become frustrated and say that the City has too many overlapping requirements if the City also had a low-impact development manual. Instead, they asserted that it would be better to include those types of requirements in the new strategy. They noted that this approach would also reduce the risk of having conflicting requirements in different documents.

With respect to opposition from the public, participants highlighted this concern as a potential barrier to the use of strata maintenance fees for maintaining greenways. Although this mechanism is not in the toolkit, it has been used previously by the City and was mentioned by participants during the discussion about the Subdivision Bylaw. In particular, participants explained that the City currently has an agreement for one area that allows them to collect strata maintenance fees for the purpose of maintaining a greenway. However, they expressed doubt that this approach could ever be used again due to rising concerns about affordability. They noted that people have become more anxious about strata maintenance fees and ask more questions about new fees, so it would be difficult for the City to negotiate that type of agreement for other areas in the future.

During the discussion about the toolkit's recommendations for a Tree Protection Bylaw, participants indicated that the public would present a major challenge to implementing some of the recommendations. For example, one participant expressed concern about the public's reaction to imposing widespread requirements for tree protection on private land. They indicated this would be very different from the City's current bylaw, which only protects significant trees and those in designated areas. In considering why property owners want trees removed, participants noted that their reasons include preserving their views of the ocean, building additions or driveways on their properties, and subdividing their properties. Since the current bylaw permits removal of hazardous trees, Participant 1 noted that "there have been some instances where…private landowners seek to have trees removed [by claiming the tree is hazardous, in order] to preserve their view".

To address public opposition or otherwise advance tree protection, participants identified three approaches that the City could take: education, incentives, and zoning. For the first approach, participants asserted that education is important in order for the public to understand both the benefits of tree protection as well as how to comply with a Tree Protection Bylaw. For the first point, Participant 3 said, "You have to…reinforce for people what's in it for them."

Although they noted that people do, indeed, care about the environment, the City should highlight the benefits of tree protection when there are competing pressures, such as development. For the latter point, Participant 1 stated, “The easier that we are able to make it for residents, the more compliance I expect we would have.”

As such, participants agreed that the City should provide information to the public about the value of retaining trees and other vegetation on properties, including slope stability, erosion control, shade (which can reduce energy consumption for cooling buildings), and benefits for people’s mental and physical health. In terms of communication methods, they suggested the City could use information sheets and bulletins as well as promote the use of i-Tree tools. For the latter, one participant explained that i-Tree tools can calculate the value of a tree to a residence based on shade provision and carbon storage.

With respect to the proposal to use incentives, participants indicated that taking a positive approach, rather than a prohibitive one, could avoid public backlash. They noted that people tend to dislike regulations and to react more favourably to incentives. Participant 3 said, “It’s amazing what people will do for incentives sometimes…with some of the building energy retrofit examples, I couldn’t believe what people are willing to jump through to get $1,000.00…”

In considering the types of incentives the City could use, participants suggested there could be credits on property taxes for tree protection or reductions on permitting and inspection fees. However, one participant noted that property tax is fairly regulated and formulaic, so that option may not be feasible. Participant 5 expressed concern that incentives would not be effective in small subdivisions. They said, “There is zero incentives that are going to be big enough to offset the $1.2-$2.2 million profit that a single owner gets because they drew a line down their property and cut six trees down.” In light of these concerns, one participant indicated that they need to explore more incentive models.

For the third approach, participants indicated that zoning could also be used to facilitate tree protection. In particular, one participant suggested that the Zoning Bylaw could be amended to reduce parking areas and limit the size of houses in single family zones. They indicated that by reducing the footprint of structures and driveways on a lot, that would leave more space for trees. The participant asserted that this was the only solution that would protect trees on single family lots when owners can generate a significant profit from subdividing the lot.

As a final point, participants noted that it is easier to deal with resistance from developers or the public when the City's requirements are based on provincial or federal legislation. In those instances, they can explain to the affected parties that the City is obligated to comply with legislation from senior governments, and this reduces opposition to such requirements.

Conflicting/Competing Priorities or Laws

For the second theme, participants highlighted the difficulty of balancing conflicting or competing priorities in their work. As Participant 10 noted, "That's what I often struggle with, is how do you reconcile all those needs of the City and of the community, and what is the priority?" These conflicts arise when dealing with the public as well as when navigating contradictory local, provincial, and federal legislation. In addition, the City must be cognizant of potential conflicts between its own bylaws.

In considering how to advance biodiversity and tree protection in the City, participants noted that two other environmental concerns have led to conflicting priorities for residents: rodent control and wildfire risk. For the first issue, participants explained that the City has been experiencing a large surge in rodent populations in recent years. One participant noted that although the City does not use chemical rodenticides on public property, the City cannot regulate their use by private landowners. As a result, there have been two owl fatalities which are believed to have been caused by secondary poisoning.

When considering potential solutions, one participant mentioned that provincial guidelines for rodent management include a recommendation to eliminate any direct connection between trees and the tops of buildings. However, the participant noted that this recommendation could conflict with restrictions on pruning trees in the Tree Protection Bylaw. As such, they suggested that an exemption could be granted to stratas to allow pruning for the purpose of rodent management. In this instance, they indicated that pruning trees might be preferable to using rodenticides.

For the second issue, participants indicated that the recent occurrence of heat domes in the City has raised concerns about wildfire risk. In particular, Participant 1 said there was "a bit of a panic scene among some residents about having trees in their yards or on their properties and the wildfire risk that they may carry…" As a result, residents pruned or cut down trees as well as removed fallen logs and other woody debris from their properties. Participant 1 noted

that logs and woody debris are key habitat features and that some residents went overboard with their fireproofing efforts.

The difficulty of balancing biodiversity with wildfire risk has also surfaced in the conflicting priorities of the federal and local governments. In particular, participants noted that the *Migratory Birds Convention Act*, 1994, SC 1994, c 22, prohibits the removal of any tree containing a pileated woodpecker nest for three years after the nest has been used by any bird species. The participants indicated that this prohibition presents a challenge when communities want to remove trees for the purpose of wildfire management or because they have been deemed hazardous. They also expressed concern that the federal government has not provided guidance for how to navigate these types of scenarios. More specifically, they indicated that the only direction they had received from the federal government was that failing to wait three years would be a contravention of the legislation. In the meantime, Participant 1 noted that for regional districts that "have to do widespread wildfire management or hazard tree management, they simply don't have the resources to check…every tree, and if these trees have a pileated woodpecker nest, what do they do? They're just going to cut them down."

In a similar example, participants described how recent provincial legislation has put environmental protection in conflict with housing development. They were referring to British Columbia's Bill 44, *Housing Statutes (Residential Development) Amendment Act, 2023*, 4th Sess, 42nd Leg, 2023 (assented to 30 November 2023), SBC 2023, c 45 (Bill 44), and Bill 47, *Housing Statutes (Transit-Oriented Areas) Amendment Act, 2023*, 4th Sess, 42nd Leg, 2023 (assented to 30 November 2023), SBC 2023, c 48 (Bill 47). The participants explained that these bills have superseded the processes and plans of local governments in two major ways: by changing their development targets in order to increase density and by streamlining or even eliminating the approval process for certain types of development applications.

With respect to the first change, one participant expressed concern that higher density developments may leave no space for treed areas on properties. For the second change, participants explained that certain types of applications will be automatically approved by the province, such that local governments will have no say in what happens on the site. As a result, participants indicated that these changes will limit local governments' ability to protect natural features during development. In considering the consequences for NbS, Participant 1 stated, "I think that, ultimately, it is going to result in more trees and natural areas removed…"

In terms of the toolkit, participants discussed the impacts of the new provincial legislation with respect to the following recommendation for a Tree Protection Bylaw: establish a maximum non-treed/cleared area for each development permit. When asked if this was a valuable recommendation, one participant indicated that they would have said yes but for the new legislation. With the push for higher density developments, they concluded that the recommendation is now problematic.

Along with changes to the approval process for certain development applications, participants indicated that local governments are under pressure to fast-track other applications because of the housing crisis in the province. Participant 3 noted that although they want to engage in proper consideration of environmental issues, “you just don’t have time” in a lot of cases.

The participants also expressed concern about whether the province would take additional steps to limit local governments’ authority in areas that might be seen as obstructing development. For example, the participants described one of the City’s current policies, which requires the siting of structures on private properties to minimize tree loss in road right-of-ways. However, Participant 8 said, “At what point does the province say ‘sorry, your rules don’t matter anymore because they’re adding more housing units, and that’s what we need’?”

Finally, participants also discussed the challenge of preventing contradictions between the City’s own bylaws. For example, they indicated that multiple bylaws may address tree protection in one way or another, so they need to ensure there is consistency in the City’s requirements. They noted that this challenge can be exacerbated when bylaws are only reviewed within the responsible department rather than across departments.

NbS Constraints in Single Family Zoning Areas

For the third theme, participants described various challenges with respect to protecting natural assets or implementing NbS in single family zoning areas. These challenges include subdivision applications, developments on single family lots, and the footprints of structures that are permitted under current zoning.

With respect to subdivision applications, participants explained that it is easier to encourage NbS performance targets for large developments than for single family lot subdivisions. This is because developers hire teams of consultants, while individual landowners

cannot afford to do so. As a result, participants noted that landowners are more likely to raise complaints with City Council if there is too much work associated with their application.

When deciding whether to grant an application, participants indicated that one consideration is the landowner's reason for wanting the subdivision. One participant noted that the City is receiving an increasing number of applications which claim that the purpose of the subdivision is to allow a family member (e.g., an elderly parent) to reside nearby. However, the participant said that most of these properties were then sold within a few years, which they attributed to the high value of the lot. As a result, the participant indicated that staff members are becoming skeptical of these claims.

With respect to developments on single family lots, participants identified challenges related to both building permits and the enforcement of regulations. For the first issue, participants noted that the City's Works and Services Bylaw applies to commercial, industrial, institutional, and multi-family building permits, but it does not apply to single family building permits. As a result, single family building permits do not include requirements to put in services such as lights, sidewalks, curb gutters, and street trees. One participant suggested that these building permits may have been exempted from the bylaw so that it would not be seen as punitive by imposing requirements when a landowner wants to tear down and rebuild a house.

However, the participant asserted that a different approach should be taken in the future. In particular, they said that single family building permits should include requirements for green infrastructure. Although the level of required service might be lower than for other developments, they indicated that environmental considerations should be incorporated, such as requirements for infiltration.

For the second issue, participants discussed the challenge of regulating developments on single family lots for the purpose of protecting natural assets. With large developments, they noted that staff have an opportunity to provide feedback to developers, such as encouraging them to preserve as many trees as possible. However, the City does not have any mechanism to prevent owners of single family lots from cutting down trees for development, such as building an addition or moving a driveway, unless it occurs in a road right-of-way. That being said, one participant indicated that the City is currently updating its Tree Protection Bylaw to address this gap.

In considering the regulations that do apply to developments on single family lots, participants indicated it is challenging to enforce those regulations. They noted that residents may be unaware of the City's requirements, and it is impossible to monitor all of the dwelling units in the City. For example, one participant said it is difficult to enforce restrictions on the amount of impervious surface in front yards. In addition, the City does not require permits for all of the types of development that might occur on a single family lot, such as paving a driveway. As a result, staff will not be made aware that such a development is occurring nor have an opportunity to provide feedback or education to residents, in those circumstances.

With respect to the footprints of structures, participants indicated that the City's current single family zoning does not leave enough space for NbS on properties. Participant 3 said, "The houses are big; the footprints are huge." Participant 5 said, "There's no space for anything other than structures." Participant 5 asserted, "It's a zoning problem," and they suggested one solution would be to amend the Zoning Bylaw to increase property setbacks and limit the footprints of structures. They pointed out that large houses are also contradictory to provincial housing targets, since the province wants to maximize density. Participant 5 elaborated on this point by saying, "You don't need a 2,000 square foot house for a single family."

Challenges Based on the Local Context

For the fourth theme, some of the challenges participants identified with respect to the toolkit's recommendations were tied to the local context of the City. For example, when discussing the recommendation to re-zone urban land to green space, participants indicated that the City does not have much undeveloped land that is not already designated as a park. However, they noted that the City had implemented this recommendation in the past when an area slated for development was re-zoned as Bert Flinn Park.

Participants also spoke more generally about challenges related to environmental protection in the City. For example, they indicated that the City faced significant public opposition when they attempted to update their Environmentally Sensitive Areas Management Strategy a few years ago. Similarly, Participant 3 noted that species-at-risk concerns are "a tough conversation. Right now, you're just trying to hold the habitat infrastructure together enough to allow that area to still be sustained…" With respect to protecting biodiversity in the City, Participant 3 said, "…it's complicated, it's complex, it's hard to manage, and then we've got all these layers of pressure on things." They explained that those layers include the housing crisis and the impacts of climate change.

Finally, participants indicated that the City's archaeologically sensitive zones can pose a challenge for restoration work and tree planting. In particular, they noted that it can be expensive to comply with obligations under the *Heritage Conservation Act*, RSBC 1996, c 187, with respect to the discovery of heritage objects or sites. As a result, they said the City tries to minimize soil disturbance in sensitive areas. However, they noted that the City's maps of archaeologically sensitive zones are not available to the public, so this may also present a significant challenge for residents who try to plant trees on their properties and discover a heritage object or site.

4.2.3. Additional Ideas

In addition to considering the recommendations in the toolkit, participants discussed other ideas for mechanisms that can support NbS in communities. These ideas included mechanisms that the City has already implemented, examples from other municipalities, and new options that were generated by participants during the World Café.

One recommendation in the toolkit is to extend the development setbacks required by the *Riparian Areas Protection Regulation*, BC Reg 178/2019, to all watercourses, rather than limiting them to fish habitat. One participant indicated that the City had not only done this already but also exceeded provincial requirements for setbacks from ditches. The participant noted that the City was concerned about water quality, and a larger setback allowed more natural filtration to occur before water entered the ditches.

With respect to the recommendation to impose landscaping and road design requirements to enhance natural areas and water infiltration in rural areas, the participants asserted that this recommendation could also be applied to non-rural areas. In their discussion, they identified two approaches that the City could take to "[reduce] our reliance on curbs and gutters." One was a Green Street Design for residential neighbourhoods, which could address various aspects of engineering, operations, maintenance, and urban forestry. They indicated that this mechanism had been used successfully in other cities, and they noted it was multi-purpose because it could provide additional benefits beyond water infiltration. The second approach they identified was a Parkway Road Standard, which could establish requirements for development in parkway areas. In particular, this standard would apply to areas with ditches – where curbs and gutters are not required – to ensure that development was sensitive to existing ditches.

While discussing how to address NbS considerations on private property, the participants developed a new idea for single lot subdivisions. In recognition of both space and capacity constraints for small developments, one participant suggested that the City provide a menu of NbS options to a developer. The participants discussed various ways to approach the menu, such as requiring a developer to implement two of five NbS options or using a scorecard, with different options having different values. For the first approach, one participant indicated that if a City policy required a set number of NbS options to be implemented, that would reduce the challenges that staff encounter when trying to negotiate with developers for the inclusion of NbS. Another participant indicated that a menu could also streamline the review process, such that applications would be processed more quickly if the developer met the standards in the menu.

4.2.4. Feedback on the Toolkit

The participants provided feedback on the toolkit by identifying valuable recommendations, highlighting ways to improve the toolkit, and discussing the value of its application as an analytical framework to evaluate the City's existing work.

When asked to identify the recommendations in the toolkit that they found to be most valuable, participants highlighted the following:

i) For a Tree Protection Bylaw, the recommendation to allow only partial removal of trees, if reasonable in the circumstances, such as stumping a hazardous tree at 3-5 meters above the ground, to leave habitat for wildlife – One participant noted that although this may be recommended by the City's arborists on a case-by-case basis, it would be valuable to adopt this recommendation as a formal requirement.

ii) For Comprehensive Development Zones, the recommendation to adopt green space requirements by using tools such as the Green Space Factor – One participant, who had not previously heard of the Green Space Factor, said that it sounded useful because it helps to have tools that are more prescriptive.

iii) For regulatory bylaws, the recommendation to adopt a Landscaping Bylaw – Participant 7 identified this bylaw as a potential "short-term quick win". They noted that a schedule could prescribe the types of landscaping treatments that

are prohibited, such as ones that have a high runoff coefficient (e.g., turf and artificial turf). They indicated this would have a net environmental benefit and that it would "[set] the stage…as a sort of early, gentle introduction into green infrastructure for adjacent property owners…"

With respect to opportunities for improving the toolkit, participants identified the following:

i) Multiple participants indicated it would be helpful if the toolkit provided best practice examples of specific standards/bylaw provisions (e.g., a bylaw with a definition of acceptable pruning) or of how recommendations have been implemented in other communities (e.g., promoting the donation of eco-gifts). They noted that it would be better if the City did not have to "[re-invent] the wheel."

ii) For the recommendation to adopt a Wildlife Feeding Regulation Bylaw to prohibit the feeding of wildlife, participants expressed concern about the City moving into an area that is currently a provincial responsibility. They explained that with the current process, the City reports any incidents of people feeding large wildlife, and provincial authorities intervene. If the City adopted the recommended bylaw, one participant said they would face pressure to take over enforcement.

Participants also noted that they have other mechanisms in place to address the feeding of wildlife on City lands, such as the Parks and Community Facilities Rules and Regulations Bylaw and the Littering and Dumping Prohibition Bylaw. Although they acknowledged there is a gap when it comes to feeding smaller wildlife on private property, they explained that the City has been running an education program for residents to address this issue for around 20 years.

iii) One participant indicated that multiple recommendations with respect to zoning bylaws could be addressed more effectively using other mechanisms. For example, with respect to the recommendation to use zoning and regulations to maintain and enhance ecosystem connectivity, they noted that this issue was already addressed in the Development Permit Area for environmentally sensitive areas as well as through other policies in the Official Community Plan. As another example, they said that although a zoning bylaw could set requirements

for maximum impervious cover and for a certain percentage of stormwater to be managed on-site, the latter requirement was already addressed in another bylaw. They were unsure which bylaw that was, but they said it might be the Subdivision Bylaw.

