Financing for Natural Infrastructure Projects

Viable pathways to scale up natural infrastructure investments on the Canadian Prairies

IISD REPORT

IISD | Natural Infrastructure for Water Solutions

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Natural Infrastructure for Water Solutions

Natural Infrastructure for Water Solutions (NIWS) is a 5-year initiative (2022 to 2026) led by IISD to scale up natural infrastructure across the Canadian prairies (Manitoba, Saskatchewan, and Alberta). The NIWS initiative aims for natural infrastructure to be well-understood, adopted, financed, and enabled by policy.

While science and policy are the foundation for this work, IISD is also taking a systems view—looking for opportunities and creative approaches to achieve real impact across the region, working with a network of champions, partners, and decision-makers.

Financing for Natural Infrastructure Projects: Viable pathways to scale up natural infrastructure investments on the Canadian Prairies

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Indigenous Lands and Cultures

The Indigenous Peoples of the Prairie region are rightsholders with robust knowledge and close connection to their traditional lands and with jurisdiction over their territories. The region we refer to as the Prairies—spanning the provinces of Alberta, Saskatchewan, and Manitoba, is home to incredibly diverse Indigenous lands and cultures, with multiple treaties, including Treaties 1, 2, 3, 4, 5, 6, 7, 8, and 10. We would like to acknowledge the traditional territories of the Anishinaabe, Cree, Oji-Cree, Dakota, Dene, Assiniboine, Saulteaux, Nakota, Lakota, Blackfoot, Nakota Sioux, Tsuut'ina, Iyarhe Nakoda, and the homeland of the Métis Nation. We offer respect to those who have long lived with and stewarded lands and waters across the Prairies and recognize the ongoing leadership of First Nations and Métis communities. With careful consideration and collaboration, natural infrastructure efforts can be an important part of reconciliation and an opportunity to uphold the United Nations Declaration on the Rights of Indigenous Peoples (United Nations, 2007).

Executive Summary

Natural infrastructure is a cost-effective solution to meeting many of our infrastructure needs, particularly those related to water, such as the provision of clean drinking water, flood protection, stormwater management, and climate change adaptation. Natural infrastructure encompasses preserved, restored, and engineered ecosystems, and it harnesses the power of nature to support human well-being through ecosystem services.

Mobilizing capital for natural infrastructure projects is critical for their wider implementation. Historically, public funding from government agencies—such as funds dedicated to support restoration or agricultural best management practices—has been the largest source of capital for natural infrastructure. Nevertheless, commercial financing and private investments are emerging as promising sources of capital for natural infrastructure projects. The private sector is increasingly aware of such climate and nature risks as the increasing frequency of natural disturbances and associated financial losses. Asset managers of large pools of capital could direct it to finance nature-related projects. However, there are known barriers to natural infrastructure investment. These include difficulties in quantifying and monetizing benefits, limited revenue streams, and significant time lags between investment and the realization of benefits.

Interviews with 13 investors representing the insurance sector, asset management industry, and impact investment firms (operating globally but primarily in Canada and the United States) highlighted viable financing mechanisms for natural infrastructure projects. Carbon and biodiversity credits, outcomes-based financing, natural asset companies, and insurance instruments are either being actively implemented or under consideration by private investors.

There is also increasing interest in and application of carbon credits to finance nature-related projects that sequester carbon. Canada has carbon protocols in place and under development that are linked to natural infrastructure in addition to well-developed voluntary and compliance carbon markets. Developments in the carbon market have sparked growing corporate interest in purchasing carbon credits to fulfill sustainability goals and decarbonization commitments. However, organizations are increasingly aware of the varying quality of carbon credits and the importance of ensuring credible and verified carbon emission reductions.

At the same time, the value of natural infrastructure extends far beyond carbon sequestration, to include a multitude of ecosystem benefits. For example, natural infrastructure creates recreational and educational opportunities for local residents and tourists, improves water quality and flood protection for downstream communities, and provides species habitat for the benefit of both local and for distant communities. The outcome-based financing model works well to finance natural infrastructure in light of this complexity. This model sees beneficiaries, including federal and municipal governments and private companies, pay for specific services provided by natural infrastructure, such as water quality improvement, carbon sequestration, and biodiversity enhancement. This generates revenue and returns for investors. This financing structure incorporates outcome metrics, providing a clear roadmap for achieving and verifying

environmental and social outcomes and ensuring accountability and transparency. The outcome-based model has been applied to finance natural infrastructure in the United States through projects led by Quantified Ventures and Blue Forest. It has also been applied to finance habitat improvement and restoration in Canada through the Conservation Impact Bond led by Carolinian Canada.

The following insights shared by the private investors provide a general sense of direction of how private capital can help finance natural infrastructure:

1. Investors perceive natural infrastructure financing as less risky than it used to be, owing in part to successful financing examples in the United States and other regions.
2. A financing mechanism that integrates performance-based metrics and brings in diverse stakeholders, rightsholders, and beneficiaries of natural infrastructure (e.g., the outcome-based financing model) holds promise for financing natural infrastructure, particularly in restoration projects that generate revenue streams from new ecosystem services.
3. All levels of government have an important role to play as outcome buyers and policy enablers regulating critical markets for ecosystem services and facilitating monetization of ecosystem services. Governments can also provide low-interest loans and tax incentives to investors in natural infrastructure and educate the public on the benefits of natural infrastructure to increase the willingness to pay for its benefits by private investors and taxpayers.
4. Intermediary organizations have an important role to play in coordinating and linking the interests and capabilities of parties involved in the outcome-based financing models, ensuring effective measurement and monetization of ecosystem benefits, bundling of outcomes from several projects, and negotiating prices with the outcome buyers.
5. The implementation of credible and rigorous monitoring and verification processes for outcomes delivered by natural infrastructure projects, along with the development of outcome metrics through diverse and inclusive partnerships, such as with Indigenous rightsholders, is imperative.
6. There is interest in natural infrastructure in the Canadian Prairie region, with potential revenue generation through ecosystem services such as carbon sequestration. However, the viability of the outcome-based financing model could be tested in pilot projects. These pilot initiatives should have Indigenous involvement and demonstrate a commitment to the process of reconciliation. The region would greatly benefit from the involvement of an intermediary organization that coordinates stakeholders and rightsholders and creates a project pipeline, given private investors' interest in deploying substantial capital.
7. When channelling private financing into natural infrastructure, special attention should be paid to local land rights and access, ensuring project affordability and availability of natural infrastructure projects for rural and underserved communities. Projects should also ensure net improvements in environmental outcomes, especially when monetizing and trading ecosystem services like carbon credits.

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Glossary

Blended finance	An approach to structuring project financing by involving investors with different objectives and risk tolerances. It is often a strategy to use public or philanthropic capital to leverage additional financing for a project from commercial investors. The blended finance structure makes it possible to lower the weighted average of the cost of capital for the project.
Canadian Prairies region	The prairie landscapes of Alberta, Saskatchewan, and Manitoba.
Ecosystem services	Tangible and intangible benefits provided to humans from healthy ecosystem functioning, such as clean air, water purification, recreation, and natural medicines.
Externalities	Externalities are the unintended impacts of a project, either beneficial or detrimental, on individuals, the economy, society, and the environment. These effects are not accounted for or financially borne by the parties responsible for the project.
Financing	Investing with the expectation of a financial return in the form of interest or dividends.
Grey infrastructure	Human-built infrastructure, including dams, roads, pipelines, water treatment plants, stormwater systems, and bridges, commonly made from materials like concrete and steel. The primary purpose of these structures is to meet targeted infrastructure objectives.
Infrastructure funding deficit (gap)	The difference between actual spending on infrastructure and spending that is required to maintain infrastructure in good and functional condition.
Infrastructure depreciation	The decline in infrastructure value over time. Depreciation spreads infrastructure costs over its useful life.
Institutional investors	Firms or organizations that buy, sell, and manage investments on behalf of clients.

Natural assets	Diverse components of the natural environment, such as waterbodies, forest ecosystems, and grasslands, that provide a range of ecosystem services to human societies. The "asset" perspective views the components of the natural environment as a resource from which economic benefits could be derived.
Natural infrastructure	Conserved, restored, or engineered ecosystems that provide specific infrastructure outcomes, such as flood protection, as well as a variety of co-benefits that support the environment, the economy, and community well-being (Méthot et al., 2023). Natural infrastructure is a subset of the broader field of nature-based solutions. Similar concepts include nature-based infrastructure, ecological engineering, ecosystem-based adaptation, natural assets, green infrastructure. For more information, see Méthot et al. (2023).
Pension funds	Scheme that provides retirement income based on monetary contributions from employers or members of a retirement program.
Private investments	Investments made by for-profit companies and individuals, e.g., through private equity or investment funds.
Public investments	Investments made by government and government-affiliated organizations such as Crown corporations in Canada and state-owned enterprises in other countries.
Transaction costs	Expenses incurred when an exchange takes place. Transaction costs take the form of fees or commissions during the monetary exchange. Transaction costs can also include time commitments and associated costs of bringing partners together or establishing and coordinating complex financial arrangements.

1.0 Objective of the Study

Our society relies on infrastructure for key services needed to ensure a good standard of living—roads for transportation, water treatment plants for clean drinking water, power plants for energy generation, and parks for recreation. However, as our communities grow, our infrastructure isn't keeping up—and climate change is making our infrastructure even more vulnerable (BluePlan Engineering, 2019). It is critical to innovate in approaching the problem of the infrastructure funding deficit so that our society can simultaneously address the issue of aging infrastructure, meet the needs of a growing population (Statistics Canada, 2022c), and increase the resilience of infrastructure to extreme weather events and a changing climate.

The established approach to meeting core infrastructure needs is through building "grey" infrastructure, such as roads, pipes, water treatment facilities, storm drains, and dams for water supply. Grey infrastructure is often expensive to build, has a finite lifespan and a large carbon footprint, and can lead to additional externalities on the environment, including degraded habitat and water quality, impacting the health of communities (Canadian Council of Ministers of the Environment, 2021).

Natural infrastructure—i.e., conserved, restored, and engineered ecosystems—works with nature to meet our infrastructure needs. If well designed and effectively managed and monitored, natural infrastructure can provide services comparable to grey infrastructure while delivering additional economic, environmental, social, and cultural benefits (Canadian Council of Ministers of the Environment, 2021; Méthot et al., 2023).

Wider implementation of natural infrastructure will require building municipal capacity[1] and strengthening the enabling policy environment.[2] It will also be critical to have **strategies in place to mobilize investments from diverse sources**. Currently, the public sector is the major capital provider for natural infrastructure globally and in Canada (Hudson et al., 2023; United Nations Environment Programme [UNEP], 2023). UNEP (2023) estimates that current public and private financial flows to nature-based solutions globally amount to USD 154 billion per year, with public funds accounting for 83%. There is public funding support for natural infrastructure in Canada (Box 2), and the sector will continue to be a key source of funding. Nevertheless, public funding alone cannot accelerate natural infrastructure adoption at the scale needed, considering that public budgets are often constrained (Deutz et al., 2020; UNEP, 2022; Green Purposes Company & Finance Earth, 2021).

[1] Capacity building for municipalities will improve their infrastructure asset management and ability to identity natural infrastructure opportunities. It can be achieved through education, training and communication materials and programs.

[2] Government policies set standards and guidelines for natural infrastructure implementation and provide a range of regulatory and financial incentives for natural infrastructure adoption.

Access to commercial financing, such as that from banks and private investors, particularly institutional investors, constitutes a significant source of financing capable of bridging the infrastructure funding gap. Globally, USD 87 trillion of assets under management could be made available for investments into natural infrastructure (Green Purposes Company & Finance Earth, 2021). Canadian financial assets under management were estimated to be around CAD 4 trillion in 2022 (TD Asset Management, n.d.). However, there are known barriers to natural infrastructure investment, such as difficulties in quantifying and monetizing benefits, limited revenue streams, long time lags between investment and the realization of benefits, and insufficient project scale to attract large capital providers (Hoekstra, 2022; Hudson et al., 2023; Organisation for Economic Co-operation and Development [OECD], 2022; World Bank Group, 2020).

To identify viable pathways for private sector financing for natural infrastructure (with a focus on solutions for the Canadian context), the authors of this study interviewed 13 investors from the insurance sector, asset management and impact investment companies operating in Canada, the United States, and around the world. The interviewees shared their opinions on challenges and solutions related to financing natural infrastructure, successful financing structures, and incentives that would enable them to invest more in natural infrastructure projects. The intent is to find scalable financing mechanisms for the Canadian context that, along with the growing pipeline of projects, would increase natural infrastructure adoption and improve environmental outcomes.

Box 1. Natural Infrastructure for Water Solutions Initiative

This study is part of the Natural Infrastructure for Water Solutions (NIWS) Initiative led by IISD, which aims to scale up the adoption of natural infrastructure in the Canadian Prairies region. This is the vast region of grasslands, wetlands, lakes, and cropland in the provinces of Alberta, Saskatchewan, and Manitoba. This region is known for its flat terrain and its importance for agricultural production, accounting for 82.3% of total farm area in Canada, and 54% of total farm operating revenues, based on Canada's 2021 Census of Agriculture (Statistics Canada, 2022a, 2022e).

Natural infrastructure solutions for water services on the Prairies—such as grassland and wetland restoration and conservation, on-farm water retention, floating treatment wetlands for wastewater lagoons—have been tested and proved effective for the region; however, wider adoption is needed (Birnie, 2021; Bramadat-Willcock, 2021; Puzyreva et al., 2022). Considering its flat topography, historical drainage of wetlands, and associated loss of water storage capacity that naturally mitigates floods and protects water quality, this region presents an opportunity to improve water management by scaling up natural infrastructure adoption while achieving economic prosperity, social well-being, and community resilience.

The paper provides some background on the infrastructure gap and investment needs of the water sector in Section 2.1 before presenting a range of natural infrastructure solutions (Section 2.2) and discussing the factors influencing the choice of financing instruments for natural infrastructure (Section 2.3).

The financing instruments suggested by the interviewees and overarching takeaways are summarized in Section 3, including an assessment of their applicability to the Canadian Prairies region. The Canadian Prairies region comprises a significant area of agricultural land and multiple urban and rural communities, and it is a geographical focus of the NIWS Initiative (Box 1). Finally, Section 4 presents the ethical considerations of scaling up private financing for natural infrastructure.

2.0 Background

2.1 Closing the Infrastructure Gap in Canada

2.1.1 Overview of the Infrastructure Gap in Canada

An "infrastructure deficit" or "infrastructure gap" measures the difference between actual spending on infrastructure and the spending that is required to maintain infrastructure in good and functional condition (Urban Systems, 2017). There is no perfect and consistent understanding of the infrastructure gap in Canada and the Canadian Prairies region due to data limitations and varying methodological approaches.

There is an incomplete understanding of the infrastructure gap in Canada and across the Canadian Prairies region.

The CanInfra Challenge and the Boston Consulting Group (n.d.) summarized past research on the Canadian infrastructure gap, estimating it to be between CAD 50 billion and CAD 570 billion, with an average between CAD 110 billion and CAD 270 billion (p. 9). These estimates, however, are outdated, originating from Mackenzie (2013) for 2013–14 and the Federation of Canadian Municipalities for 2007 (Mirza, 2007). This lack of knowledge about infrastructure assets is not unique to Canada; it is a common issue in other countries as well (OECD, 2022).

Despite being imprecise and dated, the figures underscore the significant scale of the gap. The lower bound of the average estimate (CAD 110 billion) surpasses the 2022 GDP of Manitoba (CAD 88 billion) (Government of Manitoba, 2023). This necessitates a substantial increase in annual infrastructure funding, in addition to regular investments, to address the gap. Additional investments are required to make infrastructure resilient to climate change and able to withstand extreme weather events.

Recent government commitments, such as the CAD 33 billion Investing in Canada Infrastructure Program for public transit, green and recreational infrastructure, and rural and northern community projects, as well as the CAD 3.375 billion Disaster Mitigation Adaptation Fund for large-scale disaster risk management projects, may have narrowed the above-mentioned infrastructure gap. However, determining whether the gap is genuinely shrinking is challenging due to the lack of consistent measurement of Canada's infrastructure assets. As mentioned in OECD (2022, p. 70), "Limited knowledge and data on both the state of infrastructure and existing financial flows make it difficult to identify or monitor problems and properly plan improvements and are thus a major barrier to investment." The Canadian government is developing its first National Infrastructure Assessment in recognition of this knowledge gap. This

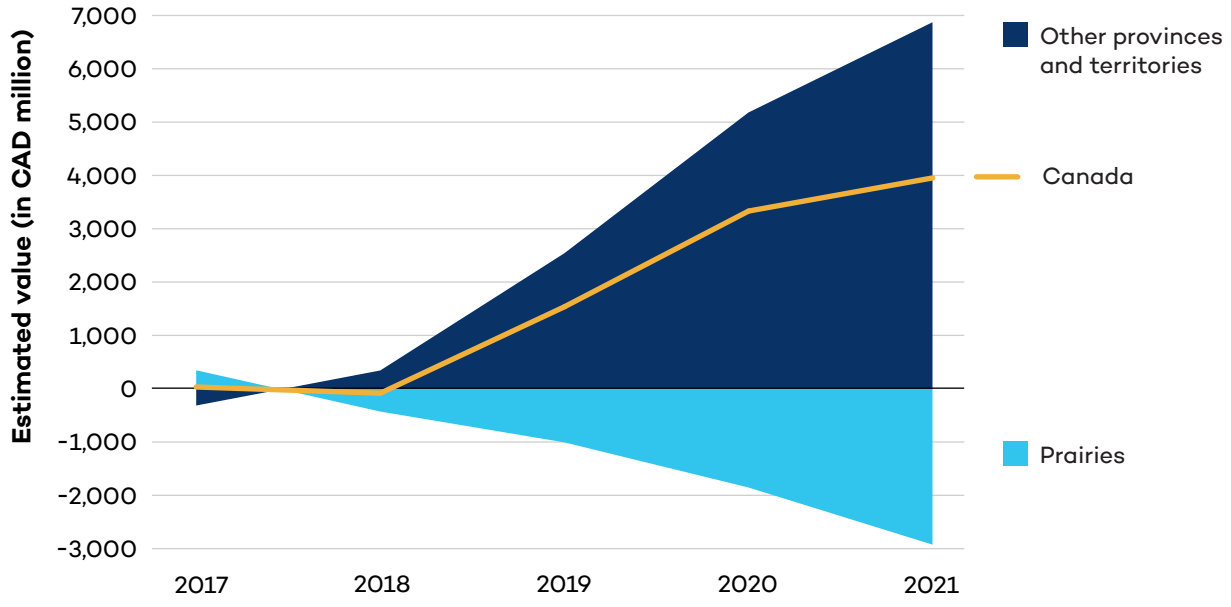
assessment aims to better understand the gap between current infrastructure status and future needs, exploring opportunities for public and private sector funding, financing, and innovative payment methods (Government of Canada, 2021a).

2.1.2 Water-Related Infrastructure Gap in Canada and the Prairies

The 2019 Canadian Infrastructure Report Card revealed concerning findings about Canada's water infrastructure. It found that 30% of linear assets, such as water and wastewater pipes, are in fair or worse condition (BluePlan Engineering, 2019). For non-linear infrastructure, such as water treatment plants and reservoirs, 21.4% of potable water assets, 30.6% of wastewater, and 16.2% of stormwater infrastructure are in fair or worse condition (BluePlan Engineering, 2019).

Statistics Canada's 2020 Canada Core Public Infrastructure Survey (2022a) underscores the challenge, stating that, despite increased capital expenditures and construction, investments have not kept up with the deterioration of existing assets, with the remaining useful life of water and sewage infrastructure declining from 2017 to 2021 (p. 2). This issue is not unique to Canada; the OECD (2022) notes that renewal rates in the water supply and sanitation sector in EU countries are typically below what is needed for the assets' life expectancy.

Figure 1. Cumulative net investments in water infrastructure in Canada and the Prairies, 2017–2021[3]



Source: Author diagram based on Statistics Canada, 2022f.

[3] "Investments minus depreciation". Further meaning of this graph is explained in the first paragraph on the next page.

Across the Canadian Prairies,[4] investments in water-related infrastructure have not kept pace with depreciation[5] (Figure 1; Table A1; Statistics Canada, 2022f). Figure 1 illustrates a declining trend in net investments in water-related infrastructure from 2017 to 2021, resulting in an accumulated deficit of approximately CAD 3 billion over this period of time (blue section of the graph).

There is a growing water-related infrastructure gap across the Canadian Prairies.

2.1.3 How Is Water Infrastructure Typically Funded in Canada?

Municipalities own and operate most public water utilities in Canada, providing water-related services such as potable water, wastewater, stormwater, rural drainage, irrigation, and flow control and flood protection (Statistics Canada, 2022b). Canada's water infrastructure is funded from a mix of sources, including municipal, provincial, and federal governments, with some limited support from the private sector (Ait-Ouyahia, 2006; Chattha, 2021; Infrastructure Canada, n.d.-a, n.d.-b).

Drinking Water and Wastewater

Canadian utilities providing drinking water and wastewater services derive their revenues primarily from fees collected for their services. According to the Canadian Water Network (2018), "Water sales and wastewater fees account for approximately 80% of NWWBI[6] [National Water and Wastewater Benchmarking Initiative] utility total revenues, with the remaining 20% generated from a combination of other service charges (development charges, fees), provincial and federal grants, development charges and other sources" (Canadian Water Network, 2018, p. 16; Figure 2)[7]. This revenue is intended to cover all costs associated with operating water systems, including operations and maintenance, source protection, and pollution prevention (Canadian Water Network, 2018).

