CITY OF PORT MOODY

NATURAL ASSET MANAGEMENT STRATEGY | MARCH 2024

URBAN SYSTEMS

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DEFINITIONS

Asset Management (AM) is a formalized, integrated, collaborative, and continuous process of bringing together the skills and expertise of people with information about assets and finances, to make informed decisions about public assets so that they support sustainable service delivery. The key best practice in AM is to consider risk, lifecycle cost, level of service, and the trade-offs between them when making decisions about assets and services they provide.

Natural Assets are the stock of natural resources or ecosystems that are relied upon, managed, or could be managed by a local government for the provision of one or more municipal services and co-benefits to a community[1], such as wetlands, forests, watercourses, soil, and other natural resources that provide ecosystem services . They provide critical services and functions to communities both on their own and as part of infrastructure systems with engineered assets[2].

Natural Asset Management (NAM) is a continuous improvement process of including natural assets in the 'assess', 'plan', and 'implement' stages of the AM process to allow evaluation of trade-offs between service, cost, and risk[3]. It includes the stock of natural resources or ecosystems that are relied upon by the City for the sustainable provision of one or more municipal services[4].

Nature-based Solutions (NbS) are actions to protect, sustainably manage and enhance natural or modified ecosystems, which address societal challenges effectively and adaptively, while simultaneously benefiting people and nature[5]. NbS encompass a wide range of initiatives, including the management of natural assets and green infrastructure.

Municipal Services can include sewer, water, drainage, municipal roads, community services, and other necessary services that are provided by the City to the public as determined by a City council. These are delivered through the municipality's infrastructure assets and natural assets.

Co-benefits are the benefits that natural assets provide beyond municipal service delivery. This may include, but is not limited to, carbon sequestration, habitat and biodiversity, food and water, disease control, recreational and cultural benefits, and health and well-being.

Sustainable Service Delivery is an approach to delivering services that ensures that services are provided to the community today in a way that:

- is fiscally, environmentally, and socially responsible and equitable;
- is adaptive to changing circumstances and future conditions; and
- does not compromise the ability of future generations to meet their own needs.

Natural Asset Management is critical for sustainable service delivery, and the health of natural assets is a key contributor to their ability to deliver services sustainably.

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[1] Municipal Natural Asset Initiative (MNAI). (2017). *Primer on Natural Asset Management*.
[2] Asset Management British Columbia (AMBC). (2019). *Integrating Natural Assets into Asset Management*.
[3] *Ibid.*
[4] (MNAI, 2017).
[5] International Union for Conservation of Nature. 2016. *Annual Report*.

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1.0 INTRODUCTION

1.1 NATURAL ASSETS AND NATURAL ASSET MANAGEMENT

1.1.1 WHAT ARE NATURAL ASSETS?

Natural Assets are the stock of natural resources or ecosystems that are relied upon, managed, or could be managed by a local government for the provision of one or more municipal services and co-benefits to a community[6], such as wetlands, forests, watercourses, soil, and other natural resources that provide ecosystem services. They provide critical services and functions to communities both on their own and as part of infrastructure systems with engineered assets[7].

Natural Asset Management (NAM) is a continuous improvement process of including natural assets in the 'assess', 'plan', and 'implement' stages of the Asset Management (AM) process to allow evaluation of trade-offs between service, cost, and risk[8]. It includes the stock of natural resources or ecosystems that are relied upon by the City of Port Moody (the City) for the sustainable provision of one or more municipal services[9].

1.1.2 WHY IS NATURAL ASSET MANAGEMENT IMPORTANT?

Natural assets play a crucial role in providing core municipal services. These natural assets are often managed separately as parks and natural areas, and their value is often not tied to the services they provide. As such, these services are often taken for granted and people may not fully appreciate the role of natural assets in delivering them. Without these natural assets, local governments would have to rely on expensive engineered infrastructure assets to provide the same services. Since there is no financial value attached to the contributions that natural assets provide, their undervaluation results in insufficient investment in them.

Relying more on engineered infrastructure rather than natural assets can lead to higher overall costs. These costs include not only the upfront construction but also ongoing operations, maintenance, and eventual renewal or replacement of the infrastructure.

