Implementation Guide

Natural Infrastructure for Water Quality

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IISD
Natural Infrastructure for Water Solutions

Associated
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Unless otherwise noted, photos and illustrations are courtesy Associated Engineering.

Table of Contents

Purpose

Natural infrastructure works–and it can do more than many people realize.

This guide is designed to demonstrate the value of natural infrastructure, moving it from a promising concept to a practical part of everyday decision making. Focusing on water quality, it demonstrates how wetlands, riparian areas, grasslands, trees, and other natural systems can be used to protect and improve water quality, either on their own or combined with engineered systems. These approaches can improve water quality while also reducing flood risk, strengthening drought resilience, and supporting water supply across the Canadian Prairies.

Developed by the International Institute for Sustainable Development (IISD), the guide draws on research, Prairie-based examples, and practical implementation advice. It is intended to support the broader adoption and scaling of natural infrastructure across Alberta, Saskatchewan, and Manitoba.

This publication is part of the Prairie Natural Infrastructure Guide Series, which also examines flood risk reduction, drought, and water supply. Together, the series highlights how natural systems can deliver multiple, interconnected benefits at the same time.

Who These Guides Are For

These guides are written for a broad audience working to increase the use of natural infrastructure across the Prairies. The groups below will find them particularly helpful and each plays an important role in implementing the actions needed to scale up natural infrastructure (see Section 3).

Government and Infrastructure Owners

Watershed and Conservation Organizations

Indigenous Nations and Knowledge Holders

Practitioners and Contractors

Education, Training, and Knowledge Organizations

Private Sector and Investment Partners

Indigenous Acknowledgement

The region of focus for IISD's Natural Infrastructure for Water Solutions (NIWS) initiative spans over 200 traditional territories and homelands across the provinces we call Alberta, Saskatchewan, and Manitoba–including the Indigenous territories of the Nêhiyaw-Askiy (Plains Cree), Woodland Cree, Iyarhe Nakoda (Stoney Nakoda), Anishininiimowin (Oji-Cree), Niitsítapi (Blackfoot), Tsuut'ina, Očhéthi Šakówiŋ, Nakoda Oyadeb (Nakota), Lakota, Dakota, Anishinaabe (Ojibwe), Anisininew (Ojibwe Cree), and Salteaux, alongside Métis Nations, including the Otipemisiwak Métis, Métis Nation–Saskatchewan, and Red River Métis.

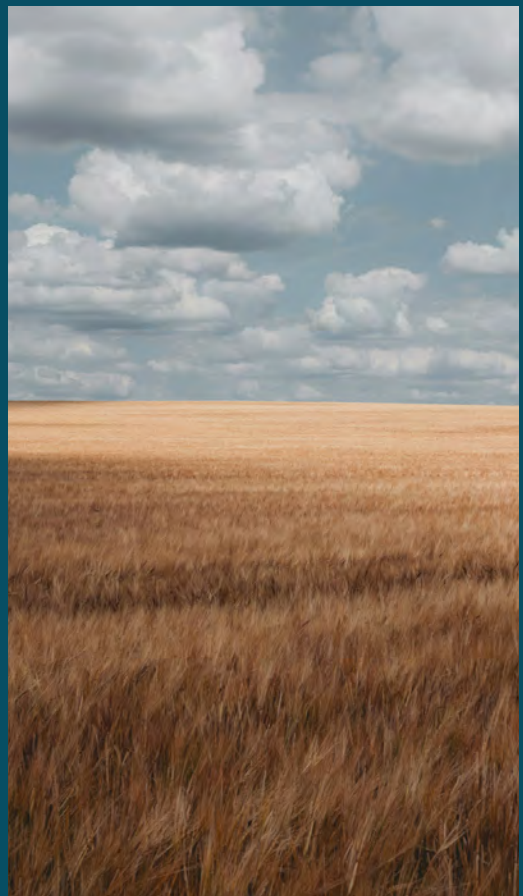


Photo by Jez Timms on Unsplash

Examples of Natural Infrastructure Solutions

RIPARIAN AREA CONSERVATION

Protecting the natural vegetation along rivers, streams, and lakes. These areas stabilize banks, filter runoff, provide wildlife habitat, and improve water quality.

RE-GRADED DITCHES

Reshaped drainage channels with gentle slopes to hold and slow runoff water. They increase water retention, reduce erosion, filter pollutants, and support water infiltration.

AGROFORESTRY & SHELTERBELTS

Trees and shrubs planted alongside crops or in rows. In addition to protecting from the wind, this practice also improves soil health, reduces erosion, conserves moisture, and provides habitat for wildlife.

FILTER FIELDS AND PONDS

Low-lying fields and shallow ponds used to intercept runoff from farmland before it reaches streams and lakes. Slowing the water lets sediment settle out and lets plants and soil capture nutrients.

BIORETENTION, BIOSWALE, RAIN GARDEN

Reshaped drainage channels and basins with gentle slopes to capture and slow runoff. They increase water retention, reduce erosion, filter pollutants, and support water infiltration.

WETLANDS

Areas where land is covered by water, either permanently or seasonally. Wetlands support diverse plants and wildlife and help store and improve water quality.

BIOREMEDIATION

Using living organisms, like plants or microbes, to clean up pollutants from soil, water, or air.

PRAIRIE POTHOLE WETLANDS

Shallow, seasonal water basins unique to the Prairie region that are vital for wildlife and water storage.

BACK-FLOODED DAMS

Berms or small dams built to hold nutrient-rich runoff water on agricultural lands. This stored water can soak into the soil, helping conserve moisture and reduce erosion.

CONSTRUCTED & FLOATING TREATMENT WETLANDS

Human-made systems designed to mimic natural wetlands. They treat and store water while providing habitat and recreational space.

PERMEABLE PAVEMENT

Paving surface that allows water to pass through into the soil below. It reduces stormwater runoff, filters pollutants, and helps recharge groundwater in urban areas.

Photo credit: IISD

Photo credit: Ducks Unlimited Canada

Photo credit: East Interlake Watershed District

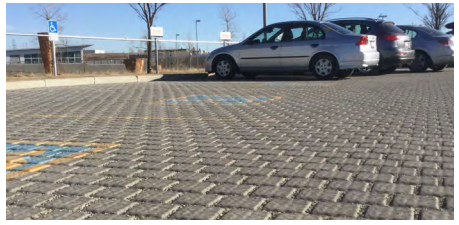


Photo credit: ALIDP

Natural infrastructure is also described using related terms such as “nature-based solutions,” “green infrastructure,” “ecosystem-based approaches,” “low-impact development,” “sustainable design,” and “natural assets.” While these terms have slightly different meanings depending on the context, they all emphasize working with nature to deliver infrastructure and community benefits.

Prairie Water Quality Context

Good water quality depends on natural systems that filter water and trap sediment, nutrients, and contaminants as it moves across the land. Development, landscape changes, and agricultural runoff can reduce this natural ability.

As communities grow and the climate changes, water quality can be affected by increased runoff, erosion, and the movement of sediment, nutrients, and contaminants. Natural infrastructure can help restore important watershed functions, including filtration, infiltration, and groundwater recharge, while supporting cleaner water and more resilient communities.

What Is Natural Infrastructure?

In this guide, natural infrastructure refers to ecosystems, whether natural, restored, or constructed, that provide environmental, social, and infrastructure-related benefits. Many types of natural infrastructure are suitable for use on the Prairies (see pages 11 to 13), including natural systems such as wetlands, forests, and rain gardens.

Natural infrastructure differs from conventional grey infrastructure. Grey infrastructure refers to engineered systems that rely on human-made materials, such as concrete, steel, and asphalt. In many cases, the two approaches work effectively together. Integrating natural and grey infrastructure can improve resilience, reduce long-term costs, and deliver multiple co-benefits.

Why the Prairies Are Ideal for Natural Infrastructure

Considered the breadbasket of Canada, the Prairies are a key agricultural region, with large acreage devoted to growing crops and raising livestock. At the same time, the region’s population is growing, with expanding towns and cities and increasing demands on infrastructure. This increases pressure on land and water systems. Natural infrastructure can help balance these demands.

The Prairies feature a diverse range of landscapes, including grasslands, forests, river valleys, and wetlands. One of its most distinctive features is the globally significant Prairie Pothole Region, which is defined by thousands of small, shallow wetlands formed by glacial activity. Unlike larger, permanent wetlands, prairie potholes are highly dynamic, filling and drying out with changing conditions. This allows them to store water during wet periods and slowly release it over time, making them especially effective for natural flood storage and groundwater recharge.

Photo credit: Freshwater Conservation Canada

Photo credit: Alisha Goldstein, EPA

What Is a Watershed?