Regarding First Nations' water and wastewater infrastructure in Canadian provinces (excluding British Columbia), First Nation chiefs and councils currently oversee their daily operations on reserves, whereas the federal government provides advice and financial support for construction, operations, and maintenance (Government of Canada, 2021b). The government of Canada

[4] Canadian provinces of Manitoba, Saskatchewan, and Alberta.

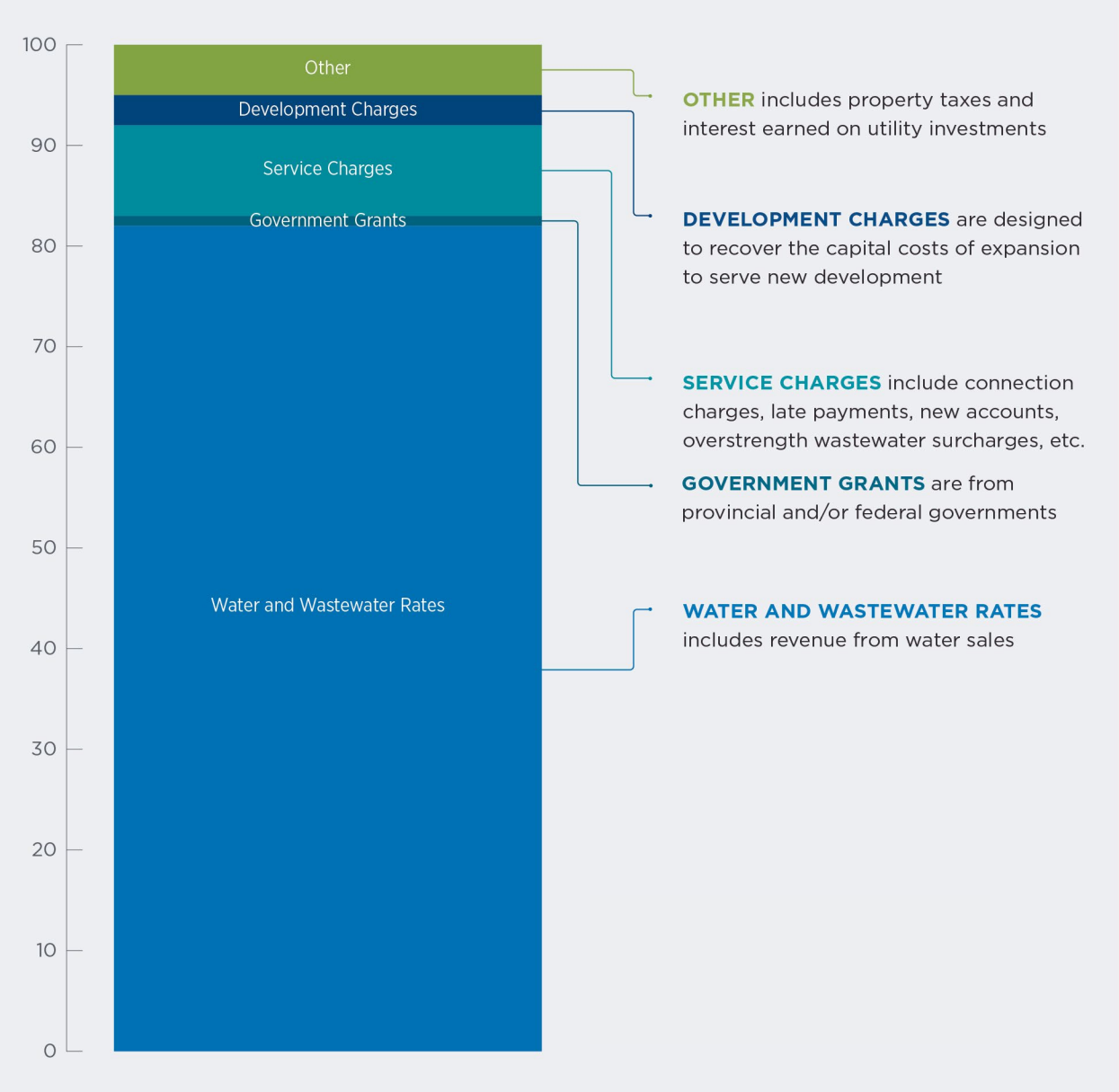
[5] Loss of value due to aging.

[6] The NWWBI collects operational and financial data annually from 55 participating utilities, municipalities and regions from British Columbia, Alberta, Manitoba, Saskatchewan, Ontario, Quebec, and Nova Scotia to identify best practices and performance improvement opportunities (Canadian Water Network, 2018).

[7] For the list of all revenue options—both "user pay" and "not user pay"—that are available to municipalities for funding water and wastewater infrastructure, see Federation of Canadian Municipalities and National Research Council (2006).

intends to gradually transition these services to First Nation-led organizations, which will assist communities in financing, procurement, and maintenance of water and wastewater infrastructure (Government of Canada, 2022b). One transition has already occurred in Atlantic Canada in 2022, with the Atlantic First Nations Water Authority taking responsibility for operating, maintaining, and upgrading water and wastewater assets in participating First Nations. This initiative is funded from the federal government budget over the next decade (Atlantic First Nations Water Authority, 2022; Indigenous Services Canada, 2022).

Figure 2. Average breakdown of revenue sources of water and wastewater utilities in Canada



Source: Canadian Water Network, 2018, reprinted with permission.

Stormwater

Historically, there have been challenges in securing funding for stormwater infrastructure upgrades in Canada. Stormwater infrastructure construction and operation are primarily funded through property taxes, but this funding source is considered unreliable due to competition with other municipal services (Canadian Water Network, 2018). Additionally, some properties that generate stormwater runoff, such as schools and government-owned land, are exempt from property taxes. When funding falls short, raising property taxes can face political opposition.

Furthermore, while property taxes support the installation of stormwater infrastructure based on property values and development charges, there is limited funding available for upgrades (Canadian Water Network, 2018; Environmental Commissioner of Ontario, 2016). Government grants often don't cover operation and maintenance costs (Environmental Commissioner of Ontario, 2016), resulting in ill-equipped stormwater assets that are vulnerable to extreme flood events, erosion, and water pollution (Canadian Water Network, 2018).

To address this, Canada is increasingly adopting dedicated user-pay approaches, like stormwater user fees, for funding both the installation and maintenance of stormwater infrastructure (Canadian Water Network, 2018; STEP, 2020). This "user fee" approach is generally recommended for all types of water infrastructure for its sustainability while having the socio-economic situation of the paying users in mind and ensuring equity (Canadian Water Network, 2018; City of Hamilton, 2023; Ragan & Harcourt, n.d.; Sahib, 2020).

As mentioned, utilities use a mix of funding sources for water infrastructure, with the largest share derived from user fees in the case of water and wastewater infrastructure. Utilities can pay for the renewal of infrastructure from their savings/cash reserves accumulated from user fees, borrow and repay the money over time through low-interest loans and bonds, or a combination of the two (Canadian Water Network, 2018). The advantage of debt financing[8] is that it spreads out the costs over a longer period of time, which promotes intergenerational equity, and the costs are not borne entirely by the current users. However, utilities need to ensure sustainable cost recovery through their operations to repay the loan and the cost of debt service.

2.2. The Role of Natural Infrastructure

2.2.1 Natural Infrastructure Types and Benefits

Amid the challenges of funding conventional grey water infrastructure, natural infrastructure emerges as a viable solution when carefully managed, designed, and maintained. Natural infrastructure can be a conserved ecosystem, a restored ecosystem, or a nature-based engineered feature (Figure 3), and can either directly deliver infrastructure services or enhance and protect infrastructure service delivery from grey infrastructure (United Nations Environment

[8] Debt financing is a method of raising capital by borrowing money from lenders or investors, with the obligation to repay the borrowed amount along with interest over a specified period.

Programme, 2023). While cost-efficiency depends on specific projects and locations (Ishaq et al., 2023; Puzyreva et al., 2022), mounting evidence indicates that natural infrastructure can offer cost-effective solutions for various infrastructure needs (Eyquem et al., 2022; Eyzaguirre et al., 2023; Méthot et al., 2023; UNEP et al., 2014; World Economic Forum et al., 2022). Bassi et al. (2021) estimated that in the global water and sanitation sectors, natural infrastructure could cover 25% of investment needs, surpassing grey infrastructure by being 50.7% more cost-effective. It has also demonstrated cost savings in water supply (Gray, 2019), stormwater (City of Edmonton, 2014), and wastewater (American Rivers et al., 2012).

In contrast to grey infrastructure that depreciates over time, natural infrastructure can appreciate if managed well, delivering more benefits as time passes (Gartner et al., 2013; Lieuw-Kie-Song & Pérez-Cirera, 2020; Roy, 2018). For example, the water quality benefits of a restored wetland increase over time when the vegetation is more established, making it sustainable and cost-effective over the long term.

Natural infrastructure can also deliver multiple environmental and social benefits simultaneously, leading to greater societal return on investment. For example, a constructed wetland designed for water treatment and improving downstream water quality can, at the same time, provide recreational and educational services, as well as flood control, carbon sequestration, and species habitat. These ecosystem services are critical and correspond to many environmental agendas and goals, such as the Kunming-Montreal Global Biodiversity Framework,[9] Canada's National Adaptation Strategy, and actions under Canada's 2030 Emissions Reduction Plan.

Natural infrastructure can be implemented alone or as part of hybrid approaches where grey and natural elements complement each other to optimize performance given specific needs. For example, wetlands can be incorporated at the polishing stage of wastewater treatment in combination with grey infrastructure for primary and secondary treatment.

The range of costs associated with natural infrastructure varies depending on the natural infrastructure type[10] and factors such as project complexity, labour requirements, machinery, and site topography and location. (City of Edmonton, 2011; Ishaq et al., 2023). The typical costs of natural infrastructure projects include

- feasibility studies, development of the design, engineering[11]
- installation costs, such as costs of acquiring land,[12] labour, seeds
- maintenance costs, such as improvements to soil and vegetation (e.g., mulching), repairs of components of natural infrastructure (e.g., culvert repair in water retention projects)

[9] https://www.cbd.int/gbf/

[10] For example, conservation of ecosystems avoids many of the extra costs associated with ecosystem restoration.

[11] Vajjhala (2020) emphasizes several stages of upfront work required for most natural infrastructure projects such as identifying and framing "infrastructure options that respond to a primary beneficiary or stakeholder(s') need" and developing initial project concepts, design specifications, and conducting feasibility studies (p. 10).

[12] Costs of acquiring land for a natural infrastructure project can be significant, for example the land acquisition for the La Broquerie tertiary wetland treatment system in Manitoba, Canada (SteinbachOnline.com, 2017).

Figure 3. Categories and examples of natural infrastructure

Conserved Ecosystems

Conserving existing natural ecosystems to prevent their loss and/or optimizing their function to enhance infrastructure outcomes

Examples

Wetland, grassland, floodplain, and forest conservation, riparian buffers, and urban tree canopy

Restored Ecosystems

Restoring or enhancing degraded ecosystems to deliver infrastructure outcomes

Examples

Wetland, grassland, floodplain, and forest restoration, riparian buffers, and urban tree canopy

Engineered Ecosystems

Engineering and constructing new ecosystems that incorporate ecosystem features to deliver infrastructure outcomes

Examples

Constructed wetlands, water retention sites, floating treatment wetlands, soil cells, green roofs, and bioswales

Source: Méthot et al., 2023.

2.2.2 Beneficiaries and Implementing Parties

Federal, provincial, and territorial governments, as well as local authorities in Canada are responsible for infrastructure service delivery in Canada. For water services specifically, municipalities are responsible for implementing and maintaining water-related infrastructure, such as stormwater management, water supply systems and wastewater treatment facilities, and would have a key role in adopting natural infrastructure approaches. At the same time, natural infrastructure can have many proponents and interested parties involved in the conservation, restoration, or engineering of natural features in urban and rural settings, such as watershed and conservation groups, farmers, homeowners, and Indigenous Peoples and communities.

Different stakeholders and rightsholders may be interested in different outcomes and benefits of natural infrastructure.

The benefits of natural infrastructure can accrue to multiple entities, which is an important consideration for mobilizing funding for these projects. In the case of landscape restoration, municipal stormwater engineers may be interested in flood mitigation and improving water

quality, federal policy-makers may be interested in how landscape restoration helps communities adapt to climate hazards and improve biodiversity, food processors and restaurant chains such as McDonald's and Cargill might be seeking carbon offsets from ecosystem restoration, and the insurance sector sees value in reducing risks and vulnerability to extreme weather events to reduce compensation payouts. Based on the motivations of each group, there is potential to design innovative funding mechanisms for natural infrastructure implementation (for example, the outcome-based financing model discussed in Section 3.1.3). Vajjhala (2020) recommends identifying the clear lead beneficiary or a consolidated group of beneficiaries to initiate the natural infrastructure project.

There are multiple types of capital available for natural infrastructure projects and several factors that influence the choice of financing instruments detailed in the following section.

2.3. Investing in Natural Infrastructure: Key concepts

2.3.1 Sources of Capital and Financing Mechanisms Available for Natural Infrastructure

Since water-related and other ecosystem services provided by natural infrastructure at scale benefit many water users in the watershed, government is well placed to invest in natural infrastructure on citizens' behalf, especially when projects are implemented on public land. At the same time, private land—covering 11% of Canada's total landmass (McFatridge, 2018)—plays an important role in providing ecosystem services, and some efforts aim to invest in private land conservation and restoration (e.g., the Alternative Land Use Services [ALUS] model in Canada). Therefore, as mentioned earlier, the potential project proponents and partners could vary and may include conservation organizations, private landowners, government, municipalities, and urban developers.

Public and private organizations, such as municipalities and private sector companies, can raise capital for natural infrastructure projects from public or private sources as part of their operations through **debt** and **equity** financing and **grant** funding.[13] Larger natural infrastructure projects can also be financed directly via a Special Purpose Vehicle by debt and equity instruments. Financial incentives provided by governments to private investors (e.g., tax incentives or catalytic capital to get projects off the ground) can play a significant role in the uptake of natural infrastructure (Climate Bonds Initiative, n.d.; Georgetown Climate Centre, n.d.).

The following section describes these general financing options for infrastructure projects with examples of possible applications to natural infrastructure in the context of Canada/the United States/Europe when available. Note that these examples do not represent an exhaustive list of

[13] More common in the case of public sector and not-for-profit organizations.

investment mechanisms.[14] Also, some of these established ways to raise financing have had only a limited or no known application to natural infrastructure to date (e.g., equity financing); however, other ways to raise funds are more common in cases of natural infrastructure (e.g., government grant funding).

Debt

What is it?

Debt financing involves borrowing money and paying it back with interest. Investors can contribute debt capital for financing projects by various means, including bonds, debt instruments, or loans. The project developer agrees to repay the principal debt along with accrued interest within a specified timeframe.

How can it help finance natural infrastructure?

Municipalities looking to invest in natural infrastructure can issue "use of proceeds bonds," such as green bonds, to attract capital from the private sector. The capital raised from selling these bonds is earmarked for a particular project and purpose, e.g., natural infrastructure projects that have a positive, measurable impact on the environment. Another type of bond (known as pay-for-results/pay-for-success) is tied to the performance of the project, where the interest paid to investors varies based on the achievement of targets specified in the agreement. These bonds can be purchased by asset management companies (e.g., pension funds investing on behalf of a group of individuals).

In general, bonds have usually been issued by water utilities to finance large capital projects like wastewater treatment plants (Gartner et al., 2013). The money borrowed this way can later be repaid from water rate revenues. It should be noted that bond financing works better for large-scale projects and might not work well for smaller landscape restoration unless projects are bundled. For any debt financing, investors need to be confident in repayment. As stated in OECD (2022, p. 72), "Investors seek evidence that providers have a strong ability to manage taxes and tariffs, collect revenues, prepare and manage transparent budgets, devise capital plans, co-ordinate contracts and tender processes."

Green banks in the United States, for example, offer low-cost debt financing to clean energy projects that reduce emissions (EPA, n.d.-a). Connecticut Green Bank was the first bank established in the United States in 2011 and, since 2021, has been expanding its financial offerings to projects in the "areas of environmental infrastructure," such as water, parks, and land conservation (Connecticut Green Bank, n.d., 2023). In the United States, investments in climate resilience projects are often made through statewide bond measures; states issue and sell bonds

[14] Some recent publications that provide more details on various financing options available for restoration of nature, improving biodiversity, and climate change adaptation through nature-based solutions include Gouett et al. (2023), Rendlen & Uzsoki (2021), and the Smart Prosperity Institute (2021).

and allocate funds toward activities that mitigate the impacts of climate change, such as nature-based climate solutions.[15]

Equity

What is it?

Equity financing implies that the investor is providing capital for a share of ownership and profits of the project/company. Equity investments are generally considered riskier than debt, which is often reflected in the risk-adjusted return on these investments above the debt return (Informed Investor, 2023).

How can it help finance natural infrastructure?

Various entities can finance natural infrastructure projects by obtaining a share of ownership, i.e., equity stake, in the project, which will enable them to share its profits. (for example, in the case of the government, providing public land for an equity stake in the entity operating natural infrastructure). Examples of equity investments in natural infrastructure are very limited. One case that aligns with this instrument is the model implemented by Ecosystem Investment Partners in the United States. Ecosystem Investment Partners is a private equity firm that invests in ecological restoration and conservation by acquiring, restoring, and permanently protecting lands, which enables them to establish mitigation banks that sell ecosystem credits to businesses looking to offset unavoidable and permitted environmental impacts (Ecosystem Investment Partners, n.d.).

Another example of equity financing is private investors allocating capital to a water utility for a share of ownership in the public water utility. However, this rarely happens in Canada (Federation of Canadian Municipalities & National Research Council, 2006). The water utility would then use the capital raised to invest in a natural infrastructure project.

A private investor also has the option to directly invest equity capital in natural infrastructure projects by acquiring shares or direct ownership. Typically, when it comes to conventional infrastructure projects, investors generate profits or bear losses based on the financial success of the project, receiving dividends or distributions that align with their ownership interests.

Grants

What are they?

Grants are money provided for specific purposes by governments, private companies, philanthropic groups, or individuals. Grants do not need to be repaid and are often awarded

[15] See B-867 Drought, Flood, and Water Resilience, Wildfire and Forest Resilience, Coastal Resilience, Extreme Heat Mitigation, Biodiversity and Nature-Based Climate Solutions, Climate Smart Agriculture, Park Creation and Outdoor Access, and Clean Energy Bond Act of 2024. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB867

competitively through calls for proposals. Grants tend to be smaller in amount and often serve to "spark catalytic change in a field or region" and in the predevelopment phase of natural infrastructure projects (Vajjhala, 2020, p. 11).

How can they help finance natural infrastructure?

Governments can make funding available through dedicated funding programs to meet specific objectives like flood control, carbon sequestration, or other priorities. Provincial and federal government grants are one-time investments made to support natural infrastructure projects. Grants can also fund project development costs. They do not require repayment but may require matching funds (they are, therefore, not a financing mechanism). See Box 2 for an analysis of public sector grant funding allocated to natural infrastructure in Canada.

Performance-Based Payments

What are they?

Performance-based payments also do not require repayment; however, they are contingent upon delivering a service. The standard mechanism applicable to natural infrastructure projects is payments for ecosystem services associated with sustainable land-use practices that reward the continuous provision of ecosystem services, such as water treatment and carbon sequestration.

How can they help finance natural infrastructure?

Private donors (e.g., individuals, foundations, or businesses relying on clean water or looking to reduce water risks) can make philanthropic investments in landscape restoration or other types of natural infrastructure. The ALUS program in Canada is partially funded by private foundations and philanthropic organizations that have an interest in environmental sustainability. It provides payments to farmers and landowners to implement practices that benefit the environment (ALUS, n.d.). In the United States, the Inflation Reduction Act (IRA) of 2022 made historical investments in water, climate resilience, and biodiversity by making a commitment of USD 24.9 billion to help farmers and forest landowners implement voluntary climate-smart conservation practices, with USD 850 million being made available in 2023 (Bipartisan Policy Centre, 2022; Hill-Gabriel & Cep, 2023). Moreover, the Bipartisan Infrastructure Law in the United States signed on November 15, 2021, is investing USD 50 billion to increase resilience to extreme weather events, including through ecosystem restoration, and USD 55 billion in drinking water, wastewater, water reuse, conveyance, and water storage infrastructure (The White House, 2022).

Box 2. Analysis of grant funding for natural infrastructure in Canada

Based on the analysis of 24 federal and provincial programs with available funding data, Saleh and Puzyreva (2024) estimated that approximately **CAD 346.6 million** in grant funding is directed toward natural infrastructure **annually** across Canada by federally funded programs such as the Disaster Mitigation and Adaptation Fund and Investing in Canada Infrastructure Program. About CAD 69.3 million in funding is invested in the Prairies. Looking at provincially funded programs in the Prairies, Saleh and Puzyreva (2024) estimated that an additional CAD 29.1 million is directed toward natural infrastructure annually in this region, totaling **CAD 98.4 million/year**. While some of these grants directly target natural infrastructure, it is more common for them to invest indirectly via investments in conservation, restoration, or resilience.

As demonstrated, there are various ways in which the private and public sectors can invest in natural infrastructure.