Traditionally, AM processes have focused solely on engineered infrastructure. However, there is a growing recognition that including natural assets in AM processes is beneficial. Effective NAM practices can help local governments decrease costs, improve levels of service, improve adaptation to climate change, and reduce unfunded liabilities while

[6] Municipal Natural Asset Initiative (MNAI). (2017). *Primer on Natural Asset Management*.
[7] Asset Management British Columbia (AMBC). (2019). *Integrating Natural Assets into Asset Management*.
[8] *Ibid.*
[9] (MNAI, 2017).

preserving the broader benefits natural assets provide to communities. As such, it is now an expectation that municipalities integrate natural assets into broader AM practices[10].

Natural assets contribute significantly to community resilience in the face of climate change and can be more resilient to various environmental stresses compared to engineered infrastructure. By protecting, enhancing, and maintaining these natural assets, communities can find diverse solutions to extreme weather events, reducing their reliance on costly engineered solutions. Additionally, natural asset management offers co-benefits such as improved habitat, clean air, and biodiversity.

NAM involves understanding both the strengths and limitations of engineered infrastructure and natural assets. It also considers how these assets interact within the broader system of service delivery. Recognizing natural assets as integral components of this system will lead to more informed decision-making processes within the City.

Despite ongoing efforts by the City to protect natural assets, such as Council's declaration of a climate emergency and the adoption of Port Moody's Climate Action Plan, the Environmentally Sensitive Areas (ESA) Management Strategy, development setbacks, Development Permit Areas (DPAs), Urban Forest Management Strategy (UFMS), and Parks protection and management action, there is a need to integrate these initiatives across the organization and into established financial processes.

What NAM is…	What NAM is <u>not…</u>
• A process of protecting, enhancing, and maintaining natural assets • A way of including natural assets into complex decision-making processes about municipal service delivery • A continuous improvement process • A multi-disciplinary practice that involves tools, processes, and practices from many different departments	• A "one and done" project • A conservation or protection plan • A separate or silo-ed process • One person's job

[10] Professional Practice Guidelines on Local Government Asset Management issued by Engineers and Geoscientists of BC establish professional practice expectations that natural assets be included in asset management processes.

1.1.3 HOW DOES THE NATURAL ASSET MANAGEMENT STRATEGY FIT INTO BROADER PICTURE OF ASSET MANAGEMENT?

The City practices asset management as a way of improving the sustainability of service delivery from built assets. The City's practices align with the process outlined in *Asset Management for Sustainable Service Delivery: A BC Framework*. The City's approach to NAM has been designed to integrate with, and build upon, existing asset management processes.

Figure 1. Asset Management for Sustainable Service Delivery[11]



[11] Asset Management BC. (2019). *Integrating Natural Assets into Asset Management: A Sustainable Service Delivery Primer*.

Other key terms

Nature-based Solutions (NbS) are actions to protect, sustainably manage and enhance natural or modified ecosystems, which address societal challenges effectively and adaptively, while simultaneously benefiting people and nature[1]. NbS encompass a wide range of initiatives, including the management of natural assets and green infrastructure.

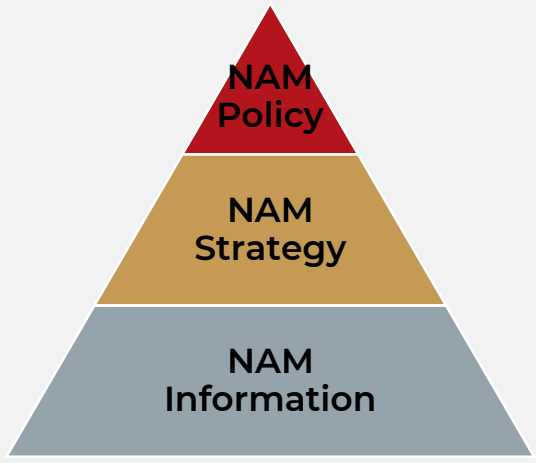
Co-benefits are the benefits that natural assets provide beyond municipal service delivery. This may include, but is not limited to, carbon sequestration, habitat and biodiversity, food and water, disease control, recreational and cultural benefits, and health and well-being.

NAM Policy – establishes the objectives the City is working to achieve through NAM.

NAM Strategy – identifies the approach the City will take to achieve the objectives.

