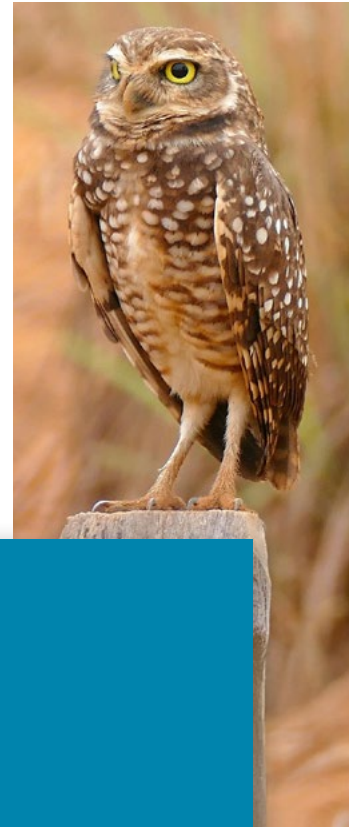
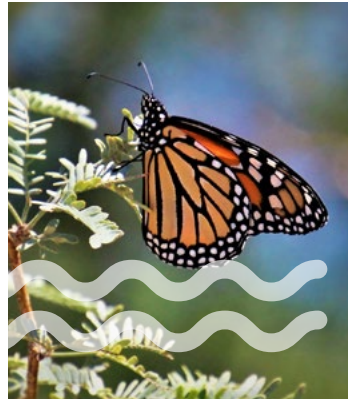




Maximizing Natural Asset Management Efforts

Summary of initiative to maximize Species at Risk, Critical Habitat, and Infrastructure Service Values in the **Winnipeg Metropolitan Region, Manitoba**

March 2025





Invest in Nature

The Natural Assets Initiative (NAI) is a Canadian not-for-profit that is changing the way local governments – an increasingly, other watershed agencies – deliver everyday services, increasing the quality and resilience of infrastructure at lower costs and reduced risk. The NAI team provides scientific, economic and municipal expertise to support and guide local governments in identifying, valuing and accounting for natural assets in their financial planning and asset management programs, and developing leading-edge, sustainable and climate-resilient infrastructure.

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Please cite as:

Natural Assets Initiative. (2025). *Maximizing natural asset management efforts: Summary of initiative to maximize Species at Risk, Critical Habitat, and infrastructure service values in the Winnipeg Metropolitan Region, Manitoba*. NAI. naturalassetsinitiative.ca

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Purpose

This document summarizes the results of an initiative undertaken by the Natural Assets Initiative (NAI) to work with the Winnipeg Metropolitan Region (WMR) to advance their natural asset management efforts by identifying and prioritizing management actions related to natural assets that benefit species at risk (SAR), critical habitat (CH) and the provision of core local government services. The project took place between February 2022 and July 2023.

Note to the reader on terminology

NAI uses the term “natural assets” in its work. We recognize that not all Indigenous Peoples would accept or use this term. In some NAI projects with First Nations, NAI has substituted natural assets with terms like “natural features” or “land water or other resources” according to the knowledge, worldviews, and perspectives of First Nations partners. NAI has continued the use of “natural assets” in this project for the simple reason that most of its methodologies are rooted in asset management processes that public sector entities in Canada must adopt.

Introduction

Natural asset management refers to the process of understanding, accounting for, and employing regenerative approaches for stocks of natural resources or ecosystems that contribute to the provision of services required for the health, well-being, and long-term sustainability of a community and its residents. There is a growing body of evidence indicating that natural assets can help to deliver critical infrastructure services, and a wide range of other positive outcomes. A variety of efforts are underway to optimize, or “stack” natural asset management efforts so they deliver the widest array of potential outcomes.

Within this context, the federal government, through Environment and Climate Change Canada, has supported efforts to develop approaches whereby natural asset management efforts can also provide beneficial outcomes for Species at Risk (SAR) and critical habitat. The rationale for doing so results from the joining of two imperatives: first, natural asset management is an inherently scalable practice because it is rooted in asset management practices that public sector entities must adopt in Canada; second, the federal government, in collaboration with provinces and territories, is developing the Pan-Canadian Approach to Transforming SAR Conservation in Canada. The latter is intended to move away from species-by-species protection and more towards considering larger ecosystems in their entirety. Together, these imperatives provide a promising potential approach for protecting SAR and CH at watershed scale, while at the same time delivering critical services that local governments and others require. Stated differently, this approach could expand the rationale and business case for protecting SAR and CH.

NAI and partners first piloted the approach in the Comox Valley (MNAI 2021); the project described in this document builds on these initial efforts together with a parallel undertaking in the Winnipeg Metropolitan Region.

Winnipeg Metropolitan Region

The Winnipeg Metropolitan Region (WMR) is the agency tasked to coordinate a regional approach to land use planning and infrastructure development for Manitoba's capital region (region). The region constitutes 18 municipalities including the City of Winnipeg, and is home to approximately 874,290 people, representing approximately 65% of the provincial population (Statistics Canada, 2022)¹ and approximately 65% of its Gross Domestic Product (based on the Winnipeg Census Metropolitan Area) (Statistics Canada, n.d.).² The region is forecasted to reach approximately 1 million people by 2050. The location and jurisdictional boundaries for the WMR are shown in Figure 1 and Figure 2

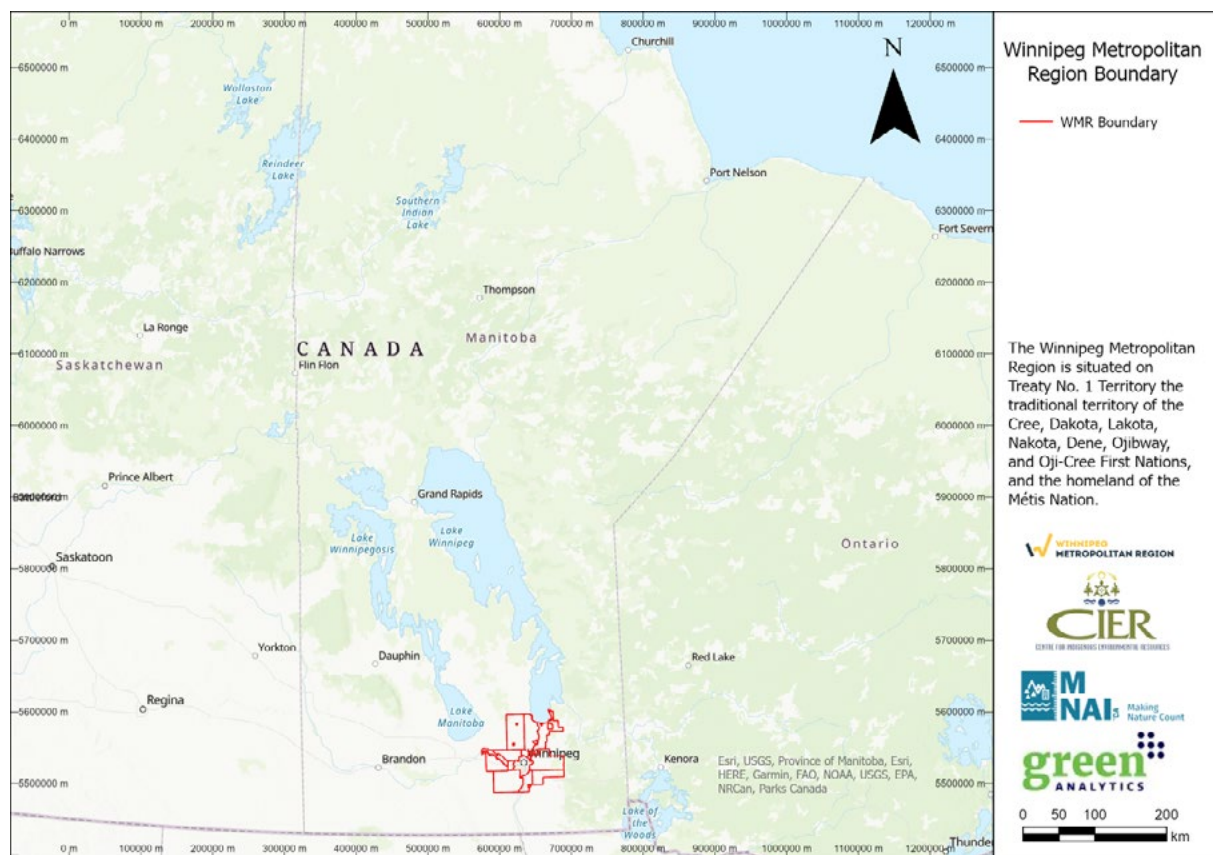


Figure 1: Map of Region in Relation to the Rest of the Province

¹ Statistics Canada, "Table 98-10-0002-01 Population and Dwelling Counts: Canada and Census Subdivisions (Municipalities)," February 9, 2022, www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810000201.

² Statistics Canada, "Table 36-10-0468-01 Gross Domestic Product (GDP) at Basic Prices, by Census Metropolitan Area (CMA) (x 1,000,000)," accessed October 25, 2021, doi.org/10.25318/3610046801-eng.

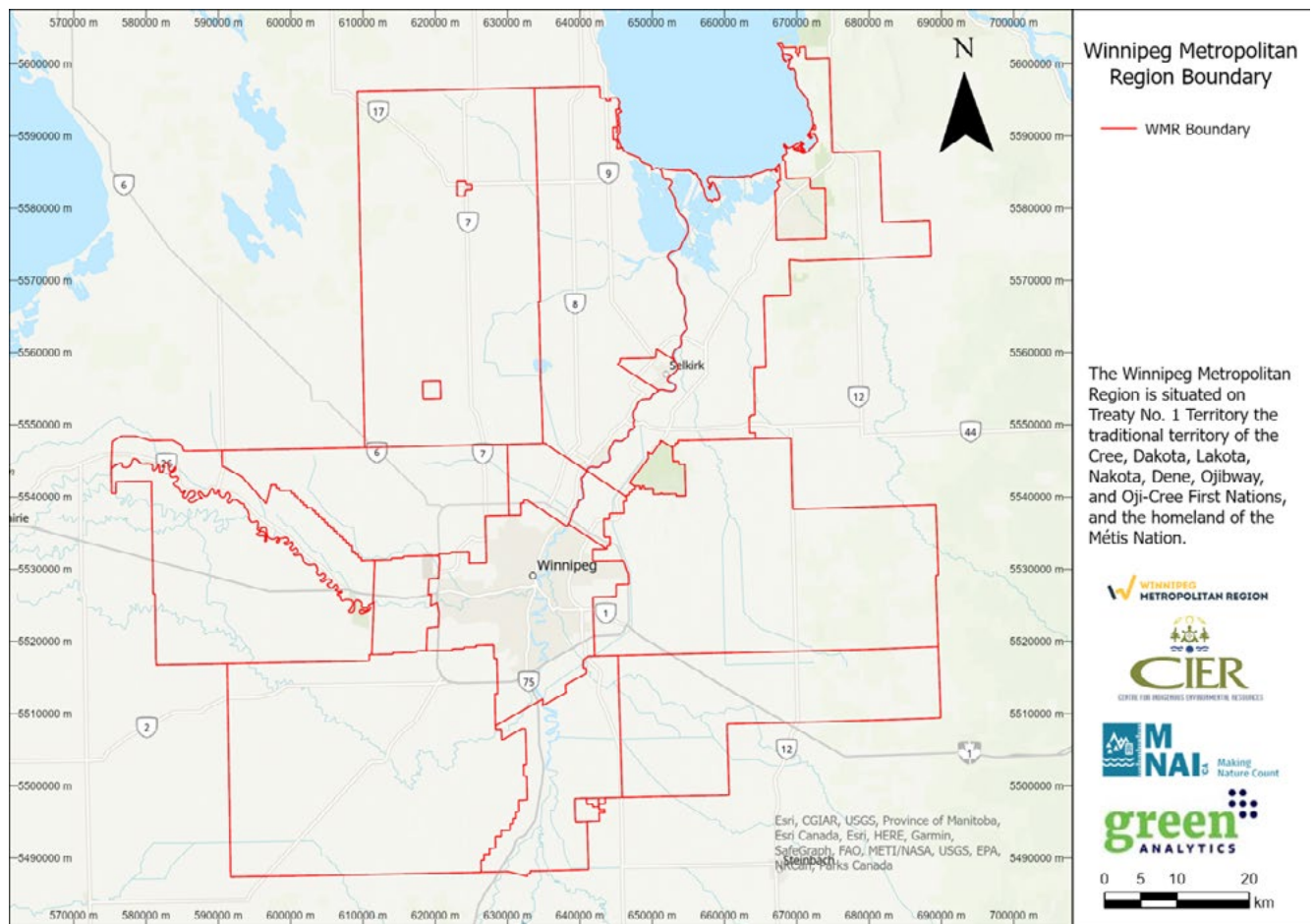


Figure 2: Map of the Region and its Municipal Boundaries

The region is located in Treaty One Territory, which is the traditional territories of the Cree, Dakota, Dene, Ojibway, and Oji-Cree First Nations, and the homeland of the Red River Métis Nation. There are various First Nations' land holdings across the region. Many of the First Nations have reserve lands, Treaty Land Entitlement (TLE) or private ownership in urban areas and throughout the region.

As part of its role and responsibilities, the WMR must develop a regional plan to enhance the economic and social development of the region. This includes policies for sustainable land use and development including responses to climate change and the protection, management and enhancement of the environment. Policies must consider natural lands of rare and historic significance. Understanding where and what SAR/CH are found is critical to this understanding as well as building a robust natural asset network in the region.

Collaborating with the WMR on this project supports building an understanding of the SAR/CH in the region and the methods used to achieve this. Further, the project provides an example of how to quantify ecosystem benefits associated with CH key to protecting SAR. Together, this provides an example of how the WMR could provide rationale to support the implementation of policies that protect, restore and enhance SAR/CH.

