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Municipal Planning Tools for Integrated Asset Management

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Executive Summary

The practice of asset management involves strategic coordination by an organization to maximize the value of its assets in line with its organizational objectives. In Canadian municipalities, this means using asset management systems to manage both current and future assets to deliver services that meet social, political, and environmental objectives while minimizing risk and supporting long-term sustainability through cross-departmental collaboration.

Asset management in Canada emerged from efforts to manage grey infrastructure, which includes roads, bridges, transit, water, wastewater, stormwater, buildings, and sport and recreation facilities. In this report, assets are defined as anything that requires assessment and management to provide services. This definition recognizes that natural assets such as watercourses, aquifers and tree cover need to be managed with the intent to provide services, much like grey infrastructure. This can range from managing tree growth around power lines to maintaining forests that support stormwater management. It also recognizes that natural assets can deliver essential services while supporting climate resilience and ecological health.

While there is a growing body of resources supporting natural asset management, municipalities continue to face challenges managing these assets for service delivery. As with grey assets, the management of natural assets is challenged by misalignment between short political cycles and the much longer lifecycles and benefits of these assets. Nonetheless, there is increasing interest across Canada in implementing natural asset management approaches.

Local governments use municipal planning to guide the allocation and regulation of land and set organizational objectives, which are a key input into asset management systems. Given the links between municipal planning and organizational objectives for asset management, this report investigates the opportunities and challenges for integrating natural assets and grey infrastructure using municipal planning tools. These tools include regional strategies, official or municipal plans, zoning or land-use bylaws, subdivision controls or approvals, and development permits or regulations. The research in this report was conducted through a landscape analysis, workshops and interviews.

The report recommends the creation of a single unified standard for using municipal planning tools to enable integrated natural and grey asset management. It also provides recommendations for future activities that could relate to natural and grey asset management solutions, including developing consistent standards for valuation, condition assessment, and performance measurement; supporting communities of practice to build local capacity; exploring how Indigenous knowledge systems can inform shared stewardship; improving access to and governance of data across jurisdictions; and clarifying the roles of provincial and federal governments and other organizations, such as watershed agencies, in enabling or constraining natural asset management.



"Governments across Canada are navigating the challenge of managing infrastructure to deliver services while balancing fiscal constraints, evolving climate risks, customer expectations, and social and environmental responsibilities."

1. Introduction

Governments across Canada are navigating the challenge of managing infrastructure to deliver services while balancing fiscal constraints, evolving climate risks, customer expectations, and social and environmental responsibilities [1]. Asset management is one way to approach these intersecting pressures. According to the Federation of Canadian Municipalities (FCM), local governments face unique challenges because they own approximately 60% of public infrastructure assets and play a critical role in managing those assets to deliver services to their communities [2], [3]. Municipal governments are the most common type of local government in Canada [4] and are the focus of this report.

Asset management refers to coordinated efforts by an organization to derive value from its assets in alignment with its overarching objectives and is guided by standards such as the International Organization for Standardization (ISO) 55000 Series and Public Sector Accounting Standard PS 3150, Tangible Capital Assets [5], [6]. In Canada, public sector asset management refers to the process of managing existing and new assets (typically public infrastructure) to deliver services to communities [7].

Asset management in Canada has its roots in the management of grey infrastructure, which includes items such as roads, piped stormwater systems, and water treatment facilities; however, in this report, assets are defined as anything that requires assessment and management to provide services. This definition recognizes that natural assets such as watercourses, aquifers, and trees also need to be managed so they can continue to provide their services. This can range from managing tree growth around power lines to maintaining forests that support stormwater management.

In some instances, natural assets have been shown to deliver essential services at a lower cost than grey infrastructure while also supporting both climate resilience and human and ecological well-being [8], [9], [10]. By better managing their natural assets in coordination with grey assets (hereafter referred to as integrated asset management), jurisdictions across Canada can improve service delivery while realizing co-benefits like climate change mitigation and adaptation, environmental quality and ecosystem health, conservation of cultural assets, and improved health and social equity [11], [12].