NAM Information – provides the basis for understanding the natural assets that are within the City's jurisdiction, the services they provide, and risks to these assets and services. This information will support decision-making and will be improved over time as needed. Core sources of this information include the Natural Asset Inventory, the City's Integrated Stormwater Management Plans (ISMPs), watershed data collected through the Adaptive Monitoring Framework (AMF), the Environmentally Sensitive Areas (ESA) Management Strategy, and the Urban Forest Management Strategy (UFMS).

Figure 2. The City's Approach to Natural Asset Management



This work on NAM complements the City's efforts to effectively adopt and manage green infrastructure. Together, all of these efforts support the City to move towards improved understanding and implementation of nature-based solutions – an approach that the City is working on in collaboration with the Action on Climate Team (ACT) from Simon Fraser University (SFU).

This work is inherently interdisciplinary, requiring input and participation from Financial Planning, Infrastructure Engineering, Development Planning, Policy Planning, Environment & Parks, Information Services, Project Delivery, and Operations.

1.2 PURPOSE OF THIS STRATEGY

The purpose of this NAM Strategy is to identify the approaches that the City will take to implement the NAM Policy and build momentum for NAM practices at the City.

The NAM Strategy includes a natural asset inventory and valuation of services. The inventory and valuation are a necessary step in any NAM program and will provide Council and staff with information on the quantity and value of natural assets within the City, the role of natural assets in municipal service delivery, and why NAM is critical for the community.

Objectives of the Natural Asset Management Policy

1. To ensure that natural assets are prioritized in decision-making processes, policy development, infrastructure planning, land use planning, social planning, and development planning. (decision-making)
2. To develop and maintain reliable information about natural assets within the City's jurisdiction and the municipal services they provide to inform planning, decision-making, risk management, and communication with other jurisdictions, partners, landowners, and the public. (reliable information)
3. To identify and secure the financial and human resources required for NAM to support sustainable service delivery. (human & financial resources)
4. To build knowledge and capacity of staff, Council, and the public around NAM. (building capacity)

2.0 THE CITY'S NATURAL ASSETS

2.1 VALUATION METHODOLOGY

NAM is a process of continuous improvement. The natural asset inventory and valuation uses the best available information, accompanied by appropriate methods and assumptions to meet the objectives of this NAM Strategy. This process lays the foundation for future improvements in NAM.

Assumptions and data sources for each asset and service are detailed in the natural asset inventory (see Appendix A). The following is a summary of the methodology and data sources.

Valuation of Services

There are various methods of valuing the services provided by natural assets. Given that the focus is on *municipal services* provided by natural assets (as a subset of broader ecosystem services), the replacement cost method was used. Replacement cost method assumes that

the value of the service provided by the natural asset is considered equal to the equivalent costs the municipality would incur to replace the natural asset with engineered infrastructure that provides the same level of service.

This is a useful method for informing decisions regarding when and how to protect, maintain, and enhance natural assets, because it provides an indication of the cost the municipality may incur if the natural asset no longer exists, but the same level of service is desired. A drawback of this method is its potential to undervalue services, as it does not account for the broader ecosystem services offered by natural assets. Additionally, it focuses solely on the capital cost of replacement infrastructure, neglecting the full lifecycle cost.

To apply the replacement cost method, an estimation of the level of service provided by the natural asset is necessary. Natural assets are complex systems with various mechanisms, dependencies, and interdependencies, making it challenging to accurately quantify municipal service levels without detailed, localized studies. Simplified methods were used to quantify and valuate the services provided by natural assets to meet the City's objectives. Additional detailed study to achieve higher accuracy is not required to meet the City's objectives—for making informed decisions about the financial resources required for NAM to support sustainable service delivery—at this time (see Section 1.2). For a detailed understanding of the methods and assumptions used to estimate the level of service provided by each natural asset for various services refer to the natural asset inventory (see Appendix A).

The value transfer method was used to estimate the economic worth of air purification, carbon sequestration ,and carbon storage for forests based on findings from the Urban Forest Management Strategy (UFMS). Unit costs were extrapolated to determine the estimated replacement costs for the updated land area, which is more expansive than the land area considered in the UFMS. Details are provided in Appendix A.