Project Overview

The project objectives are:

- 1/ Understand the nature and extent of overlap between natural assets that provide local government services and natural assets that are relevant to local SAR/CH.
- 2/ Identify management actions that benefit both natural assets for local government service delivery, and SAR/CH.
- 3/ Conduct a cost/benefit analysis of management actions and their outcome on service delivery to demonstrate benefits to natural assets and SAR/CH.

The overarching approach, first developed during the Comox Valley project and tested again in the Manitoba Capital Region, is presented in Figure 3.

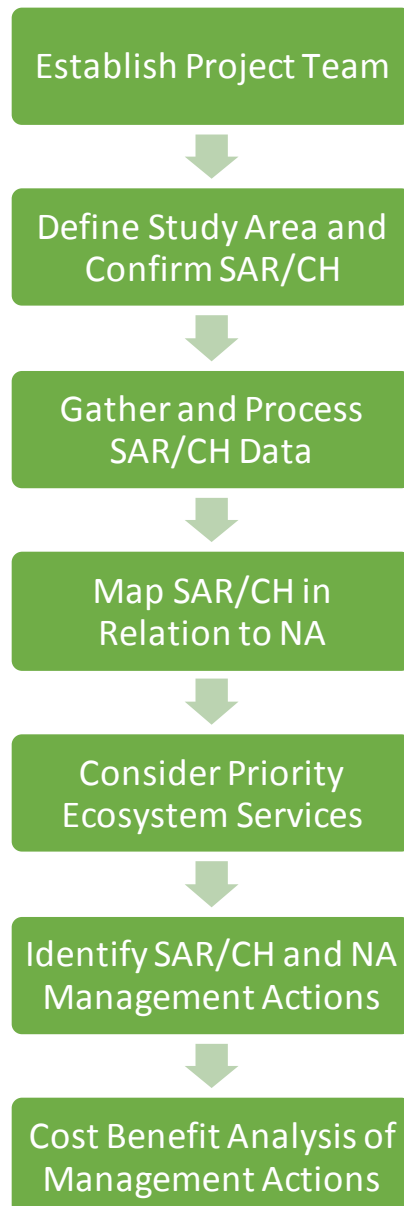


Figure 3: Overview of Approach to Land, Water and Other Natural Resources, Natural Asset Management, and Species At Risk

As is shown in Figure 3, the approach comprises seven steps. Each is described in detail in a section of this report, which is organized as follows:

- The **Context** chapter provides an overview of natural assets and natural asset management along with the connection between natural asset management and SAR/CH.
- Following the Context chapter, a series of chapters speak to the main steps in the project, starting with the need to **Establish the Project Team** (Step 1).
- The **Define Project Area and Confirm SAR/CH** (Step 2) chapter describes the need to identify the geographic area of interest for the project.
- The **Gather and Process Natural Asset Data** (Step 3) chapter identifies the numerous data sources that were employed in the project.
- The **Map Natural Assets and SAR/CH** (Step 4) chapter presents the geographic location and distribution of natural assets in relation to SAR/CH are presented.
- The **Consider Priority Ecosystem Services** (Step 5) chapter provides an overview of the discussion and outcomes of a meeting with local experts to identify priority ecosystem services for the WMR.
- The **Identify Management Actions** (Step 6) chapter describes the process and outcomes of collaboration with local experts and the project partners to identify management actions that are relevant to the local context as well as SAR/CH are articulated.
- The **Cost-Benefit Analysis** (Step 7) chapter presents the results of a cost-benefit analysis of the management actions.
- The **Conclusion** chapter summarizes the findings, limitations and articulates next steps in this area of study.

Context

Why manage natural assets?

A growing number of local governments as well as other watershed agencies recognize that it is as important to understand, measure, manage, and account for natural assets (NA) as it is for engineered ones. Doing so can enable local governments and other entities to effectively provide *core* services such as stormwater management, water filtration, and protection from flooding and erosion, as well as *additional* services such as those related to recreation, health and culture. Outcomes of what has become known as Natural Asset Management (NAM) can include cost-effective and reliable delivery of services, support for climate change adaptation and mitigation, and enhanced biodiversity.

How to manage natural assets

There are numerous ways to manage NA. NAI uses methodologies and tools rooted in standard asset management and provides advisory services to help local governments implement them.

The outer ring in Figure 4 describes the main steps involved in asset management. The steps are based on the *Asset Management for Sustainable Service Delivery: A BC Framework* (AMBC 2019) which depicts the continual cycle of asset management through three phases: Assess, Plan, and Implement. NAI has developed methods and tools to integrate natural asset considerations at each step of this process with significant investments, piloting, refinement, peer review, and documentation of lessons in multiple Canadian provinces. NAI's mission is to make natural asset management a mainstream practice across Canada, and in support of this, for local governments to accept and use the methodologies and tools in standard ways across the country.

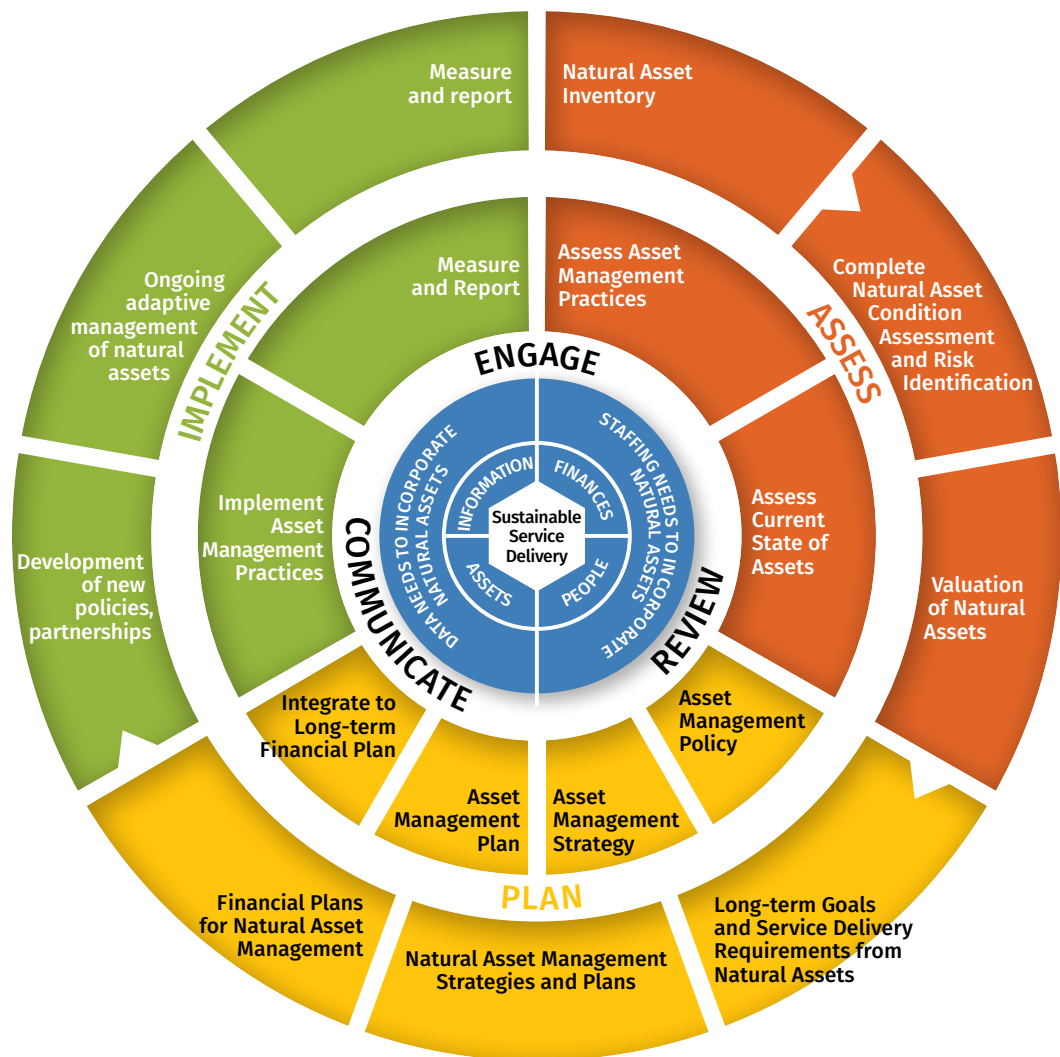


Figure 4: The Natural Asset Management Process [adapted from Asset Management BC]

Why consider species at risk and critical habitat in natural asset management

In NAI's methodology, the primary objective of natural asset management is to understand, measure, and manage the contribution of NA to the provision of *core infrastructure services* (e.g., drinking water filtration, flood mitigation), with local governments often being the primary beneficiary of the services. NAI's methods and tools focus primarily on this objective.

A secondary objective is to understand, measure, and manage the contribution of NA to other outcomes that may be of less direct relevance to the local government and asset management, but which are nevertheless important. Examples could include health, recreational, cultural, or aesthetic values; they might also include SAR and CH. Beneficiaries of these *additional services* may include the general public, or subsets of it.

NAI methods and tools in relation to this second objective are somewhat limited. Considering both primary and secondary objectives in natural asset management may “stack” or optimize efforts and outcomes. For this reason, NAI has invested in developing an approach for considering SAR/CH along with natural asset management considerations.

This project is an opportunity to:

- a/** understand the nature and extent of overlap between NA that provide local government services and NA that are relevant to SAR/CH in a single location;
- b/** based on this, to identify management actions that benefit both SAR/CH and local government service outcomes in that location; and
- c/** further refine an approach that can be applied in other jurisdictions.

Project relevance is underscored by the well-defined connection between biodiversity and service delivery from NA. Protecting SAR and CH can contribute to biodiversity, and, although the mechanisms have not yet been defined or researched, may also support many types of natural asset service delivery.

Within the context presented above, the NAI team embarked on a project with the Winnipeg Metropolitan Region to understand the nature of overlap between SAR/CH and natural assets along with options for managing one of these for the benefit of both. As is described below, the process began with the identification and engagement of a project team.

STEP 1 Establish a Project Team

The first step in the process is to identify and engage a project team. For this project, NAI developed a team consisting of:

As is shown in Figure 1, the first step in the project was to identify and engage a project team. During the initial Comox Valley pilot project, a team approach was identified as essential to engage local experts, whose advice is vital to ensure project focus and relevance. For this project, NAI developed a team consisting of:

- **Project leads** responsible for managing and undertaking the content work.
- A **Local Expert Advisory Group (LEAG)** whose purpose was to provide expert, local advice and perspectives.

The project leads from NAI and the WMR are listed in Table 1.

Table 1: Project Leads

Name	Representation
Michelle Molnar	NAI
Amy Taylor	Green Analytics as technical leads for NAI
Kevin Horrocks	Green Analytics as technical leads for NAI
Colleen Sklar	WMR
Natalie Lagassé	WMR
Anuj Kathuria	WMR
Ryan Litovitch	WMR

LEAG members represented a range of perspectives, as is noted in Table 2.

Table 2: Local Expert Advisory Group (LEAG) Members

Name	Affiliation
Jim Bear	WMR First Nations Advisor
Laren Bill	WMR First Nations Advisor
Sarah Lee	Canadian Wildlife Service
Chris Friesen	Province of Manitoba
Madeline Dessler	Province of Manitoba
Jeff Long	Province of Manitoba
Richard Farthing-Nicol	Center for Indigenous Environmental Re-sources
Linda Nichol	Manitoba Association of Watersheds

The LEAG members, with support from the Project Team, met at key junctures throughout the project to discuss and advise on:

- 1/ The proposed project area, by considering the following questions:
 - ☐ How large does the study area need to be to encompass SAR/CH?
 - ☐ What are the geographic boundaries of local governments?
 - ☐ How do watershed boundaries align with political boundaries and SAR/CH?
 - ☐ What ecosystem services do the NA within potential project boundaries provide?
- 2/ The ecosystem services of focus for the study (e.g., stormwater management, drinking water supply, wastewater treatment, recreation, carbon storage, etc.)
- 3/ Available data sources for NA and SAR/CH
- 4/ Management actions that could benefit NA and SAR/CH that are applicable and relevant to the region
- 5/ Data gaps and means to fill them

The outcome of Step 1 was the formation of the LEAG, which proved essential to this project and, it may be inferred, any future projects of this nature as they helped ground it in local realities. The individuals involved:

- Had knowledge regarding the presence and habits of local SAR/CH
- Understood and/or are involved in local government and related land use processes
- Brought a First Nations world view and knowledge to the project
- Inform and validate potential management actions for natural assets and SAR/CH

Table 3 summarizes the focus of each LEAG meeting.

Table 3: Summary of LEAG Meetings

Meeting Number	Focus
Meeting 1	Introductions ■ Overview of natural asset management ■ Overview of project (including natural assets and SAR within the region) ■ Overview and requirements of LEAG
Meeting 2	Approach reminder ■ Review and discuss possible project boundaries ■ Confirm project boundary ■ Identify priority ecosystem services

Meeting 3	Progress update ■ Introduce potential management actions and associated data needs
Meeting 4	■ Discuss and confirm management actions and associated data needs

Meetings with WMR and First Nations representatives took place as needed following meeting 4. The focus of the meetings was on confirming the priority management actions. A final meeting with representatives from the WMR focused on reviewing and finalizing draft results for the cost-benefit analysis.

STEP 2 Define Project Area and Confirm Species at Risk/Critical Habitat

A well-defined project area is required for the project. Step 2 of the approach involved defining the project area and confirming the SAR/CH on which to focus the assessment.