When asked to expand on this point, Participant 3 noted both that a “zoning bylaw…can do a lot” but also that “zoning is very limited in what you can do”. To reconcile these conflicting points, they explained that it is undesirable to include everything in a zoning bylaw because it is already difficult to manage all of the things that it must address. They noted that other bylaws or policies can be more specific when addressing details like stormwater management. In addition, other bylaws and policies can provide overarching requirements that apply to every new development, such as the City’s BC Energy Step Code Rezoning Applications Policy (which addresses energy efficiency), rather than being limited to a specific customized development zone.

When asked to provide feedback on the analytical framework that evaluated the City’s existing work, one participant said they found it “really valuable”. In particular, they indicated that it was helpful to look at the City’s work from an outside perspective. Another participant also commented on the merit of having the City’s work reviewed through an independent lens. They noted that when staff conduct reviews, they are usually very focused, and NbS is a consideration but not the focus. As such, they indicated there was value to having a review that focused on NbS considerations.

Chapter 5. Discussion

5.1. The Use of Regulatory Mechanisms to Support Nature-based Solutions in Municipalities

As previous research has shown, regulatory mechanisms offer a key opportunity for municipalities to mainstream the use of NbS in urban areas (Duffaut et al., 2022; Wamsler et al., 2020b). However, municipal staff may lack knowledge about how to design new, and modify existing, mechanisms for this purpose (Kabisch et al., 2016). To address this knowledge gap, I conducted this study to explore how municipalities can use regulatory mechanisms to facilitate the uptake of NbS. To do this, I developed a toolkit of recommendations for how to use different types of regulatory mechanisms to support NbS. Then, I tested the utility of the toolkit in a case study and workshop in the City of Port Moody, British Columbia.

This study has confirmed previous findings that various types of regulatory mechanisms can incorporate measures to advance NbS in communities (Duffaut et al., 2022; Dushkova & Haase, 2020; Wamsler et al., 2020b; van der Jagt et al., 2023). In particular, the toolkit contains 159 recommendations relating to 20 different categories of regulatory mechanisms, which range from site-scale development permits to regional-scale plans. This spectrum of coverage highlights the potential for municipalities both to tailor NbS projects to local conditions and to connect them to overarching goals for watershed health and resilience.

In addition, the recommendations in the toolkit address all of the NSI key areas: climate action; biodiversity; sustainable service delivery; and health, equity, and justice. This confirms that NbS can benefit both more-than-human species and human populations in multiple different ways. Further, 15 out of the 20 categories of regulatory mechanisms have recommendations that address two or more key areas. These results support previous findings that NbS can be multifunctional and often provide co-benefits (Raymond et al., 2017).

In considering the various types of regulatory mechanisms in the toolkit, one of the workshop's findings highlighted the differing yet complementary roles of some of the mechanisms. For example, bylaws can either stipulate all of the requirements for a particular area, or they can delegate authority to the General Manager to establish certain requirements in standards or manuals. The latter approach allows staff to modify those requirements as circumstances change over time, while bylaws can only be amended by Council, which can be a

time-consuming process. This approach provides greater flexibility in areas that are evolving quickly as new research and best practices emerge, such as stormwater management and green infrastructure. As such, this example illustrates the interconnected roles of different mechanisms, which together can create a regulatory framework that advances the implementation of NbS in municipalities.

The flexibility provided by these types of mechanisms may also aid in the management of NbS over time (Andersson et al., 2017). In particular, many NbS projects involve living organisms and so will require continuous monitoring and maintenance (Duffaut et al., 2022). As urban areas change due to development and/or the impacts of climate change, NbS may require supportive interventions in order to ensure their health and survival (Andersson et al., 2017; Bush & Doyon, 2019). As a result, municipalities will need to employ adaptive management strategies with respect to NbS projects (Bush & Doyon, 2019; Qi et al., 2020; Raymond et al., 2017), and this may require similar adaptability in the municipality's regulatory framework (Andersson et al., 2017).

5.2. Challenges and Opportunities

During the workshop in Port Moody, participants identified potential challenges and barriers they might encounter with respect to various measures that the City could adopt to advance NbS. These challenges centered around four themes: conflicting/competing priorities or laws, issues related to the local context of the City, NbS constraints in single family zoning areas, and opposition from developers or the public. The participants also discussed potential solutions to some of these challenges.

For the first challenge area, participants indicated that they struggle to balance the conflicting priorities of the City and the public as well as to navigate contradictory legislation from higher levels of government. As an example of the first issue, City residents who were concerned about wildfire risk and rodent control have removed trees and other habitat features, and they have also used rodenticides on their properties (the latter of which have been connected to owl fatalities). These actions conflict with the City's goals of protecting wildlife and trees. As an example of the second issue, requirements for nest protection in the federal *Migratory Birds Convention Act*, 1994, SC 1994, c 22, restrict municipalities' efforts to remove trees both for safety reasons and for wildfire management. Similarly, British Columbia's Bills 44 and 47 have superseded municipalities' processes and plans by increasing density targets and

by limiting or removing municipal oversight for certain types of development applications. Participants expressed concern that these changes will leave less space for treed areas, impair municipalities' ability to protect natural features, and limit their capacity for incorporating NbS considerations into new developments. As such, municipalities must strike a balance between conflicting concerns in the community while also adapting to new requirements that may be imposed by higher levels of government.

In considering the challenges presented by federal and provincial legislation, other studies have also found that local governments may face difficulty in mainstreaming NbS due to a hostile regulatory environment (Rahman et al., 2023; Zuniga-Teran et al., 2020). In particular, Rahman et al. (2023) noted that local governments are bound by national and sub-national regulations, but those regulations may not support the use of NbS. For municipalities to advance NbS successfully, there must be alignment across the various levels of government (Rahman et al., 2023; Zuniga-Teran et al., 2020). However, this may be difficult to achieve when those governments have different priorities. In order to strike a balance amongst competing concerns, governments must be careful not to make short-term decisions about urgent issues, such as the housing crisis, that may have negative consequences in the long-term, when the impacts of climate change become more severe.

For the second challenge area, participants described various obstacles to NbS implementation that were connected to the local context of Port Moody. In particular, the City recently faced public opposition to their efforts to enhance environmental protection, and they are also grappling with increasing pressures from the housing crisis and climate change. In addition, the City contains archaeologically sensitive zones, so it is challenging to engage in restoration and tree planting in those areas because that work can lead to the discovery of heritage objects or sites (which triggers obligations under the *Heritage Conservation Act*, RSBC 1996, c 187). These findings confirm the context-specific nature of NbS implementation, which has also been highlighted in other studies (Andersson et al., 2017; Duffaut et al., 2022; Gómez Martín et al., 2021; Krauze & Wagner, 2019; Zuniga-Teran et al., 2020). In particular, NbS must be designed for the socioecological context in which they will be embedded, in order to ensure their long-term efficacy (Duffaut et al., 2022; Gómez Martín et al., 2021; Krauze & Wagner, 2019). In addition, each municipality will face different challenges with respect to various issues, such as land availability, level of development, and existing regulations (Zuniga-Teran et al., 2020). As a result, regulatory mechanisms that are intended to advance NbS will need to be tailored to the local context.

For the third challenge area, participants identified multiple constraints that limit NbS implementation in single family zoning areas, including the difficulty of encouraging NbS performance targets for subdivisions and developments on single family lots. This is due to both the limited financial resources of individual landowners (in contrast to large developers) as well as gaps in the City's regulatory framework. As an example of the latter issue, the City's Works and Services Bylaw does not apply to single family building permits, so those permits cannot impose requirements for NbS. In addition, it is difficult to enforce those regulations that do apply to single family lots because the City must educate residents about their obligations as well as monitor their compliance, which requires a lot of resources. These examples highlight some of the challenges related to mainstreaming NbS on private property, an issue which has also been addressed in other studies (Bogdzevič, 2023; Wamsler et al., 2020b). In particular, Wamsler et al. (2020b) identified a key barrier to NbS as being when municipalities "have very little influence over private land" (p. 6). This problem has been demonstrated in Port Moody, as participants noted both a lack of regulation related to NbS on single family lots as well as the difficulty of enforcing those regulations that are in place.

In addition, participants indicated that the City's current single family zoning does not provide enough physical space for NbS. In particular, they noted that single family lots not only have small property setbacks but also allow large footprints for structures and parking areas. One participant asserted that amending the Zoning Bylaw to address these issues is the only way to protect trees in these areas. These findings mirror those of Duffaut et al. (2022), namely that municipal zoning may fail to leave space for NbS. As such, municipalities should consider how they can use zoning and other regulations both to enhance protection for and to increase the use of NbS on single family lots.

For the final challenge area, participants indicated that the City may face opposition from developers or the public if they try to implement various measures that support NbS. With respect to the first group, they asserted that developers may become frustrated if they feel the City has too many overlapping requirements. With respect to the second group, they expressed concern about the public's reaction to certain measures. For example, residents may object to a bylaw that protects trees on private land because they want to remove trees in order to preserve their views of the ocean, subdivide their properties, or build additions or driveways. These concerns are in line with Bogdzevič's (2023) assertion that property owners may resist new limitations on how they can use their land. They also support Wamsler et al.'s (2020a) finding that residents are likely to contest NbS projects due to "personal interests and a lack of

environmental awareness" (p. 240). Since municipal governments are elected by their residents, they will need to be cognizant of potential opposition to NbS and consider ways to mitigate that opposition.

In the present study, participants discussed two approaches the City could take to address public opposition: incentives and education. With respect to the first approach, participants agreed that incentives can be a strong motivator for residents to engage in actions that benefit the environment, such as retrofitting buildings. However, they also acknowledged that incentives would not be effective for discouraging subdivisions in single family zones (and tree removal resulting therefrom) due to the significant financial windfall that landowners receive from subdividing and selling a portion of their property. With respect to education, participants noted that it is important for residents to understand both the benefits of NbS as well as how to comply with bylaws that protect them. In support of the first point, Sari et al. (2023) found that the single most common driver for social acceptance of NbS was their perceived benefit. As such, it is critical that municipalities communicate the benefits of NbS for residents, including with respect to human health as well as climate change mitigation and adaptation (Duffaut et al., 2022; Dushkova & Haase, 2020; Kabisch et al., 2016; Raymond et al., 2017; Sari et al., 2023). Through these approaches, municipalities can work to garner public support for mechanisms that advance NbS in their communities.

5.3. Future Research and Refinement of the Toolkit

Of the four NSI key areas considered in this research, 76% of the toolkit's recommendations were connected to biodiversity (although this categorization was not exclusive, and some of these recommendations addressed other key areas as well). In contrast, only 48% of the recommendations addressed sustainable service delivery; 25% addressed climate action; and 11% addressed health, equity, and justice. In considering these findings, it was surprising that a low number of recommendations addressed climate action since NbS have largely been promoted as a tool for climate change mitigation and adaptation (Government of Canada, 2024; Nature-based Solutions for supporting sustainable development, 2022). One possible explanation is that although all of the resources I used to build the toolkit considered the impacts of climate change, that was not the primary focus for most of them. Instead, many of the documents centered around protecting natural assets and/or blue-green infrastructure, which have clear benefits for biodiversity.

In addition, although natural areas have the potential to sequester and store carbon (Drever et al., 2021; Teo et al., 2021) as well as to mitigate both flooding (Epelde et al., 2022; Qi et al., 2020) and the urban heat island effect (Emilsson & Sang, 2017), I did not identify recommendations that only addressed protection of these areas as contributing to climate action. Similarly, I did not connect these recommendations to either sustainable service delivery or health, equity, and justice, even though ecosystem functioning is critical for the provision of ecosystem services (Hernández-Blanco et al., 2022), and natural areas have clear benefits for human health (Bratman et al, 2012, as cited in Bayulken et al., 2021; Kolokotsa et al., 2020). My reasoning was that the purpose of the toolkit is to aid in decision-making, and the coding of the key areas is intended to allow practitioners to identify the central actions that advance each key area. As such, I did not believe it would be useful if most of the recommendations were categorized as addressing all four key areas. Instead, I only included a key area if it appeared to be one of the main purposes of the recommendation. However, to avoid any misunderstanding about the value of natural areas, the published form of the toolkit should include an introductory section that stresses the co-benefits of natural areas for the other three NSI key areas. In addition, future research could explore how to use regulatory mechanisms to support these areas more explicitly in NbS projects.

In considering the case study and workshop in Port Moody, which were intended to test the utility of the toolkit, participants confirmed that they found various recommendations in the toolkit to be valuable. However, they were not able to comment on the structure of the toolkit, as provided in Appendix A, because they did not review that form of the toolkit. Instead, they were provided the analytical table in Appendix B, which outlined recommendations that were tailored to the City's own documents. As such, a future research project could solicit feedback from practitioners on the format of the toolkit in Appendix A in order to explore how it could be refined for ease of use.

In the workshop, the participants did provide some comments and suggestions that can be considered for future iterations of the toolkit. For one, they expressed concern about the recommendation to adopt a bylaw that prohibits the feeding of wildlife because that bylaw could shift responsibility for this issue from the province to the municipality. In particular, the provincial government currently addresses any incidents involving the feeding of large wildlife, but a bylaw would need to be enforced by the municipality. As such, the toolkit's recommendation could be amended to acknowledge this potential impact on municipal resources, so practitioners can consider this point when deciding whether to adopt such a bylaw. In addition to providing

feedback on various recommendations, the participants also discussed other ideas for using regulatory mechanisms to support NbS. For example, they suggested that municipalities could develop a menu of NbS options for developers to implement in single lot subdivisions. In sum, these comments and ideas provide valuable insights that can be incorporated into a future version of the toolkit.

The participants also suggested that the toolkit could be improved by providing best practice examples of specific standards/bylaw provisions and of how other communities have implemented various recommendations. With respect to this proposal, the ACT Team explicitly considered whether to include best practice examples in the toolkit and decided not to do so. In particular, the toolkit is intended to synthesize and streamline the recommendations from seven resources that themselves provide a much higher level of detail as well as examples of provisions and cases. Our reasoning was that the toolkit should provide a short summary of key considerations, so it would be easier for practitioners to review than some of the longer resources. However, when the toolkit is published, its introduction should recommend that practitioners consult the source documents for more information about how to implement the various recommendations.

Finally, one participant suggested that some of the recommendations for Zoning Bylaws could be shifted to other mechanisms, such as an Official Community Plan or a Subdivision Bylaw. Their reasons for this suggestion included the fact that it is already difficult to manage all of the things a Zoning Bylaw must address, that other bylaws and policies could establish overarching requirements for all developments instead of for only one comprehensive development zone (e.g., the City's BC Energy Step Code Rezoning Applications Policy, which addresses energy efficiency), and that other mechanisms could be more effective for achieving certain goals. For example, they indicated that ecosystem connectivity is already addressed in both the City's Official Community Plan and its Development Permit Area for environmentally sensitive areas, so it is not necessary to use zoning to enhance connectivity. However, the toolkit is intended to provide a broad suite of options, so practitioners can consider different approaches and evaluate trade-offs between them. As such, the ACT Team has decided not to remove any recommendations from the Zoning Bylaw section in case other practitioners find them to be useful for their municipality's circumstances.

In summary, this research has demonstrated that the toolkit does provide value to practitioners, but it also has some gaps that ought to be addressed. In particular, future

research could explore how regulatory mechanisms can support NbS in ways that explicitly address the three NSI key areas that were under-represented in the toolkit, namely climate action; sustainable service delivery; and health, equity, and justice. In addition, a future study could examine the toolkit's utility for practitioners, based on its format in Appendix A. Finally, the toolkit's introduction could be drafted, and its recommendations amended, to incorporate some of the feedback provided by the workshop's participants. By addressing these issues, the toolkit can be refined to provide the greatest value to municipal governments who want to advance NbS in their communities.

Chapter 6. Conclusion

In its AR6 report, the IPCC (2023b) made it abundantly clear that humans must acknowledge our interdependency with ecological systems in order to mitigate and adapt to climate change. At the same time, the UN (n.d.) has highlighted the interconnections between climate change, biodiversity loss, and pollution; thus, solutions must be tailored to address all three of these environmental crises as much as possible. The enormous scale of this challenge will require coordinated efforts and solutions that can be implemented across regions.

Since municipalities both contribute to and are vulnerable to the impacts of climate change, they will need to play a significant role in this global effort (UN, 2019). In considering a path forward, NbS offer a key opportunity for municipalities to address climate change along with the other environmental crises facing our world. In particular, NbS can be multifunctional and provide co-benefits in multiple areas, including biodiversity, ecosystem services, climate change mitigation and adaptation, and human health and equity.

In order to mainstream NbS in urban areas, municipalities will need to adopt regulatory mechanisms that facilitate and/or require their use (Duffaut et al., 2022). In addition, they will need to adapt their existing regulatory environment from one based on grey infrastructure to one based in nature. To accomplish this shift, municipalities require information about how to use regulatory mechanisms most effectively to advance NbS. In order to support this effort, the toolkit developed as part of this research project may fill an important knowledge gap by providing options and recommendations for practitioners to consider.