A watershed includes the land that drains water to the same river, lake, wetland, or groundwater system. Rain and snowmelt move across the landscape through streams, wetlands, soils, and groundwater–connecting everything upstream and downstream.

Watersheds connect:

- Water
- People and communities
- Ecosystems and infrastructure

Why Watersheds Matter

Many natural infrastructure projects occur on agricultural and rural lands, while many flood and water quality benefits are realized downstream in towns and cities. This means successful watershed management depends on shared responsibility, partnerships, and coordinated investment across the landscape.

How Do Watersheds and Natural Infrastructure Work Together?

Natural infrastructure works throughout the watershed from wetlands and riparian areas to farms, parks, and urban green spaces. Different solutions perform different functions, but together they help slow runoff, increase infiltration, recharge groundwater, reduce erosion, and improve water quality.

Watershed-scale planning helps identify where different natural infrastructure solutions will provide the greatest combined benefit over the long term.

Watershed Resilience Requires Collaboration

Because watersheds cross property lines and jurisdictional boundaries, addressing flood risk and other water challenges requires coordinated action among Indigenous communities, landowners, agricultural producers, municipalities, watershed organizations, governments, conservation groups, and residents.

Natural infrastructure is most effective when planned and implemented at the watershed scale. By working together, partners can identify opportunities that provide the greatest collective benefit, align investments, and strengthen long-term resilience across the landscape.

Lasting results come not from a single project, but from many complementary actions implemented over time. Section 3 highlights the priority actions that different organizations and sectors can take to help accelerate the adoption of natural infrastructure across the Canadian Prairies.

Understanding Natural Infrastructure

Natural infrastructure uses ecosystems and natural processes to provide services that support communities and the environment.

Unlike conventional grey infrastructure that often focuses on a single function, natural infrastructure can deliver multiple benefits simultaneously, including:

- improve water quality
- reduce flood impacts
- enhance drought resilience and groundwater recharge
- provide habitat and biodiversity benefits
- increase climate adaptation and community resilience.

A Continuum of Solutions

Natural infrastructure can be implemented using various approaches depending on landscape conditions, community expansion, local economy, and watershed objectives.

The most effective and cost-efficient approach is to maintain existing natural systems first. Alongside protecting and maintaining existing natural assets, efforts can also include restoring degraded systems, enhancing working landscapes, and integrating natural infrastructure into built environments.

These four approaches form a continuum of solutions, with the appropriate approach reflecting the unique characteristics and priorities of each region and watershed. Successful watershed strategies often combine all four approaches.

Natural Infrastructure Continuum Across Landscapes

Indigenous Knowledges and Relationships with the Land and Its Water

Indigenous Knowledges

Indigenous Knowledges are grounded in long-standing relationships with land and water. These knowledges recognize that humans are part of nature and have responsibilities to care for ecosystems on behalf of future generations.

For many Indigenous Peoples, land is not viewed simply as a resource or commodity, but as a living relationship that supports culture, identity, health, and community well-being. Water, plants, animals, and ecosystems are deeply interconnected.

Colonialism and development disrupted many of these relationships by displacing Indigenous Peoples from their lands and limiting opportunities to practice stewardship and governance. Despite these impacts, Indigenous communities across the Prairies and Canada continue to lead and support important work related to land stewardship, restoration, monitoring, and climate resilience.

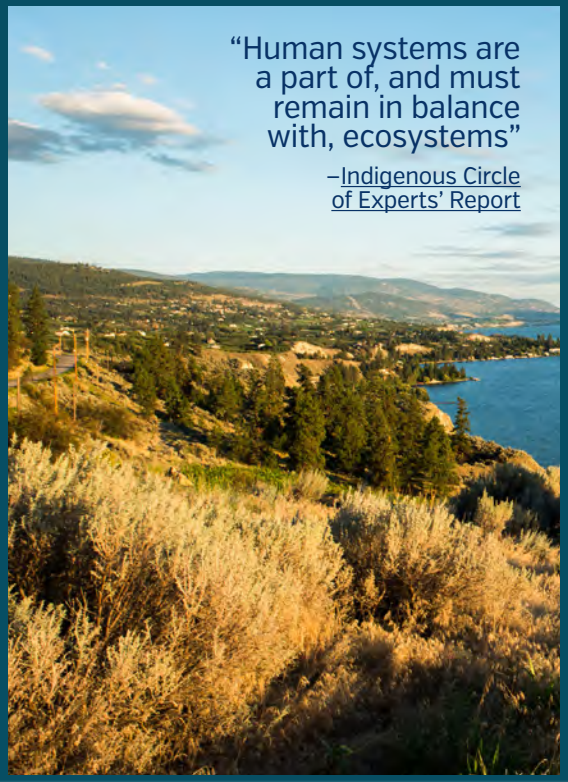
Recognizing and respecting Indigenous ways of knowing can strengthen natural infrastructure planning by supporting more holistic, long-term, and place-based approaches to caring for land and water.

k'əmcnitkw Floodplain Re-Engagement Project, Penticton Indian Reserve #1, BC

The k'əmcnitkw Floodplain Re-engagement Project is restoring historic floodplain habitat along the channelized q'awsitkʷ (Okanagan River) through collaboration among Indigenous Nations, community partners, researchers, and volunteers.

The project reconnected approximately 8,800 m² of historic floodplain and riparian habitat, improving conditions for fish, wildlife, and culturally significant species such as ntytyix (Chinook salmon). Partnerships with the Penticton Indian Band, Okanagan Nation Alliance, En'owkin Centre, project funders, students, and community volunteers have been central to restoration, monitoring, and knowledge sharing.

By combining Indigenous stewardship with Western ecological science, the project demonstrates how floodplain restoration can support biodiversity, cultural values, and watershed resilience, while naturally filtering pollutants to improve water quality.



Different Ways of Valuing Nature

Natural infrastructure can provide environmental, cultural, social, and economic value. Many of these connected benefits are not fully captured through traditional financial decision-making lenses.

ENVIRONMENTAL VALUE

Supporting biodiversity, healthy ecosystems, water storage, and cleaner air and water.

CULTURAL VALUE

Protecting relationships to land, Traditional Knowledge, cultural practices, and sense of place.

SOCIAL VALUE

Supporting recreation, mental health, education, community connections, and safer communities.