Data Sources

The natural asset inventory was developed using land cover data from the City. To enhance the accuracy of this inventory, whenever possible and practical, assumptions regarding the level of service and replacement cost were derived from local data found in master plans like the Integrated Stormwater Management Plans.

Values from the UFMS are derived from i-Tree Canopy software developed by the US Department of Agriculture and Davey Tree Experts.

2.2 VALUATION OF THE SERVICES

Inventory and Value of Services

Based on findings, natural assets in the City have an estimated value of **$376.56 million (M)** if those natural assets were replaced with engineered infrastructure that provides the same level of service. Based on findings from the UFMS, treed forests provide air purification and carbon sequestration services with an additional value of **$2.94 M per year**.

The following is a summary of the natural asset inventory based on the scope and methodology described in Section 2.1 and detailed in Appendix A.

Table 1. Valuation of Service Provided by Natural Assets

Natural Asset Class	Natural Asset	Services	Value
Forest	Treed	Erosion Prevention Carbon Storage Rainwater Detention (runoff rate control) Rainwater Quality Treatment Rainwater Retention (runoff volume control)	$194.59 M
	Shrubby	Erosion Prevention Rainwater Detention (runoff rate control) Rainwater Quality Treatment Rainwater Retention (runoff volume control)	$4.7 M
Wetlands	Open Water	Rainwater Detention (runoff rate control) Rainwater Quality Treatment Rainwater Retention (runoff volume control)	$1.13 M
	Marsh	Rainwater Detention (runoff rate control) Rainwater Quality Treatment Rainwater Retention (runoff volume control)	$4.36 M
Lake	Lake	Rainwater Detention (runoff rate control) Rainwater Retention (runoff volume control)	$30.17 M
Watercourse	Stream*	Rainwater Conveyance	$141.61 M
Grand Total			$376.56 M

Note: All values are in 2023 dollars
**Streams include stream classes A (Fish Bearing), AO (Seasonally Fish Bearing), B (No Fish - Food Nutrient Value), and C (No Fish - Low Food and Nutrient Value). It is not known whether streams capture seasonal watercourses.*

Risks to Service Delivery

There are numerous risks to the sustainable delivery of the services provided by natural assets, most particularly land conversion and climate changes. Qualitatively, these risks include:

- Land Development: The expansion of urban areas and infrastructure development can lead to disruption of ecosystems and the services they provide, alongside habitat destruction and loss of biodiversity.
- Climate Change: Climate change poses a broad and pervasive risk, impacting natural assets in various ways, including altering temperature patterns, precipitation, and overall ecosystem dynamics. These changes are expected to increase the frequency and severity of:
    - Drought: Prolonged periods of water scarcity can compromise the function of natural assets and affect their capacity to support various services and exacerbating the overall vulnerability of these ecosystems.

- Pests and Disease: This risk primarily affects forests and shrublands, where invasive species and diseases can harm native flora and fauna, disrupting the balance of these ecosystems.
- Forest Fires: The risk of forest fires is likely to increase over time due to climate change-induced factors like higher temperatures and prolonged droughts. These fires can devastate forests and their associated services.
- Floods: The increased frequency and intensity of floods can result in damage to natural assets, such as wetlands and floodplains, affecting their ability to provide essential services like flood control.
- Landslides: Landslides can disrupt landscapes and affect the stability of natural assets, particularly in hilly areas. When landslides become debris flows, this can affect the ability of watercourses to provide stormwater conveyance.

3.0 STRATEGY FOR ADVANCING NATURAL ASSET MANAGEMENT PRACTICES

3.1 PRINCIPLES OF THE STRATEGY

Natural assets are complex and managing them involves understanding trade-offs based on context-specific and evolving information. Static processes and tools are limited in their ability to capture the complexity required for decision-making. The NAM Strategy reflects this reality through a set of principles:

Simplicity: Complexities are best navigated through simple, flexible, and collaborative processes that involve the right people with the right knowledge, and that build on existing organizational systems where possible.

> Application: The NAM Strategy aims to integrate natural asset information and considerations into current processes rather than creating new, standalone processes.

Collaboration: Equipping the right people with the right information and creating a structure for collaboration to understand trade-offs is a critical pathway for success.