In addition, this research has highlighted some of the opportunities and challenges that municipalities may face while developing a regulatory framework that supports NbS. In particular, certain mechanisms can provide greater flexibility for changing NbS requirements as new best practices emerge. This flexibility is important in areas that are evolving quickly, and it can also facilitate the adaptive management of NbS over time. In terms of challenges, municipalities may struggle to balance conflicting priorities, both within the community and across jurisdictional boundaries, as well as to mitigate potential opposition to NbS requirements. As a result, municipalities will need both to explore ways to enhance public support and to seek alignment with other governments. Further, just as NbS projects should be designed for the socioecological context in which they will be implemented (Duffaut et al., 2022; Gómez Martín et

al., 2021; Krauze & Wagner, 2019), so should regulatory mechanisms be tailored to the local circumstances of each community.

Thus, by adopting regulatory mechanisms that facilitate the uptake of NbS, municipalities can advance solutions that address both environmental and social concerns in urban areas. These measures are essential for tackling the world's environmental crises because they recognize the interdependency of humans and ecosystems and reinforce the fact that people must live in harmony with nature rather than trying to tame it (Cui et al., 2021). In order to do their part in addressing the crises we all face, municipalities must create a regulatory environment that advances NbS for the benefit of both the humans and the more-than-human species in their communities.

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Appendix A.

NSI Regulatory Mechanisms Toolkit

Sections of the Toolkit

Watershed Scale

1.1 Regional Growth Strategy/Regional Conservation Strategy

- 1.1.1 General Recommendations
- 1.1.2 Urban Containment/Growth Boundary

1.2 Agricultural Land Reserve

1.3 Watershed Plan (Integrated Stormwater Management Plan)

Community Scale

2.1 Official Community Plan

- 2.1.1 Policies
- 2.1.2 Designation of Environmentally Sensitive or Significant Area (ESA)
- 2.1.3 Environmental Development Permit Area (EDPA)
- 2.1.4 Marine/Shoreline Development Permit Area (DPA)
- 2.1.5 Other DPA's
- 2.1.6 Urban Containment/Growth Boundary

2.2 Zoning Bylaws

- 2.2.1 General Recommendations
- 2.2.2 Comprehensive Development Zones (Customized Zoning Regulations)
- 2.2.3 Density Averaging and Transfer
- 2.2.4 Conservation Zoning

2.3 Regulatory Bylaws

- 2.3.1 General Recommendations

Watershed Scale		
Recommendation	**NSI Key Area**	**NbS Approach**
1.1 Regional Growth Strategy/Regional Conservation Strategy		
1.1.1 General Recommendations		
Set a goal to maintain and enhance biodiversity[1]	Biodiversity	Ecosystem-based Management
Promote integrated watershed management[1]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management
Prioritize connectivity (e.g., wildlife corridors, riparian corridors, and greenways between natural areas)[1,2]	Biodiversity	Ecosystem-based Management/ Natural Asset Management/ Blue-Green Infrastructure Strategies
Require buffers (secured by conservation covenant) for land adjacent to the Agricultural Land Reserve and for development on lots with sensitive ecosystems[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management/ Blue-Green Infrastructure Strategies
Designate regional green zones, greenways, and habitat corridors[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Acquire, protect, and restore ecologically significant areas[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Prevent the conversion of agricultural land to non-agricultural uses[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
1.1.2 Urban Containment/Growth Boundary		
Establish urban containment boundaries, and secure a commitment that 90+% of growth will occur within the boundaries[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Designate the boundary around existing serviced areas to encourage compact development[2] and protect surrounding natural areas[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Include a policy not to extend servicing to areas outside of the boundary[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management

Include a policy to prevent or minimize development (e.g., satellite developments) outside of the boundary[2,3]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Maintain large-lot (5+ hectares) zoning outside of the boundary[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
1.2 Agricultural Land Reserve		
Ensure that bylaws are consistent with the *Agricultural Land Commission Act*'s mandate to protect farmland and do not allow non-farm uses of land in the Agricultural Land Reserve [1*]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
1.3 Watershed Plan (Integrated Stormwater Management Plan)		
Coordinate land use activities, include integrated stormwater/rainwater management planning, provide detailed maps of sensitive ecosystems, maintain ecosystem functioning, promote connectivity between ecosystems (e.g., establish/enhance wildlife corridors), and discourage the fragmentation of ecosystems[1]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management

[*] Pursuant to section 46 of the *Agricultural Land Commission Act*, SBC 2002, c 36, these restrictions on local government bylaws are mandatory.

Community Scale		
Recommendation	**NSI Key Area**	**NbS Approach**
2.1 Official Community Plan		
2.1.1 Policies		
For subdivisions near the Agricultural Land Reserve, require vegetated buffer areas, use cul-de-sacs instead of roads ending at the Agricultural Land Reserve (to avoid pressure to extend development into the Reserve), and ensure that changes to water flows will not increase flooding or reduce groundwater[2]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management
Include policies to enhance air quality, water conservation, rainwater management, surface water quality/quantity, and groundwater quality/quantity[2]	Sustainable Service Delivery	Ecosystem-based Management
Include policies to address climate change mitigation, and align these policies with air quality goals[2] (e.g., reducing greenhouse gas emissions, encouraging energy-efficient developments/green transportation, producing food locally, retaining carbon in vegetation/soils)[1]	Climate Action/ Sustainable Service Delivery	Ecosystem-based Management
Include policies to address climate change adaptation (e.g., resiliency, sea level rise, flood planning, wildfires)[1]	Climate Action	Ecosystem-based Management
Establish criteria for evaluating and balancing trade-offs between goals (e.g., fire-proofing efforts should not remove brush stands that provide important habitat for wildlife or that buffer ecosystems from development)[2]	Climate Action/ Biodiversity	Ecosystem-based Management
Establish development standards that require a consideration of cumulative impacts (e.g., habitat fragmentation) as well as off-site impacts (e.g., increased risk of flooding or sedimentation downstream)[2]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management
Prioritize connectivity (e.g., wildlife corridors, riparian corridors, and greenways between natural areas)[1,2]	Biodiversity	Ecosystem-based Management/ Natural Asset Management/

		Blue-Green Infrastructure Strategies
Maintain large-lot (5+ hectares) policies for rural areas[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Direct 90+% of new development into urbanized areas to protect natural areas[1] and minimize wildfire risk[2]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
In order to avoid weakening growth management, do not identify residential/urban reserves[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Provide guidance for decisions about proposed development, including for subdivisions, based on the type of ecosystem(s) present on the land[1] (e.g., reject applications that would damage an ecologically significant area)[2]	Biodiversity	Natural Asset Management
Include restrictions on the use of land that is environmentally sensitive to development[4†]	Biodiversity	Natural Asset Management
Designate land uses and prescribe densities that concentrate development in areas away from riparian corridors, greenways, sensitive ecosystems,[1] and agricultural land[2]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Discourage satellite developments and subdivisions with lot sizes of 0.8 to 5 hectares (parcels of this size are too small to sustain resource or agricultural uses, and they increase habitat fragmentation due to the large portion of each lot that is cleared for structures and/or lawns)[1,2]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Include policies for the preservation, protection, restoration, and enhancement of biodiversity and the environment[1,2]	Biodiversity	Natural Asset Management
Prioritize the acquisition/protection of diverse ecosystems, ecologically sensitive areas, and buffer zones around them[1,2]	Biodiversity	Natural Asset Management
Support parkland acquisition and/or dedication, including requiring landowners to provide 5% of their land as parkland during subdivision of three or more lots (or cash in lieu)[1]	Biodiversity	Natural Asset Management

[†] Pursuant to section 473 of the *Local Government Act*, RSBC 2015, c 1, this is a mandatory component of any Official Community Plan.

Establish criteria that must be met before new greenfield development is permitted (based on e.g., density, infrastructure, building permits, and/or demographics)[1]	Biodiversity	Natural Asset Management
Include a map of future uses of land, sensitive ecosystems, wildlife corridors, riparian areas, nests of significant bird species, boundaries of EDPA's, and greenways[1,2]	Biodiversity	Natural Asset Management/ Blue-Green Infrastructure Strategies
Promote green development approaches through award programs and fast-tracking of approvals[2]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management/ Blue-Green Infrastructure Strategies
Establish a moratorium on new businesses, hotels, and other hospitality industry permits near NbS[3]	Health, Equity & Justice	N/A
2.1.2 Designation of Environmentally Sensitive or Significant Area (ESA)		
Map environmentally sensitive areas and green infrastructure networks (i.e., core habitat areas and the natural corridors connecting them)[5]	Biodiversity	Ecosystem-based Management/ Natural Asset Management/ Blue-Green Infrastructure Strategies
Designate environmentally sensitive or significant areas (to prohibit development in these areas[3]) based on the Province of BC's Sensitive and Other Ecosystems Map codes and descriptions (designate either specific ecosystem types or delineated areas on a map)[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Extend the prohibition against development to a buffer zone around the protected area (see *Develop with Care 2014*[2] for suggested buffer widths); where possible, buffers should be on public lands to avoid being compromised by landowners' activities[2]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
2.1.3 Environmental Development Permit Area (EDPA)		
Designate the entire community as an EDPA in order to manage and enhance connectivity[1]	Biodiversity	Ecosystem-based Management
Establish criteria for evaluating and mitigating cumulative impacts (e.g., habitat fragmentation) as well as off-site impacts (e.g., increased risk of flooding or sedimentation downstream) from development[2]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management

Identify and track environmental indicators to evaluate if the plan is achieving its targets/benchmarks[1]	Biodiversity	Ecosystem-based Management
Designate EDPA's based on the Province of BC's Sensitive and Other Ecosystems Map codes and descriptions (designate either specific ecosystem types or delineated areas on a map)[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Ensure EDPA's are adjacent to ESA's and/or encompass them (for the latter, this would be necessary if it is not possible to prohibit all development in the ESA) in order to prevent or mitigate damage to them[3]	Biodiversity	Natural Asset Management
Require a permit for any development in the EDPA (i.e., subdivision, construction, or any alteration to the land aside from minor landscaping)[1]	Biodiversity	Natural Asset Management
Set conditions in a development permit to protect ecosystems, and tailor those conditions to the specific site or base them on geological features or ecosystem types[1,2,3,5] *See Appendix B for more information*	Biodiversity	Natural Asset Management
Require developers to provide a security deposit, which can be used for habitat restoration if the developer does not comply with the permit's conditions[1]	Biodiversity	Natural Asset Management
Embed EDPA's in a regulatory infrastructure that prioritizes conservation and restoration to enhance their effectiveness[1]	Biodiversity	Natural Asset Management
Designate the EDPA as a development approval information area to require information as part of an application for a development permit (e.g., require an environmental or blue-green infrastructure impact assessment)[1,6]	Biodiversity	Natural Asset Management/ Blue-Green Infrastructure Strategies
Establish a development checklist to ensure that a proposed development meets all of the community's goals (e.g., economic, social, and environmental goals; see a sample checklist in *Develop with Care 2014*[2])[1,2]	Climate Action/ Biodiversity/ Sustainable Service Delivery/ Health, Equity & Justice	N/A
Enact regulatory bylaws through which fines can be levied for non-compliance with permit conditions, in order to	N/A	N/A

facilitate enforcement (otherwise, the only remedy available is an injunction)[1]		
Conduct inspections to monitor compliance[1]	N/A	N/A
For any alteration to a building that is conducted without a permit, file a notice on land title[1]	N/A	N/A
If a permit holder is not complying with conditions, withdraw the permit and/or issue a stop work order[1]	N/A	N/A
2.1.4 Marine/Shoreline Development Permit Area (DPA)		
Set conditions in a development permit to minimize impacts to marine ecology and to address risks from climate change (e.g., sea level rise) and other hazards (e.g., storm surge/flooding, erosion, slope stability, etc.)[1] *See Appendix C for more information*	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Adopt the guidelines for development in coastal areas provided by the Stewardship Centre for British Columbia's Green Shores program[2‡]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Designate a DPA to encompass the area that is 15-30 meters on either side of a shoreline[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Natural Asset Management
2.1.5 Other DPA's		
Establish objectives to promote reduction of greenhouse gas emissions, energy conservation, water conservation,[4,5] groundwater protection, and/or farm protection[1]	Climate Action/ Sustainable Service Delivery	Ecosystem-based Management
Ensure that wildfire DPA's align with tree bylaws (e.g., permit tree removal for wildfire risk reduction [although this should be balanced against habitat protection], ensure replacement trees conform to FireSmart guidelines, etc.)[5]	Climate Action/ Biodiversity	Ecosystem-based Management/ Blue-Green Infrastructure Strategies
Adopt landscaping strategies to achieve the objectives set out above (e.g., plant trees for passive solar gain, cooling,	Climate Action/ Biodiversity/	Blue-Green Infrastructure Strategies

‡ To learn more about the Green Shores program, please visit: https://stewardshipcentrebc.ca/green-shores-home/

and carbon storage; locate trees to serve as a windbreak; select drought-resistant species)[5]	Sustainable Service Delivery	
Ensure that DPA's in areas with steep slopes impose requirements for tree retention to prevent erosion[5]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Designate areas with a high risk of sediment movement and erosion as hazard development permit areas, and provide guidelines to minimize erosion (e.g., require land clearing to be staged and to minimize exposed soils, restrict activities during periods of high rainfall or snowmelt, etc.)[2]	Sustainable Service Delivery	N/A
2.1.6 Urban Containment/Growth Boundary		
See section 1.1.2 for recommendations		
2.2 Zoning Bylaws		
2.2.1 General Recommendations		
Utilize zoning and regulations to maintain and enhance ecosystem connectivity[1]	Biodiversity	Ecosystem-based Management
Ensure that the permitted density will not exceed the available water supply (accounting for the needs of fish, wildlife, etc.)[2]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management
Impose regulations to promote energy conservation (e.g., locate structures on parcels to capture solar energy, require overhangs for summer shade, require geothermal systems, etc.)[2]	Climate Action/ Sustainable Service Delivery	Ecosystem-based Management
Impose regulations to minimize off-site impacts from development (e.g., habitat disturbance or increased sedimentation/risk of flooding downstream)[2]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management
Zone for infill development (e.g., laneway housing) to prevent urban sprawl and to protect agricultural and rural lands from development[6]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Preserve large lots in areas of high ecological value/outside the urban containment boundary (smaller parcels are less likely to sustain resource or agricultural uses, and they	Biodiversity/ Sustainable Service Delivery	Natural Asset Management

increase habitat fragmentation due to the large portion of each lot that is cleared for structures and/or lawns)[1,2]		
Re-zone urban land to green space[3]	Biodiversity/ Health, Equity & Justice	Natural Asset Management
Impose regulations for land use and development density to prioritize compact communities[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Concentrate growth/development away from ecologically significant areas, agricultural lands, hazard areas, and heritage sites[2]	Climate Action/ Biodiversity/ Sustainable Service Delivery/ Health, Equity & Justice	Natural Asset Management
Prevent development and activities that might generate pollution in areas with sensitive ecosystems[1] or valuable natural assets[4]	Biodiversity	Natural Asset Management
Establish development setbacks from sensitive ecosystems, watercourses,[1] and agricultural land[2]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Zone for eco-districts[3]	Climate Action/ Biodiversity/ Sustainable Service Delivery/ Health, Equity & Justice	Blue-Green Infrastructure Strategies
Impose regulations for screening and landscaping[1,5] (e.g., requirements for tree cover that specify the species and/or minimum number/density of trees, requirements for vegetation buffers between land uses, etc.)[5]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Impose regulations for controlling surface & rainwater runoff from paved/roof areas[1] and/or to require features for water collection and storage (e.g., rainwater collection systems, naturalized ponds, etc.)[2]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Impose regulations to minimize impervious cover[1,5] and promote canopy cover (e.g., maximum site/lot coverage, maximum impervious cover, setbacks for above and below-ground structures to preserve trees on adjacent lots, reduced/flexible parking requirements, etc.)[5]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies

Support the development of urban agriculture[3]	Sustainable Service Delivery/ Health, Equity & Justice	Blue-Green Infrastructure Strategies
Zone for higher density development along transit corridors to dissuade vehicle use[§]	Climate Action/ Sustainable Service Delivery	N/A
Preserve historic districts[3]	Health, Equity & Justice	N/A
Encourage mixed-use, nodal development within the urban containment boundary[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery/ Health, Equity & Justice	N/A
Utilize a Mandatory Inclusionary Zoning Overlay to require a percentage of all new multi-family development within a specified distance of NbS to be affordable housing units[3]	Health, Equity & Justice	N/A
Limit touristic/short-term rental apartments near NbS[3]	Health, Equity & Justice	N/A
2.2.2 Comprehensive Development Zones (Customized Zoning Regulations)		
Require site plans that ensure energy-efficient developments, encourage green transportation options, and consider risks from climate change when locating buildings/infrastructure[2]	Climate Action/ Sustainable Service Delivery	Ecosystem-based Management
Customize permitted uses, green space requirements (e.g., Green Space Factor), and other needs for a site (e.g., avoid sensitive areas, preserve natural assets, or create buffers/wildlife corridors)[2]	Climate Action/ Biodiversity/ Health, Equity & Justice	Natural Asset Management/ Blue-Green Infrastructure Strategies
Set out detailed guidelines and requirements for all aspects of development (e.g., the construction process[3] and timing,[2] blue-green infrastructure that must be installed [e.g., green roofs or green walls],[3] and/or natural areas/parkland that must be preserved[1])	Climate Action/ Biodiversity/ Sustainable Service Delivery	Natural Asset Management/ Blue-Green Infrastructure Strategies

[§] Park, K., Ewing, R., Scheer, B. C., & Ara Khan, S. S. (2018). Travel Behavior in TODs vs. Non-TODs: Using Cluster Analysis and Propensity Score Matching. *Transportation Research Record: Journal of the Transportation Research Board, 2672*(6), 31–39. https://doi.org/10.1177/0361198118774159

Require site plans that enhance ecosystem services, manage rainwater, and protect the quality and quantity of surface and groundwater[2]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Require site plans that include affordable housing units[3]	Health, Equity & Justice	N/A
2.2.3 Density Averaging and Transfer		
Encourage densification of development in areas with low environmental value in exchange for protection of areas with high environmental value in a comprehensive development zone[1,2]	Biodiversity	Natural Asset Management
2.2.4 Conservation Zoning		
Prevent development on land outside of the urban containment boundary[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Prevent development on land that contains a sensitive ecosystem or that is located in a greenway/wildlife corridor[1]	Biodiversity	Natural Asset Management
Zone public land with high ecological value as a natural park (rather than a municipal park, which permits activities that conflict with habitat protection), and register a conservation covenant, or a conservation organization as a joint owner, on title to ensure long-term protection[2]	Biodiversity	Natural Asset Management
2.3 Regulatory Bylaws**		
2.3.1 General Recommendations		
Require landowners to obtain a permit before carrying out certain activities, and establish parameters for how the activity can occur[1]	N/A	N/A

** Pursuant to section 9 of the *Community Charter*, SBC 2003, c 26, municipalities must seek provincial approval before enacting bylaws that address public health, protection of the natural environment, wildlife, or the removal/deposit of soil or other material (when the latter is with regard to the quality of the soil/material or with regard to contamination).