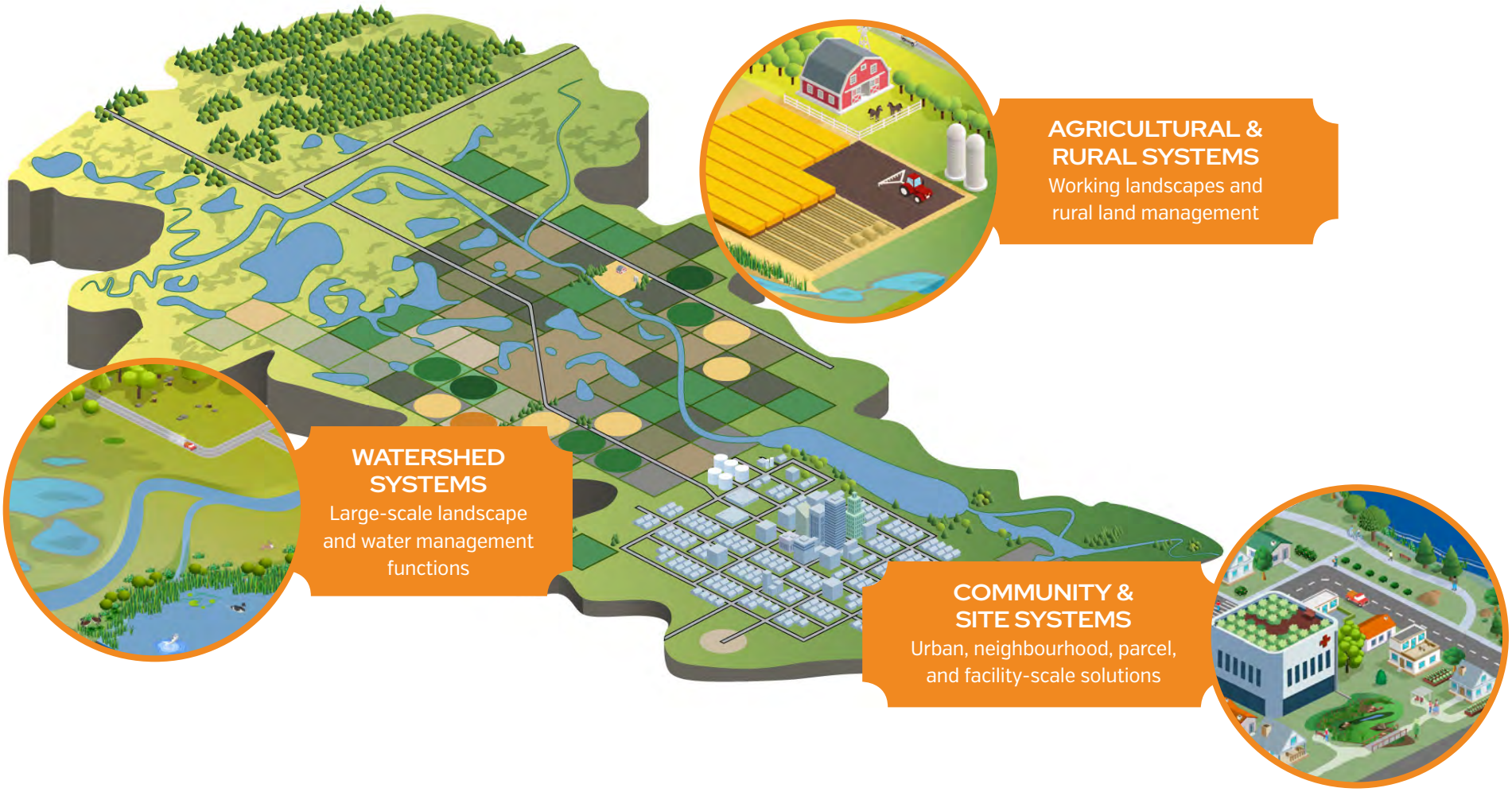
ECONOMIC VALUE

Reducing infrastructure costs, lowering flood damages, improving drought resilience, and supporting long-term sustainability.

Recognizing multiple ways of valuing nature can support more balanced and informed decision making.

Natural Infrastructure Solutions at Different Scales

Natural infrastructure can be applied across different parts of the landscape, from integrated approaches across a watershed to agricultural lands and urban areas. Different solutions are suited to different contexts, but together they help slow, store, recharge, and filter water while supporting broader environmental and community benefits.



Key Water Functions Supported by Natural Infrastructure

SLOW WATER
Reduce flood peaks and erosion

STORE WATER
Increase flood storage and drought resilience

RECHARGE WATER
Increase infiltration and support groundwater and base flows

FILTER WATER
Improve water quality and ecosystem health

2

Water Quality Roles of Natural and Grey Infrastructure

Natural infrastructure captures and filters sediment, nutrients, and contaminants before they are carried downstream.

Grey infrastructure manages the remaining water treatment needs.

The most resilient water supply systems use both.

GREY INFRASTRUCTURE

Provides targeted treatment and protection where risks remain even with the use of natural infrastructure. Grey infrastructure is particularly useful in developed areas and around critical infrastructure.

Grey infrastructure can help to
- Treat water to meet quality standards
- Protect critical infrastructure
- Manage urban drainage
- Reduce residual contaminant loads

Examples: Storm sewers, potable water and wastewater treatment plants, detention ponds, filters, outfalls.

Use natural infrastructure where appropriate, or combine it with grey infrastructure where needed for even more resilient systems.

Water Quality Starts Across the Watershed

Water quality is best protected when precipitation is managed close to where it falls. Natural infrastructure helps slow, filter, and infiltrate water throughout the watershed, capturing sediment and nutrients before they reach downstream communities.

As landscapes become more developed, impervious surfaces like roads, rooftops, and parking areas reduce infiltration, increasing runoff and carrying more pollutants into downstream water bodies. The most resilient strategies integrate a hybrid approach with both natural and grey infrastructure across a connected watershed system.

Watershed-Scale System

- Greatest opportunity to improve water quality through filtration
- Solutions are planned and/or coordinated at a watershed-scale
- Wetlands, riparian areas, grasslands, and floodplains reduce sediment and pollutants

Agricultural & Rural Systems

- On-site opportunities to slow runoff, increase infiltration, and retain water on the landscape
- Solutions are planned and/or coordinated at a more site-specific or localized level
- Water management can often be integrated with agricultural production

Community & Site Systems

- Development and infrastructure constraints limit available space for natural infrastructure
- Solutions are planned and/or coordinated at a more site-specific or localized level
- Rain gardens, bioswales, soil cells, and constructed wetlands help manage and filter runoff close to where rain falls

Use natural infrastructure where appropriate or combine it with grey infrastructure where needed for even more resilient systems.

Watershed-Scale Systems

Coordinated watershed-scale conservation and restoration

Maintain natural systems
Native grasslands, riparian areas, and wetlands, including prairie potholes

Restore wetlands
Temporary and permanent wetland basins, including prairie potholes

Restore rivers and streams
Floodplain reconnection and channel naturalization with bends and meanders

Restore riparian areas and riverbanks
Live staking, naturalized plantings, bioengineering, and riverbed enhancements

Restore groundwater recharge
Infiltration areas and soil health improvements

Restore and protect water retention
Beaver dams and beaver dam analogues

PRIMARY BENEFITS — Water Quality, Flood Mitigation, Drought and Water Supply — SECONDARY BENEFITS

Natural Infrastructure Solutions for Watershed Systems

Watershed systems provide the greatest opportunity to improve water quality by slowing, storing, and naturally conveying water across the landscape. Protecting and restoring these large-scale natural systems strengthens water quality while also supporting drought resilience, groundwater recharge, biodiversity, and flood management.

Natural Infrastructure Examples

WETLANDS AND NATURAL AREA PROTECTION

RIPARIAN RESTORATION

PRAIRIE POTHOLE WETLANDS

Photo credit: Ducks Unlimited Canada

NATIVE GRASSLANDS

2

Agriculture and Rural Systems

Working landscapes and rural land management

Build natural water retention features
Small dams and constructed wetlands

Restore and protect wetlands
Temporary and permanent wetland basins, including prairie potholes

Enhance sustainable drainage systems
Regraded ditches, back-flooded dams, filter fields, and naturalized channels

Restore marginal farmlands
Perennial vegetation, riparian restoration, and buffer zones

Establish and protect trees
Shelterbelts, windbreaks, and silvopasture

Restore riparian areas
Live staking, naturalized plantings, bioengineering, and riverbed enhancements

PRIMARY BENEFITS
Water Quality
Flood Mitigation
Drought and Water Supply
SECONDARY BENEFITS

Natural Infrastructure Solutions for Agricultural and Rural Systems

Agricultural and rural landscapes cover much of the Canadian Prairies, creating one of the greatest opportunities to improve water quality. Solutions in agricultural and rural systems focus more on individual projects rather than the large-scale planning and coordination seen at a watershed scale. Many natural infrastructure practices can be integrated into working landscapes while supporting agricultural productivity, water management, and long-term soil health.

Natural Infrastructure Examples

WETLAND RESTORATION

AGROFORESTRY & SHELTERBELTS

RIPARIAN BUFFER

REGRADED DITCHES

FILTER FIELDS

BACK-FLOODED DAMS

Photo credit: East Interlake Watershed District

Community and Site Systems

Urban, neighbourhood, parcel, and facility-scale solutions

Enhance stormwater management
Rain gardens, constructed wetlands, bioswales, and soil cells

Consider land-use development to enhance flood protection
Naturalized stormwater ponds and tree canopy

Build bioswales
Vegetated conveyance channels

Build bioretention cells and rain gardens
Vegetated conveyance channels

Restore riparian areas
Live staking, naturalized plantings, bioengineering, and riverbed enhancements

Enhance urban tree canopy
Maintain healthy tree canopy, expand canopy cover, and soil cells

PRIMARY BENEFITS — Water Quality, Flood Mitigation, Drought and Water Supply — SECONDARY BENEFITS

Natural Infrastructure Solutions for Community and Site Systems

Community and site-scale natural infrastructure filters runoff close to where rain falls. Although space is often limited in developed areas, integrating natural infrastructure into streets, parks, neighbourhoods, and redevelopment projects can trap sediment and nutrients, improve water quality, and complement conventional stormwater systems by reducing the volume of contaminated runoff they carry.

Natural Infrastructure Examples

CONSTRUCTED WETLANDS

GREEN ROOFS

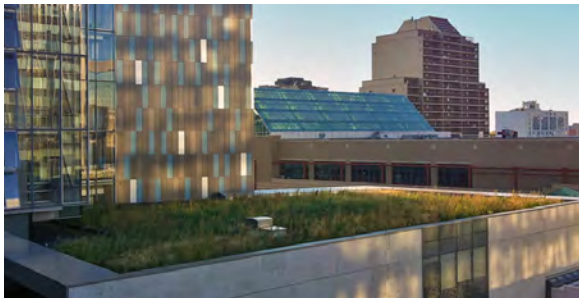


Photo credit: Mark Bauche

BIORETENTION, RAIN GARDENS

Photo credit: Mat Langford

BIOSWALES

Photo credit: IISD

SHORELINE RE-NATURALIZATION

SOIL CELLS

Common Metrics

PERCENT CHANGE (%)
Shows how much a solution increased or decreased a measurable outcome such as peak flow, runoff or erosion.