> Natural infrastructure projects are particularly well suited for blended finance schemes that mix various sources and types of financing and, more importantly, try to leverage public and philanthropic funds to de-risk investments and attract the participation of private finance. (Earth Security, 2021)

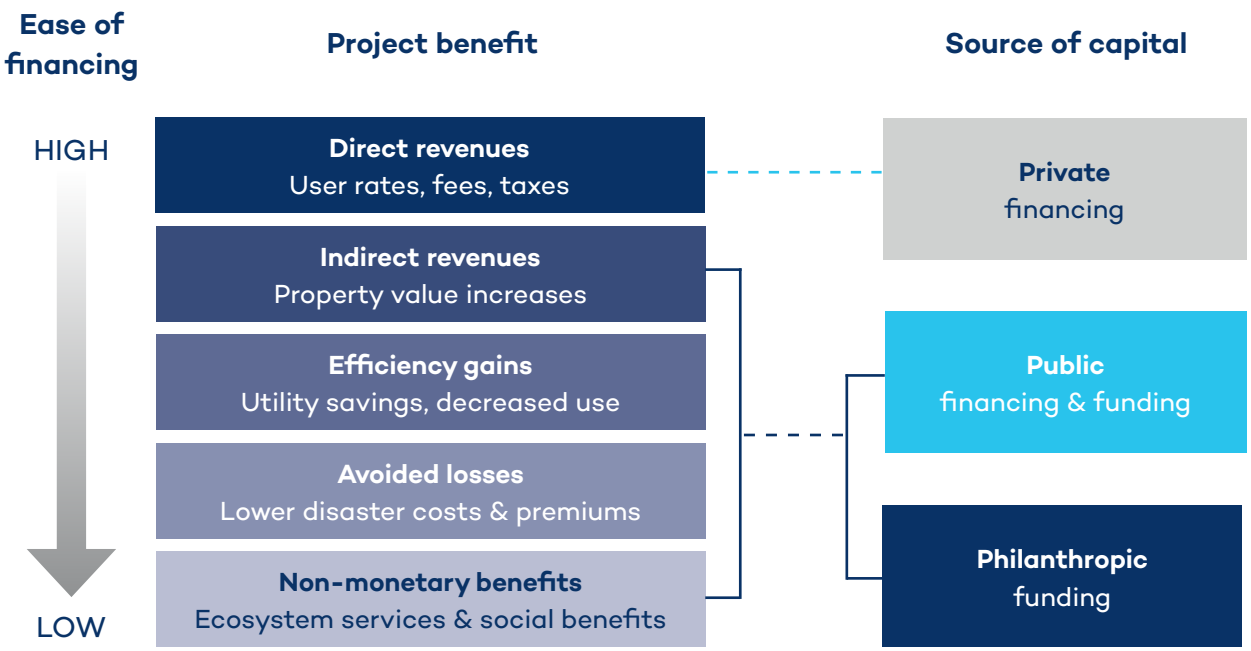
In the case of conservation and restoration projects, blended finance structures can effectively capture a suite of ecosystem service value streams (Smart Prosperity Institute, 2021) (see Section 5.1.3). Green banks in the United States are examples of a blended finance mechanism used to finance clean energy projects and, increasingly, nature-based solutions (Earth Security, 2021; Nicholas Institute for Environmental Policy Solutions & Environmental Policy Innovation Center, 2023). Green banks can offer credit enhancements and co-investments to leverage private capital (United States Environmental Protection Agency [EPA], n.d.-a). Another example of the blended finance strategy is the Clean Water and the Drinking Water State Revolving Funds (CWSRFs), which are public sources of funds in the United States for water infrastructure projects that raise additional capital from U.S. capital markets to increase lending capacity (OECD, 2022). The funds can also provide guarantees on local debt to improve access to credit markets and reduce interest rates for applicants installing water infrastructure (EPA, n.d.-b).

2.3.2 Factors Influencing Investment Mechanisms for Natural Infrastructure

Section 2.3.1 discussed the common ways natural infrastructure projects could be financed based on the typical mechanisms applied to infrastructure projects. The capital providers are typically the entities interested in sustainability-related outcomes provided by the project and are both direct and indirect beneficiaries of natural infrastructure's ecosystem services. The specific financing or funding structure for a natural infrastructure project (debt, equity, philanthropic funding, government grants, blended finance, etc.) would depend on a combination of the following factors:

- **Direct Revenue Generation.** As shown in Figure 4, private financing favours natural infrastructure projects that generate direct and stable revenues and predictable returns—through water tariffs, user fees, taxes, and other payments from the beneficiaries. Public and philanthropic funders are instead more open to projects with non-monetary benefits. In some contexts, however, where the risk of high-impact disasters is significant, cost savings can be a compelling motivator for investors and/or beneficiary funders. In the Western United States, for example, water supply and infrastructure protection from reducing the risk of catastrophic fire has driven public investment in fuel reduction and ecosystem restoration projects (U.S. Department of Agriculture Forest Service, 2022). As climate change increases the severity and frequency of natural disasters, risk reduction may become a greater motivator for natural infrastructure financing. Overall, capital mobilization from paying beneficiaries is critical for scaling up private investments in natural infrastructure projects. In turn, the potential for revenue generation depends on the proximity of natural infrastructure to users of its services, their willingness to pay for the benefits, and the socio-economic context. There are also important equity considerations, as mentioned in Canadian Water Network (2018, p. 25): "There are certain instances, such as small, rural and remote communities where the cost of services exceed users' capacity to pay, where there is a need for government subsidies, at least in the short-term." Also, new revenue streams that are enabled by government regulations can emerge over time and create opportunities for private financing of natural infrastructure, such as regulated carbon markets (see Section 3.1.1).

Figure 4. Potential sources of capital for natural infrastructure projects



Source: Vajjhala, 2020.

- **Type of Natural Infrastructure.** Preserving an existing ecosystem may be best supported with a conservation agreement, while the restoration or engineering of natural infrastructure may require different mechanisms (e.g., see Section 5.1.3). The type of natural infrastructure and the benefits that accrue from it also influence a project's investment horizon, which is an important consideration for investors. For example, pension funds are more interested in long-term investments to match their long-term liabilities, while some investment funds may be interested in shorter-term investments. Typically, natural infrastructure projects are long-term endeavours because planted vegetation and associated ecological processes need time to get established for maximum benefits. Carbon accumulation in restored wetlands, for example, can take decades to build to its original condition, and even then, it might fail to fully restore original levels of wetland ecosystem function (Burden et al., 2019; Mateos-Moreno et al., 2012). Factors such as management and climate also play an important role in a wetlands' ability to deliver benefits such as carbon sequestration (Valach et al., 2021).
- **Investors' Objectives.** Different investors are attracted by different outcomes and ecosystem services provided by the natural infrastructure project. There are private investors interested in monetary returns (cash flow) and non-monetary returns (i.e., nature-positive impacts that are not used for offsets, such as favourable corporate social responsibility and environmental, social, and governance [ESG] ratings). Therefore, the financing mechanism and conditions for the provision of capital could differ based on these motivations.

- **The Scale of Natural Infrastructure Projects.** In the case of a natural infrastructure project implemented on a watershed scale and requiring large landscape planning, government is usually involved. These projects are also likely to involve public land (in Canada). Larger-scale projects tend to be better able to attract institutional investors. In addition, there is an economy of scale associated with larger projects when it comes to transaction costs such as time, procurement, cost of capital, and so on. Smaller projects implemented on farmland and delivering water quality benefits can be bundled, and their outcomes sold to the larger benefiting entity, like government.
- **Perception of Natural Infrastructure Performance Risks.** This is especially relevant for outcome-based financing involving private financiers (Section 3.1.3). For outcome-based financing, the risk of achieving stated outcomes is determined by how well the natural infrastructure is evaluated, the type of metrics selected, and required government regulatory compliance (e.g., for water utilities). Typically, the risks associated with the natural infrastructure project performance are negotiated and distributed across investors in the financing structure. As noted in OECD (2022, p. 110), the perception of risks is "heterogeneous, depending on the actor and their motivations and incentives to act."
- **Policy Resiliency.** This extends to various elements of the enabling policy environment, including enforcing regulations related to the environmental targets that natural infrastructure can help meet, and the development and enforcement of compliance markets and industry reporting standards.[16] Clear, consistent, and long-term policies ensure predictability for businesses and are important for increasing private investments in natural infrastructure. For example, if the enabling policy for biodiversity and carbon markets is strong, transparent, and oriented toward the long term, it can increase the confidence of private investors in channelling their capital toward natural infrastructure that produces these ecosystem benefits.

There has historically been less diversity in terms of instruments and vehicles used to channel private capital into the water sector (OECD, 2022). Natural infrastructure for water services is a new investment opportunity with the potential for a meaningful impact for private investors, especially those driven by ESG motivations. However, it has some challenges in terms of successfully raising private capital. Known barriers to natural infrastructure investment are difficulties in quantifying and monetizing benefits, lack of revenue streams, long time lags between investment and the realization of benefits, and the fact that projects are often small and localized (Hoekstra, 2022; Hudson et al., 2023; World Bank Group, 2020). Also, nature-based projects tend to be smaller in the amount of investments (Hudson et al., 2023). Not all commonly known ways to mobilize capital discussed in Section 2.3.1 have been effectively applied to natural infrastructure to date.

[16] The developments under the Task Force on Nature-related Financial Disclosures and the ESG guidelines are driving interest from private businesses in mitigating environmental impacts and investing in nature-positive projects. While these reporting standards are largely voluntary, governments are looking into using these standards to expand mandatory reporting (DeLoach, 2023; Lewis, 2023; Yalamanchili & Hardy, 2023).

To identify viable pathways for private financing of natural infrastructure, the following section presents findings from the interviews with private investors detailing the specifics of each financing instrument considered or tested for a natural infrastructure project. The intent is to identify scalable financing mechanisms, which, along with the growing pipeline of projects, would increase natural infrastructure adoption and improve environmental outcomes, with a specific focus on the Canadian Prairies region.

3.0 Insights From Private Investors

This section highlights examples of financing mechanisms that can be used to support natural infrastructure projects based on interviews with 13 investors from the insurance sector, asset management, and impact investment companies operating in Canada, the United States, and the global market.

3.1 Instruments Considered by Private Investors

3.1.1 Carbon Credits

Overview

Carbon credits are tradable permits or certificates that generally represent one tonne of carbon dioxide equivalent (CO_2e) (Peterdy, 2020). Compliance credits are regulated across jurisdictions under cap-and-trade programs. To implement the cap-and-trade programs, a jurisdiction needs to have a specific emission reduction target and identify emitters covered by the regulation (Center for Climate and Energy Solutions, n.d.). A certain number of allowances/carbon credits representing the threshold of their permitted number of greenhouse gas (GHG) emissions can be issued to a corporate entity. If the company can reduce its GHG emissions below its allowance, the result is an excess of compliance credits that can be held for future needs or sold to entities that exceed their GHG emissions limits. Conversely, if the corporate entity exceeds its emission limits, it will be required to purchase additional carbon credits from corporate entities that have emitted less than their allowed limit, or GHG offset providers that have generated GHG mitigation credits (Peterdy, 2020).

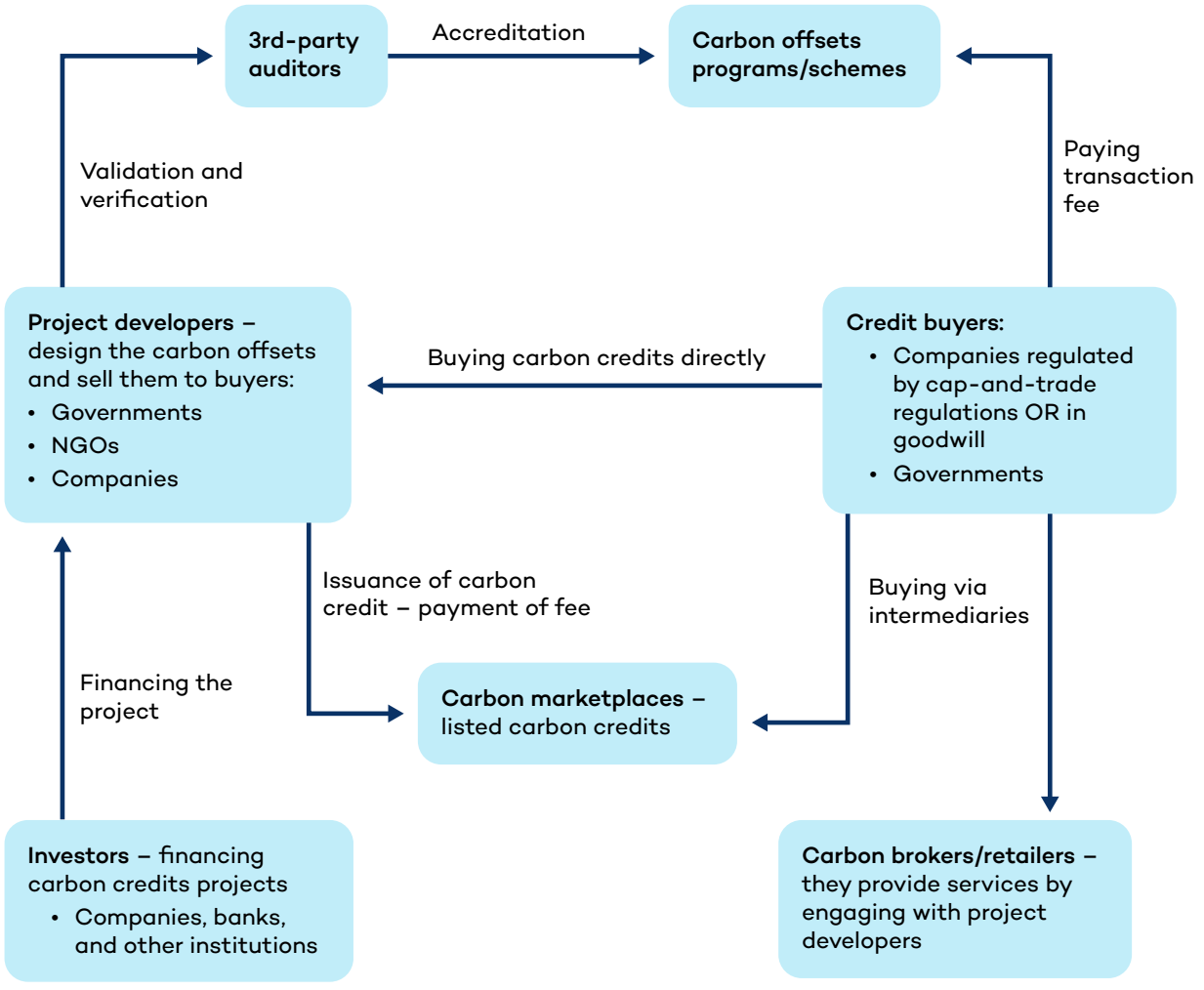
Importantly, compliance credits are different from carbon offset credits. Contrary to compliance credits, offset credits are not necessarily subject to any emission trading scheme from a specific jurisdiction, and they can be exchanged either within a compliance market[17] or in the voluntary market globally. While both compliance credits and offset credits have measurement units in tonnes of CO_2e, the difference lies in the use of the measurement. Compliance credits measure the limit of allowed emissions, while carbon offsets measure the compensation for emissions through carbon reduction investments (Peterdy, 2020). The current landscape of carbon markets distinguishes between avoided emissions credits and removal credits. Notably, the Verra voluntary carbon standard is anticipated to mandate the separation of credits into avoided and removal categories in future iterations. Removal credits commonly encompass carbon capture and storage, direct air capture, and natural solutions such as reforestation, afforestation, and restoration credits. However, one interviewee suggested that avoided emissions hold comparable, if not greater, significance compared to removals. This is underscored by the argument that protecting

[17] In Canada, only projects that comply with federally and provincially approved protocols can be used for compliance offset purposes.

trees not only averts the release of emissions but also increases the potential for continual carbon sequestration, consequently qualifying as removals.

Both compliance credits and offset credits can be used to finance carbon reduction projects. These projects are defined as **nature-based** or **mechanical**. Nature-based projects are restoration and conservation initiatives such as mangrove and forest restoration and avoided conversion of intact nature-based carbon sinks (i.e., natural infrastructure). Mechanical projects represent investments in energy efficiency and CO_2 reduction and capture technologies using grey infrastructure (Peterdy, 2020).

Figure 5. Investing in natural infrastructure through carbon credits



Source: Author diagram based on Paia Consulting, 2021.

Figure 5 depicts the carbon offset market mechanism. It explains the process of generating offset credits by the project developer, which undergo verification by third-party auditing firms and accreditation or certification by independent standards bodies (such as Verra, Gold Standard or CAR, among others). Carbon brokers then play a role in matching the demand and supply of carbon credits between credit buyers and issuers.

In Practice

In Canada, regulated carbon markets were first created as part of provincial systems in Alberta, British Columbia, and Quebec/California. In 2007, Alberta passed the Specified Gas Emitters Regulation under the Climate Change and Emissions Management Act, which established a GHG pricing regime for industrial emissions (Sopher & Mansell, 2013). British Columbia introduced a carbon tax in 2008, and in 2009, Quebec adopted its GHG emission reduction target for 2020, which was essential in setting up its cap-and-trade scheme with the adoption of the Regulation Respecting a C&T System for Greenhouse Gas Emission Allowances in December 2011 (Fernandes, 2022; Gouvernement du Québec, 2018). At the federal level, the demand for carbon credits was created by the Greenhouse Gas Pollution Pricing Act, which came into force in 2018 and introduced an output-based pricing system (OBPS) for industrial GHG emissions. The OBPS outlines the procedures to compensate for excess emissions through offset credits or through the purchase of compliance credits (Government of Canada, 2024). Offset credits are generated from voluntary projects implemented in accordance with a federal offset protocol (Environment and Climate Change Canada [ECCC], 2023b). To support the compliance requirements set under OBPS, in June 2022, the government launched the Greenhouse Gas Offset Credit System (Federal Offset System). The offsets in the Federal Offset System can also be purchased by companies looking to reduce their GHG emissions as part of their voluntary climate commitments, in addition to compliance offsetting. As for the provincial carbon offsetting systems in Canada (many of which were established earlier), if the offset credits are generated from projects under "recognized protocols," these credits can be used to meet the demand of the federal OBPS market. For example, offsets generated from Alberta's offset program can also be used for compliance under OBPS. In Alberta, four protocols are being used in agriculture; however, no protocols are fully developed and in use for wetlands, forages, or forestry[18] (Government of Alberta, n.d.). Climate Action Reserve, in partnership with Viresco Solutions, developed a Grassland Protocol for eligible projects in Canada that are relevant to natural infrastructure (Climate Action Reserve, n.d.). This protocol provides incentives for the ranching community to refrain from converting grasslands to cultivated crops, thereby fostering robust biodiversity outcomes.

Certain projects based on aquatic ecosystems can provide large carbon sequestration benefits. These benefits can potentially be captured by so-called "blue" carbon credits and generate a revenue stream to fund conservation and restoration of water-related habitats. Tahiry Honko's

[18] Voluntary offsets from actions meeting the approved provincial protocols can be listed on the Alberta Emissions Offset Registry for purchase by regulated emitters in Alberta.

project in Madagascar is an example of a blue carbon credit. The restoration and conservation of mangroves sought to ensure flood protection and resilience for local communities. Since 2018, the project has issued 1,300 carbon credits per year, raising USD 27,000 every year. The revenue generated by the sale of carbon credits is able to cover both project costs and social infrastructure for the local community, such as schools and hospitals (OECD, 2021).

Main Takeaways

Carbon compliance or offset credits can be a mechanism to monetize the ecosystem services of carbon sequestration from natural infrastructure projects and raise funding to invest in restoration or conservation activities or engineered natural infrastructure projects. According to the interviews with impact investors and asset managers, the demand for these credits is strong.

Despite the benefits of monetization of the carbon sequestration service and the growing demand for carbon credits, there are several important criticisms of carbon offsets and compliance credits that strongly affect their trustworthiness.[19] These concerns include companies making misleading claims about GHG reductions or using voluntary carbon offsets as a substitute for reducing emissions within their own operations. While voluntary carbon offsets can be a legitimate way to support emission reductions and certifiable co-benefits, they should not be used to enable companies to continue emitting GHGs without taking concrete steps to reduce their emissions (Scher & Christophersen, 2023). Recent research has shed light on a persistent problem: certified carbon credits frequently fall short in validating the benefits they purport to offer (Greenfield, 2023). Moreover, studies indicate a notable misalignment between the claims they make and the actual outcomes achieved, notably in terms of reforestation, emissions reduction, and broader climate advantages. This misalignment has also exposed an apparent tendency among a substantial portion of carbon credits to overstate their impact on ecosystem protection. Consequently, these findings raise significant concerns about the efficacy of the verification process for carbon credits, underscoring the need for greater scrutiny and transparency in this domain (Greenfield, 2023).

Other issues associated with carbon offset credits are potential leakages, the risk of reversal, and additionality challenges. **Leakages** are defined as unintended consequences of the carbon reduction project resulting in increased carbon emissions elsewhere. For example, the leakage can happen when the user of the area whose activities result in carbon emissions, e.g., logging, moves to a new area to perform this activity, resulting in no net changes in emissions, known as "activity-shifting" leakage. Leakages can also be market related. For example, a reforestation project might affect not only the supply chain of timber but also its demand and market price somewhere else (Natural Climate Solutions Alliance & Boston Consulting Group, 2022).