As a condition of any permit, require posting of a security deposit that is equal to the cost of the work being done (so the municipality can complete the work if necessary)[1]	N/A	N/A
Establish fines for offences[1]	N/A	N/A
Conduct public awareness campaigns about the types of activities that require permits[1]	N/A	N/A
2.3.2 Types of Bylaws		
Pesticide Use Bylaw: Prohibit and/or impose restrictions on the use of pesticides on residential or municipal land[1] to prevent contamination of water sources[4]/harm to wildlife††	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management/ Blue-Green Infrastructure Strategies
Invasive Species Bylaw: Regulate the control and eradication of defined invasive species[1]	Biodiversity	Ecosystem-based Management
Wildlife Feeding Regulation Bylaw: Prohibit the feeding of wildlife[2] (with the exception of bird feeders)	Biodiversity	Ecosystem-based Management
Air Quality Bylaws (i.e., Vehicle Idling Bylaw, Open Burning Bylaw, and Solid Fuel Burning Appliances Bylaw): Protect air quality by restricting vehicle idling, regulating/banning open burning, and reducing emissions from wood stoves and fireplaces (e.g., ban excessive smoke, require new or replacement appliances to meet the standards in the *Solid Fuel Burning Domestic Appliance Regulation*, etc.)[2]	Climate Action/ Sustainable Service Delivery	Ecosystem-based Management
Animal Control Bylaw: Regulate the impacts of domestic animals by prohibiting the sale of un-neutered animals, prohibiting free-roaming cats, and requiring dogs to be leashed in sensitive habitats[2]	Biodiversity	Ecosystem-based Management/ Natural Asset Management

†† Pursuant to the *Integrated Pest Management Regulation*, BC Reg 604/2004, municipalities may not regulate pesticides that fall under the definition of "excluded pesticide" (namely, those in Schedule 2), the use of pesticides on certain types of land (specified therein), the use of pesticides for managing pests that transmit human diseases or impact agriculture/forestry, and the use of pesticides for buildings and inside buildings.

Soil Removal & Deposit Bylaw: Restrict soil deposit and removal to protect water quality, to regulate activities that disturb substantial amounts of land outside of EDPA's, and to enhance protection inside of EDPA's (by providing additional enforcement mechanisms)[1]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Watercourse Protection Bylaw: Regulate activities that are carried out in and around watercourses, riparian areas, and wetlands to protect water quality and prevent fouling by imposing requirements for erosion and sediment control, prohibiting the enclosing of watercourses, prohibiting the discharge/washing of concrete into watercourses,[1] and limiting the total suspended solids and turbidity in watercourses (to control contaminants)[2]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Rainwater Management Bylaw: Regulate the stormwater system in order to protect water quality and natural assets[1,4] by imposing requirements for design and installation of drainage systems (to maintain the proper flow of water in a stream or ditch or to prevent erosion), for property owners to connect buildings/structures to drainage works in a specified manner,[1] and for ongoing maintenance[2]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Natural Asset Management
Nuisance Abatement Bylaw: Prohibit actions that may undermine a natural asset upon which the community relies (e.g., nuisance)[4]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Landscaping Bylaw: Regulate landscaping and screening by imposing standards for each zone (e.g., requiring certain species of native vegetation), requiring a restoration/landscaping plan from an environmental professional,[1] and restricting the conversion of native landscapes to those with high water demands (e.g., lawns)[2]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management/ Blue-Green Infrastructure Strategies
Tree Protection Bylaw: Restrict tree removal to protect the urban forest[1,3,5]	Climate Action/ Biodiversity/	Natural Asset Management/ Blue-Green Infrastructure Strategies

See Appendix D for more information	Sustainable Service Delivery	
Green Infrastructure Bylaw: Develop a comprehensive bylaw which encompasses prohibitions, regulations, and requirements for development permits and impact assessments, as well as for all activities requiring permits (i.e., in lieu of separate bylaws for tree removal, pesticide use, etc.)[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Natural Asset Management/ Blue-Green Infrastructure Strategies
2.4 Conservation Covenants‡‡		
Identify priority areas for conservation, and ensure that a review process is triggered by any application for a development permit, subdivision, or rezoning in those areas[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Offer reduced property taxes in exchange for landowners registering conservation covenants on land titles[1]	Biodiversity	Natural Asset Management
Negotiate an agreement with the landowner (and register it on title) to specify the activities permitted on the land, regulate construction and subdivision, establish setbacks from ecological areas, and identify features that must be preserved[1] (e.g., protect vegetation, trees, or ecosystems; require management and/or restoration activities; prohibit actions that could alter/damage protected features; require documentation prior to subdivision; require fencing to restrict access, etc.)[1,5]	Biodiversity	Natural Asset Management
Include a baseline report that documents the state of the land at the time of registration[5]	Biodiversity	Natural Asset Management
If entering into a working landscape agreement (i.e., allowing sustainable activities on the land), specify the priorities for management of the area as well as the management approach[5]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management

‡‡ For more information about drafting conservation covenants, please see West Coast Environmental Law Research Foundation/Land Trust Alliance of British Columbia's BC Conservation Covenant Handbook at: https://www.wcel.org/publication/bc-conservation-covenant-handbook-guide-best-practices-conservation-covenants-british

Develop greenways or trails that span several adjoining parcels[1]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Blue-Green Infrastructure Strategies
Consider requiring multiple parcels of land to be sold together (to ensure consistent protection or management of greenways or trails that span the parcels)[1]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Blue-Green Infrastructure Strategies
Consider including an easement or statutory right-of-way to secure access to the property (e.g., for staff to inspect and/or maintain blue-green infrastructure on the property, for a public trail or wildlife corridor, etc.)[1,2,5]	Biodiversity/ Sustainable Service Delivery	Ecosystem-based Management/ Blue-Green Infrastructure Strategies
Conduct inspections to monitor compliance[1]	N/A	N/A
Ensure that new owners of the land are kept informed about the requirements of the covenant[1]	N/A	N/A
Due to the difficulty of monitoring and enforcing covenants, consider asking an NGO to be the covenant holder[1]	N/A	N/A
Due to the difficulty of monitoring and enforcing covenants, consider reserving their use for large ecosystem features (e.g., riparian areas) and significant ecological features on greenfield and redeveloped sites[1]	N/A	N/A
2.5 Subdivision and Servicing Bylaws		
Include regulations for vegetation protection and erosion control to protect watercourses[1]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Ensure that drainage standards include the protection or restoration of natural watercourses, native soils, and trees[5]	Biodiversity	Natural Asset Management
Adopt a low-impact development design and policy manual[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Adopt a stormwater design and policy manual[1]	Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Ensure that stormwater management standards include on-site capture and infiltration facilities to enhance water security and support tree retention (e.g., require post-development site runoff to match pre-development levels)[1,5]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies

Maximize the boulevard width for tree planting strips (minimum of 2 meters when sharing space with utilities, absolute minimum of 1.5 meters with additional soil volume under sidewalk/root bridges)[5]	Climate Action/ Biodiversity	Blue-Green Infrastructure Strategies
Impose regulations for the minimum soil volume that is required for tree roots (or require soil cells)[5]	Biodiversity	Blue-Green Infrastructure Strategies
Impose regulations for landscaping (e.g., standards for the landscape plan, plant spacing, plant type, stock quality, irrigation, and drainage)[5]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Impose firm setbacks for tree planting from utilities and infrastructure when there is a risk of a hazard (e.g., intersection visibility, gas main connection), while allowing flexibility in other situations[5]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Facilitate tree planting through flexible streetscape design standards by establishing a hierarchy of preferred and alternative compliance methods for each component[5]	Climate Action/ Biodiversity	Blue-Green Infrastructure Strategies
In rural areas, impose landscaping and road design requirements to enhance natural areas and water infiltration (e.g., extensive revegetation, narrow pavement, shallow drainage swales, no curbs, etc.)[1]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
2.6 Amenity Density Bonuses		
Allow densification/variation in lot configuration in exchange for preserving natural assets (e.g., tree stands, wetlands, etc.), and register a conservation covenant to ensure long-term protection of the asset[1,5]	Biodiversity	Natural Asset Management
Allow densification in exchange for providing amenities (e.g., parkland, green space, waterfront access, daycare facilities, or restoration of a degraded ecosystem) that have a value of 50-60% of the increase in the land's value from densification[1]	Climate Action/ Biodiversity/ Sustainable Service Delivery Health, Equity & Justice	Natural Asset Management/ Blue-Green Infrastructure Strategies
Allow densification in exchange for extensive tree planting[6]	Climate Action/ Biodiversity/	Blue-Green Infrastructure Strategies

	Sustainable Service Delivery	
Allow densification in exchange for the provision of affordable housing[3]	Health, Equity & Justice	N/A
In the OCP, clarify the maximum uplift for each zone, include a list of priority amenities for each neighbourhood, and provide a clear formula for calculating the value of uplift and the value of amenities[1]	N/A	N/A
2.7 Tax Incentives/Lower Development Cost Charges (DCC's)		
Dedicate revenue from DCC's to the acquisition of parkland[1] and/or the restoration and improvement of natural areas[4]	Biodiversity	Natural Asset Management
Encourage redevelopment of brownfield and greyfield sites (rather than developing greenfield sites), and enhance the local ecosystem during redevelopment[2]	Biodiversity	Blue-Green Infrastructure Strategies
Incentivize blue-green infrastructure, and disincentivize impervious surfaces[3]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Encourage development of empty lots/unoccupied buildings into affordable housing[3]	Health, Equity & Justice	N/A
2.8 Property Tax Exemptions, Freezes, Credits, & Support		
Offer reduced property taxes in exchange for landowners registering conservation covenants on land titles[1]	Biodiversity	Natural Asset Management
Sign an exemption agreement with the landowner which specifies that the tax exemption will only be granted if the owner adheres to the specified conditions in the conservation covenant (i.e., the full taxes plus interest are payable in the event of a breach)[1]	N/A	N/A
Conduct inspections to monitor compliance with the conservation covenant[1]	N/A	N/A
Reduce/freeze property taxes or provide support for low-income homeowners near NbS locations[3]	Health, Equity & Justice	N/A

2.9 Riparian Areas Protection		
Exceed the requirements for setbacks and damage mitigation in the *Riparian Areas Protection Regulation*, BC Reg 178/2019 (RAPR) (e.g., establish setbacks for all watercourses rather than limiting them to fish habitat,[1] consider the needs of species other than fish, etc.[2])	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
Utilize the RAPR's simple assessment process, rather than the detailed assessment, to maximize setbacks[7]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management
For agricultural buildings (to which the RAPR does not apply), adopt the Partnership Committee on Agriculture and the Environment's standards[§§] for setbacks[1]	Sustainable Service Delivery	Blue-Green Infrastructure Strategies
2.10 Land Acquisition		
Require landowners to provide 5% of their land as parkland during subdivision of three or more lots (or cash in lieu),[1,2] or negotiate a larger percentage in exchange for development concessions[2]	Biodiversity	Natural Asset Management
Promote the donation of eco-gifts by private landowners (these gifts may qualify them for federal/provincial tax relief)[2]	Biodiversity	Natural Asset Management
Purchase ecologically significant land jointly with a land trust organization or other level of government[2]	Biodiversity	Natural Asset Management
2.11 Building Permits		
Set conditions for landowners to provide works and services that meet the standards established by bylaws (e.g., for rainwater management)[1]	Sustainable Service Delivery	Blue-Green Infrastructure Strategies
Require landowners to supply a maintenance plan for rainwater infrastructure, and incorporate it into a covenant	Sustainable Service Delivery	Blue-Green Infrastructure Strategies

[§§] To review current standards, please visit: https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/strengthening-farming/local-government-bylaw-standards-and-farm-bylaws/agricultural-building-riparian-setbacks

registered on title, with a rent charge payable in the event of a breach[1]		
For any alteration to a building that is conducted without a permit, file a notice on land title[1]	N/A	N/A
2.12 Important Bird and Biodiversity Area/Key Biodiversity Area		
Prioritize protection/conservation for these areas[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
Designate EDPA's for these areas[1]	Biodiversity	Ecosystem-based Management/ Natural Asset Management
2.13 Impact Assessments		
Assess the effects of new development on community values, blue-green infrastructure, and biodiversity[1,6]	Biodiversity/ Sustainable Service Delivery Health, Equity & Justice	Ecosystem-based Management/ Natural Asset Management
2.14 Parcel Taxes		
Utilize parcel taxes to generate revenue for protecting/maintaining natural areas that provide specific ecosystem services[4]	Biodiversity/ Sustainable Service Delivery	Natural Asset Management/ Blue-Green Infrastructure Strategies
2.15 Statutory Right-of-way/Public Utility Easement		
Register on title to grant access to a public authority/utility for the purpose of maintaining blue-green infrastructure on private land[4]	Biodiversity/ Sustainable Service Delivery	Blue-Green Infrastructure Strategies
2.16 Bare Land Strata		
Preserve natural assets through strata ownership of land (i.e., individuals own their homes but not the land, so they cannot cut down trees, etc.)[5]	Biodiversity	Natural Asset Management
2.17 Conservation Fund		
Dedicate funds for parkland acquisition and/or stewardship activities[1]	Biodiversity	Natural Asset Management

Appendix A:
NSI Key Areas – Definitions and Explanations

In this toolkit, the four applicable NSI key areas have been defined and colour-coded as follows:

- Climate Action – Recommendations are connected to climate action if they reduce greenhouse gas emissions/enhance sinks that remove greenhouse gases from the atmosphere (i.e., mitigation) and/or reduce risk from projected climate impacts (i.e., adaptation).
    - For greater clarity, the following points will explain how various recommendations may be connected to climate action:
        - Measures that reduce energy consumption and/or address land use in a way that reduces vehicle kilometers traveled (e.g., compact development, mixed-use/nodal development, or transit-oriented development, when implemented with careful planning) can reduce greenhouse gas emissions in areas where vehicles have combustion engines and/or electricity is produced from the burning of fossil fuels. When implemented to prevent land clearing for urban expansion, these measures can also minimize encroachment on natural areas, which will protect the carbon stored in those areas and allow additional sequestration of greenhouses gases to occur.
        - Agricultural land can, with climate-appropriate practices (e.g., soil management techniques such as no-tillage), be used to store and sequester carbon.
        - Climate adaptation includes measures that address drought, wildfire risk, urban heat, extreme weather (e.g., higher intensity precipitation events that increase runoff), and sea level rise.
        - Greener urban form (e.g., bioswales, green spaces, green roofs and walls, urban forests and trees, etc.) can sequester greenhouse gases, reduce urban heat island effects, reduce heating/cooling costs for buildings (and corresponding greenhouse gas emissions from energy consumption), and decrease the risk of flooding by enhancing the absorption of precipitation.

- Biodiversity - Recommendations are connected to biodiversity if they support ecosystem health and resilience, prevent habitat degradation or fragmentation, and/or protect, enhance, or restore wild species, natural areas, ecosystem connectivity, or ecological processes (e.g., hydrological cycles, pollination, etc.).
    - For greater clarity, the following will explain how various recommendations may be connected to biodiversity:

        - Compact development can promote biodiversity if it prevents urban sprawl (and corresponding habitat destruction) and/or if it expands urban green space.
        - Green spaces (e.g., parks, greenfield sites, or brownfield sites) can support greater biodiversity than more developed urban land.
        - Agricultural land can support biodiversity when it is managed sustainably (e.g., with agroforestry or low intensity farming).
        - Large lot sizes in rural areas, areas of high ecological value, and areas outside of urban containment boundaries can support greater biodiversity than small lot sizes because it is less likely that the lot will be fully cleared/developed.
        - Street trees, green roofs, and other vegetated areas can support biodiversity by providing habitat for species.
        - Native species enhance biodiversity, while introduced or invasive species negatively impact biodiversity.

- Sustainable Service Delivery – Recommendations are connected to sustainable service delivery if they reduce costs for providing a municipal service (e.g., stormwater management), reduce energy consumption, enhance ecosystem services (e.g., recreational opportunities, water filtration, water storage, groundwater recharge, air purification, or food production), or mitigate hazards (e.g., pollution, erosion, sedimentation, or flooding).

    - For greater clarity, the following will explain how various recommendations may be connected to sustainable service delivery:

        - Compact development and transit-oriented development can be used to minimize urban sprawl and the corresponding need for expanded municipal infrastructure networks (e.g., sewer, electrical, transit, etc.).
        - Public trails and parks are a municipal service because they provide recreational opportunities for residents.
        - Permeable surfaces will enhance water infiltration and improve stormwater management.
        - Greener urban form (e.g., green roofs and walls, urban forests and trees, etc.) can reduce heating/cooling costs for buildings.

