IISD | Natural Infrastructure for Water Solutions

REPORT SUMMARY

Nature That Works

Benefits and performance of natural infrastructure for water management

May 2025

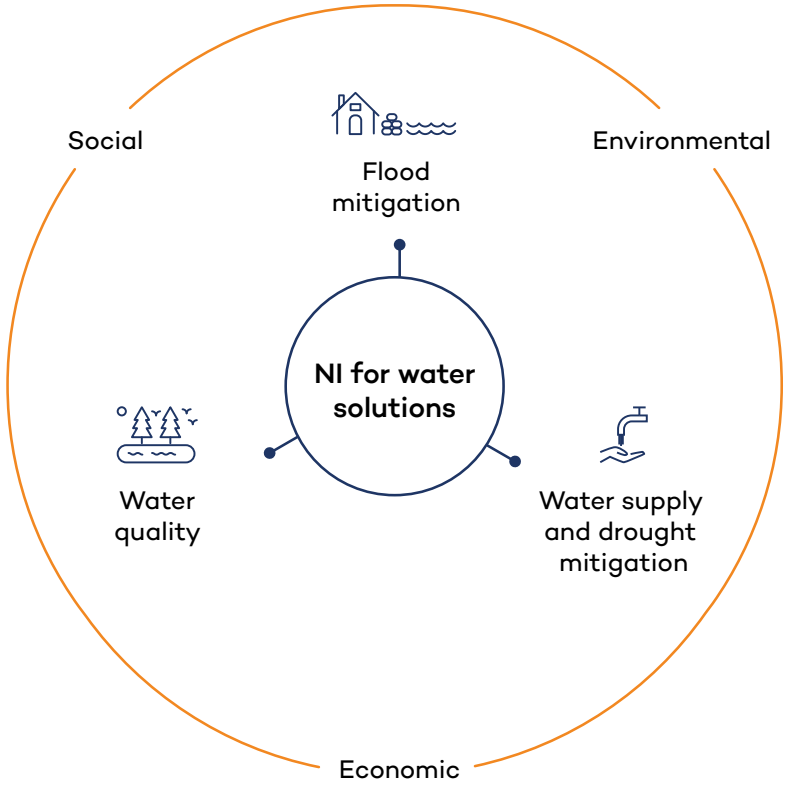
New report unpacks the benefits of 17 types of natural infrastructure for Prairie water resilience.

Across the Canadian Prairies, natural infrastructure assets are helping to bridge the growing water-related infrastructure gap while delivering social, economic, and environmental co-benefits. Natural infrastructure supports three critical water management areas (Figure 1):

- flood mitigation,
- water supply and drought mitigation, and
- water quality.

As our water needs grow, natural infrastructure will need to complement conventional "grey" infrastructure, such as pipes and treatment plants, to support the delivery and enhancement of infrastructure services. In the race to adapt in the face of climate change, natural infrastructure can enhance the resilience of grey infrastructure against extreme weather events.

Figure 1. Natural infrastructure benefits framework for water management in the Canadian Prairies region



Source: Author diagram.

Why Is Natural Infrastructure So Urgently Needed?

Approximately 30% of Canada's water-related grey infrastructure (e.g., pipes, water treatment plants) is in fair, poor, or very poor condition, and its replacement will cost taxpayers billions. Natural infrastructure can help by delivering reliable, cost-effective infrastructure services and co-benefits, either on its own or in conjunction with grey infrastructure.

Climate change means that communities can expect more frequent, higher-intensity floods and droughts. Natural infrastructure can help ensure a reliable water supply, manage stormwater and wastewater, and reduce risks from extreme events.

Across the Canadian Prairies, human land use continues to expand and intensify, often at the expense of natural systems like native grasslands, forests, and wetlands. Protecting these remaining ecosystems can help to provide affordable infrastructure services, while bolstering ecosystem health and resilience.

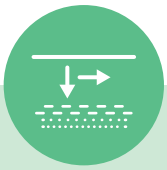
What Types of Natural Infrastructure Assets Are Included?

Our research describes the key water-related benefits and performance of 17 types of natural infrastructure relevant to the Canadian Prairies. These include eight natural assets—both conserved and restored ecosystems—and nine constructed assets. The assets are organized into four functional families based on the shape (morphology) and position of natural infrastructure assets on the landscape and their role in water management (Figure 2).

Within these functional families, the natural and intact assets serve as exemplars for delivering water-related services and co-benefits. Constructed assets that perform similar functions are also included; these can be designed and managed to mimic the features and processes of natural assets, particularly in urban areas where conservation or restoration may be constrained.

Figure 2. Functional families of 17 types of natural infrastructure



	Cover	Basins	Watercourses	Groundwater
Features	Vegetation and/or substrate	Surface depression	Sloped channel	Subsurface reservoir
Functions	Runoff generation and attenuation	Storage	Conveyance	Recharge, baseflow generation, and storage
Dominant mechanisms	Evapotranspiration and/or retention	Detention and/or retention	Surface flow	Percolation, interflow
Natural assets	• Grasslands • Forests	• Lakes and ponds • Wetlands	• Rivers and streams • Riparian areas • Streambank bioengineering	Aquifers
Constructed assets	• Soil cells • Green roofs • Permeable pavements	• Constructed wetlands • Rain gardens • Rainwater harvesting • Bioretention	Bioswales	Infiltration trenches

Source: Authors.

How Does Natural Infrastructure Support Flood Mitigation?