The **risk of reversal** refers to the possibility of carbon reductions being reversed in the future due to unforeseen circumstances such as catastrophic natural disasters (e.g., wildfires, pest infestations), the risk of which may be increased by climate change or poor management. A

[19] The criticisms outlined in this section mostly refer to offset credits rather than compliance credits, which are usually very carefully measured according to accepted methodologies.

solution to mitigate the risk of reversal is the establishment of buffer pools. By establishing sufficient buffer pools at both the project and global levels under international standard bodies, carbon credit projects can remain credible and continue to produce high-quality outcomes even in the face of unforeseen challenges (Natural Climate Solutions Alliance & Boston Consulting Group, 2022).

As for the **additionality requirement**, certain carbon projects have been criticized on the basis that the carbon reduction would have happened even without the project (Greenfield, 2023). Thus, the additionality criteria should be in place to ensure that the project generates real changes rather than simply reflecting business as usual. One way of achieving this is reviewing historical GHG data at the project location. By using this methodology, it is possible to ensure a reliable assessment of the outcomes generated by the project; however, this data might not always be available (Greenfield, 2023).

Therefore, the primary concern regarding offset credits is the quality of the credits themselves, as well as how to ensure that the underlying projects have a significant impact on mitigating climate change. More rigorous standards and verification processes could address the issue of quality. However, given the complexity of ecosystem functioning and the multiple factors that influence carbon sequestration, including climate and management, there could be data and modelling limitations to conclude with certainty whether offset credits are, in fact, providing net carbon emission reductions.

Buyers of offset credits are becoming more sensitive to the quality of the offsets and the environmental outcomes delivered by the underlying project.

One interviewee stated that buyers of offset credits are increasingly concerned about the credibility of the credits and ensuring the tangible environmental outcomes are delivered by the underlying project. Despite the criticisms, the voluntary market is shifting toward high-quality credits such as those linked to **reduced tropical deforestation** from government programs (Lombard Odier Asset Management, 2023). As another example, Nature Conservancy of Canada's (NCC's) Darkwoods Forest Carbon Project used "the highest international standards available" to generate internationally certified carbon credits on the voluntary carbon market from the Darkwoods Conservation Area in Canada (NCC, n.d.-a; Verra, n.d.). According to an asset manager, the measurement, reporting and verification process is important for determining the amount of GHG emission reductions generated from a conservation or restoration activity. Therefore, the third-party verifier has a key role in certifying carbon credits.

One interview observed that, overall, "Carbon sequestration is only a piece of the puzzle." The ecological value of natural infrastructure is much larger than carbon sequestration alone, and other environmental outcomes can be quantified for financing or certified under carbon credit standards (See Sections 3.1.2 and 3.1.3).

3.1.2 Biodiversity Credits

Overview

Biodiversity can be described as the collective variety of plant, animal, and microorganism species within a specific region, encompassing the different types of species and their interactions within their ecosystems (World Wildlife Fund, 2023). Biodiversity credits are a tool that allow companies to invest in projects that enhance or protect biodiversity (Gray & Khatri, 2022). Through the implementation of these projects, biodiversity credits can be traded to investors, facilitating the financing of natural infrastructure projects for positive biodiversity outcomes.

The economic justification behind this instrument is the possibility of quantifying the negative or positive impact on biodiversity through credits and debts. In this way, companies can mitigate the negative effects on biodiversity or encourage positive interventions on biodiversity (Gray & Khatri, 2022). Also, private landowners can generate income from selling biodiversity credits by restoring and conserving nature (Jennifer L, 2022).

Biodiversity offsets and biodiversity credits serve distinct purposes within the realm of nature conservation and restoration. While both involve addressing biodiversity concerns, they differ in their underlying principles and regulatory aspects. Biodiversity offsets involve compensating for environmental damage by a company. These are typically mandated by legal regulations and are often a prerequisite for obtaining permits or allowances, such as exploitation permits issued by the state. In essence, they require companies to mitigate or offset the harm caused to biodiversity resulting from their activities.

Conversely, biodiversity credits are a voluntary mechanism aimed at fostering positive contributions to biodiversity. Unlike offsets, they are not legally mandated but rather incentivize organizations to proactively enhance biodiversity. These credits are typically earned by organizations that demonstrate a measurable and beneficial impact on biodiversity through their actions and are not permitted to be used as offsets (Jennifer L, 2022).

Even if the market for biodiversity credits is in its very early stages, national legislation and private market initiatives for biodiversity are starting to set the foundation for future biodiversity markets. For example, Canada has recently proposed the Offsetting Policy for Biodiversity, with public input solicited in December 2022–February 2023 (ECCC, 2020, 2023c).

In Practice

The EcoAustralia credits is an interesting initiative that combines carbon credits with a biodiversity component. Buyers of EcoAustralia credits will directly finance conservation projects that protect biodiversity in Australia. In this case, the credits are not used for offsetting, as there is no compensation mechanism for biodiversity losses (World Economic Forum, 2022).

The UK-based organization Botanical Gardens Conservation International is initiating projects aimed at safeguarding endangered tree species for the biodiversity credit market. These projects

are facilitated by a global network of over 800 botanical gardens and conservation groups, which have identified 65 potential projects across Africa, Latin America, and Asia. The sale of biodiversity credits in the voluntary market could potentially establish a consistent revenue stream for biodiversity protection (Carbon Pulse, 2023).

Main Takeaways

New market opportunities are emerging from pricing positive and negative externalities. A financial institution interviewed as part of this study observed that more investors are integrating monetized externalities into financial instruments. In this context, biodiversity credits are gaining particular traction. This push is also coming from governments, with the introduction of new initiatives such as the biodiversity offsetting pilots in the United Kingdom (UK Government, 2013) and new biodiversity legislation in the United States (Medlong et al., 2022). New legislative initiatives in the context of government offset schemes allow for an increase in transparency and guidance on biodiversity credits. Improved guidance on offsets schemes can thus strengthen good practices for biodiversity credits traded in the voluntary market (Taskforce on Nature Markets, 2023).

Defining units for biodiversity remains the main challenge.

An important issue remains—how to define one "unit" of biodiversity. The unit for carbon credits is clearly defined as 1 metric tonne of CO_2e, whereas the unit for biodiversity credits has no clear definition.[20] Also, data availability for biodiversity is fragmented. Lack of metrics and standardization increase the complexity, potentially leading investors to malpractices (Cox, 2022). The International Union for Conservation of Nature (IUCN) Species Threat Abatement and Restoration (STAR) metric is one example of a biodiversity metric (IUCN, n.d.). Moreover, the Taskforce on Nature-Related Financial Disclosure is working on a disclosure framework on how to report and manage nature-related risks (Gray & Khatri, 2022). This initiative should provide additional clarity on biodiversity metrics.

According to one interviewee from an investment firm, the monetization of externalities should be applied systemically to integrate externalities by pricing specific impacts. For example, a biodiversity loss is monetized according to the cost increase generated for the company, which can be financial, operational, or reputational. The interviewee suggested that this approach should be based on a risk and value-creation perspective, contributing to the long-term value of the company. Investors should not perceive biodiversity as a liability, but they should perceive it as an asset that can generate future economic benefits for the company and stakeholders. As a result, the interviewee had a positive sentiment toward biodiversity credits because large biodiversity

[20] For example, a carbon credit is one exchange unit based on 1 metric ton of greenhouse gasses https://www.carboncreditcart.com/carbon-credits-101/

benefits are directly correlated to the long-term value creation of the company. Another interviewee observed that biodiversity credits have the potential to be traded at a premium. This means that the price for biodiversity credits could be higher than the usual market price of carbon credits.

Conversely, other investors consider biodiversity impossible to measure, raising issues with possible standardization. Biodiversity in Indonesia is very different from biodiversity in Brazil. Thus, a biodiversity credits system acknowledges and accounts for differences among various management interventions and locations, rendering it a complex framework to standardize. In order to have tradable biodiversity credits, it is necessary to make biodiversity fungible. Given the difficulties in quantifying biodiversity, some investors consider nature and, therefore, biodiversity, non-fungible, preventing the creation of a biodiversity market (Cox, 2023). Another issue is the potential disruption caused by the proliferation of different metrics and standards increasing uncertainty on how to account for biodiversity.

The challenges are evidently centred on establishing robust protocols and standards. However, it is important to note that biodiversity credits necessitate the active involvement of individuals responsible for the stewardship of natural ecosystems. In many biodiversity-rich regions, conservation and restoration efforts are intricately tied to the intentions and land tenure of those who safeguard these ecosystems. It is within this context that issues like greenwashing and human rights violations can become significant points of concern.

Given these issues, some investors argue that **biodiversity has the potential to be more effective as part of carbon credits**. There are already carbon credits with biodiversity co-benefits that are typically sold at a higher price, allowing them to generate additional revenue (Manuell, 2023; Rinne, 2023).

3.1.3 Outcome-Based Financing Model

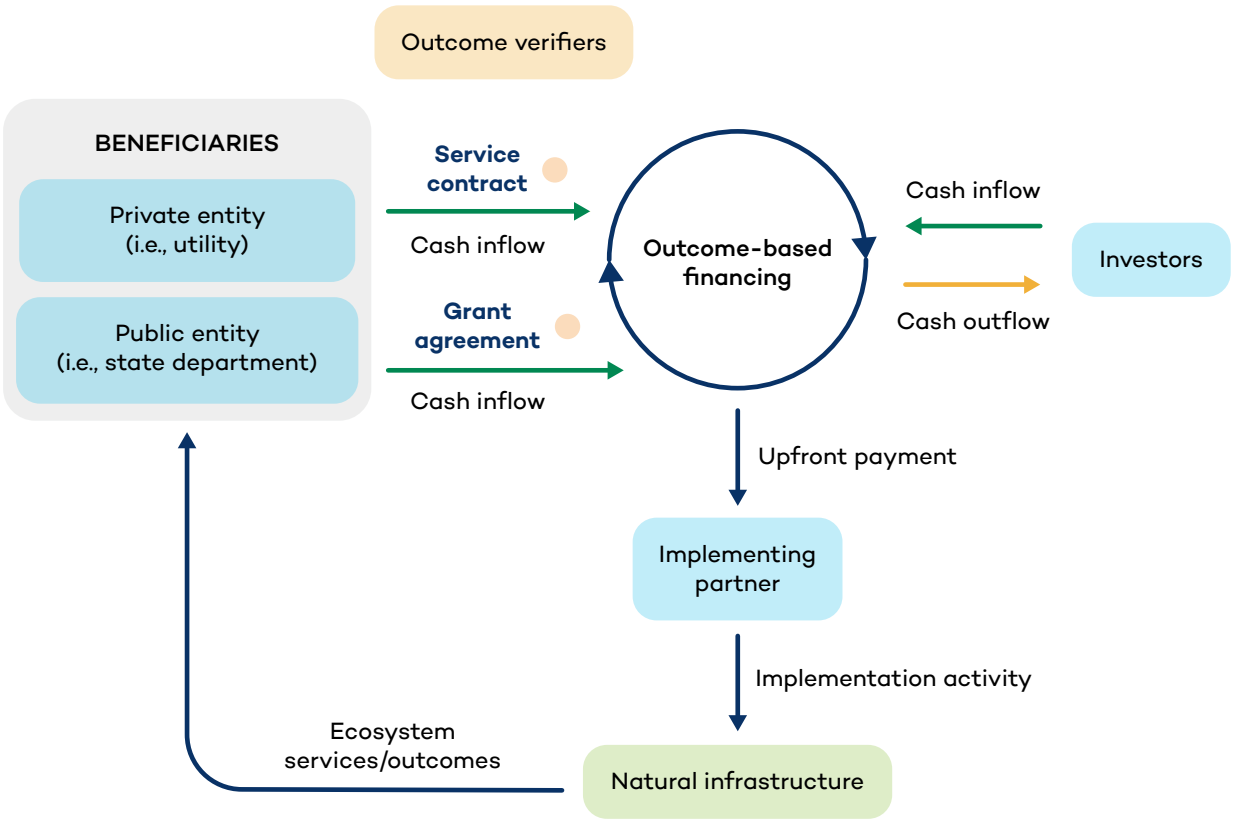
Overview

In this model, investors provide financing to cover the implementation costs of the natural infrastructure project. Project beneficiaries—whether public or private—then pay for outcomes of the natural infrastructure projects, generating the revenue stream to repay investors (Blue Forest Conservation & Encourage Capital, 2017). The model is coordinated by a facilitator or an intermediary who determines the payment and contract terms for all parties involved and who may also coordinate the implementation of projects (Figure 6).

One example of the outcome-based financing model is the environmental impact bond (EIB), which is gaining traction in financing natural infrastructure. The structure is based on the repayment of the debt and interest through the monetization of the environmental benefits generated by the project. Conventional bonds and EIB bonds differ in certain aspects. While both are characterized by predetermined interest rates and maturity periods, EIBs incorporate performance-based elements to the payment structure. Typically, the EIB aligns

the payment structure with the achievement of the specific environmental outcomes by the maturity date (Peña, 2022). However, while the measurement of environmental outcomes is a distinct characteristic, in some cases, the payment amounts do not vary depending on the quantity or quality of environmental outcomes based on stakeholders' preferences (see Forest Resilience Bond example below). Also, unlike conventional bonds, EIBs are contracts on future outcomes (OECD, 2021).

Figure 6. Outcome-based financing model



Source: IISD elaboration based on Convergence & Blue Forest Conservation 2020, page 5.

In Practice

The Buffalo Sewer Authority EIB and the Forest Resilience Bond (FRB) are two examples of successful outcome-based financing models.

Buffalo Sewer Authority EIB

The Buffalo Sewer Authority EIB, issued in 2021, is the largest U.S. EIB issued to that date for natural infrastructure and stormwater mitigation projects (Quantified Ventures, 2021). The project involved a collaboration between public and private entities. Quantified Ventures served

as the intermediary, facilitating the establishment of the EIB and coordinating the participation of beneficiaries and investors. Morgan Stanley played a key role as the primary investor, while foundations and the Buffalo Sewer Authority were the main beneficiaries who acquired the outcomes generated by the natural infrastructure. The Buffalo Sewer Authority used bond proceeds to implement a natural stormwater infrastructure project that included the construction of rain gardens, tree plantings, and permeable pavement. These measures effectively collect and divert stormwater, preventing it from entering the sewer system during peak periods. The project aligned with the Buffalo City Rain Check Program 2.0 (RainCheck, n.d.), which specifically targeted green infrastructure investments across six sewer basins. Moreover, the program involved multiple stakeholders, including property owners, schools, and non-governmental organizations (NGOs).

The performance of the Buffalo Sewer Authority EIB was linked to the positive outcomes of the natural infrastructure. In the event that the green stormwater infrastructure project successfully achieves or surpasses the 200-acre implementation goal, the EIB offers a refinancing option with enhanced flexibility and reduced debt service. However, should the project fail to meet its objectives by the year 2028, the Buffalo Sewer Authority has the option to redeem the EIB, albeit at a higher price.

An important success factor in this model was the fact that the performance outcome was set independently from the bond. The administrative order by the EPA required the Buffalo Sewer Authority to implement certain activities to improve combined sewage treatment, with financial penalties if the target is not met by a specific date (Buffalo Sewer Authority, 2021). This presented an excellent opportunity for these outcomes to be integrated into the EIB and thus investors' confidence in the credibility of the targets and the commitment of the bond issuer to meet them. Another factor was the willingness of the municipal utility's board to think outside the box and integrate performance metrics into the contact.

Soil and Water Outcomes Fund

The Soil and Water Outcomes Fund, also with the involvement of Quantified Ventures, is another example of outcome-based financing, which is applicable in the agricultural context. Quantified Ventures borrows and effectively distributes money to farmers so they can implement regenerative agricultural practices on their land (Quantified Ventures, n.d.). An independent organization monitors and quantifies water quality improvements and carbon sequestration outcomes of the practices, and then these outcomes are sold to the interested government and corporate beneficiaries, which is thus enabled to repay the debt (Green Finance Institute, n.d.; Quantified Ventures, n.d.). The model thereby allows the stacking of multiple outcome payments. As of 2023, this fund has been expanded to allow 12 midwestern states in the United States to fund conservation on private lands (Quantified Ventures, n.d.).

Forest Resilience Bond

Another example is the FRB for the Yuba Project, successfully implemented by Blue Forest, in partnership with the Tahoe National Forest, Yuba Water Agency, and World Resources Institute. The total investment amounted to USD 4 million over 5 years for the North Yuba River watershed in Tahoe National Forest, California. The structure comprised a service contract with the Yuba Water Agency, which was interested in the water quality and quantity benefits of the project[21] and a grant agreement with the Department of Forestry and Fire Protection of the State of California, which was interested in the fire prevention benefit of the project. Alongside market-rate investors, foundations have participated by providing a concessional loan to support the innovative model of the FRB (EPA, 2021).

The main objective of the project was forest restoration to mitigate fire risks in the area. This included additional benefits such as the protection of water quality and improving water flows for downstream supply. The Yuba Water Agency recognized the water benefits of forest restoration by stipulating the contractual payments that allowed the project sponsor to attract private investors and secure the realization of the project. Blue Forest also managed to attract private and impact investors. The investors' participation arose for different interests and reasons. For example, some investors were looking at the societal returns, others at increasing forest restoration investments, and others at insurance risk reduction on properties (EPA, 2021). However, in contrast to the Buffalo Sewer Authority EIB, Blue Forest did not integrate outcome metrics into the contract with the water utility since this would have created uncertainty for the utility in terms of payments and budget planning. Rather than creating the payment-for-success structure where the return to investors would be variable, the water utility was interested in implementing a pilot. The main metric used was the acres restored. The pilot started with the partial landscape restoration, and the second contact with the water utility was contingent upon the success of the first pilot. The Yuba Water Agency was interested in the environmental benefits of forest restoration for their operation and licensing, and a cost-benefit analysis was produced. Recognizing the benefits of the first pilot project, the Yuba Water Agency raised its commitment from USD 1.5 million for the first FRB to USD 6 million for the second (Blue Forest Conservation, 2021). Overall, Blue Forest was able to capitalize on the success of the first Yuba Forest Resilience Bond, issuing a new *Yuba II Forest Resilient Bond* in 2021. With an increased financing of 25 million USD compared to the first FRB, the new project intends to focus on forest resilience and post-fire restoration activities.

Deshkan Ziibi Conservation Impact Bond

In Canada, an example of the outcome-based financing model is the Deshkan Ziibi Conservation Impact Bond (CIB), launched in March 2020 (Deshkan Ziibi Conservation Impact Bond Leadership Team, 2021). The project raised CAD 130,000 from the VERGE Breakthrough Fund in the form of a legally binding loan over 3 years at a 5% interest rate to restore 150 acres in the Carolinian Zone, Ontario. This region is highly biodiverse; however, its biodiversity is

[21] The Yuba Water Agency owns and operates water storage facilities, generates hydropower, and supplies water to eight irrigation districts for agricultural uses. https://www.yubawater.org/175/About-Yuba-Water-Agency

under threat because of conversion of forest cover to cropland, pasture, and urban development (Deshkan Ziibi Conservation Impact Bond Leadership Team, 2021). Pollinator Partnership Canada (a non-profit), 3M corporation and the federal government would pay the investors for the cost of implementing the project plus a premium if the project is successful. A crucial part of this pilot project was the inclusion of both Indigenous and Western worldviews in the design of the CIB. The First Nation partners were actively engaged in an ethical space[22] and provided guidance on the outcome metrics based on their values. Five pay-for-success metrics were selected for evaluation: a) number of hectares of habitat improvements (increasing habitat quantity, quality, and commitment); b) number of people engaged with learning about the land; c) number of intercultural and cross-sectoral economic opportunities; d) nature connectedness which reports on "impacts related to enhancing relationships among people and between people and ecosystems", and e) quantity and quality of ecocentric sightings which reports on "impacts related to enhancing relationships among non-humans within ecosystems" (Deshkan Ziibi Conservation Impact Bond Leadership Team 2021, p. 75). However, specific outcomes were not strictly embedded into the financial agreements since it was a pilot project. As stated in Deshkan Ziibi Conservation Impact Bond Leadership Team (2021, p. 81), "The outcome payer funding is legally bound to the achievement of specific outcomes, but thresholds and outcome reporting has a bit more leniency as the viability of the pay-for-success model is being tested and adapted through the prototype."

Main Takeaways

During the interviews, representatives from two organizations with the roles of the facilitator or intermediary in this model underlined several key aspects of the successful implementation of outcome-based financing models.

Monetization of Ecosystem Services and Diversification of Cashflow

An intermediary recognized the critical role of the outcome-based financing model in financing natural infrastructure: "We believe that the outcome-based financing model can contribute to scaling up investments in natural infrastructure." Compared to other financing models for natural infrastructure, an outcome-based financing model can help diversify cash flow, create economic advantages for beneficiaries, and generate returns for investors (Blue Forest Conservation, 2021). In other words, this structure can improve the financing profile of natural infrastructure by incentivizing investors to take on some of the risks.

[22] "Ethical space involves groups from disparate worldviews engaging with each other. […] The purpose of ethical space is to create a safe setting where knowledge systems can interact while the integrity of each diverse system is respected and validated" (Deshkan Ziibi Conservation Impact Bond Leadership Team, 2021, p. 51).

An outcome-based financing model can create opportunity to diversify cash flow, create economic advantages for beneficiaries, and generate returns for investors.