RETURN ON INVESTMENT (ROI)
Compares economic benefits to dollars invested.

SOCIAL RETURN ON INVESTMENT (SROI)
Captures broader social, environmental and economic value.

COST-BENEFIT RATIO
Compares total benefits to total costs. Values greater than 1 indicate benefits exceed costs.

ECOSYSTEM SERVICE VALUE (ESV)
Estimates the value of services provided by natural systems, such as flood mitigation, water quality improvement, and wildlife habitat.

How Natural Infrastructure Effectiveness Is Measured

The following pages summarize Prairie-based evidence showing how natural infrastructure can improve water quality and provide additional benefits.

Evidence in this guide focuses on three questions:

WATER QUALITY PERFORMANCE
Measures how effectively natural infrastructure:

- Traps sediment
- Removes nutrients
- Filters pollutants
- Reduces erosion

ECONOMIC PERFORMANCE
Measures whether natural infrastructure can:

- Reduce water treatment costs
- Lower infrastructure costs
- Reduce long-term maintenance needs

CO-BENEFITS
Measures additional benefits such as:

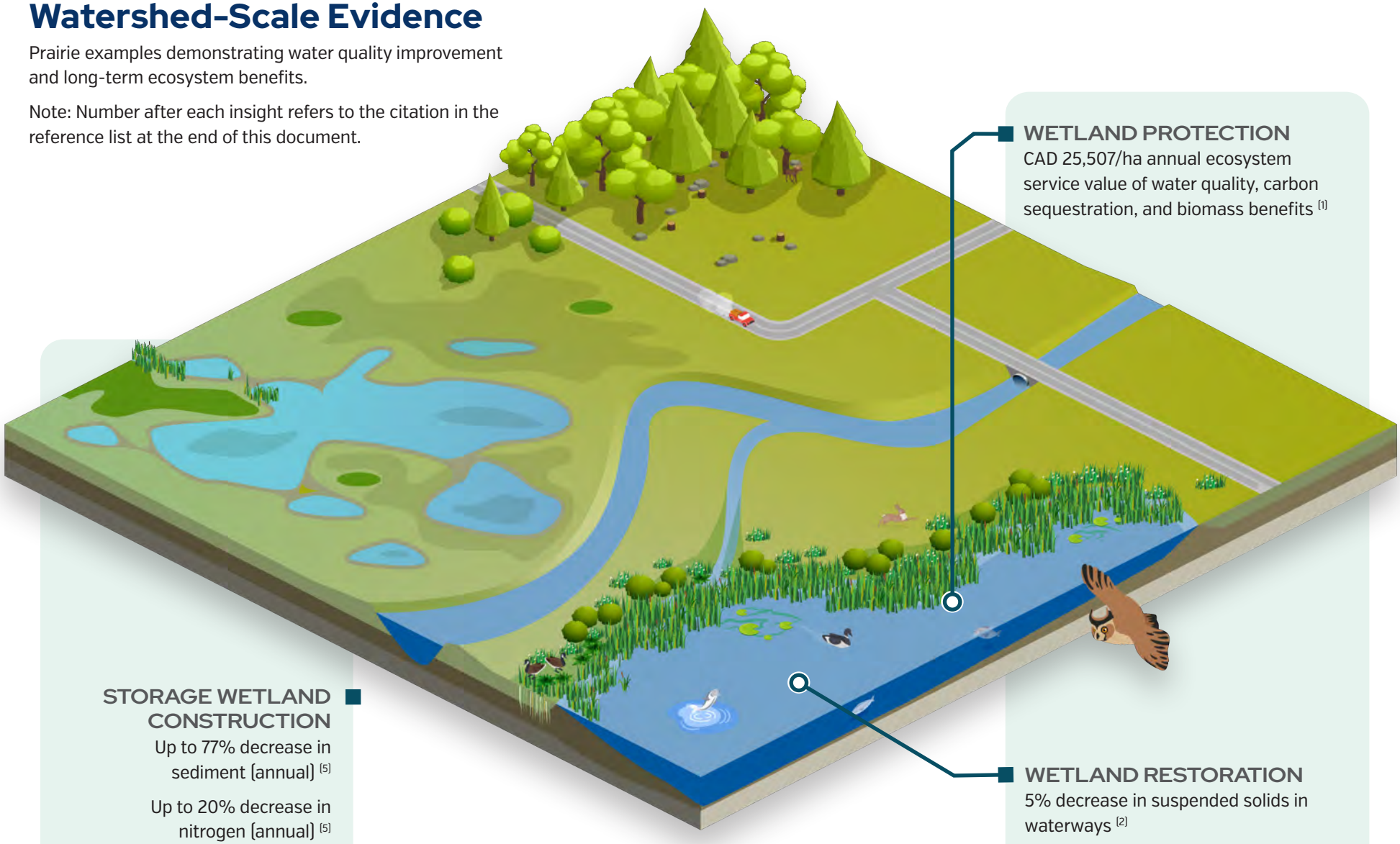
- Flood management
- Drought resilience
- Habitat and biodiversity
- Recreation and community well-being

Important Note:
Results are intended to support relative comparison and understanding. Actual performance will vary depending on local conditions, design, scale, and watershed context.

Watershed-Scale Evidence

Prairie examples demonstrating water quality improvement and long-term ecosystem benefits.

Note: Number after each insight refers to the citation in the reference list at the end of this document.



WETLAND PROTECTION

CAD 25,507/ha annual ecosystem service value of water quality, carbon sequestration, and biomass benefits [1]

STORAGE WETLAND CONSTRUCTION

Up to 77% decrease in sediment (annual) [5]

Up to 20% decrease in nitrogen (annual) [5]

Up to 12% decrease in phosphorus (annual) [5]

BACK-FLOODED DAMS

CAD 10/kg of phosphorus is the value of reduced eutrophication [6]

Disclaimer: Values on pages 11–13 are for relative comparison since local context will affect the specific values. Dollars presented are based on the study's references and have not been converted.

WETLAND RESTORATION

5% decrease in suspended solids in waterways [2]

Up to 17% decrease in sediment loading [3]

Up to 95% decrease in nitrogen [4]

Up to 92% decrease in phosphorus [4]

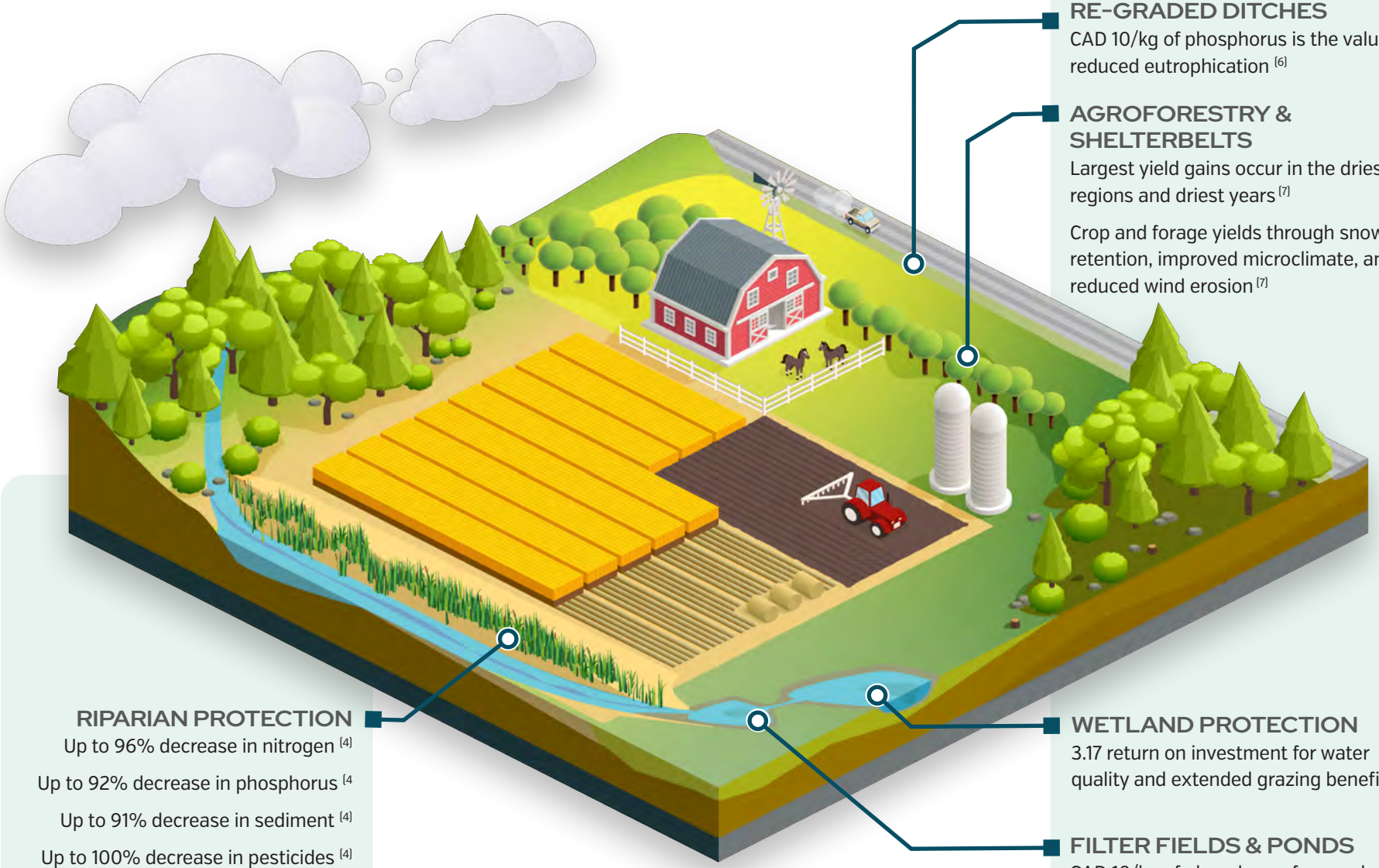
Up to 70% decrease in sediment [4]