For the region, the LEAG was presented with a series of maps depicting various ranges for SAR/CH within the region. A total of 21 animal species (Table 4) listed as extirpated, endangered, or threatened by the provincial government and also listed as threatened or endangered under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) were presented to the group along with a list of six plant species (Table 5) with the same designations.

Table 4: List of Animal Species Discussed by the LEAG

Scientific Name	Common Name	Data Source(s)
<i>Riparia riparia</i>	Bank Swallow	Manitoba Conservation Data Centre
<i>Hirundo rustica</i>	Barn Swallow	Manitoba Conservation Data Centre
<i>Dolichonyx oryzivorus</i>	Bobolink	Manitoba Conservation Data Centre
<i>Athene cunicularia</i>	Burrowing Owl	Manitoba Conservation Data Centre
<i>Cardellina canadensis</i>	Canada Warbler	Manitoba Conservation Data Centre
<i>Chaetura pelagica</i>	Chimney Swift	Manitoba Conservation Data Centre
<i>Chordeiles minor</i>	Common Nighthawk	Manitoba Conservation Data Centre
<i>Antrostomus vociferus</i>	Eastern Whip-poor-will	Environment Canada, Manitoba Conservation Data Centre
<i>Vermivora chrysoptera</i>	Golden-winged Warbler	Environment Canada, Manitoba Conservation Data Centre
<i>Ixobrychus exilis</i>	Least Bittern	Environment Canada, Manitoba Conservation Data Centre
<i>Quadrula quadrula</i>	Mapleleaf Mussel	Manitoba Conservation Data Centre
<i>Lanius ludovicianus migrans</i>	Migrant Loggerhead Shrike	Manitoba Conservation Data Centre
<i>Danaus plexippus</i>	Monarch	Manitoba Conservation Data Centre

Scientific Name	Common Name	Data Source(s)
<i>Erynnis martialis</i>	Mottled Duskywing	Manitoba Conservation Data Centre
<i>Odocoileus hemionus</i>	Mule or Black-tailed Deer	Manitoba Conservation Data Centre
<i>Contopus cooperi</i>	Olive-sided Flycatcher	Manitoba Conservation Data Centre
<i>Falco peregrinus</i>	Peregrine Falcon	Manitoba Conservation Data Centre
<i>Charadrius melodus</i>	Piping Plover	Manitoba Conservation Data Centre
<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker	Environment Canada, Manitoba Conservation Data Centre
<i>Asio flammeus</i>	Short-eared Owl	Manitoba Conservation Data Centre
<i>Anthus spragueii</i>	Sprague's Pipit	Manitoba Conservation Data Centre

Table 5: List of Plant Species Discussed by the LEAG

Scientific Name	Common Name	Data Source(s)
<i>Vernonia fasciculata</i>	Fascicled Ironweed	Environment Canada, Manitoba Conservation Data Centre
<i>Platanthera praeclara</i>	Riddel's Goldenrod	Manitoba Conservation Data Centre
<i>Agalinis aspera</i>	Rough Agalinis	Environment Canada, Manitoba Conservation Data Centre
<i>Cypripedium candidum</i>	Small White Lady's-slipper	Environment Canada
<i>Symphyotrichum sericeum</i>	Western Silvery Aster	Environment Canada, Manitoba Conservation Data Centre, NatureServe Canada - EBAR Range Mapping

During the first LEAG meeting, the group discussed the foregoing species lists in terms of their geographic distribution, data availability, habitat characteristics, ecosystem service provision and the degree to which they are representative of other species within the region.

At the second LEAG meeting, the group reviewed watershed boundaries maps for the region as well as flood designation areas in relation to SAR/CH distribution to identify the geographic area within the region on which to focus the project. In their deliberations, the LEAG considered:

- the watershed and flood designation boundaries;
- the distribution of SAR/CH in the region;
- the trade-offs with focusing on one area of the region versus another in terms of the distribution of natural assets; and
- the services provided by natural assets and the SAR and CH distribution across the region.

The outcome of this step was that, ultimately, the group concluded that it was desirable to consider the entire regional geography

STEP 3 Gather and Process Natural Asset Data

The third step in the process involved gathering and processing data for the natural assets within the region. The point of doing so is to develop a geospatial understanding of the presence and extent of natural assets in the project area so that this can be integrated with details of SAR and CH.

These are summarized below in Table 6.

Table 6: Datasets Used to Map NA Within the Regional Boundary

Descriptive Name	Source	Purpose
Road Network	WMR	Buffered roads were inserted into the base landcover data to account for breaks between assets which were often not reflected in the original data.
Updated Water Bodies (River Features)	WMR	Rivers were found to be highly accurate to satellite imagery in this dataset and were used to account for rivers and maintain connectivity of water features not captured in ESRI or Wetland Data.
ESRI 10 m Land cover 2020 (Built Area features)	ESRI	Areas used to account for urban development and extent of towns and villages within the study area, assumed to be most up to date and prioritized over wetland datasets.
Shallow Water (Wetlands 2)	WMR	The Shallow Water areas were prioritized over the wetlands to remove overlap present between wetland and water features.
Assorted Wetland Datasets AAFC 2018-2021 (four datasets, one for each year) Canada Land Cover 2015 Manitoba Landcover dataset (Lac Du Bonnet 2005) Additional Wetland datasets outside of WMR's boundary (Wetland_2)	Government of Canada (AAFC, 2015 Landcover datasets) Province of Manitoba (Manitoba Land Initiative website)	Each file was processed to account for areas of wetlands over time, to supplement ESRI data for wetland land cover.
ESRI 10 m Landcover dataset 2020	ESRI	Used as the base file for land cover for the entire study area.

The outcome of this step was a comprehensive (but not exhaustive) understanding of natural assets in the project area using authoritative data sets. This step underpins the ability to undertake subsequent analysis.

STEP 4 Map Natural Assets and Species at Risk/Critical Habitat

Once the foregoing datasets for the region were collected, they were combined using GIS and clipped to the regional boundary. The type and extent of the various natural assets were then delineated and quantified. Figure 5 demonstrates the location and extent of natural assets within the region.

Figure 5: Natural Assets Within the Regional Boundary

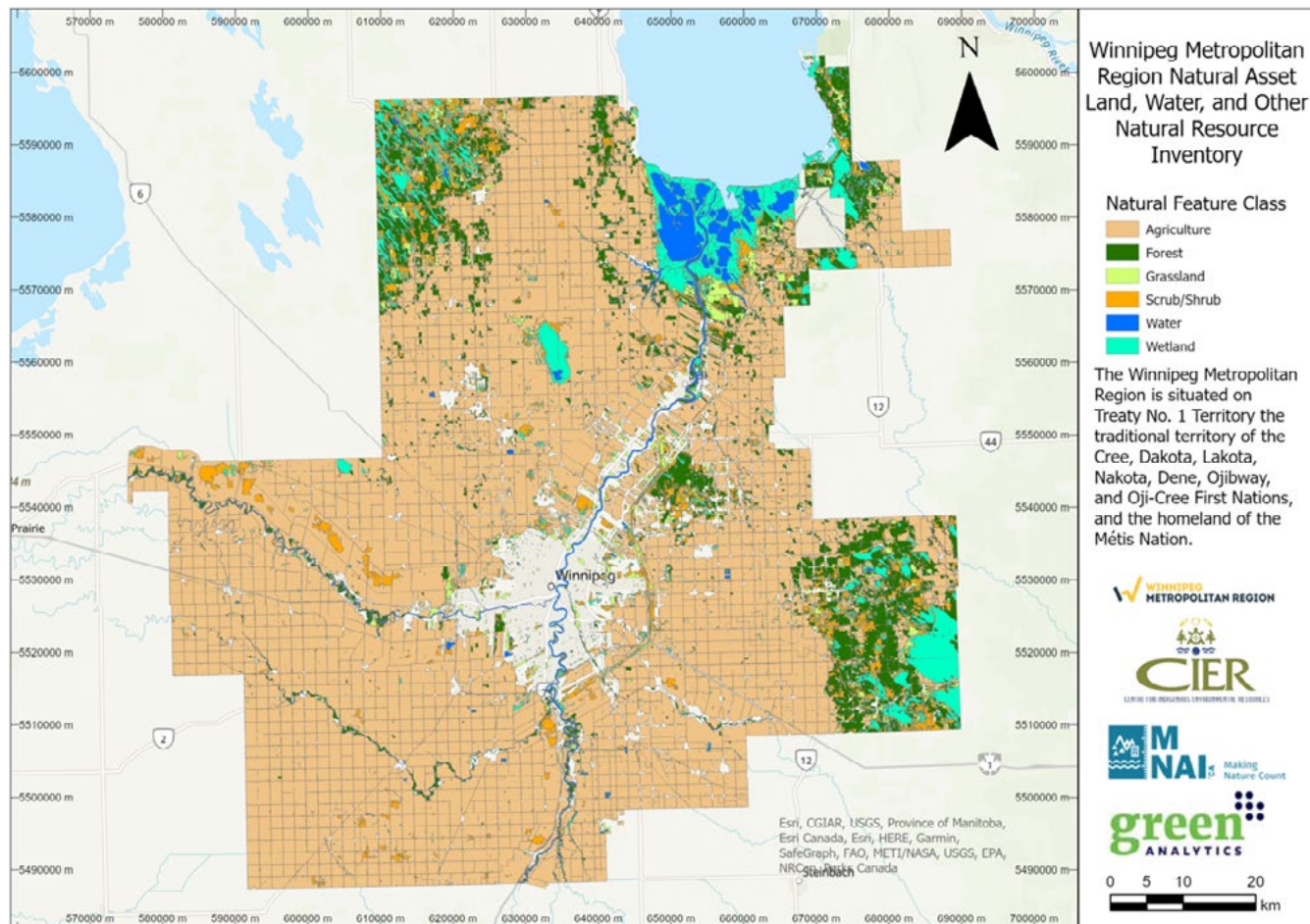


Table 7 quantifies the natural assets by asset type, demonstrating the extent of assets present within the boundary. The most dominant natural feature in the region is agriculture; this makes up more than 67% of the total area. Forest and wetlands were the next most dominant, occupying a little over 8% and 5% respectively of the total area.

Table 7: Summary of Natural Assets by Natural Feature Class in the Region

Asset Type	Area (ha)	% of Region
Agriculture	53,7339.34	67
Forest	64,994.24	8
Grassland	17,866.68	2
Scrub/Shrub	34,134.868	4
Water	17,018.04	2
Wetland	42,919.79	5
TOTAL	714,272.96	88

Within this step, the data was processed to depict natural assets in relation to SAR/CH; the maps below show the location and extent of a number of SAR/CH within the region. Note that not all species discussed by the LEAG are represented in the maps. Figure 6 shows the areas within the region that are relevant to a selection of animal SAR; Figure 7 shows areas within the region that are relevant to a selection of plant SAR.

Figure 6: Map of Critical Habitat for Animal SAR in the Region set Against the Project Area Boundary