- Health, Equity & Justice – Recommendations are connected to health, equity, and justice if they advance affordable housing, mitigate gentrification, address social issues, enhance food security, support low-income households, improve the equitable distribution of NbS, and/or increase access to services or green spaces.

    - For greater clarity, the following will explain how various recommendations may be connected to health, equity, and justice:

- Access to green space supports public health (e.g., improved air quality, improved mental health, etc.) and can help to overcome environmental injustices within communities.
- Mixed-use/nodal development can increase access to services by reducing the distance that must be traveled to access those services.

Appendix B:
Recommended Conditions for an Environmental Development Permit Area

1. Protection of specific ecosystem elements:

    a. Trees - Relocate proposed structures/services/roads to prevent root impacts; erect fencing around trees during construction or on a permanent basis; prune branches to reduce wind load in trees;[5] retain logs/stumps/standing snags/wildlife trees to provide habitat[2,5]

    b. Bird Nests - Establish a buffer zone around bird nests during development (the width may vary by species)[1]

    c. Wetlands/Vernal Pools – Prohibit filling or draining of permanent or seasonally wet areas; prohibit the conversion of vernal pools into year-round water features[2]

2. Preservation/enhancement of ecosystems:

    a. Ensure that the siting of development on the parcel avoids areas that are ecologically significant or provide ecological connectivity[1,5]

    b. Establish setbacks for different types of watercourses[1]

    c. Require actions to protect/enhance the natural environment[1,5] (e.g., plant or retain vegetation/trees in riparian areas to protect fish habitat, control drainage, minimize erosion, and stabilize slopes)[1]

    d. Require plans for mitigating environmental damage[1] (e.g., erosion and sediment control,[1] vegetation protection[1] [e.g., reduce soil compaction by avoiding the use of machinery near retained vegetation; minimize soil disturbance to prevent the spread of invasive plants, etc.[2]], vegetation rehabilitation[1] [e.g., maintain the original composition and density of native species when replanting[5]], and landscaping[1] [e.g., stockpile and replace existing soils; require at least 20 cm of topsoil for lawn areas, etc.[2]])

    e. Require post-development rainwater flows to watercourses to remain at the pre-development quality and volume[1]

    f. For zones adjacent to ESA's, require natural landscaping to provide a transition between the ESA and the development area[5]

    g. Restrict the timing of development/loud activities, so they do not interfere with hibernation, bird nesting, bird migration, plant flowering, butterfly egg laying, fish spawning, or significant species' breeding seasons[1,2]

h. Avoid or restrict the installation and use of outdoor lighting in areas adjacent to protected areas[2]

3. Restoration of degraded/damaged ecosystems:

   a. Plant native trees and plants; remove invasive species[5]

   b. Restore watercourses or other natural features[1]

4. Mitigation of off-site impacts:

   a. Require plans to prevent increased sedimentation downstream[2]

   b. Require mitigation of impacts to neighbouring ecosystems (e.g., avoid illuminating a wetland at night)[2]

   c. Require mitigation of impacts to agricultural land (e.g., ensure that run-off from roads and subdivisions does not increase flooding or reduce groundwater supplies)[2]

5. Monitoring and reporting (by qualified professionals):

   a. Require an environmental monitor to be on site during construction[2]

   b. Require monitoring and reporting of site conditions[5]

   c. Require a riparian assessment[5]

   d. Require a stand prescription (to reduce the likelihood of windthrow along newly exposed forest edge)[5]

   e. Require the identification of hazardous trees[5]

Appendix C:
Recommended Conditions for a Marine DPA

1. Minimize impacts to marine ecology:[1]

    a. Ensure that the siting of development on the parcel avoids areas that are ecologically significant

    b. Restrict the installation of shoreline protection measures, and prioritize soft measures over hard measures

    c. Require the preservation of natural beach transport processes (i.e., erosion and accretion)

    d. Restrict the use of fill in areas upland of the shoreline

    e. Require the retention or replacement of natural vegetation in the riparian area, including woody debris

2. Mitigate risks from hazards:[1]

    a. Ensure that the siting of development on the parcel minimizes erosion and avoids areas that are in flood zones or on unstable slopes

    b. Impose requirements for managing stormwater runoff and drainage (e.g., stormwater should not drain to the foreshore or over the edge of bluffs/shore banks and should avoid compromising slope stability)

3. Protect waterfront views and public access, if appropriate[1]

Appendix D:
Recommended Contents for a Tree Protection Bylaw

1. Define:

    a. Protected trees[5] – Define based on diameter[1,5], species[1,5], heritage value[1,5], wildlife value[1,6] (e.g., host to birds that are protected under the *Migratory Birds Convention Act*[1]), and/or location (based on either a defined area or type of area [e.g., steep slopes, riparian areas, environmentally sensitive areas, floodplains[1,6]])

    b. Tree protection zone[5] – Define the area surrounding a tree that must be protected to prevent damage to roots

    c. Applicant/application[5] - Designate the information that will be required for the application

    d. Acceptable pruning[5]

2. Prohibit cutting, removal, and damage[1,5]

3. Consider exemptions for certain groups (e.g., government, utilities, etc.) or activities (e.g., farming)[5]

4. Designate permitted removal reasons (e.g., high risk/dead/dying trees, conflict with buildings or structures, wildfire risk, invasive species, construction access, proximity to building foundations, infrastructure damage, yearly removal allowance, trees on structures)[5]

    a. Allow only partial removal, if reasonable in the circumstances (i.e., stump a hazardous tree at 3-5 meters above the ground to leave habitat for wildlife)[2]

5. Require the replacement of protected trees (with the number of replacement trees to be based on the location, tree density targets, canopy cover targets, or the number/diameter of the removed trees).

    a. Include specifications for the replacement trees (e.g., species, spacing, soil volume, adherence to stock & planting standards, etc.) or cash-in-lieu of replacement (in an amount that will cover the cost of replacement)[5]

    b. Prioritize climate-resilient native species

6. Incentivize tree retention (e.g., reduce replacement requirements if specific valuable trees are retained on site)[5]

7. Establish a maximum non-treed/cleared area for each development permit[1]

8. Include conditions in the tree permit to require specific actions on site (e.g., prevent damage to trees that are being retained, mark trees to be removed, notify the public, etc.)[1,5]

9. Require a security deposit (i.e., a refundable deposit to guarantee the applicant will comply with the conditions of the permit, such as preventing damage to trees that are being retained/replacing trees that are being removed), or enforce the permit via inspections[5]

10. Impose penalties for non-compliance (e.g., fines, stop work orders, forfeit of securities, etc.)[5]

Note: A Tree Protection Bylaw cannot prevent development to the uses and densities permitted by zoning bylaws, unless Council pays the owner compensation for the reduction in market value of the property or provides an alternative means of allowing the land to be used for the permitted use or density.[1]

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[2] Government of British Columbia. (2014). *Develop With Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia.* https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices/develop-with-care

[3] Tozer, L., Mettler, C., Neeson, E., Reyes, R. S., Morgan, A., & Amon, E. (2022). *Pathways to Living Cities: A Policy & Governance Framework.* Green Communities Canada. https://greencommunitiescanada.org/wp-content/uploads/2022/11/Living-Cities-Framework-Final.pdf

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[5] Metro Vancouver. (2021). *Tree Regulations Toolkit.* Contract report prepared by Diamond Head Consulting. https://metrovancouver.org/services/regional-planning/Documents/metro-vancouver-tree-regulations-toolkit-with-appendices-2021-05.pdf

[6] Union of British Columbia Municipalities. (2008). *Planting our Future: A Tree Toolkit for Communities.* https://toolkit.bc.ca/wp-content/uploads/2022/06/Planting_OurFuture_2008.pdf

[7] Municipal Natural Assets Initiative (MNAI). (2023). *Natural Asset Infrastructure in British Columbia: Barriers and Opportunities.* https://mnai.ca/barriers-and-opportunities

Appendix B.

Analytical Table for Port Moody, British Columbia

Sections of the Analytical Table

Analysis of Port Moody's 2014 Official Community Plan

1.0 Official Community Plan

- 1.1 OCP Policies
- 1.2 Designation of Environmentally Sensitive or Significant Area (ESA)
- 1.3 Environmental Development Permit Area (EDPA)
- 1.4 Marine/Shoreline Development Permit Area (DPA)
- 1.5 Other DPA's

Analysis of Port Moody's Other Regulatory Mechanisms

2.0 Zoning

- 2.1 Comprehensive Development Zones (Customized Zoning Regulations)
- 2.2 Density Averaging and Transfer
- 2.3 Conservation Zoning
- 2.4 Riparian Areas Protection
- 2.5 Zoning Bylaws (General Recommendations)

3.0 Regulatory Bylaws

- 3.1 Tree Protection Bylaw
- 3.2 Stream and Drainage System Protection Bylaw
- 3.3 Animal Control Bylaw
- 3.4 Anti-Idling Bylaw
- 3.5 Pesticide Use Control Bylaw
- 3.6 Soil Deposit and Removal Bylaw

Analysis of Port Moody's 2014 Official Community Plan		
NSI Recommendation and Key Area	**Relevant Contents of the OCP**	**NbS Approach**
1.0 Official Community Plan		**NSI Key Area**
1.1 OCP Policies		
Topic: Land Use & Development		
Ensure that there are restrictions on the use of land that is environmentally sensitive to development (this is mandatory)	Chapter 6, Policy 2: "The City will strive to preserve sensitive ecosystem areas, their living resources and connections between them in a natural condition and maintain these areas free of development and human activity to the maximum extent possible." Chapter 6, Policy 4: "The City will continue to identify and provide protection for High and Medium Sensitivity ESAs by requiring development permits for proposed development activity and by requiring environmental impact assessments in cases where proposed developments may negatively impact the ESA." *Explore whether additional restrictions are warranted*	Natural Assets Biodiversity
Establish a development checklist to ensure that a proposed development meets all of the community's goals (e.g., economic, social, and environmental; see a sample checklist in Develop with Care)	Chapter 5, Policy 12: "The City will encourage sustainable project development by applying the Sustainability Checklist, including energy considerations, to assess the relative strengths of a development proposal from a sustainability perspective and encourage the most sustainable project possible." *The Sustainability Checklist does not apply to all developments.*	N/A Biodiversity/ Climate Action/

	The checklist may allow detrimental trade-offs – poor scores on environmental sustainability may be offset by high scores on social sustainability. How are these trade-offs evaluated? *The OCP does not contain specific guidance for minimum sustainability scores that are required to approve development.*	Health, Equity & Justice/ Sustainable Service Delivery
Establish development standards that require a consideration of cumulative impacts (e.g., habitat fragmentation) as well as off-site impacts (e.g., increased risk of flooding or sedimentation downstream)	*This does not appear to be addressed*	Watershed Biodiversity/ Sustainable Service Delivery
Provide guidance for decisions about proposed development, including for subdivisions, based on the type of ecosystem(s) present on the land (e.g., reject applications that would damage an ecologically significant area)	Chapter 6, Policy 68: "The City will require consideration of species at risk and habitat protection as part of the development review process where applicable." *The OCP does not contain specific guidance for decisions about development based on ecosystem type or habitat protection requirements*	Natural Assets Biodiversity
Require an Impact Assessment to assess the effects of new development on community values and biodiversity	Chapter 6, Policy 4: "…requiring environmental impact assessments in cases where proposed developments may negatively impact the ESA." *Consider requiring impact assessments for other community values*	Watershed/ Natural Assets Biodiversity/ Health, Equity & Justice
Include a map of future uses of land, sensitive ecosystems, wildlife corridors, riparian areas, nests of significant bird	Map 1 (page 105) – Overall Land Use Plan Map 2 – Parks, Open Space and Public Facilities	Natural Assets/ Blue-Green Infrastructure

species, boundaries of EDPA's, and greenways	Map 13 – Environmentally Sensitive Areas *Consider adding wildlife corridors and nests of significant bird species*	Biodiversity
Designate land uses and prescribe densities that concentrate development in areas away from riparian corridors, greenways, sensitive ecosystems, and agricultural land	Map 1 – Overall Land Use Plan: On the north side of the inlet, low density development is permitted in a highly sensitive area (so development is not being concentrated near a sensitive area, in this case) Map 2 – Parks, Open Space and Public Facilities Map 13 – Environmentally Sensitive Areas Compare these maps to ensure land use plans are concentrating development away from the noted areas	Natural Assets Biodiversity
In order to avoid weakening growth management, do not identify residential/urban reserves	*It is unclear if the maps do this*	Watershed/ Natural Assets Biodiversity
Discourage satellite developments and subdivisions with lot sizes of 0.8 to 5 hectares	Map 1 – Overall Land Use Plan: Allows single-family low density residential development at the outskirts of current development. There is no indication of permitted lot size. *Re-zone undeveloped land on the outskirts of current development to prevent development or designate lot sizes greater than 5 hectares*	Natural Assets Biodiversity
Maintain large-lot (5+ hectares) policies for rural areas	Map 1 – Overall Land Use Plan: Allows single-family low density residential development at the outskirts of current development. There is no indication of permitted lot size. *See above*	Watershed/ Natural Assets Biodiversity

Direct 90+% of new development into urbanized areas to protect natural areas and minimize wildfire risk	Section 6.16: "A key component of this planning has been concentrating new development within existing brownfield and urban infill areas (Inlet Centre) and a movement away from continued sprawl and encroachment into environmentally sensitive areas." T*here is no specific policy directing new development to occur at a specified threshold in urbanized areas.*	Watershed/ Natural Assets Biodiversity/ Climate Action
Establish criteria that must be met before new greenfield development is permitted (based on e.g., density, infrastructure, building permits, and/or demographics)	*There is nothing relevant in this document*	Natural Assets Biodiversity
Promote green development approaches through award programs and fast-tracking of approvals	Environmental Award & Climate Action Award program – targeted to individuals, businesses, community groups, or schools to recognize environmental projects Section 8.3 of the OCP contemplates fast-tracking of the approval process for affordable housing projects *Consider a program for developers*	Natural Assets/ Blue-Green Infrastructure Biodiversity
For subdivisions near the ALR, require vegetated buffer areas, use cul-de-sacs instead of roads ending at the ALR, and ensure that changes to water flows will not increase flooding or reduce groundwater	N/A	Watershed Biodiversity/ Sustainable Service Delivery
Establish a moratorium on new businesses, hotels, and other hospitality industry permits near NbS	*It is unclear if this was addressed*	N/A Health, Equity & Justice

Topic: Development Cost Charges & Property Taxes		
Offer lower development cost charges or reduced property taxes to encourage redevelopment of brownfield and greyfield sites	Chapter 6, Policy 25 of the OCP: "The City will promote the cleanup and redevelopment of brownfield sites…" Chapter 6, Policy 9 of the OCP: "The City will consider…the following measures to protect and preserve sensitive ecosystems… f. density bonusing or other development incentives to facilitate the protection of all or a significant portion of sensitive ecosystems."	Blue-Green Infrastructure Biodiversity
Incentivize green infrastructure, and disincentivize impervious surfaces	*This does not appear to be included*	Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Dedicate revenue from Development Cost Charges to the acquisition of parkland and/or the restoration and improvement of natural areas	Chapter 14, Policy 3 of the OCP addresses using DCC's to fund improvements in Moody Centre (water, sewer, drainage, and transportation infrastructure)	Natural Assets Biodiversity
Topic: Land Acquisition & Protection		
Include policies for the preservation, protection, restoration, and enhancement of biodiversity and the environment	Chapter 6, Policies 2 and 4-9 Chapter 6, Policy 14: "The City will continue its efforts to restore and enhance habitat based on community priorities and available resources, particularly in areas of the city where natural areas have	Natural Assets Biodiversity

	been modified or ecological functions have been impaired. Of particular relevance are access for fish populations, the restoration of watercourse and riparian vegetation and the daylighting of creeks." Chapter 6, Policy 67: "The City will work…to maintain habitat, nesting colonies, plant communities or related ecosystem attributes that support red and blue listed plants or animals..." Chapter 6, Policy 68: "The City will require consideration of species at risk and habitat protection as part of the development review process where applicable." *Consider a policy about enhancing biodiversity*	
Identify and track environmental indicators to evaluate if the plan is achieving its targets/benchmarks	Section 17.2: "Monitoring methods may include the development of targets or indicators to track the City's progress on OCP policies and reporting the results on a regular basis." *No environmental indicators are specified*	Watershed Biodiversity
Support parkland acquisition and/or dedication, including requiring landowners to provide 5% of their land as parkland during subdivision of three or more lots (or cash in lieu), or negotiate a larger percentage in exchange for development concessions	Chapter 6, Policy 6: "The City will protect environmentally significant land by retaining or acquiring ownership of such lands, reserving or dedicating such lands…" Chapter 6, Policy 9: "The City will consider using one or more of the following measures to protect and preserve sensitive ecosystems, where appropriate: a. dedication as a city park or trailway component… b. dedication to a private land trust or non-government organization" *Consider requiring landowners to provide 5% of their land as parkland during subdivision of three or more lots (or cash in lieu to fund acquisition by the City)*	Natural Assets Biodiversity