Up to 95% decrease in pathogens [4]

Agricultural and Rural Evidence

Working landscapes can help address water quality concerns before water moves downstream and contributes to a healthier ecosystem.

Note: Number after each insight refers to the citation in the reference list at the end of this document.



RE-GRADED DITCHES

CAD 10/kg of phosphorus is the value of reduced eutrophication [6]

AGROFORESTRY & SHELTERBELTS

Largest yield gains occur in the driest regions and driest years [7]

Crop and forage yields through snow retention, improved microclimate, and reduced wind erosion [7]

RIPARIAN PROTECTION

Up to 96% decrease in nitrogen [4]

Up to 92% decrease in phosphorus [4

Up to 91% decrease in sediment [4]

Up to 100% decrease in pesticides [4]

Up to 74% decrease in pathogens [4]

WETLAND PROTECTION

3.17 return on investment for water quality and extended grazing benefits [5]

FILTER FIELDS & PONDS

CAD 10/kg of phosphorus from reduced eutrophication [6]

Community and Site Evidence

Urban natural infrastructure can filter water, lower infrastructure costs, and improve community resilience.

Note: Number after each insight refers to the citation in the reference list at the end of this document.

PERMEABLE PAVEMENT

Up to 75% decrease in suspended solids [13]

40–85% decrease in phosphorus [13]

Up to 40% decrease in nitrogen [13]

30–90% decrease in heavy metals [13]

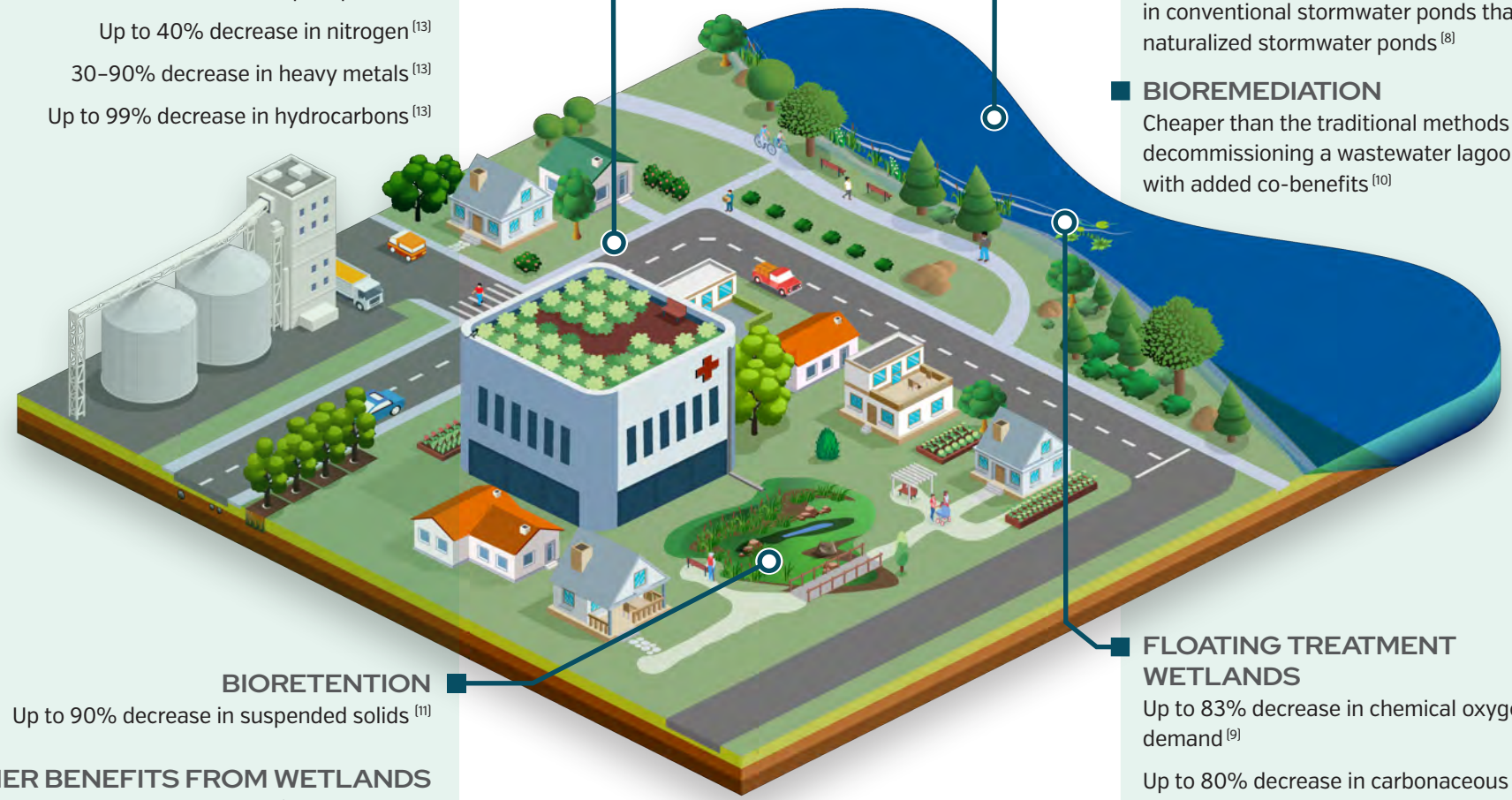
Up to 99% decrease in hydrocarbons [13]

BIORETENTION

Up to 90% decrease in suspended solids [11]

OTHER BENEFITS FROM WETLANDS

CAD 5.31 billion in annual value (including value for water supply and treatment), by the 6.6 million acres of wetlands under Ducks Unlimited Canada's management [12]



See pages 14 & 15 for case studies!

NATURALIZED STORMWATER PONDS

30x more algal biomass concentrations in conventional stormwater ponds than naturalized stormwater ponds [8]

~430x more blue-green algae in conventional stormwater ponds than naturalized stormwater ponds [4]

Up to 12x more total dissolved phosphorus in conventional stormwater ponds than naturalized stormwater ponds [8]

BIOREMEDIATION

Cheaper than the traditional methods of decommissioning a wastewater lagoon, with added co-benefits [10]

FLOATING TREATMENT WETLANDS

Up to 83% decrease in chemical oxygen demand [9]

Up to 80% decrease in carbonaceous biochemical oxygen demand [9]

Up to 67% decrease in suspended solids [9]

Up to 48% decrease in Kjeldahl nitrogen [9]

PRAIRIE CASE STUDIES

Communities across the Canadian Prairies are already using natural infrastructure to protect water quality, improve watershed function, and lower long-term costs.