> Application: The NAM Strategy will be implemented, monitored, and updated by a cross-departmental working group. The working group will enhance coordination and support consideration of complex trade-offs in decision-making. The working group will also make connections to other initiatives, such as the Urban Forest Management Strategy, the Green Infrastructure Strategy, and Nature-based solutions.

Documentation: Documenting decisions and rationale will help to build NAM practices over time and continuously improve practices with each iteration.

> Application: As the NAM Strategy is implemented, decision-making processes will be tracked and recorded to inform changes to system and information management approaches.

Continuous Improvement: NAM practices and information will improve over time as data is used, processes are tested, and challenges and successes are identified.

> Application: The NAM Strategy applies an approach of piloting new processes that integrate natural assets into decision-making, learning, and formalizing processes based on what is learned. The level of depth of understanding of natural assets will also increase over time, as more information is available and accessed for use in decision-making.

3.2 STRATEGIC ACTIONS

Improving NAM practices progressively allows the City to make informed decisions regarding the protection, maintenance, and enhancement of its natural assets, by balancing cost, risk, and level of service. The strategic actions identified will enable the City to achieve the NAM Policy objectives; and were selected based on their impact on advancing wider sustainable service delivery goals.

Table 2. Summary of Strategic Actions by Policy Objectives

	Strategic Actions	Decision-making	Reliable Information	Human & Financial Resources	Building Capacity
SHORT TERM ACTIONS (1 YEAR)					
1	Maintain the cross-departmental working group	x		x	x
2	Identify roles and responsibilities for implementing the NAM Strategy		x	x	
3	Centralize data and information		x		
4	Improve implementation of ISMP recommendations	x			
5	Integrate natural asset information into financial planning processes	x		x	
6	Communicate the NAM policy and strategy with staff and council			x	x
7	Continue relationship and support with ACT SFU			x	x
MEDIUM TERM ACTIONS (2 TO 3 YEARS)					
1	Identify specific natural assets that are at risk of loss or damage	x	x		
2	Pilot improvements to the collection and management of data on natural assets		x		
3	Integrate natural assets in capital planning processes	x			
4	Integrate natural assets in development planning processes	x			
5	Adapt/develop tools to integrate natural asset considerations into decision-making	x			x
6	Develop a communication strategy				x
7	Report on natural asset data and monitoring to stakeholders		x		x
LONG TERM ACTIONS (3+ YEARS)					
1	Embed managing risks to natural assets into municipal processes	x	x	x	x
2	Continue to build on partnerships and communication			x	x

3.2.1 SHORT TERM ACTIONS (1 YEAR)

1. **Maintain the cross-departmental working group**
   - Maintain the cross-departmental working group to enhance coordination, ownership, and decision-making, and implementation across departments. The working group will evaluate the impacts, trade-offs, and risks to natural assets in organizational processes and practices, such as development planning and capital planning.
2. **Identify roles and responsibilities for implementing the NAM Strategy**
   - Identify roles and responsibilities for implementing the NAM Strategy, and whether any additional staff resources are required.
3. **Centralize data and information**
   - Develop and maintain a natural asset inventory (underway). Identify who is responsible for maintaining the inventory, including information about natural asset condition and risk (ongoing improvement).
   - Explore the data and information that is needed and by whom, and what decision this information will inform. Discern and compile the information to be included in GIS and how to code it appropriately (e.g., water quality data) (ongoing improvement).
   - Identify opportunities to collaborate with other jurisdictions to gather data and information and make it more accessible for decision-making.
4. **Improve implementation of ISMP recommendations**
   - Review ISMP priorities through the lens of natural assets.
   - Improve implementation of ISMP recommendations and AMF monitoring through cross-jurisdictional collaboration with Coquitlam, Burnaby, and Anmore.
   - Ensure ISMP recommendations are included in development processes and requirements.
   - Include capital natural asset projects in Development Cost Charges programs, where projects support capacity improvements to service delivery that support growth.
5. **Integrate natural asset information into the City's financial planning processes**
   - Integrate natural asset information into the City's financial planning processes, such as the Asset Management Investment Plan (AMIP), to inform decisions about sustainable long-term funding for protecting, enhancing, and maintaining natural assets.
6. **Communicate the NAM policy and strategy with staff and council**
   - Increase Council's awareness of the importance of natural assets for service delivery and secure funding for protecting, enhancing, and maintaining natural assets.
   - Continue to improve staff understanding of NAM processes and practices to ensure common language and enable consideration of natural assets in planning, budgeting, and decision-making (ongoing improvement).