	Consider opportunities to purchase land jointly with a land trust organization or other level of government	
Prioritize the acquisition/protection of diverse ecosystems, ecologically sensitive areas, and buffer zones around them	Chapter 6, Policy 2: "The City will strive to preserve sensitive ecosystem areas, their living resources and connections between them in a natural condition and maintain these areas free of development and human activity to the maximum extent possible." Chapter 6, Policy 4: "The City will continue to identify and provide protection for High and Medium Sensitivity ESAs…" Chapter 6, Policy 6: "The City will protect environmentally significant land by retaining or acquiring ownership of such lands, reserving or dedicating such lands, through the registration of section 219 Land Title Act covenants or through the use of management agreements." Chapter 6, Policy 7: "Areas with unique environmental character shall be preserved and enhanced. The design of new development shall consider: …buffering of nearby properties…"	Natural Assets Biodiversity
Prioritize connectivity (e.g., wildlife corridors, riparian corridors, and greenways between natural areas)	Chapter 6, Policy 2: "The City will strive to preserve sensitive ecosystem areas, their living resources and connections between them in a natural condition and maintain these areas free of development and human activity to the maximum extent possible." Chapter 6, Policy 5: "The City will continue to integrate the ESA Management Strategy with the City's Parks and Open Spaces strategy	Watershed/ Natural Assets/ Blue-Green Infrastructure

	so that ESAs with the potential for multiple benefits such as linkages to the trails system can be acquired if necessary." Chapter 6, Policy 7: "The design of new development shall consider: …the retention of watercourses and wildlife corridors…" Chapter 6, Policy 8: "…barriers to fish movement should be removed (e.g. poorly designed or installed culverts) and watercourses should be daylighted." Chapter 6, Policy 17: "The City recognizes the importance of wildlife corridors and other measures such as underpasses and fences to mitigate the effects of development on wildlife as part of an overall environmental assessment. New developments and roads should…facilitate and improve wildlife movement and access..."	Biodiversity
Use density bonusing (allowing densification/variation in lot configuration) in exchange for: i) preserving natural assets (e.g., tree stands, wetlands, etc.), and register a conservation covenant to ensure long-term protection of the asset; ii) extensive tree planting; iii) affordable housing; or	Section 7.2 of Zoning Bylaw No. 2937 provides that developers will either provide a financial contribution to the City (to fund cultural, recreational, or other purposes that benefit the City generally) or the City may elect to accept an amenity that meets the goals in the OCP Chapter 5, Policy 14: "To encourage strong energy performance, the City will consider incentives for developers including…density bonusing"	Natural Assets/ Blue-Green Infrastructure

iv) amenities (e.g., parkland, greenspace, waterfront access, daycare facilities, or restoration of a degraded ecosystem) that have a value of at least 50-60% of the increase in the land's value from densification	Chapter 6, Policy 9: "The City will consider…the following measures to protect and preserve sensitive ecosystems… f. density bonusing or other development incentives to facilitate the protection of all or a significant portion of sensitive ecosystems." Chapter 8, Policy 10: The City will consider density bonusing to encourage new affordable housing Chapter 18, Policy 17: Potential amenities to be provided in exchange for density bonusing: community facilities, parks and recreation facilities, environmental enhancements, arts and cultural facilities, public art, streetscape and/or pedestrian related improvements, affordable or special needs housing or contributions to the Affordable Housing Reserve In the Zoning Bylaw No. 2937, section 98.2 provides for a density bonus in CD 28 "in exchange for the provision of an amenity in the form of useable open space secured for public use and access" *Consider expanding the scope of density bonusing*	Biodiversity/ Health, Equity & Justice
Clarify the maximum uplift for each zone, include a list of priority amenities for each neighbourhood, and provide a clear formula for calculating the value of uplift and the value of amenities	Section 7.2 of Zoning Bylaw No. 2937 provides a formula for calculating the value of uplift *We were not able to determine if the maximum uplift was established for each zone.* *We did not find a list of priority amenities for each neighbourhood nor a formula for calculating the value of amenities*	N/A
Topic: Urban Containment Boundary		
Include a commitment that 90+% of growth will occur within the boundary	*It is unclear if this has been done*	Watershed/ Natural Assets

		Biodiversity
Include a policy to prevent or minimize development (e.g. satellite developments) outside of the boundary Biodiversity	*It is unclear if this has been done*	Watershed/ Natural Assets Biodiversity
Include a policy not to extend servicing to areas outside of the boundary	Appendix 1, Strategy 1.3: "All City land designated as RGS "Rural' is located outside the Urban Containment Boundary and as such no development requiring municipal/regional sewer service will be allowed."	Watershed/ Natural Assets Biodiversity
Maintain large-lot (5+ hectares) zoning outside of the boundary	Appendix 1, Strategy 1.3: "Development within the City lands designated as RGS "Rural" are subject to the provisions of the existing zoning (A-2* – Extensive Rural and Recreational Zone) which limits development to one dwelling unit per 10 acres." Note: 10 acres = 4 hectares	Watershed/ Natural Assets Biodiversity
Topic: Conservation Covenants & Citizen Engagement		
Identify priority areas for conservation covenants, and ensure that a review process is triggered by any application for a development permit, subdivision, or rezoning in those areas	Chapter 6, Policy 6: "The City will protect environmentally significant land…through the registration of section 219 Land Title Act covenants or through the use of management agreements." Chapter 6, Policy 9: "The City will consider…the following measures to protect and preserve sensitive ecosystems… c. use of conservation covenants to preserve the natural values of sensitive ecosystems." Chapter 6, Policy 40: "The City will seek to protect private lands that possess significant environmental, urban forest or recreational value by covenant when associated with rezoning or subdivision applications. The City will also encourage joint public and private ownership of such areas."	Watershed/ Natural Assets Biodiversity

Due to the difficulty of monitoring and enforcing conservation covenants, consider asking an NGO to be the covenant holder	Chapter 6, Policy 9: "The covenants may be held by the City, the Province and/or a non-government organization eligible to hold conservation covenants"	N/A
Offer reduced property taxes in exchange for landowners registering conservation covenants on land titles	Chapter 6, Policy 9: "The City will consider…the following measures to protect and preserve sensitive ecosystems… e. adoption of bylaws to exempt eligible riparian property from property taxes if a property is subject to a conservation covenant…" *Consider expanding this exemption to other types of properties (not only riparian)* *Evaluate existing exemption agreement format*	Natural Assets Biodiversity
Register a statutory right-of-way/public easement on title to grant access to a public authority/utility for the purpose of maintaining green infrastructure on private land	In Chapter 6, Policy 9, a statutory right-of-way is mentioned as a way to protect sensitive ecosystems	Blue-Green Infrastructure Sustainable Service Delivery

Covenant agreement and enforcement: Negotiate an agreement with the landowner (and register it on title) to specify the activities permitted on the land, regulate construction and subdivision, establish setbacks from ecological areas, and identify features that must be preserved (e.g., protect vegetation, trees, or ecosystems; require management and/or restoration activities; prohibit actions that could alter/damage protected features; require documentation prior to subdivision; require fencing to restrict access, etc.) Include a baseline report that documents the state of the land at the time of registration For any tax exemption, specify that the exemption will only be granted if the owner adheres to the specified conditions (i.e., the full taxes plus interest are payable in the event of a breach) If entering into a working landscape agreement (i.e., allowing sustainable activities on the land), specify the priorities for management of the area as	Chapter 16, Section 16.5: For Development Permit Area 5 (Hazardous Lands), the City may require a covenant with "conditions respecting reimbursement by the owner for any expenses that may be incurred by the municipality as a result of a breach of a covenant"	Watershed/ Natural Assets/ Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery

well as the management approach Consider including an easement or statutory right-of-way to secure access to the property (e.g., for staff to inspect the property, for a public trail or wildlife corridor, etc.) Conduct inspections to monitor compliance Ensure that new owners of the land are kept informed about the requirements of the covenant		
Other considerations for conservation covenants: Due to the difficulty of monitoring and enforcing covenants, consider reserving their use for large ecosystem features (e.g., riparian areas) and significant ecological features on greenfield and redeveloped sites Develop greenways or trails that span several adjoining parcels Consider requiring multiple parcels of land to be sold together (to ensure consistent protection or management of greenways or trails that span the parcels)		Watershed/ Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery

Reduce/freeze property taxes or provide support for low-income homeowners near NbS locations	*This does not appear to be addressed*	N/A Health, Equity & Justice
Promote the donation of eco-gifts by private landowners (these gifts may qualify them for federal/provincial tax relief)	*This does not appear to be addressed*	Natural Assets Biodiversity
Topic: Other Environmental Goals		
Include policies to enhance air quality, water conservation, rainwater management, surface water quality/quantity, and groundwater quality/quantity	Chapter 5, Policy 2: "The City will encourage transit and a network of walking and cycling routes to improve affordability, reduce resource consumption, improve air quality and reduce greenhouse gas emissions." Chapter 5, Policy 16: "The City will work with the community to improve local and regional air quality, and reduce greenhouse gas emissions by: … (b) continuing to regulate open air burning; (c) developing a formal "No Idling" policy or bylaw to limit unnecessary marine vessel idling;…" Chapter 5, Policy 19: "The City will consider water conservation initiatives to reduce water consumption among residential, commercial and industrial users." Chapter 14, Policy 16: "The City will encourage water conservation measures including sprinkling regulations, the distribution of educational material which encourages water use reduction, metering of businesses, the use of drought resistant landscaping and the promotion of rain barrels and low flow fixtures in buildings. The City will meter industrial, commercial and institutional consumption and	Watershed

	also assess the feasibility of water meters for residential users." Chapter 14, Policy 17: "The City will demonstrate water conservation best practices in City facilities and seek to pilot innovative systems where appropriate. The City will set water conservation targets for parks, facilities and operations and monitor these on an annual basis." Chapter 14, Policy 18: Cooperation with other municipalities on water conservation For rainwater, reference to the Integrated Stormwater Management Plan Section 5.3.4 of Appendix 2: "Development permits…for [certain areas shall abide by these guidelines]: (xiv) Maintain pre-development volumes, timing and rates of rainwater infiltration or recharge to groundwater systems, except where alterations restore or enhance natural regimes. (xv) Minimize the extent of impervious areas covering groundwater infiltration areas and storm runoff associated with the riparian assessment area." Section 6.13: "The City of Port Moody's watercourse protection objectives are: … to develop and implement policies which would maintain or improve the quality of the natural environment including fish habitat and water quality;…" Water quality is also mentioned in some development permit guidelines under sections 5.3.2 and 5.3.4 of Appendix 2	Sustainable Service Delivery

Include policies to address climate change mitigation, and align these policies with air quality goals (e.g., reducing emissions, energy-efficient developments, green transportation, local food production, retaining carbon in vegetation/soils)	Chapter 5, Policy 1: "The City will continue to promote energy efficient building design and practices for all City-owned buildings and operations through the following targets and policies:…" Chapter 5, Policy 2: "The City will encourage transit and a network of walking and cycling routes to improve affordability, reduce resource consumption, improve air quality and reduce greenhouse gas emissions." Chapter 5, Policy 3: "The City will develop a Community-wide Sustainable Building Policy…" Chapter 5, Policy 5: "The City will develop, implement and regularly update a community GHG and energy management plan as a means to plan for an energy-wise and low-carbon future where energy demand is reduced and needs are met through sustainable practices through the community and by sustainable energy systems (e.g., renewable, affordable, reliant, efficient, etc.)." Chapter 5, Policy 8: "…support carbon sequestration through various means including tree protection and the integration of carbon retention objectives into key policies, plans and programs…" Chapter 5, Policy 9: "The City will encourage…efficient neighbourhoods and buildings to minimize resource consumption, increase use of renewable resources, increase alternative modes of transportation, reduce greenhouse gas emissions and prepare for climate change." Chapter 5, Policy 11: "The City will encourage local low carbon energy systems, including district energy, as part of larger	Watershed Climate Action

	developments and within areas expected to experience significant redevelopment." Chapter 5, Policy 12: "The City will encourage sustainable project development by applying the Sustainability Checklist, including energy considerations…" Chapter 5, Policy 13: "The City will review its development permit area guidelines to incorporate sustainable energy and climate change adaptation considerations." Chapter 5, Policy 14: "To encourage strong energy performance, the City will consider incentives for developers including variances, density bonusing, modified/alternative development standards…" Chapter 5, Policy 15: "The City will work to provide information to local developers, builders and homeowners about energy efficient building practices and available incentives and funding programs." Chapter 5, Policy 16: "The City will work with the community to improve local and regional air quality, and reduce greenhouse gas emissions by: (a) encouraging residents and businesses to investigate and adopt new behaviours and technologies; (b) continuing to regulate open air burning; (c) developing a formal "No Idling" policy or bylaw to limit unnecessary marine vessel idling;…"	
Include policies to address climate change adaptation (eg. resiliency, sea level rise, flood planning, wildfires)	Chapter 5, Policy 6: "The City will explore opportunities for implementing adaptation strategies to reduce the risk of property damage and harm and loss of life to residents, and increase community resiliency to climate change."	Watershed

	Chapter 5, Policy 7: "The City will integrate provincially established sea level rise estimates into appropriate municipal regulations to protect the community and future development from the impacts of rising sea levels." Chapter 5, Policy 9: "The City will encourage…efficient neighbourhoods and buildings to minimize resource consumption, increase use of renewable resources, increase alternative modes of transportation, reduce greenhouse gas emissions and prepare for climate change." Chapter 5, Policy 13: "The City will review its development permit area guidelines to incorporate sustainable energy and climate change adaptation considerations."	Climate Action
Establish criteria for evaluating and balancing trade-offs between goals (e.g., fire-proofing efforts should not remove brush stands that provide important habitat or buffer ecosystems from development)	*Nothing relevant in this document – perhaps they are in the Sustainability Checklist? If not, consider adding such criteria*	Watershed Biodiversity/ Climate Action
1.2 Designation of Environmentally Sensitive or Significant Area (ESA)		
Map environmentally sensitive areas and green infrastructure networks (i.e., core habitat areas and the natural corridors connecting them)	Map 13 – Environmentally Sensitive Areas *Does the map adequately identify green infrastructure networks?*	Watershed Biodiversity
	It is unclear if this has been done	Watershed/ Natural Assets

Designate environmentally sensitive or significant areas to prohibit development based on the Province of BC's Sensitive and Other Ecosystems Map codes and descriptions (designating either specific ecosystem types or areas on a map)		Biodiversity
Extend the prohibition against development to a buffer zone around the protected area (see Develop with Care for suggested buffer widths); where possible, buffers should be on public lands to avoid being compromised by landowners' activities	*It is unclear if this has been done*	Watershed/ Natural Assets Biodiversity
1.3 Environmental Development Permit Area (EDPA)		
Ensure EDPA's are adjacent to ESA's and/or encompass them (if it is not possible to prohibit development in the ESA) in order to prevent or mitigate damage to them Alternatively, consider designating the entire community as an EDPA in order to manage and enhance connectivity	Section 6.5: "High and Medium Sensitivity ESAs are designated as Development Permit Areas (DPAs) requiring development permit approval by Council prior to any development activity." Appendix 2, Section 5.2: Also includes areas with special features. An explanation is given for how these areas were identified (e.g., wildlife corridors, refuges, part of important watersheds, contain important forest ecosystems or wetlands, etc.) *Consider prohibiting development altogether in high sensitivity ESA's*	Natural Assets Biodiversity
Require a permit for any development (i.e., subdivision, construction, or any alteration to the land aside from minor	Appendix 2, Section 5.2: "A Development Permit will be required for all development and subdivision activity or building permits…" for both ESA's and Streamside Protection and Enhancement Areas	Natural Assets

landscaping)	Appendix 2, Section 5.3.4: "A Development Permit is not required for…: (i) gardening and yard maintenance activities within an existing landscaped area, such as… minor soil disturbance that does not alter the general contours of the land; (ii) …construction of a fence if no native trees are removed… (iv) …construction of a small accessory building… (v) …construction of a private trail…"	Biodiversity
Designate the EDPA as a development approval information area to require information as part of an application for a development permit (e.g., environmental or blue-green infrastructure impact assessment)	*This does not appear to have been done (phrase does not appear in document)*	Natural Assets/ Blue-Green Infrastructure Biodiversity
Set conditions* in a development permit to protect ecosystems, and tailor those conditions to the specific site or based on geological features or ecosystem types	Appendix 2, Section 5.3.1: "Development Permits issued for areas where Landscape Scale Management and Wildlife Corridors contribute to a designation of High Sensitivity or Special Feature shall [abide by these] guidelines: (i) Protection of watercourses and riparian areas… (ii) Landscape level and biodiversity objectives outlined under the *Forest Practices Code of BC Act* and the Biodiversity Objectives Guidebook... (iii) The use of native plant species and restricting the use of invasive plant species…as outlined in the City's Naturescape Policy. (iv) Ensuring that proposed developments meet the requirements of the Tree Retention Bylaw No. 2425 and working with property owners to design "Tree Retention Areas"... (v) Encouraging site plans that minimize fragmentation of large forest patches... (vi) Requiring the identification and protection of existing wildlife corridors to adjacent habitats include the existence of natural pathways (game trails), stream corridors, edge effects, natural landscaping enhancements, limitations on human access, and mitigation of intrusions such as roads."	Natural Assets Biodiversity

	There are also guidelines for areas where Watershed Management contributes to designation (Section 5.3.2), forest ecosystems (Section 5.3.3), watercourses and riparian zones (5.3.4), lakes and freshwater wetlands (5.3.5), intertidal and subtidal marine ecosystems (5.3.6), rock bluffs (5.3.7), and species at risk (5.3.8)	
Considerations for enforcement: Embed EDPA's in a regulatory infrastructure that prioritizes conservation and restoration to enhance their effectiveness Enact regulatory bylaws through which fines can be levied for non-compliance with permit conditions, in order to facilitate enforcement (otherwise, the only remedy available is an injunction) Require developers to provide a security deposit, which can be used for habitat restoration if the developer does not comply with the permit's conditions Conduct inspections to monitor compliance		Natural Assets Biodiversity