Constructed Wetland and Water Retention

PELLY'S LAKE, MB

Rather than build conventional grey infrastructure (i.e., an engineered reservoir and flood-control structures) to store water and manage spring flows, the Redboine Conservation District created Pelly's Lake, a managed wetland that holds back spring runoff and releases it slowly. An IISD assessment valued the wetland's benefits to surrounding agricultural lands, water resources, and ecosystem health. The roughly 1.48 million m^3 wetland is projected to provide about CAD 2 million per year in clean water and flood-protection benefits, while reducing operating costs compared with the built alternative. Between 2019 and 2050, it is expected to deliver an estimated CAD 60 million in infrastructure and ecosystem-service value—illustrating how natural infrastructure can support water management, flood resilience, and long-term community sustainability.

Photo Credit: IISD

Photo Credit: Brazeau County

Floating Treatment Wetlands

BRAZEAU COUNTY, AB

Brazeau County installed engineered floating wetlands in a wastewater lagoon to treat sewage from a nearby rural community. Native plants are grown on floating platforms, allowing their roots to absorb nutrients such as nitrogen and phosphorus while supporting microorganisms that help break down pollutants. The system also incorporates solar-powered aeration to improve treatment performance and water quality. Early results indicate the floating wetlands are successfully providing tertiary treatment, improving effluent quality before it is released and ultimately enters the North Saskatchewan River downstream. The project is also expected to extend lagoon cleaning intervals, lowering long-term operating costs. Designed for a 50-year lifespan, the floating wetlands demonstrate how natural infrastructure can provide lasting environmental and financial benefits while supporting healthier aquatic ecosystems.

PRAIRIE CASE STUDIES

Communities across the Canadian Prairies are already using natural infrastructure to protect water quality, improve watershed function, and lower long-term costs.

Bioremediation With Wetlands

NIVERVILLE, MB

Bioremediation in Niverville demonstrates how decommissioned wastewater infrastructure can be transformed into a natural asset that continues to provide environmental services and community enrichment. Following the construction of new sewage lagoons, the community partnered with Ducks Unlimited Canada to convert an unused lagoon into a treatment wetland. Native wetland vegetation was established to naturally absorb, break down, and remove contaminants remaining in settled lagoon sediments. Monitoring has shown reductions in nitrogen, phosphorus, trace elements, and biosolids, demonstrating the effectiveness of natural processes in improving environmental conditions over time. Compared to conventional grey infrastructure alternatives, the wetland approach was estimated to be 25–44% less expensive. The project highlights how wetland restoration can be a cost-effective solution for site remediation while supporting ecosystem health, water quality, and long-term community resilience.

Photo Credit: IISD

Naturalized Stormwater Retention Basins—Water quality benefits

WINNIPEG, MB

Naturalized stormwater ponds in Winnipeg show how integrating wetland vegetation with design elements that slow water movement and increase retention time can enhance water quality treatment beyond that of conventional stormwater ponds. Research at eight conventional and eight naturalized ponds in Winnipeg found that total phosphorus concentrations in conventional ponds were typically three to eight times higher (0.2-0.8 mg/L) than in naturalized ponds, where concentrations remained below 0.2 mg/L. In summer, total phosphorus levels in conventional ponds peaked at 0.9-3.3 mg/L. These gains come from designs that maximize plant growth: gently sloped, shallow littoral benches (≤ 0.5 m deep) planted with diverse native wetland plants—cattails, bulrushes, and sedges—create the zones where nutrient uptake is greatest. The vegetation captures, stores, and removes excess nutrients before runoff reaches downstream waterways. Naturalized basins are currently the City standard for new developments.

PRAIRIE CASE STUDY

Service Value of Natural Assets

CITY OF OKOTOKS, AB

UP TO CAD **84** million per year

In ecosystem services provided by natural infrastructure in Okotoks, including:

- WATER FLOW REGULATION
- CLIMATE REGULATION
- RECREATION/ AESTHETICS
- WATER QUALITY
- POLLINATION
- + EROSION PREVENTION AND OTHER SERVICES

Interested in learning more about the benefits of natural infrastructure?

Visit the NIWS website for more resources: https://www.iisd.org/niws

Natural infrastructure investments are often pursued to improve water quality, but their greatest value comes from delivering benefits for people, nature, and climate at the same time.

Natural Infrastructure Delivers Benefits for People, Nature, and Climate

While this guide focuses on water quality, natural infrastructure investments often deliver multiple benefits at the same time–creating value for communities, ecosystems, and long-term climate resilience.

Water Quality

Reducing sediment, nutrient, pollutant, and downstream contamination impacts.

NATURE FOR PEOPLE

- Recreation and well-being
- Urban cooling and shade
- Community spaces and livability
- Property and amenity value

NATURE FOR NATURE

- Habitat and biodiversity
- Ecosystem health
- Peak flow control
- Pollinator and wildlife support

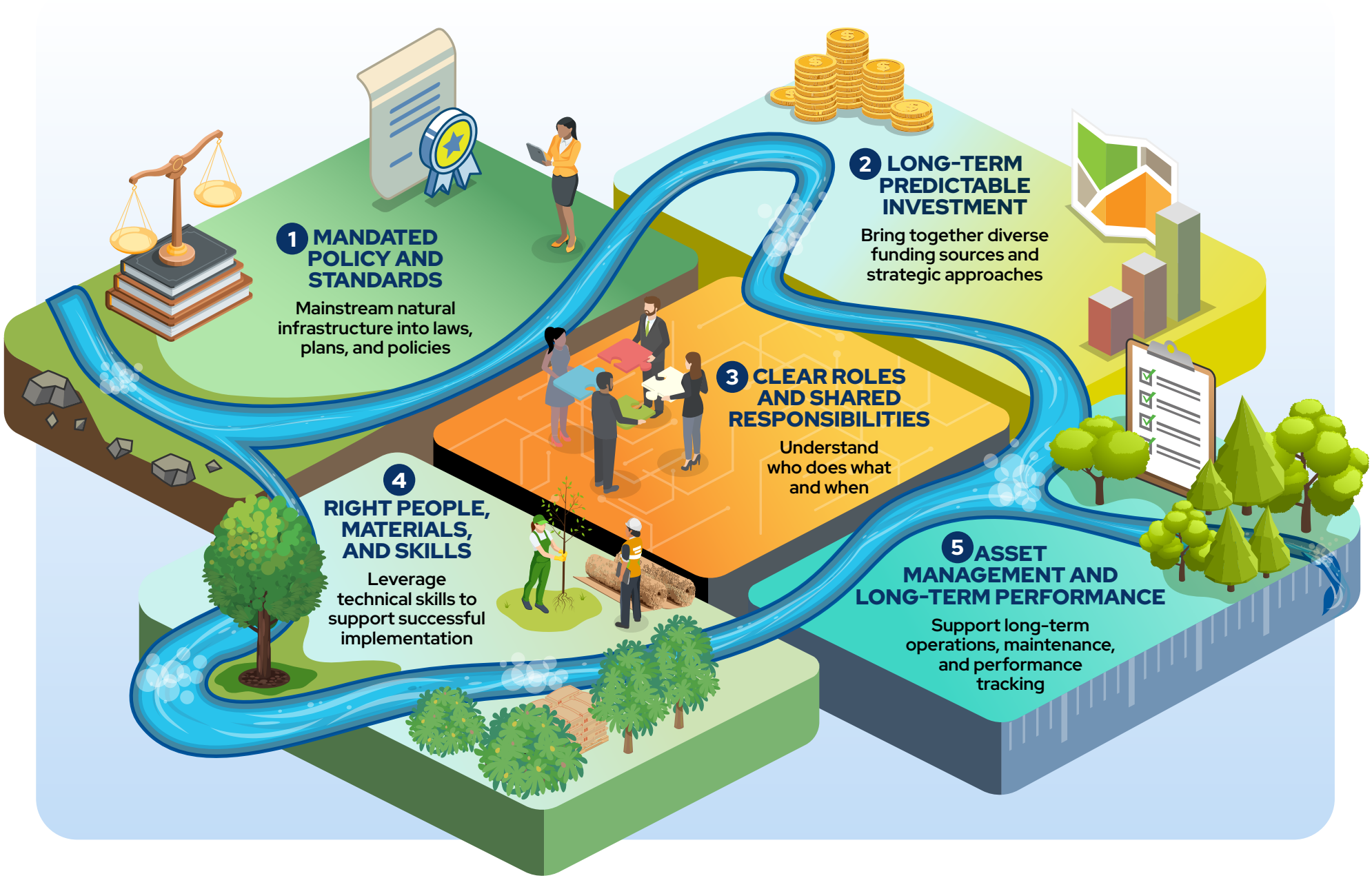
NATURE FOR CLIMATE

- Carbon storage
- Drought resilience
- Groundwater recharge
- Adaptation to changing climate conditions

Natural infrastructure investments are often pursued to reduce flood risk, but their greatest value comes from delivering benefits for people, nature, and climate at the same time.