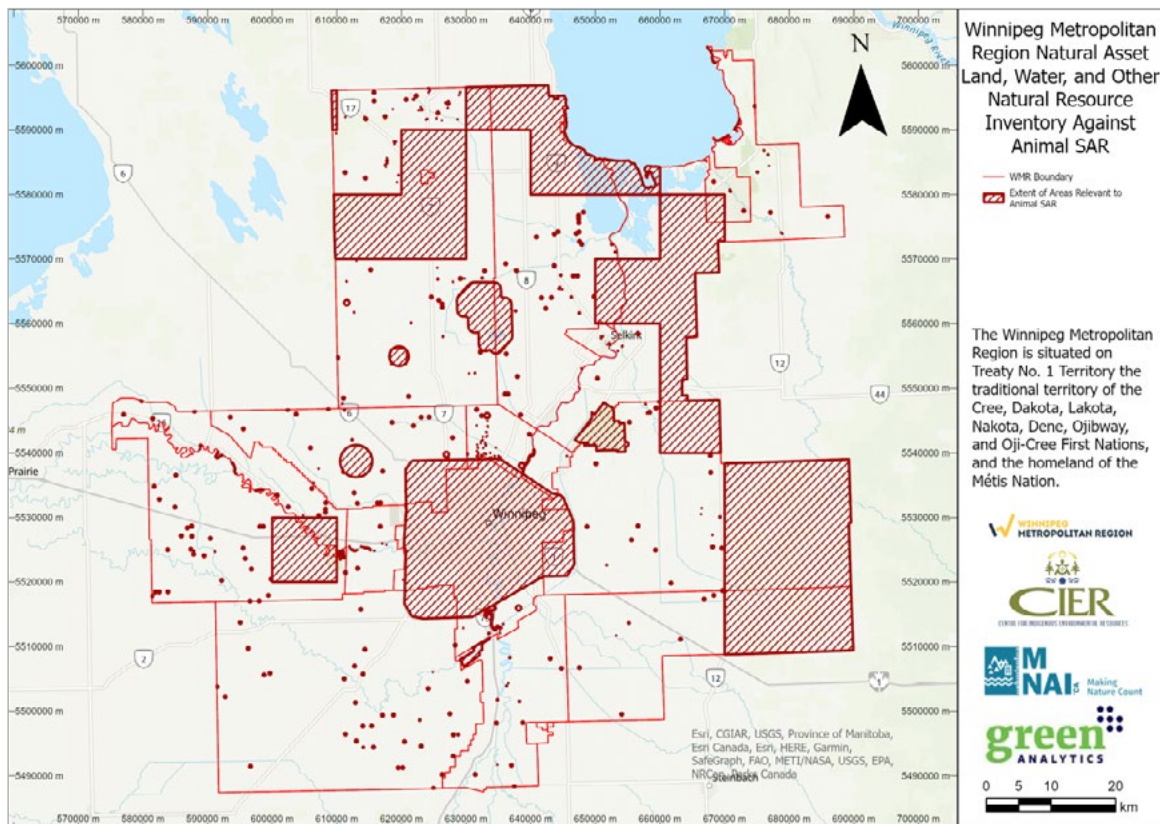
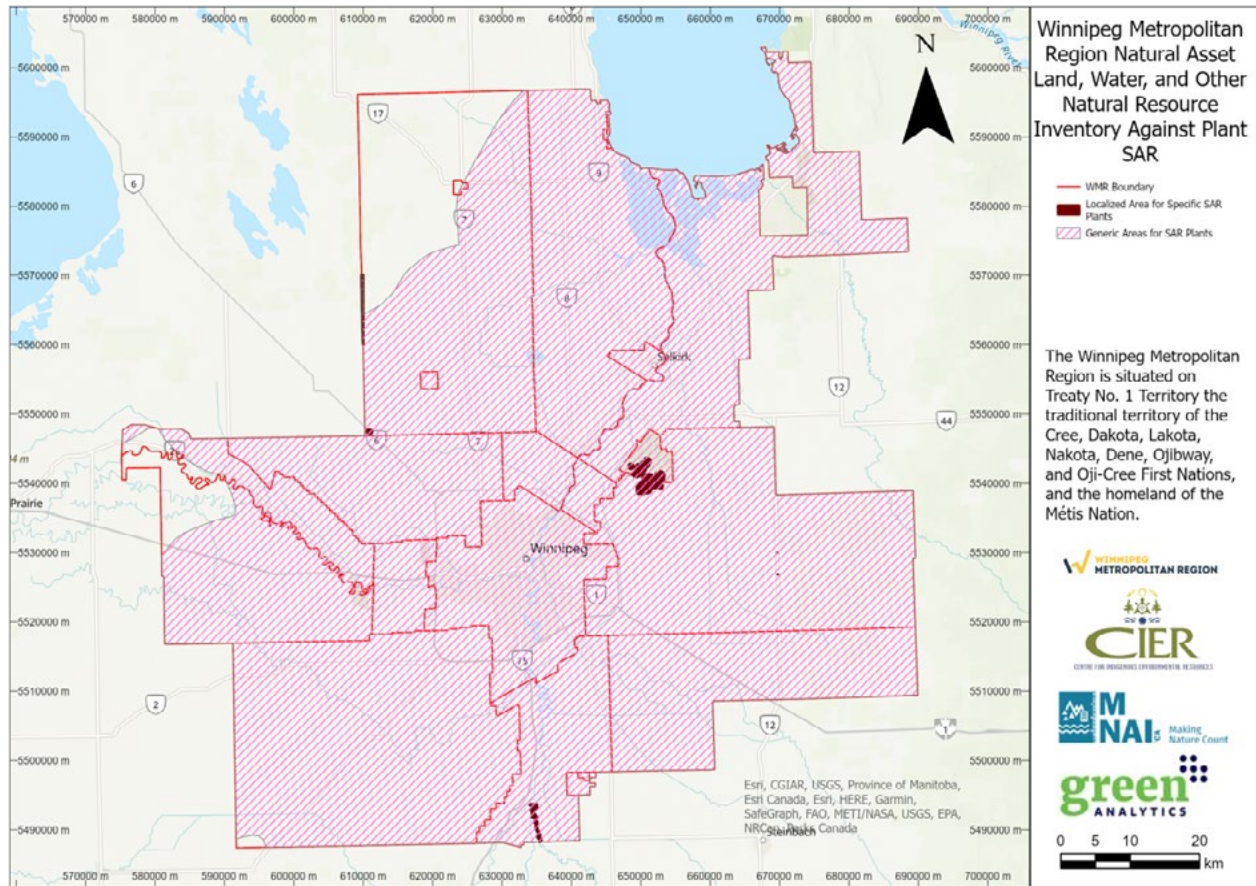
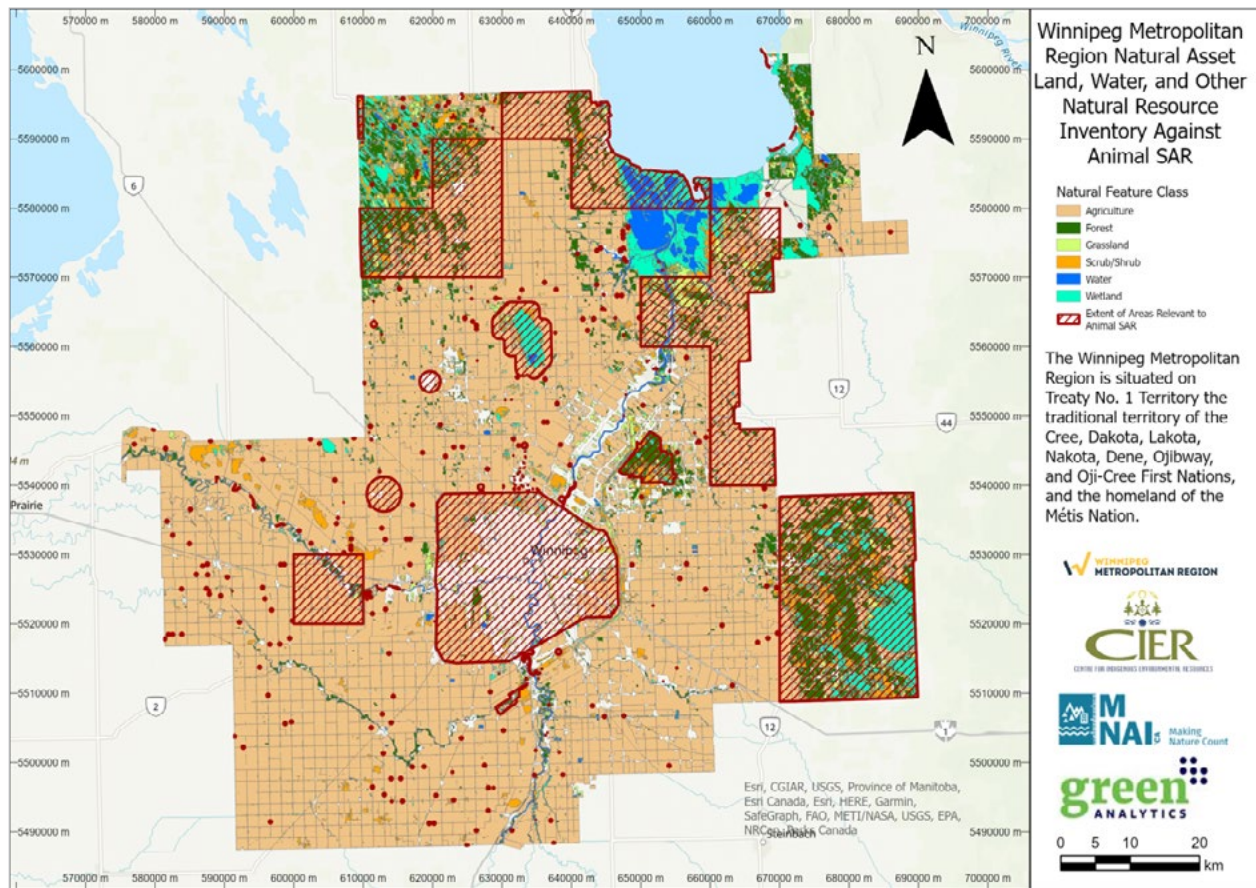


Figure 7: Map of Critical Habitat for Plant SAR in the Region set Against the Study Area Boundary



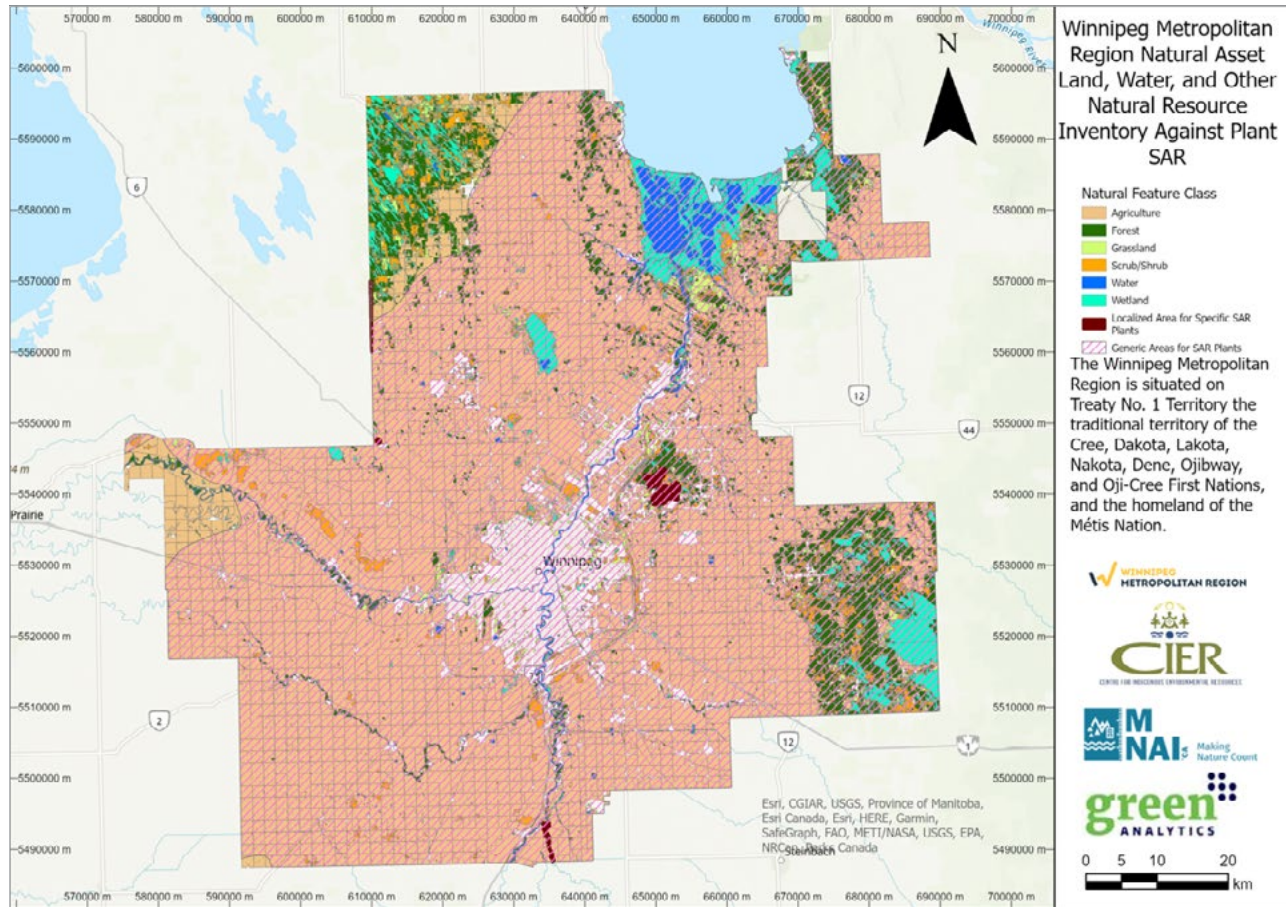
To build the analysis and apply a natural asset management “lens” to SAR/CH, the maps above can be considered relative to the location and extent of natural assets within the region. Figure 8 highlights areas relevant to some animal SAR as well as the natural assets within and surrounding those areas, and Figure 9 highlights the distribution of natural assets within the region in relation to locations relevant to some plant SAR.

Figure 8: Map Showing Critical Habitat for Animal SAR in the Region set Against Natural Assets



As seen in Figure 8, SAR habitat within the region intersects with a number of different asset types. On the east side of the map, a patch of SAR habitat corresponds to forest and wetland assets. North of the region's urban core, SAR habitat intersects with a combination of agricultural land and forest assets. There are numerous locations where SAR habitat overlaps with agricultural lands (the square and circle patches to the west of the region's urban core, as well as the red dots across the map). The SAR habitat within the city of Winnipeg (shown in the centre of the map) is less relevant to the current analysis, which is focused on the intersection of SAR and natural assets and not on the intersection of SAR and urban areas.

Figure 9: Map Showing Critical Habitat for Plant SAR in the Region set Against Natural Assets



In the map above, the red thatched lines identify areas where plant SAR species are present within the region. Such areas are concentrated to the north and east of the region's urban core and are comprised of a range of natural asset types including agriculture lands, wetlands, and forests.

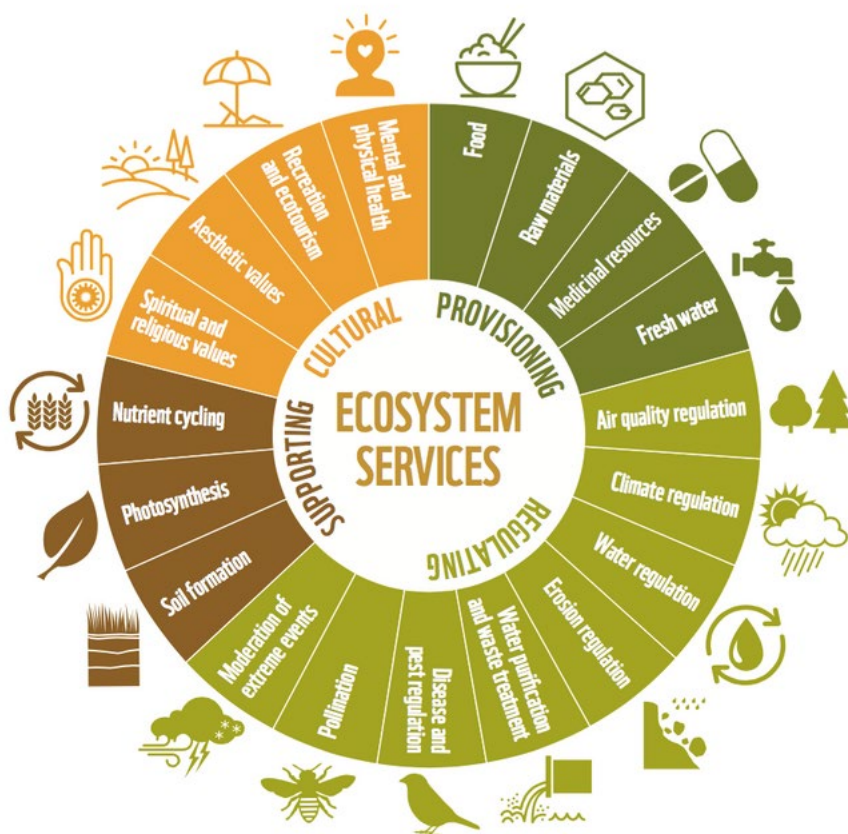
STEP 5 Consider Priority Ecosystem Services

To enable a discussion of management actions (Step 6), project partners, with guidance from the LEAG, explored ecosystem services to which management actions might be linked.