Natural assets have distinct characteristics that differentiate them from grey infrastructure and bring management implications. Grey infrastructure is typically built to provide a specific service, while natural assets are dynamic ecological systems that may offer multiple services simultaneously [13], [14]. Ownership of grey infrastructure is often clearly defined, while natural assets typically span multiple jurisdictions and may sit on a combination of public and private property. This can result in more complex governance

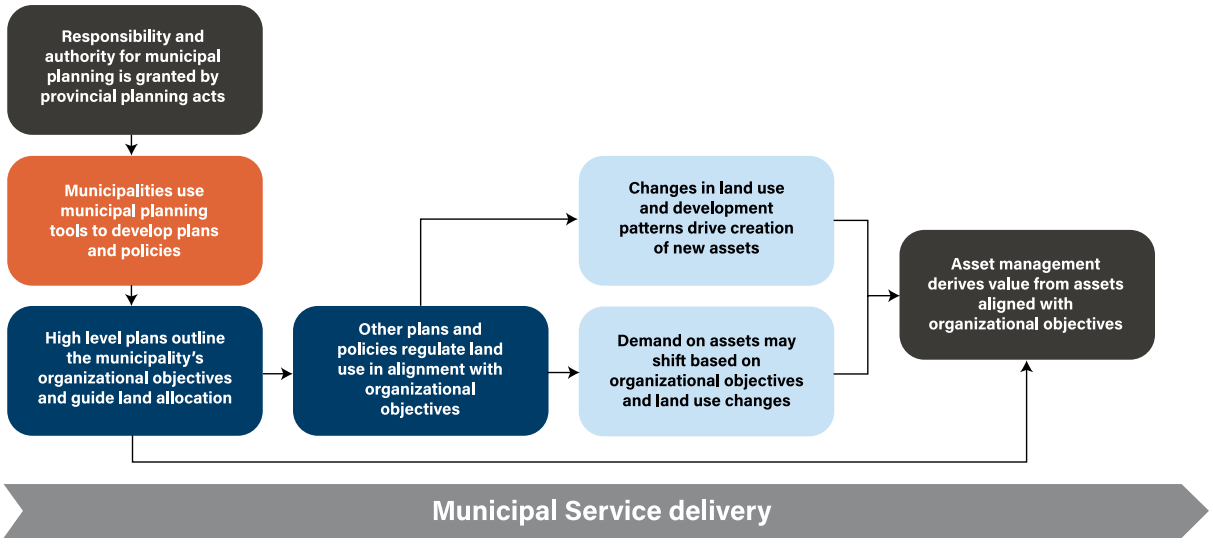
structures involving multiple levels of government and entities such as watershed organizations [15], [16]. The management of natural assets, much like that of grey assets, is challenged by misalignment between short political cycles and the much longer lifecycles and benefits offered by these assets [13], [17]. Nonetheless, there is increasing interest across Canada in implementing natural asset management approaches.

Municipal planning is a primary responsibility of municipal governments. Municipalities are granted powers and responsibilities for planning through provincial planning acts, which also outline the municipal planning tools that can be used to create municipal plans and policies [18]. Municipal planning guides the allocation and regulation of land by establishing the "pattern, scale, density, location, and type of development that is desired by the community" [19]. Changes to municipal plans and policies may impact existing assets or result in the creation of new ones by driving changes in demand for services [19]. For example, an increase in allowable density in a community may drive increased demand on existing infrastructure, such as roads, sewers, and parks. Further, changes to permitted land uses could result in impacts on or loss of existing natural assets, such as forests or watercourses.

Municipal governments also use municipal planning to establish organizational objectives (vision and goals) for their community [19]. Managing assets in alignment with organizational objectives to derive value from those assets is a core concept of asset management [1]. Figure 1 demonstrates the interlinked nature of municipal planning and municipal asset management, both of which play central roles in municipal service delivery. Given this link, one way to move toward integrated asset management is to undertake municipal planning in a way that embeds the service delivery value of natural assets alongside grey infrastructure. Therefore, this report will focus on opportunities and challenges for integrated asset management and discuss how standardization of municipal planning tools (shown in red in Figure 1) may help to facilitate integration.

The objective of this report was to investigate ways to integrate natural and grey asset management across their lifecycles using municipal planning tools, starting from the land-use planning horizon and integrated into community services planning. Identifying opportunities for standardization of municipal planning tools to enable integrated asset management may improve resilience to a changing climate, help communities achieve desired levels of service, and improve the

Figure 1: The relationship between municipal planning and asset management in municipal service delivery.



overall longevity of services. The report provides recommendations for such standardization and is intended to help inform future natural and grey asset management solutions.

2. Methods

The methods employed in this report included a literature review, workshops and interviews. The following elements are included:

- Definition and description of current approaches to grey infrastructure asset management and natural asset management;
- Identification of challenges and opportunities for integrated management of grey infrastructure and natural assets; and
- Identification of municipal planning tools where common standards could facilitate integrated asset management.