Five Action Areas to Scale Natural Infrastructure

Scaling natural infrastructure requires action across five interconnected areas. Progress can begin anywhere, but long-term success depends on advancing all five together. The following pages describe each action area, recommend a priority action to pursue to support implementation, and share case studies for inspiration.



1. Mandated Policy and Standards

Outcome: Natural infrastructure is no longer optional –it is a standard part of planning, development, and infrastructure delivery.

KEY AUDIENCES

Indigenous and local governments, municipal associations, conservation organizations and land trusts.

Governments | Watershed Partners | Collaborative Networks

WHY THIS MATTERS

Natural infrastructure becomes standard practice when expectations are clear, mandatory, and consistently applied.

Without policy certainty, implementation depends on individual champions rather than established practice.

PRIORITY ACTION

Embed natural infrastructure requirements into policies, standards, and approval processes so they become standard practice.

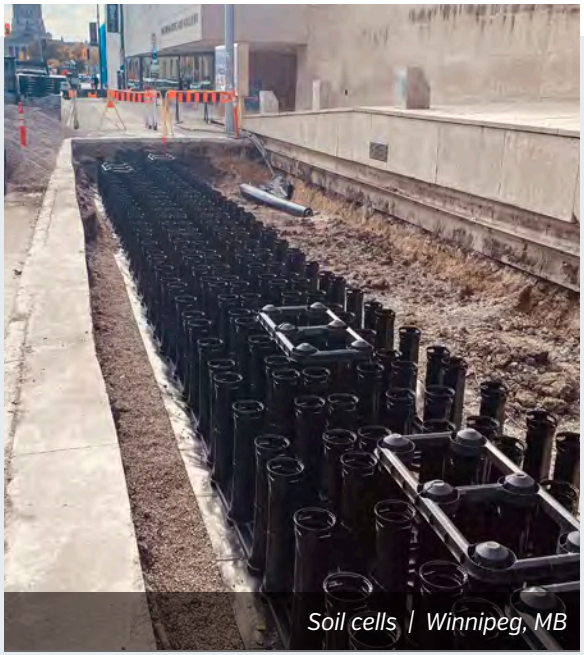
- Adopt existing, credible natural infrastructure standards and tools rather than creating new ones.
- Integrate natural infrastructure requirements into official plans, land-use bylaws, development and subdivision standards, and permitting processes.
- Make compliance with natural infrastructure requirements a condition of approval.
- Apply requirements consistently across projects and proponents.

ADDITIONAL OPPORTUNITIES

Strengthen provincial policies supporting wetland protection and restoration to improve water quality and filtration.

Require public reporting of natural infrastructure performance and value into financial and asset management frameworks.

Key Resources: CSA W218:23 Natural Asset Inventories; Standards Council of Canada Nature-Based Solutions initiatives; emerging CSA standards supporting natural asset management and natural infrastructure implementation.



Soil cells | Winnipeg, MB

PRAIRIE EXAMPLE

Winnipeg Green Infrastructure and Combined Sewer Overflow Program

As part of its Combined Sewer Overflow Master Plan, the City of Winnipeg committed to directing 10% of combined sewer program funding toward green infrastructure solutions. Specific projects are already rolling out: soil cells installed near the Winnipeg Art Gallery, a boulevard rain garden and soil-storage project on Leila Avenue (built alongside sewer-separation work), and a dry pond for stormwater retention in the north end. By combining green and grey infrastructure approaches, Winnipeg is working to reduce sewer overflows, improve water quality, and enhance the long-term performance of its wastewater system. The initiative demonstrates how stable, dedicated funding can support the routine planning and implementation of natural infrastructure alongside traditional capital projects.

2. Long-Term, Predictable Investment

Outcome: Natural infrastructure is routinely planned, protected, built, and maintained because funding is stable, accessible, and aligned with long term performance.

KEY AUDIENCES

Governments & infrastructure owners, private sector & investment partners, conservation organizations and land trusts, and municipal associations.

- Governments and Asset Owners
- Private Sector and Investors
- Watershed and Conservation Partners

WHY THIS MATTERS

Short-term funding cannot support long-term infrastructure performance. Natural infrastructure requires sustained investment for protection, implementation, monitoring, and maintenance.

PRIORITY ACTION

Establish long-term investment approaches that fund natural infrastructure as an essential component of water quality protection.

- Inventory existing natural infrastructure assets and identify the water quality and other services they provide.
- Identify priorities for protection, restoration, enhancement, and new implementation across the watershed.
- Estimate lifecycle funding needs, including planning, construction, operations, maintenance, and monitoring.
- Align funding approaches along with the water quality and broader services that natural infrastructure delivers.
- Establish stable, long-term funding mechanisms by embedding natural infrastructure into policies and asset management systems.

ADDITIONAL OPPORTUNITIES

- Collaborate with the private sector (e.g., insurers, developers) to explore alternative investment sources.
- Advocate for dedicated funding programs for natural infrastructure implementation across watershed, agriculture, community and site scales.
- Develop tools to communicate water quality benefits, such as sediment and nutrient reduction, pollution control, and broader co-benefits.

Native Grassland | Southey, SK

CANADIAN EXAMPLE

Ecological Gifts Program: Conserving land to protect water

The Ecological Gifts Program helps permanently protect wetlands, forests, shorelines, and other ecologically sensitive lands through voluntary conservation agreements and land donations. Since 1995, more than 252,000 hectares have been conserved across Canada. Protecting these areas supports water quality by filtering pollutants, reducing erosion, slowing runoff, and maintaining healthy watershed functions. By providing financial incentives for permanent conservation, the program demonstrates how sustained investment in natural infrastructure can support water quality, ecosystem health, and community resilience over the long term.

3. Clear Roles and Shared Responsibility

Outcome: Natural infrastructure is planned and delivered in a way that can be upscaled through coordinated action at the local government and watershed levels.

KEY AUDIENCES

Indigenous and local governments, municipal associations, conservation organizations and land trusts.

Governments | Watershed Partners | Collaborative Networks

WHY THIS MATTERS

Watersheds cross jurisdictional boundaries, but governance often does not. Clarifying roles and strengthening partnerships helps avoid fragmented investments and missed opportunities.

PRIORITY ACTION

Strengthen local leadership and watershed-scale collaboration to coordinate water quality efforts through natural infrastructure.

- Establish a formal mandate describing how departments and partner organizations, including developers, will work together.
- Secure dedicated resources to support ongoing watershed coordination activities, in addition to project implementation costs.
- Clearly define and communicate roles and responsibilities among organizations, interested parties, and community members involved in natural infrastructure implementation.

ADDITIONAL OPPORTUNITIES

- Develop shared watershed priorities with upstream and downstream partners to maximize water quality benefits.
- Create opportunities to collaborate with the private sector, landowners, and communities.

Photo Credit: Saskatchewan Association of Watersheds

Installing Floating Treatment Wetlands | Saskatoon, SK

PRAIRIE EXAMPLE

Floating Treatment Wetlands in Storm Pond

The Floating Treatment Wetlands project in Saskatoon, SK demonstrates how small-scale natural infrastructure solutions can improve water quality in urban stormwater systems. The Saskatchewan Association of Watersheds installed 12 floating treatment wetlands in the Kensington 1 storm pond. Planted with native sedges and rushes, the floating islands mimic natural wetland processes by filtering water and absorbing nutrients and pollutants. Water quality monitoring is helping evaluate performance and inform best management practices for future projects across Saskatchewan. As part of a broader climate adaptation initiative, the project highlights how municipal and non-profit partnerships can test innovative stormwater solutions, improve water quality, and build climate resilience.

4. Right People, Materials, and Skills

Outcome: Natural infrastructure will be protected, restored, designed, built, and maintained successfully because the right local knowledge, expertise, materials, and systems are in place.

KEY AUDIENCES

Practitioners, contractors, Indigenous Knowledge Holders & First Nations, professional associations, educational institutions, watershed organizations, supply chain partners.

Practitioners and Contractors

Education and Training Partners

Indigenous Knowledge Holders & Land Stewards

WHY THIS MATTERS

Natural infrastructure depends on living systems that require specialized knowledge and resources.

Building workforce capacity and supply chains enables projects to be delivered successfully at scale.