One interviewee observed that, in contrast to municipal green bonds that are about the **interest** in improving environmental outcomes, outcome-based financing models work out a specific **roadmap** of how outcomes are going to be achieved and verified, ensuring accountability and impact for green investments. Another interviewee highlighted the importance of adopting a scientific approach to accurately quantify and measure environmental outcomes such as water quality and carbon sequestration. Applying scientific methods ensures precise measurement and assessment of the environmental impacts, allowing for informed decision making and effective evaluation of sustainability initiatives. Also, while this approach allows for the valuation and pricing of specific outcomes, the ultimate price of these outcomes is determined by the facilitator. **The facilitator negotiates the price based on the willingness of the beneficiary to pay for the particular outcome**. Outcome monetization can also be in the form of cost reduction for the beneficiaries. For example, a restored wetland can cost-effectively meet the water treatment needs in a community and ensure compliance with water quality standards, this way reducing the need for a costly grey infrastructure upgrade (Ross, 2019).

Contractual Relationship With Beneficiaries

Involving beneficiaries is crucial for generating revenue streams from ecosystem services. Throughout the interviews, various approaches and strategies emerged regarding how to involve and engage with beneficiaries. Often, public water utilities are not inclined toward a payment-for-success arrangement where payments to investors would vary based on the project outcome. Thus, a straightforward service contract for a pilot natural infrastructure project—with the possibility of continuation if successful outcomes are achieved—is a potential option to engage interested municipalities.

Successful engagement highly depends on the strategy adopted by the intermediary to satisfy the needs and expectations of the beneficiaries. As one interviewee stated, it is important to sell to the beneficiaries **only the specific outcome** that they might be interested in and not just the model as a whole: "Once we have an established price for the water purification outcome, we meet with the water utilities and the state department. We don't ask them to be part of the model but only to buy the water purification outcome generated from the natural infrastructure."

Investors' Role

Investors play a crucial role as part of the outcome-based financing model by directly financing the implementation costs of natural infrastructure projects. According to one interviewee, the risk perception of financing natural infrastructure projects has improved over time in the

United States: natural infrastructure is no longer considered a risky investment, owing in part to successful financing examples. Investors are more aware and interested in natural infrastructure solutions; however, there are several key elements that need to be accounted for when involving investors in these models.

According to an intermediary with experience working with EIBs, investor participation depends on a clear disclosure of financial metrics and how the project intends to achieve its goals. Also, quantifiable targets are preferred because they are less subjective. Another important aspect is the creditworthiness of the issuer and the project. Private investors are willing to invest in projects with attractive risk-return profiles.

Finally, as one of the most well-developed and quantifiable "outcomes" in high demand, quality carbon credits can be integrated into an outcome-based financing structure since natural infrastructure projects hold the potential to deliver significant carbon sequestration benefits. Developments in the carbon market have sparked growing interest among corporations in purchasing carbon credits to fulfill sustainability goals and commitments. The inclusion of quality carbon credits within the outcome-based financing model provides an additional avenue for businesses to actively engage in environmental conservation and demonstrate their commitment to mitigating climate change.

3.1.4 Natural Asset Companies

Overview

In 2021, the New York Stock Exchange (NYSE) and Intrinsic Exchange Group announced the launch of a new asset class called Natural Asset Companies (NACs) (Harty, 2021). NACs aim to raise capital for natural assets and natural infrastructure by creating a long-term equity structure that can be traded in the capital market (Stead, 2022).

NACs typically hold rights to the production or sustainable use of ecosystem services, while the ownership of the natural asset itself remains with the original owner, which could be a public entity, government, or landowner. For instance, a company that holds rights to the sustainable use of a wetland can raise financing through an initial public offering (IPO). Investors are attracted by the potential revenue stream generated by the underlying ecosystem services of the natural asset. The rights related to sustainable land use encompass land regeneration, conservation, protection, and restoration. The proceeds from the IPO are then used to finance conservation or restoration efforts, such as mangrove restoration within the wetland (Carlucci, 2023).

Companies aiming to be listed on the NYSE must meet governance requirements that guarantee the board's independence and expertise. Transparent governance, coupled with rigorous third-party auditing, should enable investors to validate the company's efforts in restoration and conservation practices.

In the long term, revenue stream(s) linked to ecosystem services may be derived from, for example, tourism activities and carbon credits. NACs have the potential to unlock more

capital for nature conservation and restoration and promote the standardization of natural capital accounting.

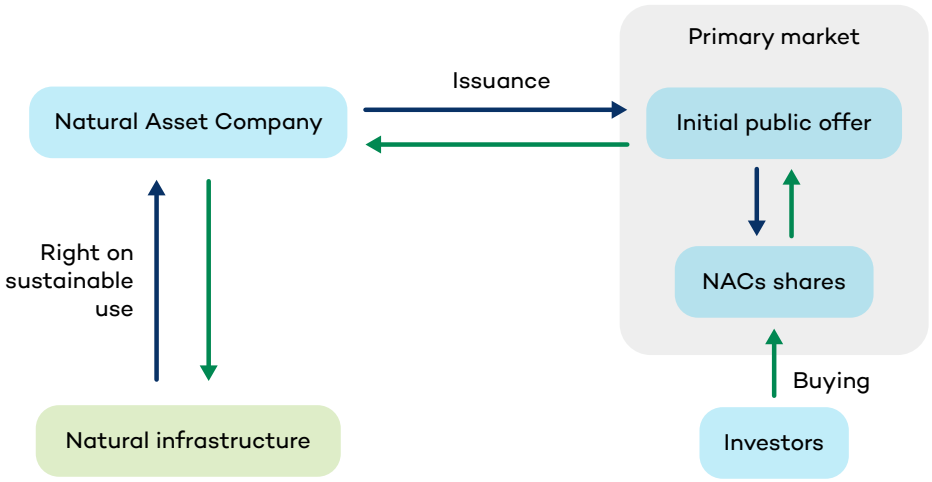
In Practice

Because the NAC concept is still in its early stages, more time is needed to see its practical implementation. However, the government of Costa Rica is currently working with the Intrinsic Exchange Group to establish a NAC (Inter-American Development Bank, 2021). This initiative aims to finance conservation practices that align with the country's environmental and social priorities. According to the government, a pilot project for a national-level NAC can contribute to the analysis of nature's economic benefits and increase capital flows for conservation and restoration practices in the country (Stead, 2022). As more NACs are established and their impact is observed, the approach can be refined and expanded, potentially leading to broader adoption.

Main Takeaways

One asset manager discussed NACs as a possible solution for financing natural infrastructure. While still in the early stages of development, NACs can advance the creation of nature accounting practices. In this context, the asset manager highlighted the **importance of viewing nature as an asset rather than a liability**. NACs have the potential to reinforce this perspective and ensure that natural capital is accounted for in terms of its economic value. Additionally, the Financial Accounting Standards Board has supported the creation of accounting practices for the NAC asset class, ensuring robust guidance on how to value nature (Stead, 2022).

Figure 7. Natural asset companies [Green arrows represent cash flow]



Source: Authors' diagram.

Another positive aspect is the investor outreach. By launching an IPO, NACs can potentially attract a large pool of capital from institutional and retail investors. According to the interviewee, this has the potential to help reduce the ongoing financing gap in natural infrastructure. Moreover, listing requirements can ensure NAC credibility and transparency, allowing investors to verify conservation activities and the company's governance.

Despite the potential benefits of financing natural infrastructure, some investors have expressed concerns. One interviewee emphasized the potential risk of "privatizing nature."[23] While NACs only hold rights for the sustainable use of ecosystem services and not land ownership, this arrangement can still generate risks, potentially infringing on local communities' rights. This is especially critical, as Indigenous communities have often experienced violations of their land rights. Therefore, the ability to exercise land stewardship rights in NACs needs to be carefully assessed by competent public authorities. The principles of the United Nations Declaration on the Rights of Indigenous Peoples and the recommendations made in 2020 by the IUCN (2020) on nature-based solutions need to be upheld. Communities should benefit directly from this funding and have opportunities for active engagement.

3.1.5 Insurance

Overview

Insurance plans typically safeguard asset owners and local governments from financial losses resulting from severe natural events. As severe weather events become more frequent due to climate change, the insurance industry is expected to bear increasing losses. In 2022, the global insured losses from extreme weather events amounted to USD 120 billion (Munich Re, 2023), and the average annual insured losses over the last 5 years (2017–2021) amounted to USD 97 billion (Munich Re, 2023). Insured losses from severe storms in the Canadian Prairies and Central Canada in June–July 2023 were estimated to be CAD 300 million (Insurance Bureau of Canada, 2024). As the frequency and intensity of extreme weather events increase, some insurance companies are no longer offering insurance coverage in vulnerable areas: for example, the large insurance company State Farm stopped offering all business and personal lines of property and casualty insurance in California in large part due to increased risk of wildfires (Flavelle et al., 2023; State Farm, 2023). The insurance industry has shown growing interest in natural infrastructure as a way to invest in resilience and buffer against financial losses (The Insurer, 2023; Moudrak et al., 2018).

Two key insurance products utilized by the insurance sector are Indemnity Insurance and Parametric Insurance:

1. **Indemnity insurance** offers compensation to the insured party for damages to assets such as properties and infrastructure. The value of the insured asset is determined based on its market price, while the insurance premium depends on the likelihood of a natural

[23] More details in Section 4.

event causing damage and the cost of repair. This insurance type is typically employed for natural events of low severity but high frequency (Bechauf, 2020).

2. **Parametric insurance** is typically provided in response to extreme natural events. The insurance payouts are dictated by specific parameters or metrics that correlate with the severity of the natural event. For instance, the policy is triggered when wind speed and rainfall exceed a certain threshold in a specified geographical area. Following such an event, the insurance company provides immediate payouts for emergency responses and long-term reconstruction (Bechauf, 2020).

Despite the insurance sector's clear understanding of climate-related challenges, there is a noticeable lack of development in insurance schemes designed to bolster resilience. A 2022 survey revealed that a mere 8% of the insurance companies interviewed[24] had implemented strategies specifically aimed at enhancing resilience (Walsh, 2021). Nevertheless, in Canada, there are emerging initiatives demonstrating the interest of the insurance sector in improving resilience through natural infrastructure, such as the Nature Force initiative. This initiative is bringing together 15 Property and Casualty (P&C) insurance companies who, in partnership with one of the leading conservation organizations in Canada (Ducks Unlimited Canada), are aiming to fund natural infrastructure "in urban adjacent areas and upstream watersheds in the Fraser Delta area of British Columbia and the highly settled regions of Ontario and Quebec" (Ducks Unlimited Canada, n.d.; Nature Force, n.d.).

The following section unpacks insights gleaned from interviews regarding initiatives to support natural infrastructure currently being considered by insurance companies.

In Practice

An interesting example of parametric insurance is provided by the Mexican Coastal Zone Management Fund established by the Quintana Roo government. The trust fund represents an institutional arrangement that allows the collection of contributions from all beneficiaries, purchase of the insurance contract, and allocation of funding for the natural asset. The trust fund was established by the Quintana Roo government and is managed by a technical committee with representatives from each category of beneficiaries: Quintana Roo state, hotel associations, local municipalities, NGOs, and secretaries of state. In addition to this, technical subcommittees consisting of experts (including coastal marine scientists) provide advice and guidance on practical aspects of the project, including maintenance and repair activities (The Nature Conservancy [TNC], 2022b).

The trust fund purchased parametric insurance, which means that the insurance payouts are based on meeting certain parameters. In this case, when the wind speed is greater than 100 knots, the parametric is activated, and the insurance provides an emergency response by distributing the payout to the trust fund to repair the reef (Figure 8) (TNC, 2022b). The model was successfully applied in 2020 when a storm hit the Caribbean coast, and the parametric insurance was

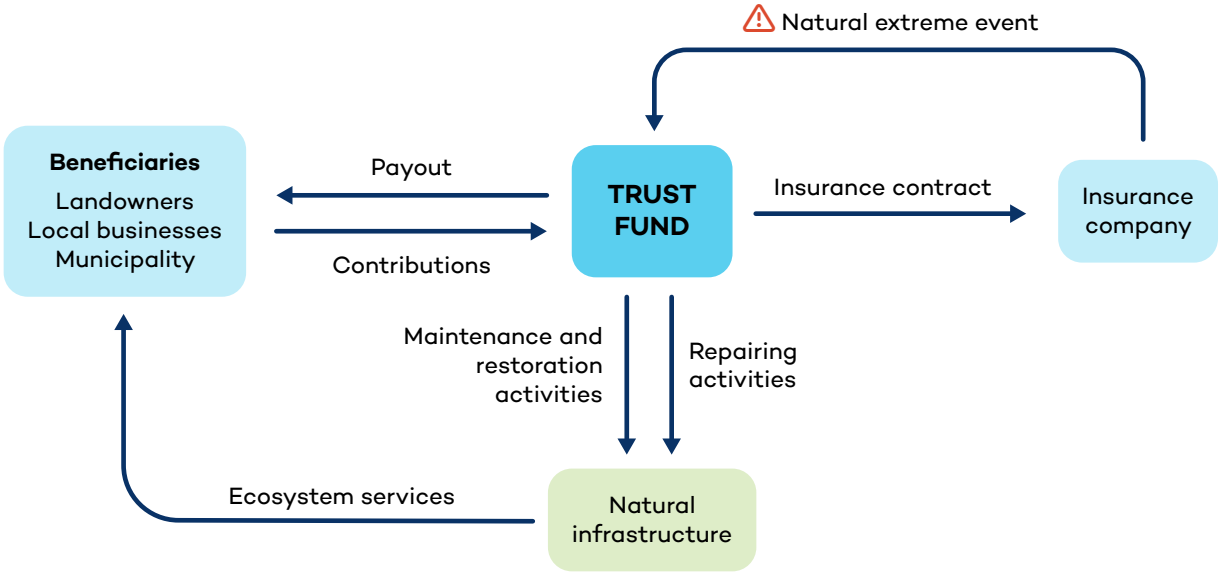
[24] The research covers insights from 29 markets, including Canada (Capgemini & Efma, 2022).

triggered, disbursing USD 850,000 to repair the reef. This was considered the first time that this insurance model provided an immediate response to recover the reef (TNC, 2022a).

An interesting aspect of this example is the self-insurance component. If the wind speed does not reach the threshold but the reef is damaged anyway, the trust fund can act as self-insurance, paying for the reef restoration (Kousky & Light, 2019). Also, as in the outcome-based financing model discussed earlier, this example brings in contributions from a diverse set of beneficiaries of the natural assets' services, which is key to its structure.

Importantly, this example illustrates the role of insurance in providing emergency response to restore natural assets/natural infrastructure in response to severe weather events. However, it does not involve the insurance industry directly investing in landscape restoration or conservation before damages occur to mitigate climate change and reduce the risks of future weather events. Schemes where the insurance industry incentivizes direct investment into resilience have been proposed, notably the resilience bond model, in which the insurance sector offers "resilience rebates"/lower insurance premiums to be invested in projects that measurably reduce risks. This instrument helps monetize avoided losses through the implementation of natural infrastructure and provides incentives for investing in proactive risk reduction (Vaijhala & Rhodes 2018). For more information, see Coalition for Private Investment in Conservation (2019). However, this concept has not yet had any practical application to indicate whether or not it is scalable (Muir, 2022). Nevertheless, Guy Carpenter, a global risk and reinsurance specialist, has begun testing the idea of a climate resilience bond pilot with multiple stakeholders (The Insurer, 2023).

Figure 8. Insurance mechanism



Source: IISD elaboration from Berg et al., 2020.

Main Takeaways

During the interviews, insurance companies discussed their roles in the context of natural infrastructure. One option is for insurers to **protect and de-risk natural assets** by insuring the natural asset. According to one interviewee, a significant barrier to insuring natural infrastructure is the lack of a long-term track record. Insurers are bound by fiduciary duties and capital requirements to ensure solvency, which can be challenging to fulfill when insuring natural infrastructure.

In this context, **insurance functions as a mechanism for transferring risk** rather than serving as a direct source of financing. While insurance mechanisms may not provide a one-size-fits-all solution for funding conservation and restoration initiatives, the process of de-risking natural assets could create additional incentives for financing natural infrastructure. De-risking natural infrastructure can enhance the financial viability of the project, thereby attracting private investors.

Insurance premiums can serve as incentives for addressing risks associated with natural assets. One interviewee noted that insurance companies could offer discounted premiums to policyholders who actively participate in restoration and conservation programs. Given that natural infrastructure can mitigate various risks like flooding or coastal erosion, property owners situated near such natural infrastructure can be charged lower premiums (Kousky & Light, 2019). An example of this is the insurance discounts for The United Services Automobile Association (USAA) members who participate in fire risk-reduction programs (National Fire Protection Association, n.d.).

Conversely, a reinsurance company stated that it is not in a position to offer discounted premiums. The central challenge in providing lower premiums is determining how to quantify risk reduction resulting from ecosystem services. For instance, it is difficult to forecast the impact of coral reef replenishment on insurance prices that protect communities from storm surges (Kousky & Light, 2019). Another issue is the lack of long-term performance data on natural infrastructure. Since insurance models rely on historical data for future projections, it can be difficult to calculate discounted premiums based on the performance of natural assets. Additionally, savings from lower premiums do not generate sufficient cash flow for reinvestment in natural infrastructure restoration.

> Savings from lower premiums do not generate sufficient cash flow for reinvestment in natural infrastructure restoration, according to an interviewee.

The interviewee also explained the lack of incentives when it comes to insuring natural assets. For an insurance contract to be purchased, there must be an entity interested in insuring the

asset. However, this becomes challenging for public goods like ecosystem services, which provide benefits for free. In such cases, entities experiencing financial losses may not own the asset and may not be motivated to pay for a premium independently (Kousky & Light, 2019).

Given these challenges, an alternative solution has emerged that incorporates a de-risking approach into a financial instrument. This solution enhances resilience through local community contributions. One insurance company presented a novel model based on a trust fund linked to an insurance contract, as described in the example of the Mexican Coastal Zone Management Fund. This model allows the identification and catalyzation of funding from various beneficiaries, such as municipalities, local governments, businesses, and landowners, to restore the natural infrastructure in case of extreme natural events. By contributing to the trust fund, beneficiaries gain long-term protection from the natural assets and their ecosystem services. The restored natural habitat can attract more tourism, increase revenue for hotels and local businesses, and generate additional tax revenue for municipalities that can be transferred to the trust fund (Beck et al., 2020).

In this model, the parametric insurance contract is established between the trust fund and the insurance company. The insurance allows a prompt response in cases of extreme natural events by restoring the natural assets and protecting the beneficiaries through the trust fund. In other words, **the trust fund is the policyholder representing all beneficiaries**. This solves one of major barrier of insuring nature—the identification of the policy owner who can contribute to the insurance scheme.

However, project developers and insurance companies might struggle to get beneficiaries on board. According to one interviewee, "It is not an easy task to convince different parties to participate to the trust fund, demonstrating why the conservation of the natural asset is essential to guarantee protection and reduce the risks from natural events."

According to this interviewee, the insurance can also potentially cover the damages incurred by the beneficiaries (such as landowners and local businesses), who would see their revenue reduced by the impact of natural hazards. This additional feature allows the extension of the insurance scheme to the beneficiaries, not only to the natural assets.

3.2 Lessons Learned From Interviews and Research

Engaging Beneficiaries of Ecosystem Services

Converting ecosystem services into revenue streams is the main barrier to private financing of natural infrastructure. One solution lies in a cost-share financing structure that involves beneficiaries. By securing contracted payments from beneficiaries, ecosystem services can be monetized effectively, as was demonstrated in several outcome-based financing models. The outcome-based financing model generates incentives that make natural infrastructure investible, offering diversified cash flows and economic benefits for beneficiaries while generating returns for investors and incentivizing them to take some risks. Revenue streams can be generated by leveraging the sale of carbon credits and biodiversity credits, as examples.

The main challenge lies in identifying and effectively engaging with beneficiaries who pay for the outcomes and making a compelling case for natural infrastructure. The success of this engagement largely depends on the intermediary's strategy to address the specific needs and expectations of each party involved. The outcome-based financing projects implemented in the United States highlighted the importance of **selling beneficiaries the specific outcomes that align with their interests** rather than the entire natural infrastructure project. In this process, it is key to provide accurate quantification and verification of the outcomes using a variety of credible metrics and methods, such as satellite imagery, on-the-ground measurement and monitoring, and sampling.

Key Roles

Intermediaries can play a crucial role in aligning potential cash flows with blended finance models, which is essential to making investment into natural infrastructure successful. Starting small and simple can build relationships and convince outcome buyers to participate. As shared in the interviews, organizations with private sector backgrounds may be better suited for the intermediary role since they understand the pressures of meeting payroll and driving innovation. It is also ideal for the intermediary organizations to be self-sustaining rather than dependent on government funding.

> Organizations capable of aligning potential cash flows into blended finance models are essential to making investment into natural infrastructure successful.

Different levels of **government** also play a crucial role in blended finance models, acting as potential outcome buyers in the blended structure, enforcing environmental regulations, and driving the demand for environmental outcomes. Private financing can be more effective with government involvement and a regulatory framework that facilitates the monetization of ecosystem services, similar to carbon credits. A tax exemption on the interest derived from investing in these types of instruments or another form of preferential tax treatment can also foster private financiers' involvement.