The rationale is that doing so builds an understanding of the type and extent of overlap between natural assets that provide local government services and natural assets that are relevant to SAR and CH in a single location. Based on this, management actions that benefit both SAR and critical services or outcomes in that location can be identified.

The objective of Step 5 was to work with the LEAG to identify high-priority services for further consideration in the context of management actions. To that end, a discussion of ecosystem services took place during the second LEAG meeting. Figure 10 was presented to the LEAG and used as a basis for discussion.

Figure 10: Ecosystem Services



Source: WWF Living Planet Report (2016)

Table 8 illustrates the services that were discussed by LEAG members.

Table 8: Ecosystem Services Discussed by LEAG Members to Create Basis for Understanding Potential Management Actions

Service Discussed by LEAG members	Definition
Regulation of freshwater quantity, location and timing (i.e., stormwater management)	For direct uses by people and indirect use by biodiversity and natural habitats [Source: Rice et. al 2018]
Fresh water (i.e., drinking water)	Ecosystems play a vital role in providing cities with drinking water, as they ensure the flow, storage and purification of water. Vegetation and forests influence the quantity of water available locally. [Source: TEEB 2011]
Carbon storage and sequestration	Ecosystems regulate the global climate by storing greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues acting as carbon stores. [TEEB 2011]
Moderation of extreme events	Ecosystems and living organisms create buffers against natural disasters, thereby preventing or reducing damage from extreme weather events or natural hazards including floods, storms, tsunamis, avalanches and landslides. For example, plants stabilize slopes, while coral reefs and mangroves help protect coastlines from storm damage. [TEEB 2011]
Food provisioning	Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems, but marine and freshwater systems, forests, and urban horticulture also provide food for human consumption. [TEEB 2011]
Pollination	Insects and wind pollinate plants which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats. [TEEB 2011]
Cultural aspects	Ecosystems contribute to the ability of Indigenous Peoples to maintain a connection to their culture and heritage. [MNAI 2022]
Physical and mental health	Walking and playing sports in green space is a good form of physical exercise and helps people to relax. The role that green space plays in maintaining mental and physical health is increasingly becoming recognized, despite difficulties of measurement. [TEEB 2011]
Tourism	Ecosystems and biodiversity play an important role for many kinds of tourism, which in turn provides considerable economic benefits and is a vital source of income for many countries. Cultural and eco-tourism can also educate people about the importance of biological diversity. [TEEB 2011]

At the second LEAG meeting, members agreed that selected services should be of benefit to local governments and SAR as well as provide a practical option of enhancing natural assets management. Of additional importance, services should capture a range of assets where the assets provide multiple services including consideration of climate vulnerability. Further, a balance between existing land uses, species, and landscape function should be considered.

An outcome of the second LEAG meeting was the identification of three services deemed high priority for the region. Although it was acknowledged that all services are important, the following services were identified for further consideration:

- Pollination
- Water filtration
- Water retention

STEP 6 Identify Management Actions

The identification of priority services in Step 5 allows for the identification of natural asset management actions for inclusion in a cost benefit analysis in Step 7. Step 6 focused on identifying the list of natural asset management actions and refining it through multiple steps including: a policy-scan and literature review; an assessment of stressors and challenges to SAR management in the project area; and the development of criteria for prioritizing management actions.

During the third LEAG meeting, examples of management actions and criteria for selecting them were presented and discussed. The LEAG determined that the selected management options:

- Should target natural assets that deliver priority ecosystem services
- Should target natural assets that are relevant to SAR/CH
- Can be directly addressed by Indigenous and municipal governments, and/or regional agencies or pursued through cooperation between various levels of government
- Have funding available to support their implementation

Discussion of management actions continued in the fourth LEAG meeting, and focused on management actions that would target the priority services identified during the third meeting. During the fourth meeting, the following management actions were discussed:

- 1/ Land Acquisition (i.e., purchase, donation, expropriation)
- 2/ Zoning (e.g., conservation designations)
- 3/ Bylaws (i.e., which regulate or prohibit certain activities; prescribe methods for carrying out activities)
- 4/ Tax instrument (i.e., including tax credits/deductions/charges to incent preferred actions);
- 5/ Fees or charges (i.e., to deter undesirable actions)
- 6/ Incentive programs for First Nations and agricultural landowners

Examples from the Comox Valley pilot project (MNAI 2021) were also reviewed (see Appendix A). In this example, the focus was on a property tax incentive to protect riparian areas, acquisition of high condition lands, and restoration of low condition lands.

To further review and refine the selection of management actions, additional meetings were held with the WMR Project Leads and the WMR First Nations Advisors (i.e., not the entire LEAG). As a result, it was determined that management actions would focus on regional priorities. This resulted in four management actions for consideration, which are identified in Table 9 below:

Table 9: Description of Management Actions

Management Action	Description
1. Establish a Land Use Designation to preserve, restore and enhance connectivity of natural assets	This management action would (i) identify either watercourse connectivity corridors or neighbouring natural asset connectivity corridors that are high in SAR / CH. It would then (ii) apply land use designations (e.g., Ecologically Significant Natural Lands) to promote protection &/or restoration and (iii) assess costs and benefits associated with the management action.
Formalize collaboration among municipalities and First Nations to identify approaches to steward important NA in the shared geography	Collaboration among municipalities and First Nations are formalized to identify approaches to better steward the important land, water and other natural resources in a given shared territory, especially in alignment with the United Nations Declaration On The Rights Of Indigenous Peoples Articles 25-29, 32, and the Framework Agreement: Treaty Land Entitlement.
Development Restrictions	Implement development restrictions targeted at wetlands, riparian areas, source water protection areas and possibly aquifer recharge areas to promote integrity of natural assets and protect source water and groundwater.
Promote Incentive Programs for public and private lands to protect, restore and enhance natural assets.	Through increased engagement with watershed districts, promote existing incentive programs for BMPs on public and private lands.

These meetings resulted in the selection of two priority management actions for further analysis. The proposed management action to implement development restrictions required data that was not available at this time (i.e., mapping of source water protection zones, as well as groundwater recharge zones and retention areas). The proposed management action to promote incentive programs was not pursued due to a lack of funding opportunities targeted to Indigenous Beneficial Management Practices (BMP), as well as watershed districts. The resulting management actions include:

Proposed Management Action 1 – Establish a land use designation to preserve, restore and enhance connectivity of natural assets.

Proposed Management Action 2 – Formalize collaboration among municipalities and First Nations to identify approaches to steward the important land, water and other natural resources in the shared geography, especially in alignment with the United Nations Declaration on The Rights of Indigenous Peoples Articles 25-29, 32,(UN, 2007) and the Framework Agreement: Treaty Land Entitlement (Province of Manitoba, 1997).

STEP 7 Cost-Benefit Analysis

The cost-benefit analysis was the final step in the project. Its employment here is to inform potential management actions. It is a hypothetical exercise and is not intended to signify the adoption of any particular strategy or management action. It involved the following actions:

- 1/ Identify the spatial areas to which the management actions will be targeted
- 2/ Measure the area (hectares) subject to each management action
- 3/ Quantify the value of the ecosystem service (i.e., stormwater management) provided by NA within the target areas
- 4/ Quantify the cost of the management actions
- 5/ Calculate a benefit-cost ratio for each management action (i.e., value of service provision in relation to cost of action)
- 6/ Quantify the benefit of the SAR/CH present within the target areas
- 7/ Calculate the benefit-cost ratio for the management actions taking into consideration the value of the ecosystem service (stormwater management) as well as the value of the SAR/CH (value of service provision as well as value of SAR/CH in relation to cost of action)

A quantitative analysis was applied to two areas for Action 1, whereas a qualitative analysis was completed for Action 2.

Management Action 1: Establish land use designations to preserve, restore, and enhance connectivity of natural assets

Management Action 1 explored changes to land use designations to preserve, restore, and enhance connectivity of natural assets, while ensuring access to land by Indigenous Peoples for traditional uses. This management action effectively addresses the leading cause of SAR/CH loss — habitat loss and degradation, while also building climate resilience (ECCC, 2014).

Links to the WMR's Regional Priorities

Regional priorities include supporting the development of a natural assets network at a regional scale, in collaboration with municipalities and Indigenous governments. Specifically, in addition to providing mapping of the regions' natural assets, there is opportunity to identify how local planning by-laws including development plans and secondary plans can be used as tools to enhance natural asset connectivity. This may involve acquiring land currently designated for uses including residential, commercial, industrial, agricultural or other purposes, where that land is deemed to be of high value for a natural asset network.

Target Area for Management Action 1

Management Action 1 of changing a land use designation in targeted areas creates the possibility that sensitive lands for SAR/CH and priority ecosystem services may have their land use designation changed (i.e., from development to protection). This exercise presumes this is undertaken via land acquisition. This means that in the cost-benefit analysis, the costs of acquisition (and thus precluding development) are contrasted against benefits of natural areas, with the latter measured in terms of a range of services provided. Furthermore, the acquisition of the targeted areas in the region should support Indigenous access to the land. The two areas identified for acquisition are further explained below.

Two areas for inclusion into the natural asset network were identified and the costs and benefits considered. A natural asset network promotes ecosystem functions and the unimpeded movement of species (CBD, 2020). Within the broader study area, the protection of wetlands and riparian areas were identified for inclusion in a natural asset network. The areas chosen are considered samples and were selected because they present a good example of how a cost-benefit analysis can be completed and used to support a rationale for a land use designation change that supports enhanced natural asset network connectivity.

Criteria used to identify spatial areas where the management action could be targeted includes:

- Areas designated for development (i.e., lands zoned for commercial, industrial, residential, or mixed-use development)
- Areas that improved connectivity
- Areas that supported SAR/CH;
- Areas that are relevant to priority ecosystem services

Based on the criteria identified above, two areas were selected for further analysis. The location of the areas within the WMR are shown in the map below (Figure 11), highlighted by the red boxes and labelled Area 1 and Area 2. Sites are located in the rural municipalities of Cartier, St. François Xavier, and St. Clements.

Figure 11: Location of Management Action 1 within the WMR

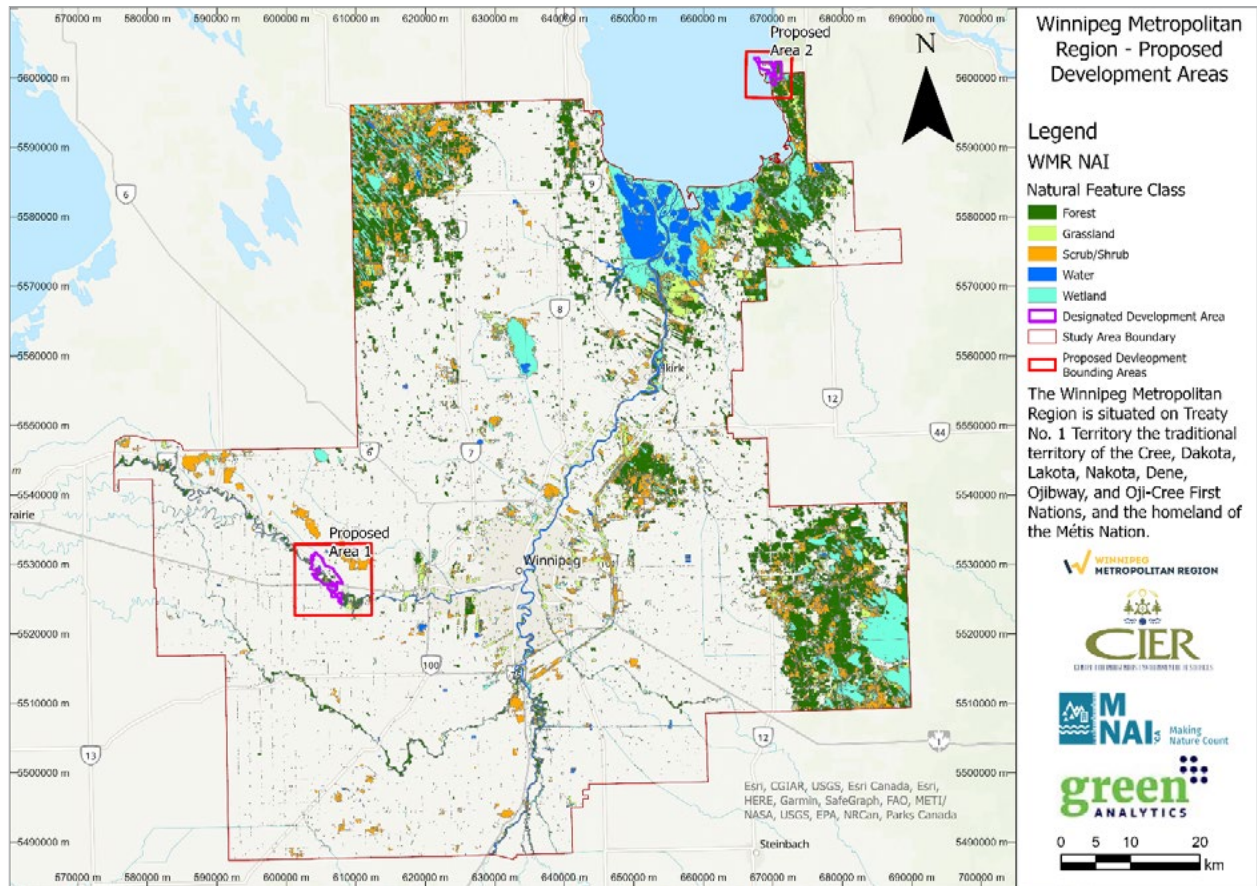


Figure 12 provides details on the type and distribution of natural assets within area 1. The purple boundary demonstrates the area of land that is designated for development. Within this boundary, the red boxes highlight the specific locations selected for management action 1.