7. **Continue relationship and support with SFU ACT**
    - Continue to build on relationships and support with ACT SFU to advance broader goals and to develop an improved understanding and implementation of nature-based solutions (ongoing improvement).

3.2.2 MEDIUM TERM ACTIONS (2 TO 5 YEARS)

1. **Identify specific natural assets that are at risk of loss or damage**
    - Identify specific natural assets that are at high risk of loss or damage, using the natural asset inventory as a guide. Identify enhancement opportunities to mitigate these risks from the ISMPs. Identify these as projects in GIS.
    - Conduct scenario testing to identify the corresponding financial implications of providing the municipal services with grey or green infrastructure.
2. **Pilot improvements to the collection and management of data on natural assets**
    - Pilot improvements to the collection and management of data on natural assets, including condition, risk, and level of service by collecting data on priority assets using the natural asset inventory as a guide and in alignment with other AM information (e.g., condition and risk frameworks).
    - Ensure this information is collected at an appropriate frequency for making decisions and that information is recorded and shared in a format that is accessible to those that need it.
3. **Integrate natural assets in capital planning processes**
    - Evaluate the impacts, trade-offs, and risks to natural assets during the early planning stages of the capital planning process. Identify near-term and priority capital projects and operational activities required to manage risks to natural assets. Include these in the capital plan and identify funding sources (e.g., actions identified in ISMPs or other plans).
    - Identify, pilot, and document opportunities for considering impacts to natural assets in the capital planning prioritization process (ongoing improvement).
4. **Integrate natural assets in development planning processes**
    - Consider feedback from multiple perspectives early in development planning processes and ensure that referrals include feedback from the cross-departmental working group.
    - Evaluate the impacts, trade-offs, and risks to natural assets during the early planning stages of the development planning process. Identify requirements to protect, enhance, or maintain natural assets to manage risks.
    - Identify, pilot, and document opportunities for considering impacts to natural assets in the development planning prioritization process (ongoing improvement).
    - As per the OCP, continue to implement the City's referral processes with First Nations for City-led projects as part of ongoing efforts to strengthen relationship building with First Nations rights holders (ongoing improvement).
5. **Adapt/develop tools to integrate natural asset considerations into decision-making**
    - Adapt existing tools to include natural asset considerations into existing practices, such as the Sustainability Report Card and Project Charter.

- Building on pilot initiatives, develop tools to guide staff in consistent consideration of natural assets in organizational processes and practices. For example, develop a list of considerations and potential co-benefits of natural assets that will be considered in capital planning initiatives.

6. **Develop a communication strategy**
   - Develop a communication strategy to build awareness with staff, council, developers, and the public of the value of natural assets, risks to these assets, and actions each party can take to manage risks.
7. **Report on natural asset data and monitoring to stakeholders**
   - Assess the data that is being collected, monitored, and reported on by the City. Share information and reporting with stakeholders and acknowledge milestones and progress towards shared objectives.

3.2.3 LONG TERM ACTIONS (5+ YEARS)

1. **Embed managing risks to natural assets into municipal processes**
   - Identify opportunities and corresponding actions to manage risks to natural assets through acquisition, regulations and standards, maintenance practices, and through policy and planning practices.
   - Integrate NAM goals into existing processes and practices, including integrating NAM objectives into municipal guiding documents such as the Parkland Strategy, Subdivision and Development Services Bylaw, OCP, Zoning Bylaw, Tree Protection Bylaw, Stream and Drainage System Protection Bylaw, and other bylaws.
2. **Continue to build on partnerships and communication**
   - Continue to build on partnerships and communication with Coquitlam, Burnaby, Anmore, First Nations, Metro Vancouver, and watershed groups. This may include activities such as watershed reporting to Metro Vancouver; collaboration with Coquitlam on upstream water inflow; securing relationships with respect to broader watershed groups to improve watershed health.