At local scales, **municipalities can work to better integrate natural assets and natural infrastructure considerations into their own operations**. In Canada, efforts by groups like the Natural Assets Initiative are helping municipalities identify and account for natural assets within decision making, and advocacy is growing to include natural assets in public sector financial statements. Growing demand from investors may push municipalities to consider new mechanisms. However, many municipalities and public water utilities as outcome buyers are averse to the uncertainty associated with variable payment amounts in outcome-based financing, as it complicates budgeting. Finding ways to address this issue is crucial.

In addition, it is important to minimize the transaction costs in these models as much as possible. Transaction costs involve the costs of capital raising, selection of metrics, legal counsel and other resources required to set up the contract. Having a long-term vision on the part of the intermediary that anticipates the replication of these models can justify and reduce transaction costs over time as more natural infrastructure projects are financed.

Also, **relationship building**, which can be time-consuming, is essential for the success of these financing instruments involving multiple partners. Sufficient time and resources should be allocated to building relationships with rightsholders and stakeholders in order to build trust and shared understanding of the goals of the financial instrument and the natural infrastructure project.

3.3 Applicability to the Canadian Prairies

This section provides insights into the applicability of the instruments discussed above to the Canadian Prairies region. In particular, Table 1 provides an illustrative assessment of the existing enabling environment for these instruments in terms of policies, protocols, active organizations, and pilot projects.

In summary, most of the instruments can be tested through pilot initiatives based on existing interest from private sector organizations, outcome buyers, and supporting policies. These pilot initiatives should have Indigenous involvement and demonstrate a commitment to the process of truth and reconciliation. As for carbon credits, there is a strong policy framework that supports the qualification and monetization of carbon benefits of natural infrastructure projects, as well as several active organizations on the Prairies, including NGOs and manufacturers, that are interested in further linking carbon credit supplies and buyers. At the same time, there are many small municipalities in the Prairie region that do not have the capacity to implement elaborate financing models and effectively recover costs of the project implementation and will rely on other levels of government for funding support. Also, investors are interested in deploying a large pool of capital, and there is a need for a coordination body to create a pipeline of natural infrastructure projects on the Prairies. The Canadian example CIB in the Carolinian Zone could be used as an inspiration and model for partnership building, centring on reconciliation in financing landscape restoration and conservation through outcome-based financing models.

Table 1. Overview of instruments highlighted by private investors in terms of their applicability to the Canadian Prairie region

Instrument name & Enabling environment rating[25] **1 – low** **2 – medium** **3 – strong**	**Description of the enabling environment on the Canadian Prairies**
Carbon credits	There are existing carbon protocols in place and under development in the Prairies linked to natural infrastructure[26] and well-developed voluntary and compliance carbon markets.[27] Organizations such as NCC and Ducks Unlimited Canada (DUC) are actively testing practices and developing carbon measurement and monitoring protocols. These organizations are working with landowners and private companies to channel more private funding toward conservation and restoration projects by selling carbon offsets on voluntary markets generated from the avoided conversion of grasslands (NCC, n.d.-b). For example, NCC has partnered with Intact Financial Corporation to "develop a made-in-Canada protocol for wetland-based carbon offsets, which will be made available for use by international standards bodies" with a primary focus on the avoided conversion and drainage of peatlands and aims to apply this protocol as a sustainable finance tool in Canada (Intact Financial Corporation, 2022; NCC, 2022). NCC is also exploring how the new grasslands carbon protocol for Canada can be applied to improve grasslands conservation on private lands (NCC, n.d.-b). DUC is measuring carbon storage and sequestration in boreal and agricultural landscapes (DUC, n.d.-b; National Boreal Program, n.d.). Moreover, there is potential for carbon credit generation through the establishment of the Indigenous Protected and Conserved Areas on the Prairies that would generate revenue for Indigenous-led land stewardship, as detailed in Ecotrust Canada (2023).

[25] Low – few or nonexistent laws and actors/organizations to support implementation or/and inherent challenges with the instrument that prevent scaling. Medium – some actors on the Prairies are interested and/or have potential be involved and some supporting legislation; however, this instrument is not fully tested, and scalability and replicability have not been determined, so could be explored through a pilot initiative. High – existing enabling environment is well developed to channel private capital through this market instrument.

[26] There are provincial protocols in Alberta for agricultural carbon offsets (Government of Alberta, n.d.). Saskatchewan is planning to establish its own voluntary carbon offset credit market (RealAgriculture News Team, 2022). Local organizations, such as Saskatchewan Soil Conservation Association, are working on a science-based protocol for soil carbon sequestration (SaskSoil, n.d.).

[27] For example, the Government of Canada's Credit and Tracking System https://marchescarbone-carbonmarkets.canada.ca/en/Welcome; Climate Action Reserve's offset registry for global carbon markets https://www.climateactionreserve.org/

Instrument name & Enabling environment rating[25] **1 – low** **2 – medium** **3 – strong**	**Description of the enabling environment on the Canadian Prairies**
	Large agriculture companies in Canada are interested in investing in carbon offsets (Wichers, 2021). For example, Nutrien—the large fertilizer company headquartered in Saskatchewan—has its own Canadian Carbon Program that aims to support growers to implement best practices and leverage voluntary and compliance carbon markets (Nutrien, 2023). There is also strong interest in voluntary carbon offsets from the Canadian banking sector (Bickis, 2022). Overall, the outlined institutions and enabling policy environment can support investment into natural infrastructure projects through the monetization of carbon benefits.
Biodiversity credits	While there is interest in Canada in developing biodiversity offset policies (which is part of the development projects' mitigation hierarchy), a step toward no-net-loss of biodiversity,[28] ongoing research to develop biodiversity metrics and measurement protocols (e.g., the Alberta Biodiversity Monitoring Institute) and the recognition of biodiversity co-benefits of many natural infrastructure interventions (e.g., on farmlands) (Eastern Canada Soil and Water Conservation Centre, 2018), the enabling environment is not yet well developed. For example, there is no biodiversity credit registry for the Prairies to easily link the suppliers of biodiversity credits to global market buyers. However, there has been an attempt on the Prairies to test this approach: from 2011 to 2015, the Southeast Alberta Conservation Offset Pilot tested a system in which industry could mitigate their impacts on biodiversity by purchasing offsets created by conversion of marginal cropland to native perennials by private landowners (Government of Alberta, 2015). Alternatively, as mentioned in Section 3.1.2, biodiversity benefits can be added onto and certified as part of carbon credits.

[28] Habitat offset provisions under the federal Fisheries Act (Fisheries and Oceans Canada, 2019), the proposed Offsetting Policy for Biodiversity that was open for public input from December 2022 to February 2023 (Government of Canada, 2020, 2023b).

Instrument name & Enabling environment rating[25] **1 – low** **2 – medium** **3 – strong**	**Description of the enabling environment on the Canadian Prairies**
Outcome-based financing model	While the authors are not aware of an outcome-based financing model applied to a natural infrastructure project in the Canadian Prairies, certain preconditions exist that could make it a viable option for financing natural infrastructure in this region and a way to bring in diverse pool of funders and private sector financing. For example, various entities in the Prairies could potentially be outcome buyers of benefits generated by natural infrastructure. The Canadian Prairies is an agricultural region situated within the Lake Winnipeg watershed that for a long time has been trying to address the issue of nutrient runoff from non-point[29] and point sources[30] of pollution which results in the eutrophication in the Lake Winnipeg. The federal government runs the Lake Winnipeg Basin program, which funds[31] a range of actions to improve the health of Lake Winnipeg by targetting nutrient reduction and collaborative governance (Government of Canada, 2022a), and thereby is indirectly "purchasing" water quality improvements on Lake Winnipeg. Provincial governments have also demonstrated interest in natural infrastructure outcomes by funding a range of interventions: Manitoba invested around CAD 7.5 million in 2021–22 through Conservation Trust, Growing Outcomes in Watersheds (GROW) and Wetlands GROW Trusts into ecosystem goods and services[32] arising from conservation and land-use changes on agricultural land (Manitoba Habitat Heritage Corporation, 2023). Agricultural companies (such as Nutrien) who are interested in soil health, improved water quality, and carbon sequestration might also be natural infrastructure outcome buyers in the Prairies. At the same time, in addition to potential outcome buyers, there is a need for a coordinating organization/body that would be interested in championing the outcome-based financing approach with a long-term vision for potential scaling and replication, as discussed in Section 3.2.

[29] Agricultural and urban runoff.

[30] Discharge from wastewater treatment facilities and industry.

[31] The Lake Winnipeg Basin funding program invested CAD 1.59 million in 2023 to support 25 projects (ECCC, 2023a).

[32] The ecosystem goods and services (EGS) that this funding program is aiming to increase are biodiversity, production of harvestable wildlife, mitigation of floods and droughts, water quality, erosion control, carbon sequestration, soil health, recreation (MHHC, n.d.).

Instrument name & Enabling environment rating[25] **1 – low** **2 – medium** **3 – strong**	**Description of the enabling environment on the Canadian Prairies**
	Therefore, while there is some enabling environment and potential for revenue generation from natural infrastructure's ecosystem services in the Prairies, their viability would need to be tested in a pilot. The model of the Soil and Water Outcomes Fund implemented in the agricultural regions of the midwestern United States (described in Section 3.1.3) could be considered for the pilot in the Prairies region.
NACs (low rating)	NACs represent a very new concept that allows conservation- and restoration-focused companies to access financing from global capital markets through an IPO and rely on the revenue generation from ecosystem services, similar to other financing instruments (Section 3.1.4). It is too early to tell whether this instrument could be effectively applied to the Canadian Prairies. Emerging examples from other parts of the world will provide more insights on what is required in terms of legal structures, accounting methods, and valuation for this instrument to work and what the ownership structure of a NAC means in the context of reconciliation with Indigenous Peoples in Canada.
Insurance	Because the insurance industry faces financial risks from more frequent extreme weather events, it has an incentive to support the resilience of Prairie communities with natural infrastructure. As mentioned in Section 3.1.5, the insurance sector can directly invest in conservation and restoration or provide insurance products that support nature restoration. For example, a product could protect the natural asset from damage or protect the construction of natural infrastructure. Companies such as Co-operators and Intact Financial Corporation, which provide property and casualty insurance in Canada and the Prairies, recognize the increasing threat of climate change to their business (Co-operators, n.d.; Intact Financial Corporation, n.d.). Intact Financial Corporation is a direct investor in wetland restoration and conservation through its partnership with NCC (Intact Financial Corporation, 2022). Moreover, Swiss Re, in partnership with the Natural Assets Initiative (NAI), the Insurance Bureau of Canada, and the Intact Centre on Climate Adaptation, initiated a project to explore insurance products that would help Canadian local governments protect their natural assets against damage from extreme weather events (Eyquem et al., 2022; NAI, n.d.). The insurance-related products that incentivize natural infrastructure implementation or protect natural infrastructure from damages are yet to be tested and scaled in the Canadian Prairies.

Source: Authors.

4.0 Ethical Considerations of Scaling Up Investments Into Natural Infrastructure

There is an ongoing debate about the effectiveness and ethical implications of "market-based" instruments[33] as they relate to implementing nature-based solutions or natural infrastructure. A common critique is that market-based instruments reflect a "neo-liberalization of nature" (McAfee & Shapiro 2010), where market-based approaches are "trying to sell nature to save it" (Arsel & Büscher 2012, as cited in Muradian et al., 2013).

Effective solutions to increase private financing for natural infrastructure rely on market-based approaches—creating revenue streams through monetization of ecological services like carbon sequestration, which could then be traded between entities or individuals. These solutions would address a key challenge of private investments "stemming from the 'public good' dimension of such investments" and create incentives for the private sector to invest in natural infrastructure (Hudson et al., 2023, p. 2). However, this approach also raises concerns about the **ownership of land, natural assets, and underlying ecosystem services**, especially considering the "common good" dimension of many ecosystem services. As noted in the statement issued before the UN 2023 Water Conference, "Water is a human right. It needs to be managed as a common good" (United Nations, 2023). Financial mechanisms could potentially compromise local land rights or access. According to Indigenous Climate Action (2021, p. 6, p. 18), projects framed as "nature-based climate solutions" "may bring with them new corporate interests in Indigenous Lands" and lead to "'green grabbing' … [the] appropriation of land and resources for environmental ends" Therefore, a solid legal framework that prioritizes Indigenous rights, equity, and justice is essential (Vogel et al., 2022).

In addition, the growing interest in land conservation tied to market-based mechanisms may unintentionally fuel **land speculation**, driving up the cost of land and, by extension, the cost of conservation or climate adaptation efforts (McCarthy, 2022). In the United States, for example, an analysis of private land values found that policy-makers may underestimate the policy budgets necessary to achieve environmental goals by a factor of up to 37.5 (Nolte, 2020), in part due to rising land values (McCarthy, 2022). Well-intentioned efforts aimed at conservation, often including detailed analytics to guide targeted efforts, may backfire if investors use the data for profit and drive up the cost of public policy options. Land speculation can also affect farmland across the Prairies. For example, in Saskatchewan, while investors own only a small share of the province's land base, their activity is affecting the availability and price of farmland (Magnan & Desmarais, 2017).

[33] Market-based instruments provide economic incentives to reach desired goals. These instruments could be adjusting the price of goods and services (e.g., through a subsidy or a levy), enforcing limits on the quantity or quality of goods and services (e.g., tradable water permits, carbon offsets), and communication of relevant information and improving market demand (e.g., through product labeling). (University of Waterloo, n.d.).

Also, the issues pertaining to the quality of carbon credits and other offset systems outlined in Section 5.1.1 need to be taken into consideration when assessing their potential to finance natural infrastructure at scale. As mentioned before, one critique of carbon offset schemes is that they could enable the private sector to claim net-zero or carbon neutrality, while letting these companies avoid needed emissions cuts (Qi et al., 2021). There is also concern that nature-based solutions could be used to offset harm (i.e., related to emissions) in one area by conserving or restoring ecosystems in another when these actions are not equivalent, leading to **greenwashing** through private sector claims of "no net harm." Offsetting schemes should not overshadow the importance of conservation as a key priority.

The implications of private sector finance must also be explored through the lens of **equity**, recognizing that while additional finance can "increase the pie" for natural infrastructure, how the "pie" is sliced is critical for the distribution of benefits and justice outcomes" (Toxopeus et al., 2020). There are Indigenous, rural, and underserved communities across the Prairies where access to funding or other infrastructure supports falls short, and there is a need to embed equity considerations in scaling up financing within projects and programs. As mentioned in Canadian Water Network (2018, p. 54), there are "thousands of municipal water systems in Canada [and a] … wide variability in the state of repair of those systems and the socio-economic realities of the communities they support." Also, in financing schemes where a tax or levy needs to be placed on the community to repay investors for the natural infrastructure implementation and when these costs exceed users' capacity to pay, government funding support would be required.

5.0 Conclusion

This paper reviewed the financial instruments that are currently considered or applied in natural infrastructure financing in Canada, the United States, and beyond and assessed their applicability to the Canadian Prairies. The instruments highlighted by private investors are carbon and biodiversity credits, outcomes-based financing, NACs, and insurance mechanisms. The following are the key takeaways of the analysis and recommendations toward a viable pathway to financing natural infrastructure:

1. Investors are considering natural infrastructure to be less risky than before, owing in part to successful financing examples in the United States and other parts of the world. Investor interest is also driven by new standards, such as the Task Force on Nature-Related Financial Disclosures and Task Force on Climate-related Financial Disclosures[34] and ESG reporting guidelines. These guidelines increase companies' awareness of their dependencies on nature and climate events, which is beneficial for attracting private capital to natural infrastructure.
2. The financing mechanism that incorporates performance-based metrics and brings in diverse stakeholders, rightsholders, and beneficiaries of natural infrastructure—the outcome-based financing model—is a promising mechanism for financing natural infrastructure. It has been tested and scaled through several projects in the United States and tested in a Canadian pilot. Outcome-based financing is particularly well suited for restoration projects when they generate revenue streams from new ecosystem services, such as carbon credits and water quality improvements, and where there are regulatory compliance drivers. The outcome metrics embedded in the model ensure accountability, transparency, and impact for the investments into natural infrastructure.
3. The outcome-based financing models also require clear roles for government and the intermediary organizations. Government continues to be an important stakeholder as the outcomes buyer and policy enabler. Government can also support natural infrastructure financing by providing low-interest loans and tax incentives to investors in natural infrastructure and educating the broader public on the benefits of natural infrastructure, which helps increase the willingness to pay for its ecosystem benefits. The intermediary is a key coordinating body that links the interests and capabilities of parties involved, ensures effective measurement and monetization of ecosystem benefits, and negotiates the price with outcome buyers. Ideally, this organization should have an entrepreneurial mindset and a vision of becoming financially self-sustaining to ensure continuity of capital provision, which is often not the case with conventional funding programs.
4. It is important to implement credible and rigorous monitoring and verification processes for outcomes delivered by natural infrastructure projects. This extends to various ecosystem services, such as carbon sequestration, water purification, and social benefits.

[34] Guidelines for public companies and other organizations to disclose their environmental risks.

There is also an imperative in building diverse partnerships in the financing models and shaping outcome metrics in a more inclusive matter as demonstrated by the Deshkan Ziibi Conservation Impact Bond, which has incorporated Indigenous rightsholders' inputs. In addition, from an investor and outcome buyer perspective, bundling of outcomes is recommended to effectively scale up natural infrastructure financing and attract private capital investors who usually manage large pools of capital. The role of the intermediary is critical in this process.

5. The principles and lessons outlined in the paper can be applied to the Canadian Prairie region. There is some enabling environment and potential for revenue generation from natural infrastructure's ecosystem services in the Prairies, especially when it comes to carbon credits. However, the viability of some other instruments, such as the outcome-based financing model, would need to be tested. To advance this, there is a strong need for intermediary organization(s) that would facilitate relationships between many stakeholders and rightsholders who are generally new to natural infrastructure financing. Partnerships with First Nations and Indigenous organizations will also be crucial in these models, and there are opportunities to align natural infrastructure evaluation frameworks with Indigenous values and perspectives.
6. In channelling private financing to natural infrastructure, particular attention should be given to considerations of local land rights and access, ensuring affordability and availability of projects for rural and underserved communities, and net improvements in environmental outcomes, especially when monetizing and trading ecosystem services like carbon credits.

Ultimately, the choice of the instruments to finance or fund natural infrastructure will depend on several factors, such as the type of natural infrastructure,[35] potential for direct revenue generation from the project, land ownership or entitlement, the time to realize the benefits and the associated investment horizon, objectives of the private investors (monetary or non-monetary returns), the scale of a natural infrastructure project, and the amount of investment required.

[35] Restoration and engineered ecosystem solutions or conservation.