Figure 12: Area 1 for Management Action 1

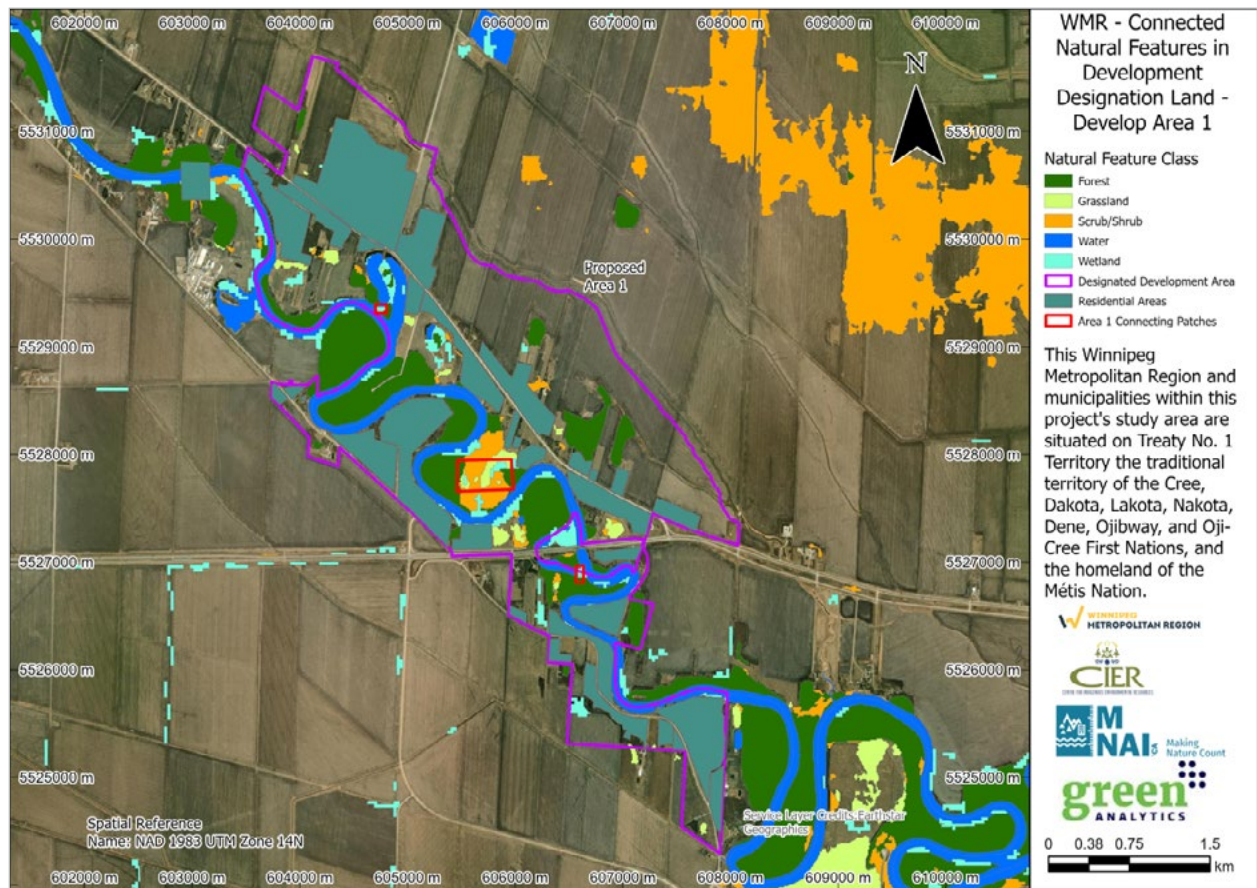
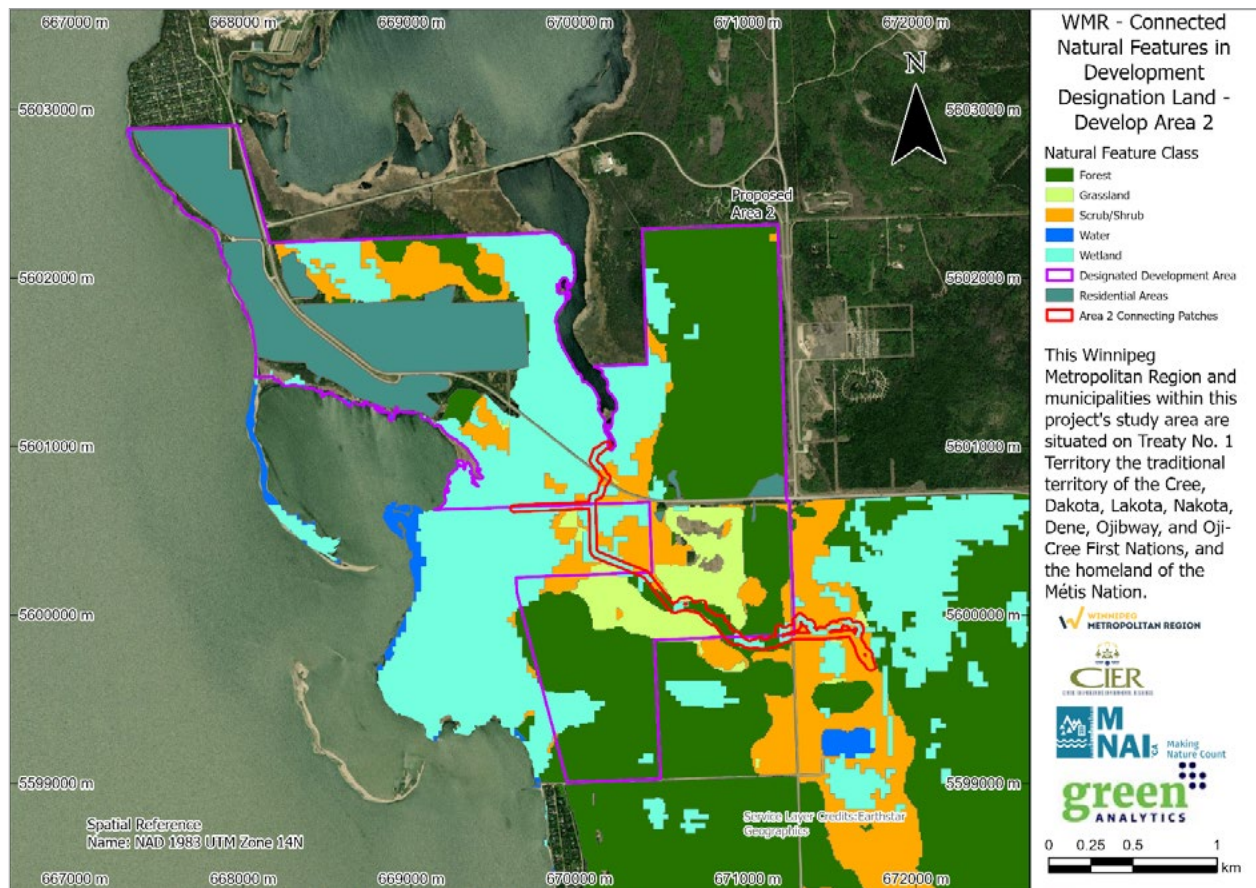


Figure 13 provides details on the type and distribution of natural assets within area 2. The purple boundary demonstrates the area of land that is designated for development. Within this boundary, the red boxes highlight the specific location selected for management action 1.

Figure 13: Area 2 for Management Action 1



While the protection, enhancement, and management of natural assets provides a wide range of benefits, the analysis focused on water-related benefits and pollination benefits, given LEAG input which stressed the importance of water management and agriculture in the Prairies. To arrive at estimates of nature's contribution to the priority benefits, ecosystem service values were calculated by applying dollar/hectare or dollar/household estimates for ecosystem services by landcover type present within the identified area.

It is important to note that each hectare of natural assets can have a very different contribution to the priority ecosystem services based on socio-economic, biophysical, and geographical features. Ideally, a valuation of ecosystem services should involve detailed ecological and economic studies of each ecosystem of interest for each land cover type. However, such studies are costly and time consuming. To address this, a benefit transfer approach was used. This approach provides indicative or order-of-magnitude values for services to help prioritize management actions to protect, enhance, and manage natural assets.

Average estimates of the per-hectare value of ecosystem services were derived from a literature review. Specifically, estimates for this management action relied on three studies, including:

- 1/ Troy and Bagstad (2013), a benefit transfer study that utilizes primary studies completed in regions with a similar ecological and socio-economic context, that utilizes primary studies completed in regions with a similar ecological and socio-economic context, employs an acceptable methodology, and was peer reviewed;
- 2/ Dupont and Renzetti (2013) which assessed the total economic value of water use in Canada, and;
- 3/ Saini et al. (2018), who estimated the stormwater capacity of land, water and other natural resources in Ontario's Peel Region.

Table 10 provides the hectares of each natural asset type for each location for Action 1.³ Table 11 provides the value of ecosystem services provided by land cover type included in areas 1 and 2 (see Appendix B for additional details).

Table 10: Landcover types in areas identified for Management Action 1

Land, water, and other natural resources type	Area 1 total hectares	Area 2 total hectares
Forest & Shrubland	166	260
Grassland	18	39
Water & Wetland	131	128
Total	315	427

Table 11: Ecosystem Service Values for Areas #1 and #2

Ecosystem Service	Type of Natural Assets	Hectare / Year or Household / Year (2022 CDN dollars)
Water Filtration	Forest & Shrubland	\$1,743/ha/yr
	Grassland	\$33/ha/yr
	Water & Wetland	\$792/household/yr
Water Retention	Forest & Shrubland	\$1,878/ha/yr
	Grassland	\$25/ha/yr
	Water & Wetland	\$1,878/ha/yr
Pollination	Forest & Shrubland	\$25/ha/yr
	Grassland	\$25/ha/yr
	Water & Wetland	N/A

³ A 20m stream buffer was added to the streams of this management action in recognition that a healthy buffer contributes to provision of priority service by slowing runoff, filtering pollution, mitigating erosion and shading of streams to promote fish health.

WHAT DO THE NUMBERS MEAN?

Three things should be borne in mind when considering the dollar values presented.

First, they do not involve detailed modelling but rather, are based on literature and existing studies. Therefore, they should be considered indicative, not precise.

Second, the dollar values should be considered low-end estimates. This is because only three service values were considered (water filtration, water retention, and pollination) when in fact these areas would provide many other services with readily-calculable market and non-market values.

Third, the use of discount rates is to determine the present value of future cash flows in the analysis and reflect the fact the money is worth more now than in the future. It has been argued that renewable resources should use a lower discount rate to reflect the reality that ecosystem services are provided over a much longer period of time. As noted, the analysis used three discount rates over a 30-year period: a 0% discount rate recognizes that land, water, and other natural resources do not depreciate over time; a 2% discount rate is common for socio-economic studies; a 5% discount rate is a conventional rate.

Costs and Benefits of Management Action 1

The cost-benefit of Management Action 1, area 1 was developed with the following assumptions:

- Land use designation changes are applied in the year 1
- Land acquisition to increase connectivity occurs in three phases of roughly equal acquisition in years 1, 4, and 6
- Ecosystem service benefits are fully realized at the time of acquisition
- Per household values are applied at a local scale for water filtration, pollination and water retention, but at a regional scale for SAR/CH

With the target areas identified, the costs and benefits of area 1 of this management scenario were calculated. The cost of this management action was calculated as the sum of:

- i/ the cost to acquire lands⁴;
- ii/ the administrative and legal costs associated with land acquisition⁵; and
- iii/ the monitoring, operations, and maintenance costs to maintain natural assets.⁶

⁴ Land acquisition costs were estimated from current land costs in the relevant areas, using Realtor.ca.

⁵ Legal and administrative costs were estimated at \$50,000 per purchase.

⁶ Monitoring, operations and maintenance costs were estimated at 3% of land acquisition costs.

The present value of the costs was calculated over a 30-year period assuming discount rates of 0%, 2% and 5%.

NET PRESENT VALUE, BENEFIT COST RATIO & DISCOUNT RATES EXPLAINED

Net Present Value (NPV) is the current value of all future cash flows – both positive and negative – over the entire life of a project or management action. Holding all else constant, actions with a positive NPV are worth undertaking, while those with a negative NPV are not.

Benefit Cost Ratio (BCA) is an indicator that reflects the relationship between the relative costs and benefits of a project or management action. If the BCA is greater than 1, the project or management action is expected to deliver a positive NPV.