For any alteration to a building that is conducted without a permit, file a notice on land title If a permit holder is not complying with conditions, withdraw the permit and/or issue a stop work order		
1.4 Marine/Shoreline Development Permit Areas		
Designate a DPA to encompass the area that is 15-30 meters on either side of a shoreline	Map 13 – Environmentally Sensitive Areas *ESA's do not encompass the entire shoreline - there is some extension into the inlet, but it is unclear if it is 15-30 meters*	Natural Assets Biodiversity/ Climate Action
Set conditions** in a development permit to minimize impacts to marine ecology and to address risks from climate change (e.g., sea level rise) and other hazards (e.g., storm surge/flooding, erosion, slope stability, etc.)	Appendix 2, Section 5.3.6 sets out the following guidelines: "(i) Osprey nests and the structures that support them should be protected in compliance with the Wildlife Act. (ii) Nests and structures that support the active nesting by birds should not be removed during the nesting season…" *Consider additional conditions*	Watershed/ Natural Assets Biodiversity/ Climate Change/ Sustainable Service Delivery
Adopt the guidelines for development in coastal areas provided by the Stewardship Centre for British Columbia's Green Shores program	*This does not appear to have been done (phrase does not appear in document)*	Watershed/ Natural Assets Biodiversity/ Sustainable Service Delivery

1.5 Other Development Permit Areas		
Establish objectives to promote the reduction of GHG emissions, energy conservation, water conservation, groundwater protection, and/or farm protection	These points are not included in the overarching objectives for Development Permit Areas 1, 2, or 3, but 1 and 2 mention incorporating natural systems in lieu of mechanical ones (e.g., sunlight and wind for lighting and ventilation on pages 145 & 167). There are additional references to some of these points in specific neighbourhood designs *Consider adding these objectives*	Watershed Climate Action/ Sustainable Service Delivery
Adopt landscaping strategies to achieve the above objectives (e.g., plant trees for passive solar gain, cooling, and carbon storage; locate trees to serve as a windbreak; select drought-resistant species)	Conservation of mature vegetation is mentioned but without these specific objectives *Consider addressing these objectives*	Blue-Green Infrastructure Biodiversity/ Climate Action/ Sustainable Service Delivery
Designate areas with a high risk of sediment movement and erosion as hazard development permit areas, and provide guidelines to minimize erosion (e.g., require land clearing to be staged and to minimize exposed soils, restrict activities during periods of high rainfall or snowmelt, etc.)	Map 14 – Hazardous Lands (Development Permit Area 5) Appendix 2, Section 6.2: "Hazardous lands are considered to be areas of the City that may be subject to land slides, debris torrents, mud flows, earthquake liquefaction, erosion, or floods." Appendix 2, Section 6.6 - Guidelines	N/A Biodiversity/ Sustainable Service Delivery
Ensure that DPA's in areas with steep slopes impose requirements for tree retention to prevent erosion	Appendix 2, Section 6.6.3: "Development on steep slopes shall take place in a manner which maximizes the retention of existing vegetation."	Blue-Green Infrastructure Biodiversity/

		Sustainable Service Delivery
Ensure that wildfire DPA's align with tree bylaws (e.g., permit tree removal for wildfire risk reduction [although this should be balanced against habitat protection], ensure replacement trees conform to FireSmart guidelines, etc.)	*Wildfire is not mentioned in Development Permit Area 5*	Watershed/ Blue-Green Infrastructure
		Biodiversity/ Climate Action/ Sustainable Service Delivery

Analysis of Port Moody's Other Regulatory Mechanisms		
NSI Recommendation	**Relevant Contents of Port Moody Document**	**NbS Approach** **NSI Key Area**
2.0 Zoning - Zoning Bylaw No. 2937 (2018)		
2.1 Comprehensive Development Zones		
Require site plans that ensure energy-efficient developments, encourage green transportation options, and consider risks from climate change when locating buildings/infrastructure	Various CD's provide for bike parking Section 6.10.3 requires off-street bicycle parking for new residential buildings – not limited to CD's Section 6.11.1 requires EV charging availability for new residential off-street parking spaces (with some exceptions) – not limited to CD's *No reference to climate change or efficient/efficiency in this document*	Watershed Climate Action/ Sustainable Service Delivery
Customize permitted uses, greenspace requirements (eg. Green Space Factor), and other needs for a site (e.g., avoid sensitive areas, preserve natural assets, or create buffers/wildlife corridors)	Section 14.1 establishes Comprehensive Development Districts, the details of which are in Schedule D, along with Comprehensive Development Zones In Section 98.3.7, the permitted use for Area 7 of CD 28 is "parks, habitat enhancement areas, public courtyards and greenways" *Consider adding more NbS requirements to other zones*	Natural Assets/ Blue-Green Infrastructure Biodiversity
Set out detailed guidelines and requirements for all aspects of development (e.g., the construction process and timing, green	*There does not appear to be anything relevant to NbS in this document based on a keyword search*	Natural Assets/ Blue-Green Infrastructure

infrastructure that must be installed [e.g., green roofs or green walls], and/or natural areas/parkland that must be preserved)		Biodiversity/ Climate Action
Require site plans that enhance ecosystem services, manage rainwater, and protect the quality and quantity of surface and groundwater	*There does not appear to be anything relevant in this document based on a keyword search*	Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Require site plans that include affordable housing units	Section CD82 address affordable housing for CD82 Section 96 address affordable housing for CD26 Sections 128 and 177 address affordable housing for CD71	N/A Health, Equity & Justice
2.2 Density Averaging and Transfer		
Encourage densification of development in areas with low environmental value in exchange for protection of areas with high environmental value in a comprehensive development zone	The OCP contemplates density transfers for heritage conservation and provision of land for improvements to neighbourhood access	Natural Assets Biodiversity
2.3 Conservation Zoning		
Prevent development on land outside of the urban containment boundary	*Our review was unable to determine if these objectives have been addressed*	Watershed/ Natural Assets Biodiversity
Prevent development on land that contains a sensitive ecosystem or that is located in a greenway/wildlife corridor		Natural Assets Biodiversity

Zone public land with high ecological value as a natural park (rather than a municipal park, which permits activities that conflict with habitat protection), and register a conservation covenant/conservation organization as a joint owner on title to ensure long-term protection		Natural Assets Biodiversity
2.4 Riparian Areas Protection Regulation (RAPR)		
Exceed the requirements for setbacks and damage mitigation in the RAPR (e.g., establish setbacks for all watercourses rather than limiting them to fish habitat, consider the needs of species other than fish, etc.)	Section 5.4.5 sets out minimum riparian management setbacks for each stream listed therein Sections 5.4.3 and 5.4.4 prevent development in Riparian Protection and Enhancement Areas (RPEA's) and in Riparian Transition Areas (RTA's), subject to the listed exceptions *Were setbacks established for all watercourses, not just those that provide fish habitat?*	Natural Assets Biodiversity
Utilize the RAPR's simple assessment process, rather than the detailed assessment, to maximize setbacks	Section 5.4.5 sets out minimum riparian management setbacks for each stream listed therein *Was the simple assessment process used?*	Natural Assets Biodiversity
2.5 Zoning Bylaws (General Recommendations)		
Zone for infill development (e.g., laneway housing)	Section 5.5.1 permits Detached Accessory Dwelling Units in specified neighbourhoods	Watershed/ Natural Assets Biodiversity

Impose regulations for screening and landscaping (e.g., requirements for tree cover that specify the species and/or minimum number/density of trees, requirements for vegetation buffers between land uses, etc.)	Section 5.2.10 includes a few landscaping requirements, including the areas of lots that must be landscaped and the minimum size of landscaped area that is required between off-street parking areas and roads/adjoining lots In Schedule C (Criteria for Development of Marine Facilities), it states that undeveloped upland areas must be landscaped or retained in natural cover, and plantings must be maintained in perpetuity *Consider requirements for tree cover, vegetation buffers, etc.*	Blue-Green Infrastructure Biodiversity
Preserve historic districts	Map 3 of the OCP designates Heritage Conservation and Character Areas *Are these also addressed in the Zoning Bylaw?*	N/A Health, Equity & Justice
Preserve large lots in areas of high ecological value/outside the urban containment boundary	*Our review was unable to determine if these objectives have been addressed*	Natural Assets Biodiversity
Zone for higher density development along transit corridors (to dissuade vehicle use)		N/A Biodiversity/ Sustainable Service Delivery
Zone for eco-districts		Blue-Green Infrastructure Biodiversity/ Climate Action/

		Health, Equity & Justice
Re-zone urban land to green space		Natural Assets
		Biodiversity/ Health, Equity & Justice
Impose regulations for land use and development density to prioritize compact communities		Natural Assets
		Biodiversity
Encourage mixed-use, nodal development within the urban containment boundary		N/A
		Biodiversity/ Climate Action/ Health, Equity & Justice/ Sustainable Service Delivery
Concentrate growth/development away from ecologically significant areas, agricultural lands, hazard areas, and heritage sites		Natural Assets
		Biodiversity/ Sustainable Service Delivery
Prevent development and activities that might generate pollution in areas with sensitive ecosystems or valuable natural assets		Natural Assets
		Biodiversity

Establish development setbacks from sensitive ecosystems, watercourses, and agricultural land		Natural Assets
		Biodiversity
Utilize zoning and regulations to maintain and enhance ecosystem connectivity		Watershed
		Biodiversity
Ensure that the permitted density will not exceed the available water supply (accounting for the needs of fish, wildlife, etc.)		Watershed
		Biodiversity/ Sustainable Service Delivery
Utilize a Mandatory Inclusionary Zoning Overlay to require a percentage of all new multi-family development within a specified distance of NbS to be affordable housing units		N/A
		Health, Equity & Justice
Impose regulations for controlling surface & rainwater runoff from paved/roof areas and/or to require features for water collection and storage (e.g., rainwater collection systems, naturalized ponds, etc.)		Blue-Green Infrastructure
		Biodiversity/ Sustainable Service Delivery
Impose regulations to minimize impervious cover and promote canopy cover (e.g.,		Blue-Green Infrastructure

maximum site/lot coverage, maximum impervious cover, setbacks for above and below-ground structures to preserve trees on adjacent lots, reduced/flexible parking requirements, etc.)		Biodiversity/ Sustainable Service Delivery
Impose regulations to promote energy conservation (e.g., locate structures on parcels to capture solar energy, require overhangs for summer shade, require geothermal systems, etc.)		Watershed Climate Action/ Sustainable Service Delivery
Impose regulations to minimize off-site impacts from development (e.g., increased sedimentation or risk of flooding downstream)		Watershed Biodiversity/ Sustainable Service Delivery
Limit touristic/short-term rental apartments near NbS		N/A Health, Equity & Justice
Support the development of urban agriculture		Blue-Green Infrastructure Health, Equity & Justice/ Sustainable Service Delivery

3.0 Regulatory Bylaws		
3.1 Tree Protection Bylaw BL2961-C (2015)		
Define: a. Protected trees – based on diameter, species, heritage value, wildlife value (e.g., host to birds that are protected under the *Migratory Birds Convention Act*), and/or location (based on either a defined area or type of area [e.g., steep slopes, riparian areas, environmentally sensitive areas, floodplains]) b. Tree protection zone – area surrounding a tree that must be protected to prevent damage to roots c. Applicant/application - information that will be required for the application d. Acceptable pruning	In section 3.1, the definition of 'tree' is based on a minimum diameter of 10 cm; 'significant tree' is one identified by Council due to heritage, landmark, or wildlife value; 'wildlife tree' is also defined In section 4.2, there is a prohibition against cutting, removing, or damaging trees (that are located in a Riparian Management Zone or Environmentally Sensitive Area or are subject to a restrictive covenant or Development Approval) and significant trees (that are located anywhere) on private land Section 6.7 prohibits various activities within the drip line of trees *(this could be considered a tree protection zone)* In section 3.1, 'applicant' is defined as the owner of a parcel of land *There does not appear to be a definition for acceptable pruning. Consider extending protection to all trees rather than only trees in specific locations.*	Natural Assets/ Blue-Green Infrastructure
Prohibit cutting, removal, and damage	In section 4.1, there is a prohibition against cutting, removing, or damaging trees on City land In section 4.2, there is a prohibition against cutting, removing, or damaging trees (that are located in a Riparian Management Zone or Environmentally Sensitive Area) and significant trees (that are located anywhere) on private land	Biodiversity

Consider exemptions for certain groups (e.g., government, utilities, etc.) or activities (e.g., farming)	Section 5.1 sets out exemptions for utilities and for specific activities that are authorized by the General Manager or the Province	
Designate permitted removal reasons (e.g., high risk/dead/dying trees, conflict with buildings or structures, wildfire risk, invasive species, construction access, proximity to building foundations, infrastructure damage, yearly removal allowance, trees on structures)	Section 9.1 permits the removal of hazard trees from private property (on certain conditions being met). Hazard trees are defined in section 3.1 as being identified by a Certified Tree Risk Assessor as posing a likelihood of personal injury or property damage Section 6.8.3 sets out reasons that a Tree Removal Permit can be refused (e.g. Streamside Protection and Enhancement Area, Environmentally Sensitive Area) *There does not appear to be a list of permitted removal reasons, except for hazard trees*	
Allow only partial removal, if reasonable in the circumstances (i.e., stump a hazardous tree at 3-5 meters above the ground to leave habitat for wildlife)	*This does not appear to be addressed*	
Require the replacement of protected trees (with the number of replacement trees to be based on the location, tree density targets, canopy cover targets, or the number/diameter of the removed trees)	Section 6.2(d)(viii) provides that an application for a Tree Removal Permit must be accompanied by an arborist report, which must include a Tree Replanting Plan. This plan must include location, species, and diameter of the proposed replacement trees, as well as two replacement trees for every one being removed *Consider amending the number of replacement trees to vary with the diameter of the removed tree*	
Include specifications for the replacement trees (e.g., species, spacing, soil volume, adherence to stock & planting standards, etc.) or cash-in-lieu of replacement (in an	*This does not appear to be addressed*	

amount that will cover the cost of replacement)		
Incentivize tree retention (e.g., reduce replacement requirements if specific valuable trees are retained on site)	*This does not appear to be addressed*	
Establish a maximum non-treed/cleared area for each development permit	*This does not appear to be addressed*	
Include conditions in the tree permit to require specific actions on site (e.g., prevent damage to trees that are being retained, mark trees to be removed, notify the public, etc.)	Section 6.2(d)(vii) provides that an application for a Tree Removal Permit must be accompanied by an arborist report, which must include a Tree Retention Plan Section 7 sets out requirements for protecting retained trees *Consider additional conditions*	
Require a security deposit to guarantee the applicant will comply with the conditions of the permit, such as preventing damage to trees that are being retained/replacing trees that are being removed	Section 8.1 requires a security deposit for replacement trees *Consider requiring a deposit for tree retention as well*	
Impose penalties for non-compliance (e.g., fines, stop work orders, forfeit of securities, etc.)	Sections 12 and 13 address offences, penalties, and fines	
3.2 Stream and Drainage System Protection Bylaw BL2470 (2001)		
Regulate activities that are carried out in and around watercourses, riparian areas, and wetlands to protect water quality and prevent fouling	Section 5 prohibits fouling of the drainage system In section 4, the definition of drainage system includes streams, and the definition of stream includes wetlands	Watershed/ Natural Assets Biodiversity/ Sustainable
Impose requirements for erosion and sediment control	Sections 7.1-7.8 address sediment control	
Prohibit the enclosing of watercourses	*This does not appear to be addressed*	

Prohibiting the discharge/washing of concrete into watercourses	Section 6.4 prohibits the discharge or washing of concrete into the drainage system	Service Delivery
Limit the total suspended solids and turbidity in watercourses (to control contaminants)	In section 4, the definition of prohibited materials includes sediments that, when introduced to the drainage system, would lead to total suspended solids at a specified level above background levels	
3.3 Animal Control Bylaw BL2677-C (2008)		
Prohibit the sale of un-neutered animals	Section 10 provides that no person shall be or become an owner of a cat over 6 months of age if the cat is not neutered or spayed (with exceptions) *Consider extending this to dogs*	Watershed/ Natural Assets
Prohibit free-roaming cats	Section 10(2) provides that no unneutered or unspayed cats can be at large in the community *Consider extending this to all cats*	
Require dogs to be leashed in sensitive habitats	Section 5(1) provides that dogs must be leashed outside of off-leash areas *Verify that no off-leash areas overlap with high or medium ecologically sensitive areas*	Biodiversity
3.4 Anti-Idling Bylaw BL2859 (2010)		
Protect air quality by restricting vehicle idling	Section 3 prohibits idling for more than 3 minutes in a 60 minute period	Watershed Climate Action/ Sustainable Service Delivery

3.5 Pesticide Use Control Bylaw BL2575-C (2003)		
Prohibit and/or impose restrictions on the use of pesticides on residential or municipal land to prevent contamination of water sources/harm to wildlife	Section 3 prohibits the use of pesticides (other than those in Schedule A) on private and municipal land, with some exceptions *Consider reviewing the exceptions in Schedule A to determine their suitability* *Note: Provincial regulations include a list of exclusions for the types of pesticides that can be restricted, the land on which restrictions can be imposed, the use of pesticides for managing pests that transmit human diseases or impact agriculture/forestry, and the use of pesticides for buildings and inside buildings*	Watershed/ Natural Assets Biodiversity/ Sustainable Service Delivery
3.6 Soil Deposit and Removal Bylaw BL3012 (2015)		
Restrict soil deposit and removal to protect water quality, to regulate activities that disturb substantial amounts of land outside of EDPA's, and to enhance protection inside of EDPA's (by providing additional enforcement mechanisms)	Section 3.1 prohibits the deposit of soil or any site clearing (which may involve soil removal) except in accordance with a permit, with exceptions *Evaluate whether this adequately prevents soil removal*	Watershed/ Natural Assets Biodiversity
3.7 Other Types of Regulatory Bylaws		
Landscaping Bylaw: Regulate landscaping and screening by imposing standards for each zone (e.g., requiring certain species of native vegetation), requiring a restoration/landscaping plan from an environmental professional, and restricting the conversion of native landscapes to those with high water demands (e.g., lawns)	*Port Moody does not appear to have bylaws addressing these topics*	Natural Assets/ Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery