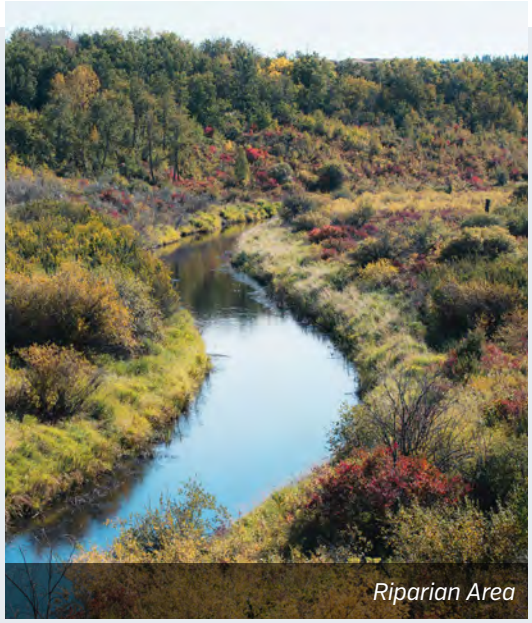
PRIORITY ACTION

Build the workforce capacity, technical knowledge, and supply chains needed to successfully deliver natural infrastructure for water quality protection and improvement.

- Develop and deliver role-specific training for practitioners, contractors, and operators on funding opportunities, design practices, maintenance requirements, and compliance obligations.
- Enable the supply chain by coordinating procurement, supporting bulk purchasing opportunities, and aligning implementation schedules with growing seasons.
- Understand local site conditions (e.g., soil type, moisture) to make sure the appropriate natural infrastructure solutions are selected.

ADDITIONAL OPPORTUNITIES

- Encourage peer-to-peer learning across jurisdictions to share experiences and lessons learned.
- Partner with post-secondary institutions and local Indigenous Nations to develop experiential learning opportunities.
- Learn from Indigenous Knowledge Holders about local water quality concerns, water movement, and land stewardship in areas of interest.
- Work with local nurseries and greenhouses to source plant species suited to local hydrology and conditions.



Riparian Area

Photo by Tristan Sosteric on Unsplash

PRAIRIE EXAMPLE

Indigenous Watershed Stewardship for Water Quality Protection

The File Hills Qu'Appelle Tribal Council (FHQTC) is advancing water quality protection in southern Saskatchewan by mobilizing Indigenous knowledges, community-based monitoring, and watershed stewardship. Working across 11 First Nations, FHQTC supports water monitoring, fish habitat protection, and the stewardship of wetlands and riparian areas that naturally filter pollutants, capture sediment, and reduce nutrient runoff. By bringing together the right people, skills, and nature, FHQTC is helping maintain healthy watersheds while building local capacity for long-term environmental management. The initiative demonstrates how Indigenous leadership and natural infrastructure can work together to protect water quality.

5. Asset Management and Long-Term Performance

Outcome: Natural infrastructure will be managed (protected, maintained) as an integral part of asset management systems.

KEY AUDIENCES

Includes Indigenous, local, provincial, and federal governments, utilities and infrastructure owners, watershed groups managing natural assets.

Governments

Infrastructure Owners and Utilities

Watershed Groups

WHY THIS MATTERS

Infrastructure delivers value only when it is actively managed.
Treating natural infrastructure as an asset helps secure long-term funding, maintenance, and public confidence.

PRIORITY ACTION

Manage natural infrastructure as essential infrastructure through asset management systems and ongoing stewardship.

- Include natural infrastructure in asset inventories.
- Report on condition, service level, and value through state of infrastructure or asset management reporting structures.
- Incorporate natural infrastructure into life-cycle and capital decisions.
- Establish ongoing maintenance and monitoring requirements to sustain performance, including water quality and supply functions where appropriate.

ADDITIONAL OPPORTUNITIES

- Assign ownership and clarify responsibilities for inspections, maintenance, and issue reporting, especially after heavy rainfall and spring melt events.
- Establish dedicated operations and maintenance budgets for water quality features, including sediment removal, vegetation management and erosion repair.
- Monitor performance and support adaptive management through clear service-level metrics.
- Plan for vegetation establishment periods and recognize that natural infrastructure performance increases over time.

Key Resources: https:/naturalassetsinitiative.ca and CSA W218:23 Standard

South Glenmore Park | City of Calgary, AB

CANADIAN EXAMPLE

Integrating Natural Infrastructure Into Asset Management

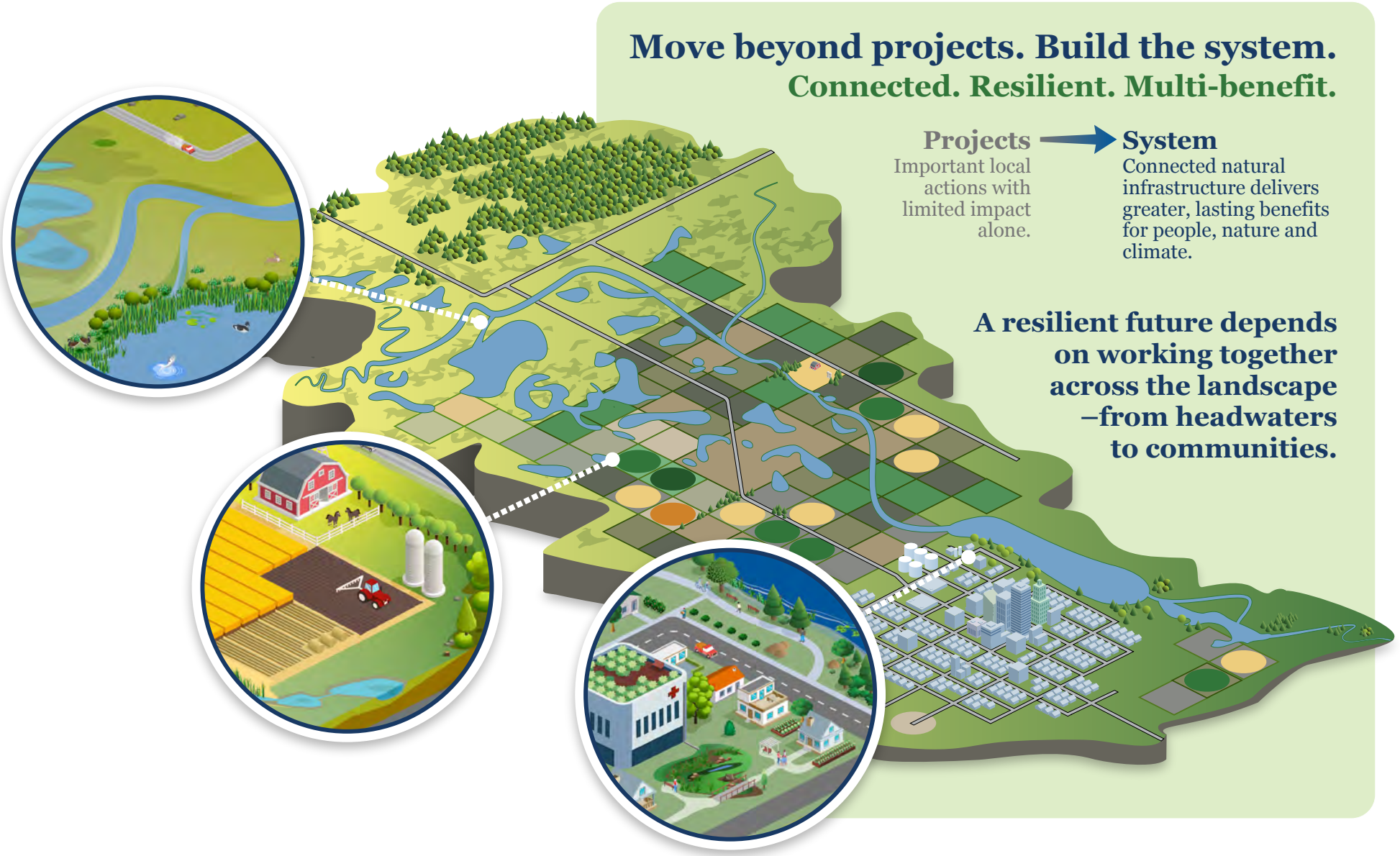
Leq'á:mel First Nation, BC is using natural asset management to strengthen stewardship of its traditional lands and waters while upholding Indigenous rights, responsibilities, and ways of knowing. Working with project partners, the Nation developed a natural asset inventory that combines Indigenous knowledge and Western science through a Two-Eyed Seeing approach. The inventory supports land use planning, watershed stewardship, restoration priorities, and informed decision making. An online mapping tool was also created to improve access to information for staff and decision-makers.

PRAIRIE PROGRESS

While many Prairie municipalities are progressing from natural asset inventories and valuation toward formal asset management integration, the City of Calgary is one of the Prairie leaders in advancing natural asset management.

Scaling Natural Infrastructure: From projects to a resilient system

Integrate nature in how we plan, fund, deliver, and manage infrastructure at the scale our communities and watersheds need.



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