Discounting future flows of money is common in CBA to reflect the assumption that a dollar today is better than a dollar tomorrow. The use of a high discount rate assumes that the benefits humans reap in the present are more valuable than the benefits provided to future generations. The use of a low discount rate can be used to recognize a project or management action can provide benefits over a long period of time, affecting future generations. To reflect ecological timeframes, this project included a 2 per cent discount rate (which is considered low and often used in social CBA), a four per cent discount rate (which is a RDCO's standard discount rate) and a 0 per cent discount rate (which reflects values remains constant over time). A topic that is currently being debated in Environmental and Ecological Economics is whether a negative discount rate should be used in environmental CBA to reflect that nature generally appreciates in value when it is well managed.

The present values of the cost of the land use designation in area 1 were estimated at:

- \$117,147,591 assuming a 0 per cent discount rate
- \$98,775,857 assuming a 2 per cent discount rate
- \$80,263,130 assuming a 5 per cent discount rate

The present values of the cost of the land use designation in area 2 were estimated at:

- \$266,966,910 assuming a 0 per cent discount rate
- \$225,295,267 assuming a 2 per cent, discount rate
- \$183,292,364 assuming a 5 per cent discount rate

It should be noted these values are a subset of the ecosystem services that could be associated with each location for Management Action 1 (see Figure 10). Meaning, the ratio of every dollar invested compared to benefits generated would be higher as more ecosystem services are considered.

Considering the benefits selected relative to the cost of Management Action 1, the following are the net present values for:

Management Action 1 - area 1:

- \$261,151,401 at a 0% discount rate, with a benefit cost ratio of 1.23, meaning for every dollar invested, \$1.23 in benefits are realized
- \$203,910,801 at a 2 per cent discount rate, with a benefit cost ratio of 1.06, meaning for every dollar invested, \$1.06 in benefits are realized
- \$149,587,223 at a 5 per cent discount and the resulting benefit cost ratio is 0.86, meaning for every dollar invested \$0.86 in benefits are realized

Management Action 1 – area 2:

- \$369,034,531 at a 0 per cent discount rate, with a benefit cost ratio of 0.38, meaning for every dollar invested, \$0.38 in benefits are realized
- \$299,851,714 at a 2 per cent discount rate, with a benefit cost ratio of 0.33, meaning for every dollar invested, \$0.33 in benefits are realized
- \$232,497,163 at a 5 per cent discount rate and a resulting benefit cost ratio is 0.27, meaning for every dollar invested \$0.27 in benefits are realized

The results presented above do not account for benefits associated with the SAR. To estimate the value of this service, a dollar/person estimate for SAR was assigned to the population surrounding the region. NAI obtained this value from a study completed in Saskatchewan (Kulshreshtha et al. 1997) which estimated the per-household willingness to pay for a program that would double the number of conserved areas to protect wilderness and wildlife habitat. The authors' findings were provided for non-Indigenous and Indigenous populations, and noted Indigenous respondents valued wilderness and wildlife habitat at a value 30 per cent higher than the non-Indigenous population.

Transferring values from the Saskatchewan study has limitations. The primary study assessed the value of both wilderness protection and wildlife habitat. Furthermore, the authors asked participants of their motivations for their reported willingness-to-pay estimates, which referenced a wider range of ecosystem services. Nonetheless, it should be clear that precise values are unknown, and the values presented should be regarded as order of magnitude estimates.

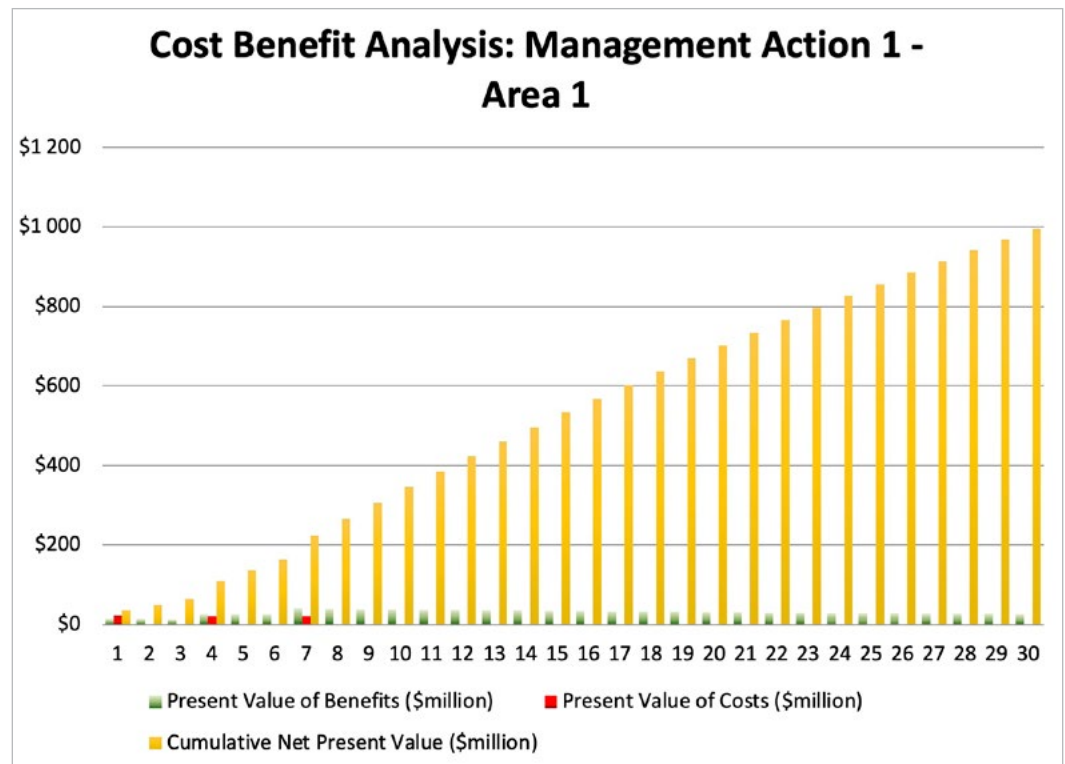
Adding this benefit to the priority ecosystem services selected provided by the natural assets results in the following net present values.

Management Action 1 – area 1:

- \$1,345,497 at a 0 per cent discount rate with a benefit cost ratio of 10.48, meaning for every dollar invested \$10.48 in benefits are realized
- \$994,944,442 at a 2 per cent discount rate and a benefit-cost ratio of 9.07. meaning for every dollar invested, \$9.07 in benefits are realized
- \$607,692,803 at a 5 per cent discount rate and the resulting benefit cost ratio is 7.36, meaning for every dollar invested \$7.36 in benefits are realized

Figure 14 depicts the distribution of costs and benefits at a 2 per cent discount rate over the 30-year period for the change in land use designation under management action 1 - area 1. A 2 per cent discount rate was chosen for representation in Figure 13 as the mid-point discount rate.

Figure 14: Cost benefit results for Management Action1 - Area 1



For Management Action 1 - area 2:

- \$1,453,105,627 at a 0 per cent discount rate, with a benefit cost ratio of 4.44, meaning for every dollar invested \$4.44 in benefits are realized
- \$1,090,885,355 at 2 per cent discount rate, with a benefit cost ratio of 3.84, meaning for every dollar invested, \$3.84 in benefits are realized
- \$753,602,743 at 5 per cent discount rate and the resulting benefit cost ratio is 3.11, meaning for every dollar invested \$3.11 in benefits are realized

Figure 15 depicts the distribution of costs and benefits at a 2 per cent discount rate over the 30-year period for change in land use designation action for management action 1 - area 2. Again, a 2 per cent discount rate was chosen for representation in Figure 13 as the mid-point discount rate.

Figure 15: Cost benefit results for Management Action 1 - Area 2

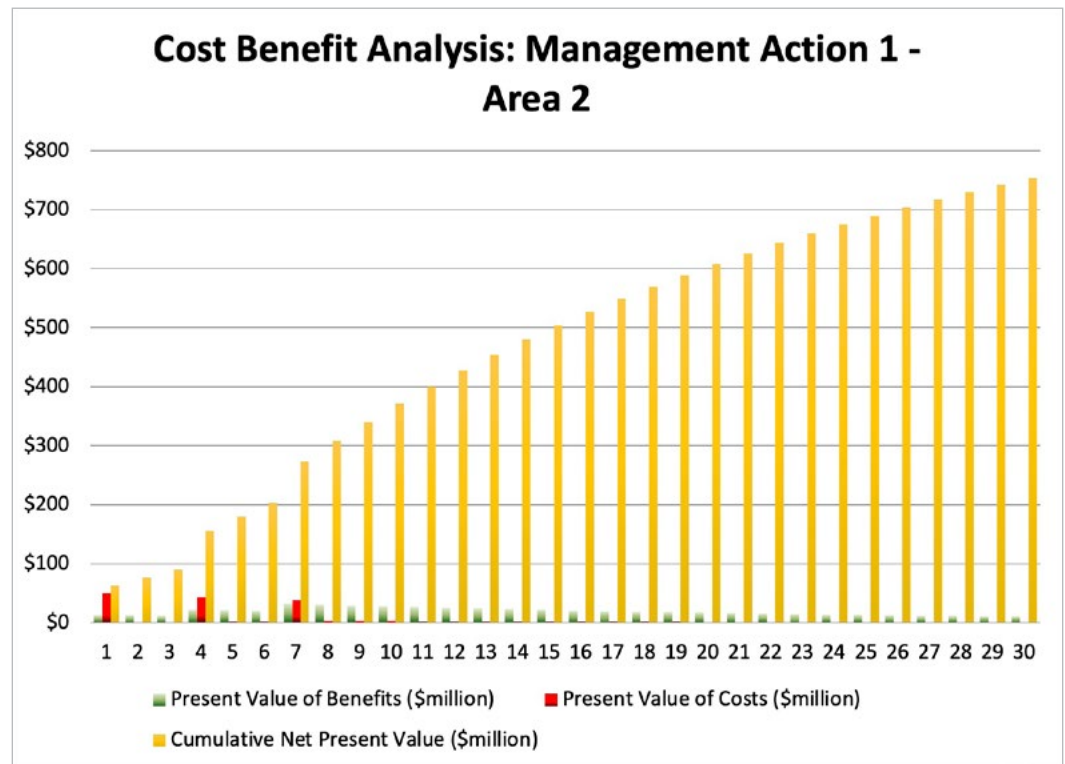


Table 12 summarizes the results of the cost benefit results for Management Action 1 for the two locations of interest. This takes into consideration the ecosystem service benefits derived from pollination, water retention and water filtration, as well as species at risk.

Table 12: Net Present Values for Ecosystem Benefits (2022 CAD\$)

Location	Discount Rate	Net Present Value	Benefit Cost Ratio
1	0%	\$1,345,497	10.48
	2%	\$994,944,4	9.07
	5%	\$607,692,803	7.36
2	0%	\$1,453,105,627	4.44
	2%	\$1,090,885,355	3.84
	5%	\$753,602,743	3.11

Management Action 2: Formalize Collaboration Among Municipalities and First Nations to Identify Approaches to Steward Important Natural Assets in the Shared Geography

Management Action 2 is to formalize collaboration among municipalities and First Nations to identify approaches to better steward the important land, water and other natural resources in a given shared territory, especially in alignment with the United Nations Declaration On The Rights Of Indigenous Peoples Articles 25-29, 32, and the Manitoba Framework Agreement: Treaty Land Entitlement. This action was not addressed quantitatively. As it undergoes refinements, a cost-benefit analysis and feasibility assessment could be completed.

Research has demonstrated two particularly notable points in respect to this action. First, the protection of Indigenous rights is essential to the protection of global biodiversity and the climate (Rights and Resources Initiative 2018). For example, studies have found that, across multiple countries, forests in Indigenous territories are better conserved, and where Indigenous rights are protected, related projects experience less environmental damage (Sze et al. 2022, Schuster et al. 2019 & Prioli et al. 2023).

Second, there is a financing gap for the protection, enhancement, and management of lands, water, and other natural resources, particularly for Indigenous Peoples (Indigenous Services Canada 2022). This management action responds to these findings and identifies opportunities to expand the efforts already taking place in the region.

The Winnipeg Metropolitan Region has recognized the importance of Reconciliation at the local level. Mayors and Reeves of the WMR, together with Chiefs of Treaty One, signed a Memorandum of Understanding (MOU) in March 2019 to announce a collective intention to reform governance in Manitoba through strong and unified commitment to reconciliation. An MOU formalizes a relationship between First Nations and municipalities as two levels of government committed to working together on shared priorities (Bear et al. 2023).

Specific actions that could be pursued by the WMR include:

- Developing a shared inventory of natural features across municipal and First Nation jurisdiction and understanding the value and uses of features from a municipal and First Nation perspectives. This has been initiated through a shared natural feature inventory across a large land area that includes municipal jurisdictions and First Nation lands and territories. By continuing to work collaboratively, the WMR Project may reveal pathways for reconciliation.

- Working with First Nations to identify if and how traditional and current land uses can be reflected in regional and municipal land use planning.
- Supporting infrastructure strategies that promote ecosystem services, such as nutrient reduction in wastewater effluent, water reuse and recycling, and SAR /CH protection to support co-developed sustainability objectives that reduce pollutants in waterways and mitigate flood and drought impacts due to climate change.
- Service sharing agreements between municipalities and First Nations to achieve streamlined implementation of water-based ecosystem services and SAR/CH protection strategies that reduce duplication of infrastructure, share capital and operating costs, and utilize economies of scale.

Conclusion

This project can be said to have contributed to two key outcomes.

The first outcome is that with this report, member municipalities and planning districts within the region may be able to better foster collaborative decision making on how to support the development of a natural asset network that supports the protection, restoration and enhancement of CH and SAR. Further, this work provides a pathway to identifying methodologies that could be used in achieving this goal that considers LEAG member expert perspectives and that considers Indigenous knowledge and rights and access to land.