Rainwater Management Bylaw: Regulate the stormwater system in order to protect water quality and natural assets by imposing requirements for design and installation of drainage systems (to maintain the proper flow of water in a stream or ditch or to prevent erosion), for property owners to connect buildings/structures to drainage works in a specified manner, and for ongoing maintenance		Watershed/ Natural Assets Biodiversity/ Sustainable Service Delivery
Air Quality Bylaws: Protect air quality by regulating/banning open burning and reducing emissions from wood stoves and fireplaces (e.g., ban excessive smoke, requiring new or replacement appliances to meet the standards in the *Solid Fuel Burning Domestic Appliance Regulation*, etc.)		Watershed Climate Action/ Sustainable Service Delivery
Invasive Species Bylaw: Regulate the control and eradication of defined invasive species		Watershed Biodiversity
Wildlife Feeding Regulation Bylaw: Prohibit the feeding of wildlife (with the exception of bird feeders)		Watershed Biodiversity
Green Infrastructure Bylaw: Develop a comprehensive bylaw which encompasses prohibitions, regulations, and		Natural Assets/ Blue-Green Infrastructure

requirements for development permits and impact assessments, as well as for all activities requiring permits		Biodiversity/ Sustainable Service Delivery
Nuisance Abatement Bylaw: Prevent actions that may undermine a natural asset upon which the community relies (e.g., nuisance)		Natural Assets Biodiversity/ Sustainable Service Delivery
3.8 General Recommendations for Regulatory Bylaws		
As a condition of any permit, require posting of a security deposit that is equal to the cost of the work being done (so the municipality can complete the work if necessary)		N/A
Establish fines for offences		
Conduct public awareness campaigns about the types of activities that require permits		
4.0 Subdivision & Servicing Bylaws - Subdivision and Development Services Bylaw BL2831-C (2010)		
Maximize the boulevard width for tree planting strips (minimum of 2 meters when sharing space with utilities, absolute minimum of 1.5 meters with additional soil volume under sidewalk/root bridges)	Schedule B, Table 2 indicates that boulevard landscaping is required for all roadways Schedule C, Section 7.6 provides that landscaping and street trees in boulevards must meet the satisfaction of the Director *Consider setting out minimum boulevard widths for tree planting strips*	Blue-Green Infrastructure Biodiversity
Impose regulations for the minimum soil volume that is required for tree roots (or	*This does not appear to be addressed*	Blue-Green Infrastructure

require soil cells)		Biodiversity
Impose regulations for landscaping (e.g., standards for the landscape plan, plant spacing, plant type, stock quality, irrigation, and drainage)	In section 6.0, the definition of 'landscaping' indicates that it must be in a form acceptable to the City Schedule C, section 7.6 provides that landscaping and street trees on boulevards must meet the satisfaction of the Director *Consider specifying requirements for landscaping*	Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Impose firm setbacks for tree planting from utilities and infrastructure when there is a risk of a hazard (e.g., intersection visibility, gas main connection), while allowing flexibility in other situations	Schedule C, section 8.3 provides that light poles shall not interfere with street trees *There do not appear to be setbacks for tree planting*	Blue-Green Infrastructure Biodiversity
Facilitate tree planting through flexible streetscape design standards by establishing a hierarchy of preferred and alternative compliance methods for each component	*This does not appear to be addressed*	Blue-Green Infrastructure Biodiversity
In rural areas, impose landscaping and road design requirements to enhance natural areas and water infiltration (e.g., extensive revegetation, narrow pavement, shallow drainage swales, no curbs, etc.)	*Our review was unable to determine if this has been addressed*	Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Include regulations for vegetation protection and erosion control to protect watercourses	Schedule C, Section 5.13 addresses requirements for rip rap to control erosion from outlets of culverts	Natural Assets

	Schedule C, section 5.15.3 and 9.1.5 addresses erosion control at construction sites Schedule C, section 5.16: "Where the major flow outfalls to a receiving watercourse, the velocity shall not exceed 1.5 m/s or an energy dissipater shall be provided to prevent erosion."	Biodiversity
Adopt a stormwater design and policy manual	*There is no mention of a manual, but Schedule C, Part 5 provides design criteria for storm drainage systems*	Blue-Green Infrastructure Sustainable Service Delivery
Ensure that stormwater management standards include on-site capture and infiltration facilities to enhance water security and support tree retention (e.g., require post-development site runoff to match pre-development levels)	*This does not appear to be addressed*	Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Ensure that drainage standards include the protection or restoration of natural watercourses, native soils, and trees	Schedule C, section 5.11 notes that watercourses are components of the drainage system and ecological system, so the Consulting Engineer must refer to BMP's and the ESA Management Strategy Section 5.11.5 provides that deleterious materials cannot enter watercourses *Consider more explicit protection/restoration of watercourses, native soils, and trees*	Natural Assets Biodiversity
Adopt a low-impact development design and policy manual	*This does not appear to be included*	Blue-Green Infrastructure Biodiversity/ Climate

		Action/ Sustainable Service Delivery
5.0 Conservation Covenants		
Identify priority areas for conservation covenants, and ensure that a review process is triggered by any application for a development permit, subdivision, or rezoning in those areas	OCP, Chapter 6, Policy 6: "The City will protect environmentally significant land…through the registration of section 219 Land Title Act covenants or through the use of management agreements." OCP, Chapter 6, Policy 9: "The City will consider…the following measures to protect and preserve sensitive ecosystems… c. use of conservation covenants to preserve the natural values of sensitive ecosystems." OCP, Chapter 6, Policy 40: "The City will seek to protect private lands that possess significant environmental, urban forest or recreational value by covenant when associated with rezoning or subdivision applications. The City will also encourage joint public and private ownership of such areas."	Watershed/ Natural Assets Biodiversity
Due to the difficulty of monitoring and enforcing conservation covenants, consider asking an NGO to be the covenant holder	OCP, Chapter 6, Policy 9: "The covenants may be held by the City, the Province and/or a non-government organization eligible to hold conservation covenants"	N/A
Offer reduced property taxes in exchange for landowners registering conservation covenants on land titles	OCP, Chapter 6, Policy 9: "The City will consider…the following measures to protect and preserve sensitive ecosystems… e. adoption of bylaws to exempt eligible riparian property from	Natural Assets

	property taxes if a property is subject to a conservation covenant…" *Consider expanding this exemption to other types of properties (not only riparian)* *Evaluate existing exemption agreement format*	Biodiversity
Register a statutory right-of-way/public easement on title to grant access to a public authority/utility (e.g., for staff to inspect and/or maintain green infrastructure on the property, for a public trail or wildlife corridor, etc.)	OCP, Chapter 6, Policy 9: A statutory right-of-way is mentioned as a way to protect sensitive ecosystems	Watershed/ Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Due to the difficulty of monitoring and enforcing covenants, consider reserving their use for large ecosystem features (e.g., riparian areas) and significant ecological features on greenfield and redeveloped sites	*Our review was unable to determine if this has been addressed*	N/A
Develop greenways or trails that span several adjoining parcels	*Our review was unable to determine if this has been addressed*	Watershed/ Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
Consider requiring multiple parcels of land to be sold together (to ensure consistent	*Our review was unable to determine if this has been addressed*	Watershed/ Blue-Green Infrastructure

protection or management of greenways or trails that span the parcels)		Biodiversity/ Sustainable Service Delivery
Covenant agreement and enforcement: Negotiate an agreement with the landowner (and register it on title) to specify the activities permitted on the land, regulate construction and subdivision, establish setbacks from ecological areas, and identify features that must be preserved (e.g., protect vegetation, trees, or ecosystems; require management and/or restoration activities; prohibit actions that could alter/damage protected features; require documentation prior to subdivision; require fencing to restrict access, etc.) Include a baseline report that documents the state of the land at the time of registration For any tax exemption, specify that the exemption will only be granted if the owner adheres to the specified conditions (i.e., the full taxes plus interest are payable in the event of a breach) If entering into a working landscape agreement (i.e., allowing sustainable activities on the land), specify the priorities	OCP, Chapter 16, Section 16.5: For Development Permit Area 5 (Hazardous Lands), the City may require a covenant with "conditions respecting reimbursement by the owner for any expenses that may be incurred by the municipality as a result of a breach of a covenant"	N/A

for management of the area as well as the management approach Consider including an easement or statutory right-of-way to secure access to the property (e.g., for staff to inspect the property, for a public trail or wildlife corridor, etc.) Conduct inspections to monitor compliance Ensure that new owners of the land are kept informed about the requirements of the covenant		
6.0 Other Regulatory Mechanisms		
6.1 Tax Incentives/Lower Development Cost Charges (DCC's) - Development Cost Charges Bylaw No. 3054 (2020) & Development Cost Charges Reduction Bylaw No. 3212 (2019)		
Offer lower DCC's to encourage redevelopment of brownfield and greyfield sites	OCP, Chapter 6, Policy 25: "The City will promote the cleanup and redevelopment of brownfield sites…" OCP, Chapter 6, Policy 9: "The City will consider … f. density bonusing or other development incentives to facilitate the protection of all or a significant portion of sensitive ecosystems." *Consider using tax incentives or DCC reductions as a way to promote redevelopment of brownfield & greyfield sites*	Blue-Green Infrastructure Biodiversity
Incentivize green infrastructure, and disincentivize impervious surfaces	*This does not appear to be included*	Blue-Green Infrastructure

		Biodiversity/ Sustainable Service Delivery
Dedicate revenue from Development Cost Charges to the acquisition of parkland and/or the restoration and improvement of natural areas	OCP, Chapter 14, Policy 3: Addresses using DCC's to fund improvements in Moody Centre (water, sewer, drainage, and transportation infrastructure) *Consider dedicating revenue to parkland acquisition or restoration projects*	Natural Assets Biodiversity
Encourage development of empty lots/unoccupied buildings into affordable housing	Section 3.1 of the Development Cost Charges Reduction Bylaw provides for reduced DCC's for affordable housing *Consider targeting empty lots & unoccupied buildings*	N/A Health, Equity & Justice
6.2 Amenity Density Bonuses		
Use density bonusing (allowing densification/variation in lot configuration) in exchange for: v) preserving natural assets (e.g., tree stands, wetlands, etc.), and register a conservation covenant to ensure long-term protection of the asset; vi) extensive tree planting; vii) affordable housing; or viii) amenities (e.g., parkland, greenspace, waterfront access, daycare facilities, or	Section 7.2 of Zoning Bylaw No. 2937 provides that developers will either provide a financial contribution to the City (to fund cultural, recreational, or other purposes that benefit the City generally) or the City may elect to accept an amenity that meets the goals in the OCP OCP, Chapter 5, Policy 14: "To encourage strong energy performance, the City will consider incentives for developers including…density bonusing"	Natural Assets/ Blue-Green Infrastructure

restoration of a degraded ecosystem) that have a value of at least 50-60% of the increase in the land's value from densification	OCP, Chapter 6, Policy 9: "The City will consider…the following measures to protect and preserve sensitive ecosystems… f. density bonusing or other development incentives to facilitate the protection of all or a significant portion of sensitive ecosystems." OCP, Chapter 8, Policy 10: The City will consider density bonusing to encourage new affordable housing OCP, Chapter 18, Policy 17: Potential amenities to be provided in exchange for density bonusing: community facilities, parks and recreation facilities, environmental enhancements, arts and cultural facilities, public art, streetscape and/or pedestrian related improvements, affordable or special needs housing or contributions to the Affordable Housing Reserve In the Zoning Bylaw No. 2937, section 98.2 provides for a density bonus in CD 28 "in exchange for the provision of an amenity in the form of useable open space secured for public use and access" *Consider expanding the scope of density bonusing*	Biodiversity/ Health, Equity & Justice
Clarify the maximum uplift for each zone, include a list of priority amenities for each neighbourhood, and provide a clear formula for calculating the value of uplift and the value of amenities	Section 7.2 of Zoning Bylaw No. 2937 provides a formula for calculating the value of uplift *We were not able to determine if the maximum uplift was established for each zone. We did not find a list of priority amenities for each neighbourhood nor a formula for calculating the value of amenities.*	N/A

6.3 Property Tax Exemptions, Freezes, Credits, & Support		
Reduce/freeze property taxes or provide support for low-income homeowners near NbS locations	*Our review was unable to determine if these objectives have been addressed*	N/A Health, Equity & Justice
Offer reduced property taxes in exchange for landowners registering conservation covenants on land titles		Natural Assets Biodiversity
Sign an exemption agreement with the landowner which specifies that the tax exemption will only be granted if the owner adheres to the specified conditions (i.e., the full taxes plus interest are payable in the event of a breach)		Natural Assets Biodiversity
Conduct inspections to monitor compliance with the conservation covenant		Natural Assets Biodiversity
6.4 Urban Containment/Growth Boundary (in a Regional Growth Strategy and/or OCP)		
Include a commitment that 90+% of growth will occur within the boundary	*Our review was unable to determine if this has been addressed*	Watershed/ Natural Assets Biodiversity
Include a policy to prevent or minimize development (e.g. satellite developments) outside of the boundary	*Our review was unable to determine if this has been addressed*	Watershed/ Natural Assets Biodiversity

Include a policy not to extend servicing to areas outside of the boundary	OCP, Appendix 1, Strategy 1.3: "All City land designated as RGS "Rural' is located outside the Urban Containment Boundary and as such no development requiring municipal/regional sewer service will be allowed."	Watershed/ Natural Assets Biodiversity
Maintain large-lot (5+ hectares) zoning outside of the boundary	OCP, Appendix 1, Strategy 1.3: "Development within the City lands designated as RGS "Rural" are subject to the provisions of the existing zoning (A-2* – Extensive Rural and Recreational Zone) which limits development to one dwelling unit per 10 acres." Note: 10 acres = 4 hectares	Watershed/ Natural Assets Biodiversity
6.5 Land Acquisition		
Require landowners to provide 5% of their land as parkland during subdivision of three or more lots (or cash in lieu), or negotiate a larger percentage in exchange for development concessions	OCP, Chapter 6, Policy 6: "The City will protect environmentally significant land by retaining or acquiring ownership of such lands, reserving or dedicating such lands…" OCP, Chapter 6, Policy 9: "The City will consider using one or more of the following measures to protect and preserve sensitive ecosystems, where appropriate: a. dedication as a city park or trailway component… b. dedication to a private land trust or non-government organization" *Consider requiring landowners to provide 5% of their land as parkland during subdivision of three or more lots (or cash in lieu to fund acquisition by the City)*	Natural Assets Biodiversity
Purchase land jointly with a land trust organization or other level of government	*Our review was unable to determine if this has been addressed*	Natural Assets Biodiversity
Promote the donation of eco-gifts by private	*Our review was unable to determine if this has been addressed*	Natural Assets

landowners (these gifts may qualify them for federal/provincial tax relief)		Biodiversity
6.6 Impact Assessments		
Require an Impact Assessment to assess the effects of new development on community values and biodiversity	OCP, Chapter 6, Policy 4: "…requiring environmental impact assessments in cases where proposed developments may negatively impact the ESA." *Consider requiring impact assessments for other community values*	Watershed/ Natural Assets Biodiversity/ Health, Equity & Justice
6.7 Building Permits		
Set conditions for landowners to provide works and services that meet the standards established by bylaws (e.g., for rainwater management)	*Our review was unable to determine if these have been addressed*	Blue-Green Infrastructure Sustainable Service Delivery
Require landowners to supply a maintenance plan for rainwater infrastructure, and incorporate it into a covenant registered on title, with a rent charge payable in the event of a breach		Blue-Green Infrastructure Sustainable Service Delivery
For any alteration to a building that is conducted without a permit, file a notice on land title		N/A
6.8 Important Bird and Biodiversity Area/Key Biodiversity Area		
Prioritize protection/conservation for these areas	Port Moody Arm is part of the English Bay, Burrard Inlet, and Howe Sound Important Bird Area (IBA)	Watershed/ Natural Assets Biodiversity

Designate EDPA's for these areas		Watershed/ Natural Assets Biodiversity
6.9 Statutory Right-of-way/Public Utility Easement		
Register on title to grant access to a public authority/utility for the purpose of maintaining green infrastructure on private land	OCP, Chapter 6, Policy 9: A statutory right-of-way is mentioned as a way to protect sensitive ecosystems	Blue-Green Infrastructure Sustainable Service Delivery
6.10 Bare Land Strata		
Preserve natural assets through strata ownership of land (i.e., individuals own their homes but not the land)	*Are these addressed in the Subdivision Bylaw?*	Natural Assets Biodiversity
6.11 Parcel Taxes		
Utilize parcel taxes to generate revenue for protecting/maintaining natural areas that provide specific ecosystem services		Natural Assets/ Blue-Green Infrastructure Biodiversity/ Sustainable Service Delivery
6.12 Conservation Fund - Community Amenity Contribution Program Corporate Policy (2017)		
Dedicate revenue to the acquisition of parkland and/or the restoration and improvement of natural areas	Section 8 specifies that $4.00 out of every $6.00 will be allocated to "public amenities…such as civic facilities, plazas, pedestrian and cycling improvements, recreation facilities, arts and cultural facilities, heritage conservation, land acquisition, environmental enhancements, and parkland improvements."	Natural Assets Biodiversity

	Consider a specified allocation to environmental projects	