APPENDIX A

NATURAL ASSET INVENTORY AND VALUATION

Natural Asset Class Label	Dominant Land Cover	Area (ha)	Area (m2)	Length (m)	Municipal Service Provided	Level of Service Assumptions	Valuation Method	Cost Assumptions	Unit Cost ($2021)	Unit	Total Cost ($2023)
Forest	Treed	1,436.2	14,361,907.9	-	Air Purification	LOS unknown; derived from i-Tree Canopy software developed by the US Department of Agriculture and Davey Tree Experts.	Value Transfer	Costs carried forward from Urban Forest Management Strategy (UFMS) and extrapolated to total area. Previously 1,953,600.00/yr for 1299 ha (UFMS).	$ 1,503.93	ha / y	$ 2,159,924.80
Forest	Treed	1,436.2	14,361,907.9	-	Carbon Seqestration	LOS unknown; derived from i-Tree Canopy software developed by the US Department of Agriculture and Davey Tree Experts.	Value Transfer	Costs carried forward from Urban Forest Management Strategy (UFMS) and extrapolated to total area. Previously $710,000.00/yr for 1299 ha (UFMS).	$ 546.57	ha / y	$ 784,984.96
Forest	Treed	1,436.2	14,361,907.9	-	Carbon Storage	LOS unknown; derived from i-Tree Canopy software developed by the US Department of Agriculture and Davey Tree Experts.	Value Transfer	Costs carried forward from Urban Forest Management Strategy (UFMS) and extrapolated to total area. Previously $21,167,400 for 1299 ha (UFMS).	$ 16,295.15	ha	$ 23,402,944.46
Forest	Treed	1,436.2	14,361,907.9	-	Rainwater Retention (runoff volume control)	Volume control up to 58mm (72%) of the 2-year, 24hr storm event (Chines) (Moody Centre Drainage; proposed)	Replacement Cost	Assumes replacement with 57mm amended topsoil depth at unit rate of $70/m3. Topsoil depth is the replacement topsoil needed (assuming porosity of 0.2) to provide volume equivalent to the difference in evapotranspiration volume between forested (assuming 40% surface water evapotranspiration) and developed conditions (assuming 20% surface water evapotranspiration).	$ 3.99	m2	$ 66,518,497.57
Forest	Treed	1,436.2	14,361,907.9	-	Rainwater Detention (runoff rate control)	Rate control for up to 50% of the 2-year, 24hr storm event (Chines)	Replacement Cost	Assumes replacement with constructed storage costof $160/m3.	$ 4,163.20	ha	$ 6,940,596.72
Forest	Treed	1,436.2	14,361,907.9	-	Rainwater Quality Treatment	Treatment up to 58mm (72%) of the 2-year, 24-hour rainfall depth (Moody Centre Drainage; proposed)	Replacement Cost	Assumes replacement with proprietary enhanced treatment system (e.g., biofilter). Costs based on 2022 budget pricing from Langley Concrete excluding taxes and FOB. Pricing is for Jellyfish JF4 and JF6 models with various cartridge / treatment flow rate configurations. Assumed a treatment area of 5 ha and a 6-month 24-hour event, with flows rates generally within the capacity of a JF4 model.	$ 5,800.00	ha	$ 9,669,355.54
Forest	Treed	180.6	1,806,396.3	-	Erosion Prevention	Area is woodlands riparian buffer and slope > 25% Erosion prevention for up to 50% of the 2-year, 24hr storm event (Chines).	Replacement Cost	Assumes replacement with synthetic Turf Reinforcement Mat (Nilex P550) and seeding.	$ 42.00	m2	$ 88,068,323.21
Forest	Shrubby	89.1	891,134.1	-	Rainwater Retention (runoff volume control)	Treatment up to 58mm (72%) of the 2-year, 24-hour rainfall depth (Moody Centre Drainage; proposed). Assumes shrubland provides a lower level of service compared to treed forest as indicated by difference in runoff coefficient (0.18 for shrubland, 0.10 fo	Replacement Cost	Assumes replacement with amended topsoil depth of 32 mm, per other assumptions under "Forest - Treed" asset.	$ 2.24	m2	$ 2,317,119.86
Forest	Shrubby	89.1	891,134.1	-	Rainwater Detention (runoff rate control)	Rate control for up to 2-year, 24hr storm event (Chines). Assumes shrubland provides a lower level of service compared to treed forest as indicated by difference in runoff coefficient (0.18 for shrubland, 0.10 for treed).	Replacement Cost	Assumes replacement with constructed storage cost of $160/m3.	$ 2,312.78	ha	$ 239,240.56