References

Ait-Ouyahia, M. (2006). *Public-private partnerships for funding municipal drinking water infrastructure: What are the challenges?* Government of Canada. https://publications.gc.ca/collections/Collection/PH4-35-2006E.pdf

ALUS. (n.d.). *Allies in delivering nature-based solutions*. https://alus.ca/supporters/

American Rivers, Water Environment Federation, American Society of Landscape Architects, & ECONorthwest. (2012). *Banking on green: A look at how green infrastructure can save municipalities money and provide economic benefits community-wide*. https://nacto.org/docs/usdg/banking_on_green_odefey.pdf

Arsel, M., & Büscher, B. (2012). Nature™ Inc.: Changes and continuities in neoliberal conservation and market-based environmental policy. *Development and Change, 43*, 53–78. https://doi.org/10.1111/j.1467-7660.2012.01752.x

Atlantic First Nations Water Authority. (2022). *2021–22 annual report: The journey continues.* https://www.afnwa.ca/wp-content/uploads/2022/10/AFNWA_Anual_Report_2021_22.pdf

Bassi, M. A., Bechauf, R., Casier, L., & Cutler, E. (2021). *How can investment in nature close the infrastructure gap?* International Institute for Sustainable Development. https://nbi.iisd.org/wp-content/uploads/2021/10/investment-in-nature-close-infrastructure-gap.pdf

Bechauf, R. (2020, December 14). *The investment case for nature-based infrastructure*. International Institute for Sustainable Development. https://www.iisd.org/articles/investment-case-for-nature-based-infrastructure

Beck, M. W., Heck, N., Narayan, S., Menéndez, P., Torres-Ortega, S., Losada, I. J., Way, M., Rogers, M., & McFarlane-Connelly, L. (2020, October 22). *Mangrove insurance: An innovative insurance solution for protecting coastal communities and mangrove ecosystems*. https://www-axa-com.cdn.axa-contento-118412.eu/www-axa-com%2Ff83724d2-fcd0-4a41-bde9-e0330a501d07_tnc_mangrove+insurance_final+hi.pdf

Berg, C., Bertolotti, L., Bieri, T., Bowman, J., Braun, J. Cardillo, Chaudhury, Falinski M., K, Geselbracht K., Hum K., Lustic C., Roberts E., Young S., & Way, M. (2020). *Insurance for natural infrastructure: Assessing the feasibility of insuring coral reefs in Florida and Hawaii*. The Nature Conservancy. https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_BOA_ReefInsuranceFeasibility_FLHI_113020.pdf

Bickis, I. (2022, November 7). *Canadian banks readying for carbon offsets to go big, even as doubts remain.* Investment Executive. https://www.investmentexecutive.com/news/products/canadian-banks-readying-for-carbon-offsets-to-go-big-even-as-doubts-remain/

Bipartisan Policy Centre. (2022). *Inflation Reduction Act (IRA) summary: Energy and climate provisions*. https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2022/08/Energy-IRA-Brief_R04-9.26.22.pdf

Birnie, S. (2021, July 16). Wetlands could help wipe out water woes. *Winnipeg Free Press*. https://www.winnipegfreepress.com/our-communities/herald/2021/07/16/wetlands-could-help-wipe-out-water-woes

Blades, D. (1997). *Depreciation in the national accounts*. Statistics Directorate, Organisation for Economic Co-operation and Development. https://www.oecd.org/sdd/na/2666804.pdf

Blue Forest Conservation. (2021, October 26). *Yuba Water Agency and Blue Forest Conservation launch world's first forest resilience bond for improved watershed health* [Press release]. https://www.blueforest.org/journal/yuba-ii-frb-press-release

Blue Forest Conservation & Encourage Capital. (2017, September). *Fighting fire with finance: A roadmap for collective action*. https://static1.squarespace.com/static/5e9a1c0d4e0c2e67582026f2/t/5f1b7a5533dc544479ee9dcf/1595636395891/FRB%2B2017%2BRoadmap%2BReport.pdf

BluePlan Engineering. (2019). *The 2019 Canadian infrastructure report card*. http://canadianinfrastructure.ca/downloads/canadian-infrastructure-report-card-2019.pdf

Bramadat-Willcock, M. (2021, November 26). New ecological reserve protects portion of Saskatchewan River Delta. *Prince Albert Daily Herald*. https://paherald.sk.ca/new-ecological-reserve-protects-portion-of-saskatchewan-river-delta/

Buffalo Sewer Authority. (2021). *Buffalo Sewer Authority sewer system environmental impact revenue bonds, series 2021 (green bonds)*. https://www.risc.solutions/wp-content/uploads/2022/05/Buffalo-Sewer-Authority-POS-2021.pdf

Burden, A., Garbutt, A., & Evans, C. D. (2019). Effect of restoration on saltmarsh carbon accumulation in Eastern England. *Biology Letters, 15*(1). https://doi.org/10.1098/rsbl.2018.0773

Canadian Council of Ministers of the Environment. (2021). *Natural infrastructure framework: Key concepts, definitions and terms*. https://ccme.ca/en/res/niframework_en.pdf

Canadian Water Network. (2018). *Balancing the books: Financial sustainability for Canadian water systems*. https://cwn-rce.ca/wp-content/uploads/2018/09/CWN-Balancing-the-Books-Report-EN-HiRes_revised.pdf

CanInfra Challenge & The Boston Consulting Group. (n.d.). *15 things to know about Canadian infrastructure*. https://static1.squarespace.com/static/59c96387268b96752ffd6100/t/59d3ee32d7bdcef89793aee4/1507061319999/15_things_to_know.pdf

Capgemini & Efma. (2022). *Insurers need to fundamentally change business models to achieve climate resiliency.* https://prod.ucwe.capgemini.com/wp-content/uploads/2022/05/05_17_Capgemini-World-PCIR_Press-Release.pdf

Carbon Pulse. (2023, October 11). *Conservation charity lines up massive project pipeline for biodiversity market.* https://carbon-pulse.com/207297/

Carlucci, E. (2023, January 4). *Addressing the nature financing gap*. International Institute for Sustainable Development. https://www.iisd.org/articles/insight/addressing-nature-financing-gap

Center for Climate and Energy Solutions. (n.d.). *Cap and trade basics.* https://www.c2es.org/content/cap-and-trade-basics/

Chattha, S. (2021, February 16). *Funding water infrastructure*. https://www.watercanada.net/feature/funding-water-infrastructure/

City of Edmonton. (2014). *Low impact development best management practices design guide edition 1.1.* https://www.edmonton.ca/public-files/assets/document?path=PDF/LIDGuide.pdf

City of Hamilton. (2023). Stormwater Funding Review. https://www.hamilton.ca/home-neighbourhood/house-home/home-water-services/water-rates/stormwater-funding-review

Climate Action Reserve. (2019). Canada grassland project protocol version 1.0. https://www.climateactionreserve.org/wp-content/uploads/2022/02/Canada_Grassland_Project_Protocol_V1.0_COMBINED_2.2022.pdf

Climate Action Reserve. (n.d.). *Canada grassland protocol.* https://www.climateactionreserve.org/how/protocols/ncs/canada-grassland/

Climate Bonds Initiative. (n.d.). *Tax incentives for issuers and investors.* https://www.climatebonds.net/policy/policy-areas/tax-incentives

Coalition for Private Investment in Conservation. (2019). *Conservation investment blueprint: Resilience bonds.* http://cpicfinance.com/wp-content/uploads/2020/12/Resilience-Bond-for-risk-reduction-Blueprint_refocus-partners.pdf

Connecticut Green Bank. (n.d.). *About us.* https://www.ctgreenbank.com/about-us/

Connecticut Green Bank. (2023). *Comprehensive plan fiscal years 2023 and 2024.* https://www.ctgreenbank.com/wp-content/uploads/2023/04/Comprehensive-Plan_FY-2024_Revised_072723.pdf

Convergence and Blue Forest Conservation, (June 2020). *Case study: The Forest Resilience Bond (FRB)*. https://www.convergence.finance/api/file/b75bff046da9893456ef4a67cefd38bc:06181b0187842d4ca63b478b46521778911a5cca3918ea6c0a39da97b6c2d6a84255d7152622ea73f0fcab705ba985d4ae1e5a9b3d5d38c7-0d92e682517efe1bb9aa1ca70a04ebdcbc7049d7d62edcbcf4d57a9cf3ccfacdcaf59f51f4289c4 4251c6d28fab717ee9af5d2e9e4d4f8e3318bf7d29805babb3ee2ad5cc3aa7fd5d03983b6682364da92c063d1031d9b4f

Co-operators. (n.d.). *2022 integrated annual report.* https://www.cooperators.ca/en/about-us/corporate-overview/annual-reports

Cox, T. (2022, December 5). *Biodiversity credits: The next big environmental market?* Environmental Finance.

DeLoach, J. (2023). *ESG reporting is already required. Here's what you need to know.* Forbes. https://www.forbes.com/sites/jimdeloach/2023/09/13/esg-reporting-is-already-required-heres-what-you-need-to-know/?sh=771abff31074

Deshkan Ziibi Conservation Impact Bond Leadership Team. (2021). *The Deshkan Ziibi Conservation Impact Bond Project: On conservation finance, decolonization, and community-based participatory research.* Western University. https://doi.org/10.5206/101121ipib

Deutz, A., Heal, G. M., Niu, R., Swanson, E., Townshend, T., Zhu, L., Delmar, A., Meghji, A., Sethi, S. A., & Tobinde la Puente, J. (2020). *Financing nature: Closing the global biodiversity financing gap*. The Paulson Institute, The Nature Conservancy, & Cornell Atkinson Center for Sustainability. https://www.paulsoninstitute.org/wp-content/uploads/2020/09/FINANCING-NATURE_Full-Report_Final-Version_091520.pdf

Ducks Unlimited Canada. (n.d.). *Wetlands as nature-based climate-change solutions.* https://www.ducks.ca/our-work/science/climate-action-and-awareness-fund/carbon-capture-project/

Ducks Unlimited Canada. (2022). *Introducing the Nature Force*. https://www.ducks.ca/news/national/introducing-the-nature-force/?gad_source=1&gclid=EAIaIQobChMIxOaQxvTYgwMVMwWtBh3X4glbEAAYASAAEgLgD_D_BwE

Earth Security. (2021). *The blended finance playbook for nature-based solutions.* https://uploads-ssl.webflow.com/62b199427426cd16f424589f/6318577b51f6fff8cae7074c_ES-The-Blended-Finance-Playbook-for-Nature.pdf

Eastern Canada Soil and Water Conservation Centre. (2018). *Enhancing wildlife and biodiversity.* https://www.nsefp.ca/wp-content/uploads/2018/08/Enhancing-wildlife-and-biodiversity.pdf

Ecosystem Investment Partners. (n.d.). *Our story.* https://ecosystempartners.com/our-story/

Ecotrust Canada. (2023). *Advancing Indigenous protected and conserved areas (IPCAs) through carbon financing.* https://ecotrust.ca/wp-content/uploads/2023/01/IPCAs-Through-Carbon-Financing_WEB.pdf

Environment and Climate Change Canada. (2020). *Offsetting policy for biodiversity.* https://www.canada.ca/content/dam/eccc/documents/pdf/offsetting-policy-biodiversity/draft-biodiversity-offsetting-policy.pdf

Environment and Climate Change Canada. (2022). *2030 emissions reduction plan.* https://publications.gc.ca/collections/collection_2022/eccc/En4-460-2022-eng.pdf

Environment and Climate Change Canada. (2023a). *Canada invests in Lake Winnipeg Basin restoration and protection.* https://www.newswire.ca/news-releases/canada-invests-in-lake-winnipeg-basin-restoration-and-protection-820277628.html

Environment and Climate Change Canada. (2023b). *Compendium of federal offset protocols.* https://publications.gc.ca/site/eng/9.918508/publication.html

Environment and Climate Change Canada. (2023c). *Share and view ideas: Offsetting policy for biodiversity.* https://www.canada.ca/en/environment-climate-change/services/biodiversity/share-view-ideas-offsetting-policy-biodiversity.html#toc1

Environmental Commissioner of Ontario. (2016). *Urban stormwater fees: How to pay for what we need.* https://www.auditor.on.ca/en/content/reporttopics/envreports/env16/Urban-Stormwater-Fees.pdf

Eyquem, J. L., Church, B., Brooke, R., & Molnar, M. (2022). *Getting nature on the balance sheet: Recognizing the financial value of natural assets in a changing climate.* Intact Centre on Climate Adaptation, University of Waterloo. https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/10/UoW_ICCA_2022_10_Nature-on-the-Balance-Sheet.pdf

Eyzaguirre, J., Crew, A., Morton, C., Tamburello, N. & Hodgson, R. (2023). *Implementation of nature-based solutions in Canada — State of play report* [Report]. Prepared by ESSA Technologies Ltd. for the David Suzuki Foundation. https://davidsuzuki.wpenginepowered.com/wp-content/uploads/2023/07/23.07.19-state-of-play-report-web.pdf

Federation of Canadian Municipalities & National Research Council. (2006). *Water and sewer rates: Full cost recovery.* https://fcm.ca/sites/default/files/documents/resources/guide/infraguide-water-sewer-rates-full-cost-recovery-mamp.pdf

Fernandes, S. (2022). *History lesson – Carbon pricing in Canada.* Brightspot Climate. https://brightspot.co/library/history-lesson-carbon-pricing-in-canada/

Fisheries and Oceans Canada. (2019). Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act*. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40939698.pdf

Flavelle, C., Cowan J., & Penn, I. (2023, May 31). Climate shocks are making parts of America uninsurable. It just got worse. *The New York Times.* https://www.nytimes.com/2023/05/31/climate/climate-change-insurance-wildfires-california.html

Fleming, A. (2022, October 6). *Natural climate solutions and carbon markets grow hand in hand.* Quantified Ventures. https://www.quantifiedventures.com/blog/natural-climate-solutions-and-carbon-markets-grow-hand-in-hand

Garrett, L. (2021, July 14). *Partnering for nature: Palladium and UK National Parks secure funding for nature restoration projects.* Palladium. https://thepalladiumgroup.com/news/Partnering-For-Nature-Palladium-and-UK-National-Parks-Secure-Funding-for-Nature-Restoration-Projects

Georgetown Climate Centre. (n.d.). *Green infrastructure toolkit.* https://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/incentive-based-tools.html

Gouett, M., Murphy, D., Wuennenberg, L., Rahim, S., & Parry, J.-E. (2023). *Innovative financial instruments for climate adaptation.* International Institute for Sustainable Development. https://www.iisd.org/innovative-financing/

Gouvernement du Québec. (2018). *Quebec cap-an-trade system for greenhouse gas emission allowances (C&T): Historical overview.* https://www.environnement.gouv.qc.ca/changements/carbone/documents-spede/historical-overview.pdf

Government of Alberta. (n.d.). *Agricultural carbon offsets – All protocols update.* https://www.alberta.ca/agricultural-carbon-offsets-all-protocols-update.aspx

Government of Alberta. (2015). *Southeast Alberta conservation offset pilot 2011-2015.* https://open.alberta.ca/dataset/68ec5fe5-19d0-4187-ad23-fa836937f5c2/resource/2ffadb40-d0d4-4dff-bc99-a8cee1a323cc/download/seacop-final-report_a.pdf

Government of Canada. (2020). *Offsetting policy for biodiversity.* https://www.canada.ca/content/dam/eccc/documents/pdf/offsetting-policy-biodiversity/draft-biodiversity-offsetting-policy.pdf

Government of Canada. (2021a). *Building the Canada we want in 2050: Engagement paper on the national infrastructure assessment.* https://www.infrastructure.gc.ca/alt-format/pdf/nia-eni/nia-eni-doc-eng.pdf

Government of Canada. (2021b). *Water in First Nations communities: Roles and responsibilities*. https://www.sac-isc.gc.ca/eng/1314034319353/1533665196191

Government of Canada. (2022a). *Lake Winnipeg basin program.* https://www.canada.ca/en/environment-climate-change/services/water-overview/comprehensive-approach-clean/lake-winnipeg/overview.html

Government of Canada. (2022b). *Supporting First Nations control of water delivery.* https://www.sac-isc.gc.ca/eng/1614386222674/1614386243479

Government of Canada. (2023a). *Canada's greenhouse gas offset credit system.* https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/federal-greenhouse-gas-offset-system.html

Government of Canada. (2023b). *Share and view ideas: Offsetting policy for biodiversity.* https://www.canada.ca/en/environment-climate-change/services/biodiversity/share-view-ideas-offsetting-policy-biodiversity.html

Government of Canada. (2024). *Output-Based Pricing System.* https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system.html

Government of Manitoba. (2020). *A proposed regulation under the Water Protection Act.* https://www.gov.mb.ca/sd/water/pubs/water/lakes-beaches-rivers/nutrient_targets_regulation_plain_language_summary_fall_2020.pdf

Government of Manitoba. (2023). *Manitoba economic accounts: Preliminary 2022 estimates.* https://www.gov.mb.ca/mbs/publications/mbs508_gdp_2022_01.pdf

Gray, E. (2019). *Insider: Green infrastructure can save water suppliers money. Now you can estimate how much.* World Resources Institute. https://www.wri.org/technical-perspectives/insider-green-infrastructure-can-save-water-suppliers-money-now-you-can-estimate-how-much

Gray, C., & Khatri, A. (2022, December). *Biodiversity credits: The little-known natural solution that could be a game-changer.* World Economic Forum. https://www.weforum.org/agenda/2022/12/biodiversity-credits-nature-cop15/

Green Finance Institute. (n.d.). *Iowa soil and water outcomes fund.* https://www.greenfinanceinstitute.com/gfihive/case-studies/soil-and-water-outcomes-fund/

Green Purposes Company, Finance Earth. (2021). *A market review of nature-based solutions: An emerging institutional asset class.* https://www.greenpurposescompany.com/pdfs/topic%20reports/Finance%20Earth%20GPC%20-%20Market%20Review%20of%20NbS%20Report%20-%20May%202021.pdf

Greenfield, P. (2023, January 18). Revealed: More than 90% of rainforest carbon offsets by biggest certifier are worthless, analysis shows. *The Guardian.* https://www.theguardian.com/environment/2023/jan/18/revealed-forest-carbon-offsets-biggest-provider-worthless-verra-aoe

Greenhouse Gas Pollution Pricing Act (S.C. 2018, c. 12, s. 186) https://laws.justice.gc.ca/eng/acts/G-11.55/

Harty, D. (2021, September 14). *NYSE's new investment vehicle—'natural asset companies'—will tap into ESG fever.* Fortune. https://fortune.com/2021/09/14/nyse-natural-asset-company-ieg-esg-investment-vehicle/

Hill-Gabriel, J., & Cep, M. (2023). *Inflation Reduction Act is making a difference for water resources, rural communities, birds.* Audubon. https://www.audubon.org/news/inflation-reduction-act-making-difference-water-resources-rural-communities-birds#:~:text=Specifically%2C%20the%20IRA%20included%20%244,impacting%20ecosystems%20throughout%20the%20country

Hoekstra, R. (2022). *How natural capital accounting can help accelerate finance for nature.* Metrics for the Future. The World Bank, Global Program on Sustainability, WAVES, System of Environmental Economic Accounting. https://thedocs.worldbank.org/en/doc/d9ffa3ebba3d16e5809ae02888f24f09-0320052022/original/how-nca-can-help-accelerate-finance-for-nature.pdf

Hudson, G., Hart, S., Verbeek, A. (2023). *Investing in nature-based solutions: State-of-play and way forward for public and private financial measures in Europe*. European Investment Bank. https://www.eib.org/attachments/lucalli/20230095_investing_in_nature_based_solutions_en.pdf

Indigenous Climate Action. (2021). *The risks and threats of 'nature-based climate solutions' for Indigenous Peoples.* https://static1.squarespace.com/static/5e8e4b5ae8628564ab4bc44c/t/617dd09782932606fc3933c2/1635635372986/ICA_-_NbCS_Sneak_Peek_Report__final_.pdf

Indigenous Services Canada. (2022). *Atlantic First Nations water authority makes history as first Indigenous water utility*. https://www.canada.ca/en/indigenous-services-canada/news/2022/11/atlantic-first-nations-water-authority-makes-history-as-first-indigenous-water-utility.html

Infrastructure Canada. (n.d.-a). *P3 Canada Fund projects.* https://www.infrastructure.gc.ca/prog/fond-p3-canada-fund-eng.html?pedisable=true

Infrastructure Canada. (n.d.-b). Funding delivered under the Investing in Canada Plan. https://www.infrastructure.gc.ca/plan/funding-financement-eng.html

Insurance Bureau of Canada. (2024). *Severe weather in 2023 caused over $3.1 billion in insured damage.* https://www.ibc.ca/news-insights/news/severe-weather-in-2023-caused-over-3-1-billion-in-insured-damage

Intact Financial Corporation. (2022, April 14). *Intact Financial Corporation announces five-part climate transition plan.* Cision. https://www.newswire.ca/news-releases/intact-financial-corporation-announces-five-part-climate-transition-plan-833367799.html

Intact Financial Corporation. (n.d.). *Intact Financial Corporation annual report 2022.* https://cdn.intactfc.com/presentations/Intact_AR-2022-EN_for-SEDAR.pdf

Inter-American Development Bank. (2021, September 14). *NYSE and Intrinsic Exchange Group announce a new asset class to power a sustainable future*. https://www.iadb.org/en/news/nyse-and-intrinsic-exchange-group-announce-new-asset-class-power-sustainable-future

International Union for Conservation of Nature. (n.d.). *Species threat abatement and restoration (STAR) metric.* https://www.iucn.org/resources/conservation-tool/species-threat-abatement-and-restoration-star-metric

International Union for Conservation of Nature. (2020). *IUCN global standard for nature-based solutions. A user-friendly framework for the verification, design and scaling up of NbS* (1st ed.). https://doi.org/10.2305/IUCN.CH.2020.08.en

Intrinsic Exchange. (n.d.). *Working areas*. https://www.intrinsicexchange.com/working-areas

Ishaq, S., Rana, A., Hewage, K., Li, J., Sadiq, R. (2023). Environmental impacts and cost analysis of low impact developments in arid climate: A case study of Okanagan Valley (Canada). *Journal of Cleaner Production, 419*, Article 138226. https://doi.org/10.1016/j.jclepro.2023.138226.