The second outcome is that the project provides a business case for practical actions, rooted in existing planning and governance frameworks, that if acted upon, will result in the protection of SAR/CH and the provision of important ecosystem services. Importantly, the business case provided here in the form of a cost-benefit analysis is likely extremely conservative given that only a small number of services were assessed. Regardless, the project established a methodology based on financial analysis best practices that can be used to communicate key information to decision-makers when developing local government budget priorities while emphasizing the protection of important services ecosystems provide.

Together, this work helps the WMR reflect on how regional planning policy objectives could be achieved in the future and facilitates their implementation.

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Appendix A - Local Government Management Tools for Species at Risk and Critical Habitat

A scan of tools for the management of species at risk and critical habitat was completed as a component of the NAI Species at Risk tool, the results of which are presented in this appendix. While there are few tools designed explicitly for local government management of species-at-risk and their critical habitat, a number of tools exist for managing environmentally sensitive ecosystems. This scan does not offer a catalogue of all species at risk and critical habitat management tools, as that was outside the scope of the overall project.

NAI uses a three-part classification to organize policies: (1) public ownership, (2) regulation, and (3) market-based instruments. No single instrument – market-based or conventional – will be appropriate for all environmental problems. Which instrument, or combination of instruments, is best in any given situation depends upon characteristics of the specific environmental problem, and the sociopolitical, and economic context.

1/ Land Acquisition Tool				
Management Tool	Explanation	Benefits	Challenges	Example(s)
Land purchase	Buying of land of known importance to species at risk in order to conserve and protect it.	■ Permanent protection for critical habitat. ■ Monitoring can be used for public education. ■ Establishes an economic value for habitat that supports species at risk. ■ A land acquisition strategy can be prepared to identify program objectives, desired land characteristics and acquisition criteria, as well as funding options for ongoing maintenance.	■ Can be cost prohibitive for local governments. ■ Application process can be arduous, requiring considerable staff capacity. ■ Violations to protected areas are difficult to enforce as infractions are usually dealt with through the courts. ■ Ongoing costs to maintain and manage land.	City of Edmonton's Natural Areas Reserve Fund earmarked for purchase of natural areas in Edmonton's tablelands; <i>Parkland Purchase Reserve Fund</i> earmarked for land in the river valley and ravines system. City of Portland's Land Acquisition Strategy earmarked for recreational needs and protection of natural and cultural resources.

1/ Land Acquisition Tool (cont'd)

Private land donation	Conservation of private land through a federal tax benefit for conservation and protection (often land important for species at risk).	■ Permanent protection for critical habitat. ■ Tax incentives for transfer of land (e.g., Eco Gifts Program). ■ Establishes an economic value for habitat that supports species at risk.	■ Can be counter-productive if acquired land is poorly managed. ■ Difficult to target priority lands.	Donation of Riverside Ranch, AB to protect westslope cutthroat trout and bull trout.
Expropriation of Land	Through Provincial and Federal (SARA), government can expropriate critical habitat for the conservation and recovery of a legally listed species at risk	■ Provides a high degree of protection. ■ Monitoring can be used for public education.	■ Not a common practice. ■ Application process can be arduous, requiring considerable staff capacity.	Land development in La Prairie, QC halted to protect Western chorus frog.

2/ Regulatory Tools

Management Tool	Explanation	Benefits	Challenges	Example(s)
Planning Documents (e.g., Official Community Plans/ Municipal Plans, Regional Growth Strategies, Watershed Plans, Biodiversity Conservation Plans, Asset Management Plans)	Planning documents are long-term policy directives prepared for a particular area. They often include environmentally significant areas and can be an important component of critical habitat and at-risk species protection.	■ Creates local or regional vision. ■ Can foster greater discussion, collaboration and cooperation on a regional scale. ■ Provides a mechanism to monitor change and the effectiveness of local policies. ■ Informs the designation of greenways, developed areas and protected areas. ■ Provides wider context for considering development proposals and associated applications for variance permits.	■ Requirement for unanimous approval by member municipalities can lead to compromises that weaken social, economic, and environmental goals. ■ Few effective enforcement mechanisms. ■ Plans can generally be weakened through amendments. ■ Implementation can be slow if there are no or few related policies currently in place.	Nottawasaga Valley Integrated Watershed Management Plan brought together stakeholders from across the watershed to develop and implement strategies to promote a sustainable and resilient watershed. City of Hamilton's Biodiversity Action Plan (in progress) to conserve and restore the region's biodiversity.

2/ Regulatory Tools (cont'd)

Zoning Tools (e.g., Development Permit Areas; Local Service Areas; Greenbelts, Urban Containment Boundaries; Cluster Zoning and Development)	Conservation zoning is a straightforward way to keep development out of environmentally sensitive areas. It is often used to reinforce environmental protection goals and to correct outdated zoning that failed to consider sensitive areas. As long as zoning does not restrict public use of the land, local governments can enforce zoning for ecosystem protection.	■ When used with other tools, zoning can be an effective way to protect critical habitat and natural infrastructure from development. ■ Local governments do not have to pay compensation to landowners for changes in the value of land due to rezoning enacted in the public interest. ■ Zoning is better received when it can be communicated as a tool to meet the goals of a community-wide planning process (e.g., OCP). ■ Enforcement mechanisms are available.	■ May promote urban sprawl by pushing residential development and other activities to regions where there are fewer restrictions. ■ Can be politically unpopular because it can decrease the value of property by limiting its uses.	Capital Regional District Green/Blue Spaces Strategy to create a corridor of protected wilderness and parkland stretching from Saanich Inlet in the east to the Sooke Basin of British Columbia. City of Whitehorse's Boundary Prefeasibility Study identifies natural values present, the general development suitability for different land uses, along with the opportunities, constraints and technical challenges the City of Whitehorse must consider. City of Saskatoon's Green Network combines aquatic areas, green areas, urban forest, trails and greenways into a connected system of natural, enhanced and engineered assets to protect and restore habitat and promote well-being.
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2/ Regulatory Tools (cont'd)

Environmental Bylaws (e.g., Watercourse Protection Bylaw; Rainwater Management Bylaw; Landscaping Bylaw; Tree Protection Bylaw; Soil Removal & Deposit Bylaw; Pesticide Use Bylaw; Invasive Species Bylaw; Subdivision Servicing Bylaw; Development Cost Charge (DCC) Bylaw; Environmental Impact Assessment)	Bylaws are a finer-scale approach to protecting critical habitat. Bylaws are designed to regulate or prohibit certain activities and prescribe methods of carrying out activities. They can serve proactive or reactive purposes. Proactive bylaws generally require landowners to obtain permits before undertaking certain activities, whereas reactive bylaws permit government staff to enforce a bylaw after the offence has taken place.	■ Can set more stringent standards for individual ecological features. ■ Opportunity for public education, particularly with proactive bylaws. ■ Provides potential for rehabilitation. ■ Can address stressors to critical habitat (e.g., pollution, invasive species). ■ Provides opportunity to address incremental changes to critical habitat.	■ Standards can be too stringent or costly to administer. ■ Can create trade-offs (e.g., tree protection for dense development). ■ Can be difficult to enforce without adequate resources (e.g., staff and training resources). ■ Ongoing monitoring and enforcement needed. ■ Requires landowners and developers to be aware of and understand bylaws and standards. ■ Standards could hinder innovation.	The Town of Gibsons amended its DCC bylaw and now collects development cost charges for improvements to natural areas. The Town of Moncton's By-Law Z213 implements minimum elevation requirements for development to be above 10.5 metres for climate change adaptation.
Performance Bonds and Covenants	Performance bonds and covenants are proactive tools to prevent or remedy damage to critical habitat from development. Performance bonds act as a security deposit that a municipality can use for habitat restoration if unintentional damage from development occurs. A conservation covenant identifies land or portions of land that development must preserve.	■ Provides protection for critical habitat without the expense of purchasing it. ■ Can be tailored to specific ecological features. ■ Acts as both a carrot and a stick, since the bond is returned if development preserves critical habitat. ■ Conservation organizations can hold covenants and assume monitoring requirements.	■ Remediation can be more costly than the performance bond. ■ Covenants lack accessible enforcement mechanisms (court is generally the only option). ■ Covenants are perceived to decrease property values.	The <i>Acadian Marshes - Percival River Salt Marsh Natural Area</i> was acquired by Island Nature Trust (PEI) through donation in two parcels. The municipality of Kommininvest, Sweden issued its inaugural Green Bond in March 2016 to encourage investment in climate solutions, which supported over 60 investment projects in 40 Swedish municipalities and regions (Kaminker et. al 2018)

3/ Market-Based Tools

Management Tool	Explanation	Benefits	Challenges	Example(s)
Environmental Tax Instruments (e.g., Water Pricing; Waste pricing; subsidies)	Environmental tax instruments aim to shift the tax burden from things that are socially desirable, such as employment, income, and investment, to things that are undesirable, like pollution, resource depletion, and waste. The goal is to help the environment and community health without hurting the economy. Environmental taxes can be structured to be revenue-neutral (i.e., total tax revenues remain unchanged), revenue-positive (i.e., total tax revenues increase) or revenue-negative (i.e., total tax revenues decrease), depending on how much tax revenue is recycled and public attitudes toward taxes.	- Helps government protect critical habitat while also providing financial flexibility. - Diversifies revenue streams. - Addresses social equity challenges (e.g., not asking everyone to pay into environmental challenges regardless of one's contribution to the problem or one's income level).	- Significant education required to overcome the public's dislike of taxes. - The public is sensitive to increases in highly visible taxes (e.g., property taxes). - Increased resources required for administration of programs. - Significant information required to set effective tax rate.	The South Saskatchewan Water Management Plan was approved in 2006 and enables water transfers in the South Saskatchewan River basin. The City of Beaconsfield, QC, charges households directly for their disposed waste, through pay-as-you-throw (PAYT) programs. These programs charge households based on the size of their garbage bin or by the quantity of garbage bags they put at the curb.
Bonuses, Fees and Charges (e.g. nitrogen and phosphorous levy, water source protection incentive programs; density bonus)	Correcting price signals can be a very effective tool to protect critical habitat, since price is proven to be a strong motivator for behavioural change. Because participation is voluntary (i.e. you can choose not to purchase an item or develop in a particular location), there is generally less resistance to changes in price than equivalent changes in levels of taxation. In addition, fees and charges can bolster and diversify local government revenues. These tools are most effective when government staff is properly educated and enforcement mechanisms are well resourced.	- Changes in prices usually invoke quick responses in behaviour - Changes culture of local government over time - Diversifies government revenues - Can be tailored to specific issues or ecological components - Provides opportunity for public education	- Instances of the rebound effect⁷ could be observed - Few opportunities for local governments to control prices - Considerable information needed to set appropriate fees, charges, and subsidies.	Ontario municipalities can offer grants to encourage landowners to take action. For example, a municipality could offer a grant to owners of septic systems to cover the cost of an inspection. Salt Spring Island uses density bonusing to secure public parkland and recreational lands.

⁷ The rebound effect refers to increased consumption that results from actions that increase efficiency and reduce consumer costs. For example, an improvement in a vehicle's fuel efficiency does not usually result in a proportional reduction in fuel use, because drivers of fuel-efficient vehicles find that they can afford to drive more. As a result, they reinvest a portion of potential energy savings on comfort. The difference between the potential fuel savings and the actual savings is the Rebound Effect.

3/ Market-Based Tools (cont'd)

Creating Markets (e.g. payment for ecosystem services)	The use of environmental taxes, charges, and subsidies assumes that governments have sufficient information to set an effective tax rate, which is exceedingly difficult with ecosystem services. These difficulties are heightened when differences in ecosystem services require governments to apply a different tax, fee, or subsidy at every site. Regulation faces similar problems, since governments need considerable information to design effective rules. In contrast, under certain conditions, creating markets for critical habitat and ecosystem services can improve societal well-being even under incomplete information.	■ Does not require perfect knowledge of critical habitat and ecosystem services in a region ■ Promotes innovation ■ A monetary value is established for critical habitat and ecosystem services.	■ Large transaction costs ■ Inefficient when there are few buyers and sellers ■ Unable to use when ownership cannot be defined and enforced ■ Unable to use when there is uncertainty about the attributes of critical habitat and ecosystem services.	Alternative Land Use Services (ALUS) invests in farmers and ranchers who are producing clean air, clean water, wildlife habitat and other ecosystem services in communities across Canada. Farmland Advantage is a research and development project that works with farmers to protect and conserve critical, natural values in British Columbia, Canada.
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Appendix B – Ecosystem Service Values Associated with Management Action 1

Land cover type	Ecosystem Service	Action	Hectares or Population	Value (2022 C\$/ha)
Forest & Shrubland	Water filtration	1	166 ha	\$1,743
Grassland	Water filtration	1	18 ha	\$33
Water & Wetlands	Water filtration	1	5,720 households	\$792/household
Forest & Shrubland	Water retention	1	260 ha	\$1,878
Grassland	Water retention	1	39 ha	\$25
Water & Wetlands	Water retention	1	128 ha	\$1,878
Forest & Shrubland	Pollination	1	166 ha	\$25
Grassland	Pollination	1	18 ha	\$25
Forest & Shrubland Grassland, Water & Wetland	SAR/CH	1	388,801 households	\$101/non-indigenous household; \$133/Indigenous household
Forest & Shrubland	Water filtration	1	166 ha	\$1,743
Grassland	Water filtration	1	18 ha	\$33
Water & Wetlands	Water filtration	1	3,304 households	\$792/household
Forest & Shrubland	Water retention	1	260 ha	\$1,878
Grassland	Water retention	1	39 ha	\$25
Water & Wetlands	Water retention	1	128 ha	\$1,878
Forest & Shrubland	Pollination	1	166 ha	\$25
Grassland	Pollination	1	18 ha	\$25
Forest & Shrubland Grassland, Water & Wetland	SAR/CH	1	388,801 households	\$101/non-indigenous household; \$133/Indigenous household