Forest	Shrubby	89.1	891,134.1	-	Rainwater Quality Treatment	Treatment up to 58mm (72%) of the 2-year, 24-hour rainfall depth (Moody Centre Drainage; proposed). Assumes shrubland provides a lower level of service compared to treed forest as indicated by difference in runoff coefficient (0.18 for shrubland, 0.10 for treed).	Replacement Cost	Assumes replacement with proprietary enhanced treatment system (e.g., biofilter). Costs based on 2022 budget pricing from Langley Concrete excluding taxes and FOB. Pricing is for Jellyfish JF4 and JF6 models with various cartridge / treatment flow rate configurations. Assumed a treatment area of 5 ha and a 6-month 24-hour event, with flows rates generally within the capacity of a JF4 model.	$ 3,200.00	ha	$ 331,017.12
Forest	Shrubby	3.7	37,280.6	-	Erosion Prevention	Area is woodlands riparian buffer and slope > 25% Erosion prevention for up to 50% of the 2-year, 24hr storm event (Chines).	Replacement Cost	Assumes replacement with synthetic Turf Reinforcement Mat (Nilex P550) and seeding.	$ 42.00	m2	$ 1,817,562.36
Lake	Lake	48.1	481,346.6	-	Rainwater Retention (runoff volume control)	Assumed to be same as Forest-Treed (conservative)	Replacement Cost	Assumes replacement with amended topsoil.	$ 3.99	m2	$ 2,229,401.22
Lake	Lake	48.1	481,346.6	-	Rainwater Detention (runoff rate control)	Assumes 25% more storage function than that provided by wetlands.	Replacement Cost	Assumes replacement with constructed storage cost of $160/m3.	$ 200.00	m3	27,937,358.68
Wetland	Marsh	8.5	85,150.8	-	Rainwater Retention (runoff volume control)	Assume to be same as lake.	Replacement Cost	Assumes replacement with 57mm amended topsoil depth at unit rate of $70/m3.	$ 3.99	m2	$ 394,383.87
Wetland	Marsh	8.5	85,150.8	-	Rainwater Detention (runoff rate control)	Assumes wetlands provide 0.2m depth of storage.	Replacement Cost	Assumes replacement with constructed storage cost of $160/m3.	$ 160.00	m3	3,953,723.04
Wetland	Marsh	8.5	85,150.8	-	Rainwater Quality Treatment	Focuses on nitrogen and phosphorus removal functions of wetlands.	Replacement Cost	Assumes replacement with nitrogen and phosphorus removal functions of a treatment plant.	$ 1,595.00	ha	$ 15,765.47
Wetland	Open Water	2.7	27,019.9	-	Rainwater Retention (runoff volume control)	Assumed to be same as Forest-Treed (conservative)	Replacement Cost	Assumes replacement with amended topsoil.	$ 3.99	m2	$ 125,144.95
Wetland	Open Water	2.7	27,019.9	-	Rainwater Detention (runoff rate control)	Assumes wetlands provide 0.2m depth of storage.	Replacement Cost	Assumes replacement with constructed storage cost of $160/m3.	$ 160.00	m3	1,003,668.79
Wetland	Open Water	2.7	27,019.9	-	Rainwater Quality Treatment	Focuses on nitrogen and phosphorus removal functions of wetlands.	Replacement Cost	Assumes replacement with nitrogen and phosphorus removal functions of a treatment plant.	$ 1,595.00	ha	$ 5,002.66
Watercourses	Natural Streams	-	-	58,093.9	Rainwater Conveyance	Assumed to provide same conveyance function as a 1050 mm pipe. Capacity equivalent for Port Moody's streams is not known. Where existing streams are currently undergrounded within Port Moody, the pipes range in size. Pipes have not been upsized capacity for climate change.	Replacement Cost	Rainwater conveyance value is assumed to be equivalent to that provided by a 1050mm pipe, including for larger systems. Assumes unit cost of $2.00/mm/m but this likely needs to be updated to reflect cost escalation in recent years.	$ 2,100.00	m	$ 141,614,216.27

Note(s): Cost assumptions are sourced from Urban System Ltd. sources and studies (2022)