Jennifer, L. (2022, December 16) *Biodiversity credits: a new way of funding nature protection*, Carbon Credits. https://carboncredits.com/biodiversity-credits-a-new-way-of-funding-nature-protection/

Kousky, C., & Light, S. E. (2019). Innovation and incentives: Bridging the gap between climate finance and natural solutions. *Duke Law Journal.* https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=3996&context=dlj

Lewis, I. (2023). *TNFD unveils final recommendations for nature-related reporting.* Impact Investor. https://impact-investor.com/tnfd-unveils-final-recommendations-for-nature-related-reporting/

Lieuw-Kie-Song, M., & Pérez-Cirera, V. (Eds.). (2020). *Nature hires: How nature-based solutions can power a green jobs recovery.* World Wide Fund For Nature, International Labour Organization. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_757823.pdf

Lombard Odier Asset Management. (2023, February). *Carbon credits: reinforcing quality for impact and returns.* https://am.lombardodier.com/ch/en/contents/news/investment-viewpoints/2023/february/8982-NA-MAR-SUS-carbon-credits.html

Mackenzie. H. (2013). *Canada's infrastructure gap:Where it came from and why it will cost so much to fix it.* Canadian Centre for Policy Alternatives. https://policyalternatives.ca/publications/reports/canadas-infrastructure-gap

Magnan, A., & A.A. Desmarais. (2017). *Who is buying the farm? Farmland investment patterns in Saskatchewan, 2003-14*. Canadian Centre for Policy Alternatives. https://policyalternatives.ca/sites/default/files/uploads/publications/SaskatchewanOffice/2017/03/Who_is_Buying_the_Farm_SK_2003-14.pdf

Manuell, R. (2023). *Biodiversity crediting to imminently face up to the challenges of bundling and stacking with carbon.* Carbon Pulse. https://carbon-pulse.com/212820/

McAfee, K. and Shapiro, E. (2010). Payments for ecosystem services in Mexico: nature, neoliberalism, social movements and the state. *Annals of the American Association of Geographers 100*, 579–599. https://www.researchgate.net/publication/233276577_Payments_for_Ecosystem_Services_in_Mexico_Nature_Neoliberalism_Social_Movements_and_the_State

McCarthy, G.W. (2022). *President's message: How to fend off land speculation*. Lincoln Institute of Land Policy. https://www.lincolninst.edu/publications/articles/2022-07-presidents-message-how-to-fend-off-land-speculation

McFatridge, S. (2018). *Economic tools for increasing nature conservation on private land.* Smart Prosperity. https://institute.smartprosperity.ca/sites/default/files/print-pb-privateland-07-09-18smcedits.pdf

Medlong, J., Keyes Fleming, G., & McCaffrey, A. (2022, December 21). *COP15 biodiversity: US legal and business perspectives*. DLA Piper. https://www.dlapiper.com/en/insights/publications/2022/12/cop15-biodiversity-us-legal-and-business-perspectives

Méthot, J., Rawluk, A., Roy, D., Saleh, T., & Kroft, E. (2023). *The state of play of natural infrastructure on the Canadian Prairies*. International Institute for Sustainable Development. https://www.iisd.org/publications/report/state-of-play-natural-infrastructure-canadian-prairies

Manitoba Habitat Heritage Corporation. (2023). *2021/2022 progress report: A summary of trust commitments and outputs to March 31, 2022*. https://mhhc.mb.ca/wp-content/uploads/2023/06/2021-22-Trust-Progress-Report-_for-Dissemination_-June-15-23.pdf

Mirza, S. (2007). *Danger ahead: The looming collapse of Canada's municipal infrastructure*. Federation of Canadian Municipalities. https://docplayer.net/8467026-Danger-ahead-the-coming-collapse-of-canada-s-municipal-infrastructure.html

Moudrak, N., Feltmate, B., Venema, H., & Osman, H. (2018). *Combatting Canada's rising flood costs: Natural infrastructure is an underutilized option.* Prepared for Insurance Bureau of Canada, Intact Centre on Climate Adaptation, & University of Waterloo. https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2018/09/IBC_Wetlands-Report-2018_FINAL.pdf

Muir, M. (2022, 7 February). *Resilience bonds: A concept too ambitious or ahead of its time?* Trading Risk. https://www.trading-risk.com/article/29o65vrdorizfddm9bhts/resilience-bonds-a-concept-too-ambitious-or-ahead-or-its-time

Munich Re. (2023). *Natural disasters in 2022.* https://www.munichre.com/content/dam/munichre/mrwebsitespressreleases/natcat_stats_2022_factsheet.pdf/_jcr_content/renditions/original./natcat_stats_2022_factsheet.pdf

Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., Ezzine de Blas, D., Farley, J., Froger, G., Garcia-Frapolli, E., Gómez-Baggethun, E., Gowdy, J., Kosoy, N., Le Coq, J. F., Leroy, P., May, P., Méral, P., Mibielli, P. … Urama, K. (2013), Payments for ecosystem services and the fatal attraction of win-win solutions. *Conservation Letters, 6*, 274–279. https://doi.org/10.1111/j.1755-263X.2012.00309.x

National Boreal Program. (n.d.). *Estimating carbon sequestration in wetlands.* https://boreal.ducks.ca/estimating-carbon-sequestration-wetlands/

National Fire Protection Association. (n.d.). *Insurance discounts for USAA members in seven states*. https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA/Become-a-Firewise-USA-site/Program-benefits/Insurance-discounts-for-USAA-members-in-seven-states

Natural Assets Initiative. (2020). *Innovative, new, nature-based insurance product to help protect natural assets.* https://mnai.ca/insurance-protect-natural-assets/

Natural Climate Solutions Alliance & Boston Consulting Group. (2022, November). *A buyer's guide to natural climate solutions carbon credits* (Draft for comment). https://www.wbcsd.org/contentwbc/download/15185/214678/1

Nature Conservancy of Canada. (n.d.-a). *Carbon brochure*. https://www.natureconservancy.ca/assets/documents/nat/Carbon-brochure.pdf

Nature Conservancy of Canada. (n.d.-b). *Projects and initiatives.* https://www.natureconservancy.ca/en/what-we-do/nature-and-climate/projects-initiatives.html#:~:text=NCC%20is%20exploring%20the%20potential,agreements%20to%20protect%20private%20lands

Nature Conservancy of Canada. (2022, April 14). *Nature Conservancy of Canada accelerates conservation in partnership with Intact Financial Corporation* [Press release]. https://www.natureconservancy.ca/en/who-we-are/news-room/news-releases/intact-wetlands-news-1.html

Nature Force. (n.d.). *Projects*. https://www.thenatureforce.com/projects/

Nicholas Institute for Environmental Policy Solutions, Environmental Policy Innovation Center. (2023). *Financing nature-based solutions using green banks.* https://nicholasinstitute.duke.edu/sites/default/files/events/financing-nature-based-solutions-using-green-banks.pdf

Nolte, C. (2020). High-resolution land value maps reveal underestimation of conservation costs in the United States. *PNAS, 117*(47), 29577–29583. https://www.pnas.org/doi/abs/10.1073/pnas.2012865117

Nutrien. (2023). *2023 environmental, social and governance ("ESG") report.* https://nutrien-prod-asset.s3.us-east-2.amazonaws.com/s3fs-public/uploads/2023-03/Nutrien%20ESG%20Report%202023_1.pdf

Organisation for Economic Co-operation and Development. (2021, September 23–24). *Background paper: 8th roundtable on financing water, focused on climate action in partnership with the U.S. government. Session 2.* https://www.oecd.org/water/Background-paper-RT-on-Financing-Water-and-Climate-Action-Session-2.pdf

Organisation for Economic Co-operation and Development. (2022). *Financing a water secure future.* OECD Studies on Water. https://doi.org/10.1787/a2ecb261-en

Output-Based Pricing System Regulations (SOR/2019-266) https://laws-lois.justice.gc.ca/eng/regulations/SOR-2019-266/index.html

Paia Consulting. (2021). *Carbon offsets and credits, explained.* https://paiaconsulting.com.sg/carbon-offsets-and-credits-explained/

Peña, F. (2022). *Financiamiento climático y la conservación de la biodiversidad: Evaluación de la eficacia de los mecanismos REDD+ en América Latina y el Caribe.* Economic Commission for Latin America and the Caribbean (ECLAC). https://www.cepal.org/sites/default/files/news/files/wp_pena_2.pdf

Peterdy, K. (2020). *Carbon credit.* Corporate Finance Institute. https://corporatefinanceinstitute.com/resources/esg/carbon-credit/

Puzyreva, M., Zhao, J., Simoes, J., & Rawluk, A. (2022). *The value of water retention beneficial management practices to farmers and landowners in the Seine Rat Roseau Watershed District*. International Institute for Sustainable Development. https://www.iisd.org/system/files/2022-12/water-retention-practices-seine-rat-roseau-watershed-district.pdf

Qi, J., Terton, A., & Vaughan, S. (2021). *Seeking common ground for climate, biodiversity, and people: How to get the debate on nature-based solutions right.* International Institute for Sustainable Development. https://www.iisd.org/articles/common-ground-nature

Quantified Ventures. (n.d.). *Soil and water outcomes fund.* https://www.quantifiedventures.com/soil-and-water-outcomes-fund#:~:text=The%20Soil%20and%20Water%20Outcomes%20Fund%20uses%20investor%20capital%20to,quality%20improvement%20and%20carbon%20sequestration

Quantified Ventures. (2021, June 22). *Buffalo Sewer Authority issues largest-ever U.S. environmental impact bond.* https://www.quantifiedventures.com/buffalo-sewer-largest-eib

Ragan C., & Harcourt, M. (n.d.). *Water user fees: Building a path to sustainability.* https://www.municipalworld.com/feature-story/water-user-fees/

RainCheck. (n.d.). *About*. https://raincheckbuffalo.org/about2/

RealAgriculture News Team. (2022). *Saskatchewan planning to launch its own carbon offset credit program*. https://www.realagriculture.com/2022/10/saskatchewan-planning-to-launch-its-own-carbon-offset-credit-program/

Rendlen, B., & Uzsoki, D. (2021). *Mapping the landscape for a nature economy*. International Institute for Sustainable Development. https://www.iisd.org/publications/report/mapping-landscape-nature-economy

Rinne, J. (2023). *From carbon to nature: What the biodiversity markets can learn from the voluntary carbon market?* Compensate Foundation. https://assets.ctfassets.net/f6kng81cu8b8/28WY8rKF43LgzZd7drlvPl/990e0fefcf67c38caf5d46104b2ed030/From_Carbon_to_Nature_2023_White_paper.pdf

Ross, J. (2019, October 27). St Pierre lagoon adds wetland cell. *The Carillon*. https://www.winnipegfreepress.com/the-carillon/local/2019/10/27/st-pierre-lagoon-adds-wetland-cell#:~:text=On%20Oct.,effluent%20entering%20the%20Rat%20River

Roy, D. (2018). *The multiple benefits of natural infrastructure*. International Institute for Sustainable Development. https://www.iisd.org/articles/insight/multiple-benefits-natural-infrastructure

Sahib, K. (2020). *Supporting urban stormwater management programs with a user-fee: The evaluation of experiences from New South Wales/Blacktown City Council, Philadelphia and Mississauga.* University of Toronto. https://tspace.library.utoronto.ca/bitstream/1807/103796/2/Sahib_Khatija__202011_MA_thesis.pdf

Saleh, T., Puzyreva, M. (2024). *Estimate of natural infrastructure public grant funding in Canada and the Prairies.* International Institute for Sustainable Development.

SaskSoil. (n.d.). *SSCA carbon committee*. https://sasksoil.ca/carbon-initiative

Scher, M., & Christophersen, T. (2023). *Why you should consider adding carbon credits to your climate action plan.* World Economic Forum. https://www.weforum.org/agenda/2023/01/consider-adding-carbon-credits-climate-action-plan/

Smart Prosperity Institute. (2021). *Invest in nature: Scaling conservation finance in Canada for a nature-smart economy.* https://institute.smartprosperity.ca/sites/default/files/Invest-in-Nature-Report_SPI.pdf

Smart Prosperity Institute. (2021). *Invest in nature: Scaling conservation finance in Canada for a nature-smart economy.* https://institute.smartprosperity.ca/sites/default/files/Invest-in-Nature-Report_SPI.pdf

Sopher, P., & Mansell, A. (2013). *Alberta: The world's carbon markets: A case study guide to emissions trading.* Environmental Defense Fund and International Emissions Trading Association. https://www.edf.org/sites/default/files/EDF_IETA_Alberta_Case_Study_May_2013.pdf

State Farm. (2023, May 26). *State Farm General Insurance Company®: California new business update*. [News release] https://newsroom.statefarm.com/state-farm-general-insurance-company-california-new-business-update//

Statistics Canada. (2022a). *Canada's 2021 census of agriculture: A closer look at farming across the regions.* https://www150.statcan.gc.ca/n1/en/daily-quotidien/220615/dq220615a-eng.pdf?st=2dsDh6Kx

Statistics Canada. (2022b). *Canada's core public infrastructure survey: Water infrastructure, 2020.* The Daily. https://www150.statcan.gc.ca/n1/en/daily-quotidien/220726/dq220726a-eng.pdf?st=L6Dcmhpz

Statistics Canada. (2022c). *Canada's population estimates, third quarter 2022.* https://www150.statcan.gc.ca/n1/en/daily-quotidien/221221/dq221221f-eng.pdf?st=rci_rRed

Statistics Canada. (2022d). *Infrastructure economic account, updated 2019 to 2021.* https://www150.statcan.gc.ca/n1/daily-quotidien/221214/dq221214c-eng.htm

Statistics Canada. (2022e). *Table 32-10-0240-01 Operating revenues, Census of Agriculture, 2021.* https://doi.org/10.25318/3210024001-eng

Statistics Canada (2022f). *Table 36-10-0608-01 Infrastructure economic accounts, investment and net stock by asset, industry, and asset function (x 1,000,000)* [Data table]. https://doi.org/10.25318/3610060801-eng

Stead, D. (2022, January 23). *Natural asset companies (NACs): What they are and why they matter.* Impact Enterpreneur. https://impactentrepreneur.com/natural-asset-companies-nacs/

SteinbachOnline.com. (2017). *$4-million lagoon project going forward in La Broquerie.* https://steinbachonline.com/articles/4-million-lagoon-project-going-forward-in-la-broquerie

Sustainable Technologies Evaluation Program. (2020). *How Canadian municipalities can fund their stormwater services.* https://sustainabletechnologies.ca/how-canadian-municipalities-can-fund-their-stormwater-services/

Taskforce on Nature Markets and Pollination. (2023). *Biodiversity credit markets: The role of law, regulation and policy.* https://uploads-ssl.webflow.com/623a362e6b1a3e2eb749839c/6452340b9bcbb3ef3f82e6b6_BiodiversityCreditMarkets.pdf

TD Asset Management. (n.d.). *2022 top 40 money managers report.* https://www.td.com/ca/en/asset-management/documents/institutional/pdf/newsroom/Benefits-canada-top-40-EN.pdf

The Insurer. (2023, September 13). *GC in talks with potential investors ahead of first climate resilience bond pilot.* https://www.theinsurer.com/reinsurancemonth/gc-in-talks-with-potential-investors-ahead-of-first-climate-resilience-bond-pilot/

The Nature Conservancy. (2022a). *Insuring nature to ensure a resilient future.* https://www.nature.org/en-us/what-we-do/our-insights/perspectives/insuring-nature-to-ensure-a-resilient-future/

The Nature Conservancy. (2022b). *A post-storm response and reef insurance primer.* https://www.nature.org/content/dam/tnc/nature/en/documents/A_POST_STORM_RESPONSE_AND_REEF_INSURANCE_PRIMER_2022_final.pdf

The White House. (2022). *Building a better America: A guidebook to the Bipartisan Infrastructure Law for state, local, tribal, and territorial governments, and other partners.* https://www.whitehouse.gov/wp-content/uploads/2022/05/BUILDING-A-BETTER-AMERICA-V2.pdf#page=151

Toxopeus, H., & Polzin, F. (2021). Reviewing financing barriers and strategies for urban nature-based solutions. *Journal of Environmental Management*, *289*, 112371–112371. https://doi.org/10.1016/j.jenvman.2021.112371

UK Government. (2013, April 9). *Biodiversity offsetting.* https://www.gov.uk/government/collections/biodiversity-offsetting

United Nations. (2007). *United Nations declaration on the rights of Indigenous Peoples.* https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf

United Nations. (2023). *Water is a common good not a commodity: UN experts.* https://www.ohchr.org/en/statements-and-speeches/2023/03/water-common-good-not-commodity-un-experts

United Nations Environment Programme (2022). *State of finance for nature. Time to act: Doubling investment by 2025 and eliminating nature-negative finance flows.* https://wedocs.unep.org/20.500.11822/41333

United Nations Environment Programme–DHI Partnership – Centre on Water and Environment, International Union for Conservation of Nature, The Nature Conservancy, & World Resources Institute. (2014). *Green infrastructure guide for water management: Ecosystem-based management approaches for water-related infrastructure projects.* https://wedocs.unep.org/bitstream/handle/20.500.11822/9291/-Green%20infrastructure%3a%20guide%20for%20water%20management%20%20-2014unep-dhigroup-green-infrastructure-guide-en.pdf?sequence=3&isAllowed=y

United Nations Environment Programme. (2023). *Nature-based infrastructure: How natural infrastructure solutions can address sustainable development challenges and the triple planetary crisis.* https://wedocs.unep.org/handle/20.500.11822/44022

United States Environmental Protection Agency. (n.d.-a). *Green banks.* https://www.epa.gov/statelocalenergy/green-banks

United States Environmental Protection Agency. (n.d.-b). *About the clean water state revolving fund (CWSRF).* https://www.epa.gov/cwsrf/about-clean-water-state-revolving-fund-cwsrf#works

United States Environmental Protection Agency. (n.d.-c). *Green infrastructure for climate resiliency.* https://www.epa.gov/green-infrastructure/green-infrastructure-climate-resiliency

United States Environmental Protection Agency. (2021). *Forest resilience bond: A public-private partnership for forest health and wildfire risk reduction.* https://www.epa.gov/sites/default/files/2021-04/documents/forest_resilience_bond_report.pdf

U.S. Department of Agriculture Forest Service. (2022). *Blue Forest—Fighting fire with finance. FS–1161(o).* https://www.fs.usda.gov/sites/default/files/USFS-BlueForest.pdf

University of Waterloo. (n.d.). Market-based instruments. https://uwaterloo.ca/implementing-sustainable-community-plans/dissemination/market-based-instruments

Urban Systems. (2017). *Asset management assessment of infrastructure.* https://canalflats.civicweb.net/document/2783/2017-12-13-%20AMIP%20Report.pdf?handle=6ADBED58CBCD4108B43278E825292781

Vajjhala, S. (2020). *Mobilizing capital for natural infrastructure in Canada: A guide for project champions and funders.* International Institute for Sustainable Development. https://www.iisd.org/system/files/2020-12/mobilizing-capital-natural-infrastructure-canada.pdf

Valach, A. C., Kasak, K., Hemes, K. S., Anthony, T. L., Dronova, I., Taddeo, S., Silver, W. L., Szutu, D., Verfaillie, J., & Baldocchi, D. D. (2021). Productive wetlands restored for carbon sequestration quickly become net CO2 sinks with site-level factors driving uptake variability. *PLoS One, 16*(3), Article e0248398. https://doi.org/10.1371/journal.pone.0248398

Verra. (n.d.). *Darkwoods forest carbon project.* https://registry.verra.org/app/projectDetail/VCS/607

Vogel, B., Yumagulova, L., McBean, G., & Charles Norris, K. A. (2022). Indigenous-led nature-based solutions for the climate crisis: Insights from Canada. *Sustainability, 14*(11) 6725. https://doi.org/10.3390/su14116725

Walsh, P. (2022, May 17). *Insurers behind the curve on climate resiliency.* Environmental Finance. https://www.environmental-finance.com/content/news/insurers-behind-the-curve-on-climate-resiliency.html

Wichers, G. (2021, July 2). Big ag goes headhunting for carbon offsets. *Manitoba Co-operator.* https://www.manitobacooperator.ca/news-opinion/news/big-ag-goes-headhunting-for-carbon-offsets/

World Bank. (2022, July 27). *What you need to know about the measurement, reporting, and verification (MRV) of carbon credits.* https://www.worldbank.org/en/news/feature/2022/07/27/what-you-need-to-know-about-the-measurement-reporting-and-verification-mrv-of-carbon-credits

World Bank Group. (2020). *Mobilizing private finance for nature.* https://thedocs.worldbank.org/en/doc/916781601304630850-0120022020/original/FinanceforNature28Sepwebversion.pdf

World Economic Forum, Alexander von Humboldt Biological Resources Research Institute, AlphaBeta – Access Partnership, Arup International. (2022). *BiodiverCities by 2030: Transforming cities' relationship with nature.* https://www3.weforum.org/docs/WEF_BiodiverCities_by_2030_2022.pdf

World Economic Forum. (2022). *Biodiversity credit market: Emerging opportunities for financing nature.* https://www3.weforum.org/docs/WEF_Biodiversity_Credit_Market_2022.pdf

World Wildlife Fund. (2023, September 19). *What is biodiversity and why is it under threat?* https://www.worldwildlife.org/pages/what-is-biodiversity

Yalamanchili, S., & Hardy, B. (2023). *How mandatory regulations are shifting the global ESG and sustainability reporting landscape.* Baker Tilly. https://www.bakertilly.com/insights/how-mandatory-esg-and-sustainability-reporting-regulations-are-shifting

Appendix A. Water-Related Infrastructure Gap in Canada and the Prairies

Table A1. Depreciation of and investment in water-related infrastructure in Canada and the Canadian Prairies, annual values from 2017 to 2021, CAD million, in constant dollars

	Geometric depreciation,[36] CAD million						Investments,[37] CAD million						Investments, depreciation, millions of CAD
Region	**2017**	**2018**	**2019**	**2020**	**2021**	**Total 2017–2021**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total 2017–2021**	**2017–2021**
Canada	**12,825**	**12,813**	**12,913**	**13,204**	**13,248**	**65,003**	**12,840**	**12,697**	**14,534**	**14,999**	**13,870**	**68,940**	**3,937**
Alberta	2,322	2,316	2,301	2,285	2,244	11,468	2,707	1,624	1,943	1,772	1,484	9,530	-1,938
Manitoba	501	499	492	501	485	2,478	418	501	319	267	243	1,748	-730
Saskatchewan	487	484	479	483	475	2,408	514	400	432	384	405	2,135	-273
Prairies	**3,310**	**3,299**	**3,272**	**3,269**	**3,204**	**16,354**	**3,639**	**2,525**	**2,694**	**2,423**	**2,132**	**13,413**	**-2,941**
Percentage in the Prairies	26%	26%	25%	25%	24%	25%	28%	20%	19%	16%	15%	19%	

Note: Infrastructure assets include the following: canals and waterways, waterworks infrastructure, water filtration plants, other water infrastructure, sewage infrastructure, sewage treatment plants, other sewage infrastructure, and water treatment equipment.
Source: Statistics Canada, 2022f.

[36] Geometric depreciation means that capital consumption occurs at the same **rate** each year (not the same **amount** each year) (Blades, 1997).

[37] "Investment means spending by businesses or governments during a given year for the purposes of construction of structures (airports, roads, etc.), purchases of equipment (locomotives, turbines, etc.), and improvements to existing facilities" (Statistics Canada, 2022d).

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