The Prairies face increasing risks of flooding as climate change brings more frequent and intense precipitation events. In cities and towns with more impervious areas, intense rainfall can cause pluvial or overland flooding, leading to flooded streets, damaged buildings, and overwhelmed drainage systems and sewer capacity. Along rivers, intense rain or runoff can cause riverbanks to overflow, resulting in fluvial or riverine flooding and causing flooded farmland, communities, homes, and infrastructure.

Natural infrastructure has proven effective in mitigating flood risk by intercepting, soaking up, storing, or slowing down water to reduce peak flows, water volume, and downstream water levels. Natural infrastructure examples for flood mitigation include the following:

Rain gardens are soil-filled depressions designed to collect, infiltrate, percolate, and evapotranspire runoff that is often collected from the roof of a building. Rain gardens are planted with drought-resistant and moisture-tolerant plants that can thrive in fluctuating moisture conditions.

Rivers and streams have been heavily modified by human activities in some areas, such as straightening or deepening the channel or installing riprap along the banks. Restoring natural features, like meanders, floodplain access, and riparian vegetation, can slow water flow, store water during floods, and improve infiltration and soil water storage.

How Does Natural Infrastructure Support Water Supply and Drought Mitigation?

Across the Canadian Prairies, ongoing drainage and altered landscapes have significantly reduced water storage capacity. At the same time, water demand is rising due to a growing population, greater industrial and agricultural use (e.g., irrigation), and climate change, which may influence the frequency and severity of droughts.

Natural and constructed assets that help retain and detain water are particularly critical, as they capture, store, and gradually release snowmelt and rainfall across a landscape. Natural infrastructure examples for water supply and drought mitigation include the following:

Rainwater harvesting involves intercepting and storing rainwater in a reservoir and can range from individual rain barrels for watering gardens to larger systems for landscape irrigation. Rainwater harvesting can provide a fit-for-purpose water source that reduces potable water demand, reduces runoff, and helps secure a water source during dry periods.

Aquifers act as natural underground reservoirs that provide water supply for many rural communities and the agricultural sector. Aquifers can store water that has infiltrated the

landscape following rain events. When watercourses and basins have lower water levels, aquifers can also provide groundwater discharge that prevents them from drying out.

How Does Natural Infrastructure Support Water Quality?

Urban development, agricultural runoff, and other land-use changes can impact water quality across the Prairies through pollutants like sediment, novel contaminants, and nutrients in runoff and surface water. Natural infrastructure uses natural processes where soil, plants, and microbial communities work to break down, degrade, and capture pollutants.

Natural infrastructure offers significant benefits for improving water quality in stormwater, wastewater, and potable water, thereby avoiding or reducing pollutant loading downstream. It often complements, augments, or replaces the outcomes of grey infrastructure alone. Natural infrastructure examples for supporting water quality include the following:

Riparian areas are lands adjacent to streams, rivers, lakes, wetlands, or other waterways. Riparian vegetation helps stabilize streambanks, reduce erosion, trap sediment, and filter contaminants and nutrients. Protecting and restoring these areas can protect water sources for communities and reduce the requirements for treatment.

Bioretention assets are constructed, vegetated depressions that are often implemented in public rights-of-way and open spaces to treat sediment, nutrients, organics, metals, and pathogens in stormwater runoff in urban areas. Bioretention assets can be customized by selecting a shape, size, media, underdrain, and vegetation that suits the location and contaminants of interest.

What Is Needed?

We need more natural infrastructure—and soon. While there is growing awareness and demand for natural infrastructure, ongoing questions are related to economic viability, performance, and implementation. Important considerations include the following:

Natural infrastructure is about more than infrastructure. Natural and constructed assets deliver and support specific water infrastructure needs. As such, they should be recognized—and funded—as infrastructure. In addition to these essential services, natural infrastructure provides multiple benefits for ecosystems, people, and economies. Nature functions as a complex system that sustains life and shapes our Prairie communities.

Natural infrastructure should be part of an integrated set of solutions, and we must work across the full spectrum, from natural assets to constructed assets to grey infrastructure. Each approach has its role to play, depending on the specific context and challenges at hand. When done thoughtfully, integrating these types of infrastructure can offer an effective approach to delivering resilient, sustainable water infrastructure.

Context is key when implementing natural infrastructure. In cities, conserved or restored natural assets may not meet all needs on their own. Constructed assets like rain gardens, green roofs, and constructed wetlands can replicate natural processes and are important solutions in urban water management.

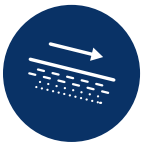
Key Takeaways to Support Prairie Water Management

Conserve and Restore Vegetative Cover

Prioritize the protection and restoration of grasslands and forests, particularly in historically degraded areas. In cities, reduce impervious surfaces by establishing and maintaining diverse vegetation, naturalizing streets or rooftops, and installing permeable pavement where possible.

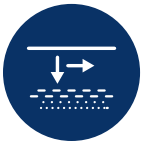
Manage Surface Water With Basins

Restore and protect wetlands in rural areas for flood control, drought resilience, and water quality. In urban areas, use rain gardens, bioretention assets, and constructed wetlands to manage increased stormwater, especially for heavy rainfall and runoff volumes.



Protect Watercourses

Restore natural river and floodplain features to slow water flow, store water on floodplains, and improve infiltration and soil water storage. Use bioswales and engineered streambanks to manage runoff and reduce erosion.



Safeguard Groundwater Recharge

Protect groundwater recharge zones to secure a key water source for many communities. Use vegetated bioretention systems and managed aquifer recharge where feasible.

Natural infrastructure takes many forms—from wetlands to rain barrels, streams to aquifers—and protecting, restoring, and enhancing these features is a smart, proven path to a stronger, more water-resilient future across the Prairies.

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