2.1 Literature Review

Academic sources were identified through keyword searches in databases such as Google Scholar, ScienceDirect, SpringerLink, Wiley Online Library, and Taylor and Francis Online. The terms used for the searches are listed below.

- Integrated asset management
- Natural asset management
- Nature-based solutions
- Integrated natural and traditional asset management
- Urban planning and asset management
- Statutory planning processes and asset management
- Planning and natural assets
- Conservation and natural assets
- Watershed and natural assets
- Natural heritage systems
- Green spaces
- Open spaces
- Green infrastructure
- Natural infrastructure
- Watershed management
- Watershed resource management

Non-academic sources included government reports, municipal government plans and policies, industry standards, and practitioner case studies and guidance documents from professional organizations. These were accessed through platforms such as the OECD iLibrary, CSA Group Store, ISO Online Browsing Platform, and the Federation of Canadian Municipalities (FCM) library. Materials from organizations engaged in related research were also referenced, such as the United Nations Environment Programme (UNEP), the Natural Assets Initiative (NAI), and the Intact Centre on Climate Adaptation. Government reports, local government policies and case studies included in the review were related to:

- Asset management standards (e.g., ISO 55000 Series, PSAB 3150), guidelines, concepts and approaches, internationally and in Canada;
- Natural asset management guidelines, concepts and approaches, internationally and in Canada;
- Opportunities and challenges related to integrating natural assets and grey infrastructure in asset management;
- Roles of governmental and non-governmental organizations in natural asset management, including Canadian federal, provincial, regional and municipal governments, watershed organizations, and non-governmental organizations;
- Legislation enabling municipal planning across Canadian provinces;
- The core function and responsibility of municipalities to manage land and infrastructure, beginning with municipal planning;
- Planning tools available to municipalities to execute their powers and the relationship of these tools to asset management; and
- Opportunities for standardization of municipal planning tools to facilitate integrated asset management.

2.2 Workshops and Interviews

The literature review was supplemented by workshops and semi-structured interviews with representatives from municipal staff and administrators, industry and consultants, First Nations, and non-governmental organizations. While municipal representatives provided input based on their individual experiences, non-municipal interest holders provided a broader perspective due to their involvement with, and representation of, multiple communities from across Canada. In total, 61 individuals were engaged and contributed their experiences.

The workshops and interviews were conducted to identify gaps and gather practitioner insights. There were three engagement activities:

- Workshop 1 (Atlantic Workshop), held in-person in Moncton, New Brunswick, in mid-April 2025, hosted by the Atlantic Infrastructure Management (AIM) Network with 28 participants from Atlantic Canada;
- Workshop 2 (Western Workshop), held virtually in late April 2025, hosted by WSP Canada with seven participants from municipal and regional governments in the Central and West Kootenay regions of British Columbia; and
- 30-minute virtual interviews conducted by WSP Canada in April and May 2025 with 26 individuals representing 18 organizations and every province.

The questions discussed at the workshops and interviews covered six topic areas:

- Understanding current practices
- Identifying barriers to integrating natural and grey asset management
- Exploring opportunities for standardization of planning tools
- Best practices and case studies
- Implementation and collaboration on solutions
- Future considerations

Participants were initially selected from small population centres (i.e., populations under 29,999) based on the assumption that smaller communities are more likely to rely on standards to support their work [20]. Further, organizations identified as having relevant experience and expertise were contacted. Snowball sampling was also used, with additional organizations contacted on the recommendation of interviewees. The sampling approach was designed to capture a broad range of perspectives across Canada. All participants consented to anonymous inclusion of responses in this report, with results presented in aggregate by theme.

3. Results and Discussion

3.1 Terminology

A key challenge in this report was the variability in terminology used across Canada. In the workshops and interviews, 64% of participants noted that a lack of common definitions made integrated asset management more challenging. The terms used in this report are provided below.

Engineered green assets: Engineered or built assets designed to emulate the functions of ecosystems and landscapes [21].

Enhanced green assets: Assets that have been designed to replicate and function like natural assets [22].

Green infrastructure: The natural vegetative systems, engineered and built features, and green technologies that collectively provide society with a multitude of economic, environmental and social outcomes [21].

Grey infrastructure: Built infrastructure assets, networks, and facilities that provide or enable the delivery of services across all infrastructure sectors, such as hospitals in the healthcare sector, roads and railways in the transport sector, and power stations in the energy sector [23].

Grey infrastructure asset management: Management of grey infrastructure using an asset management system.

Integrated asset management: Coordinated management of grey infrastructure and natural assets using an asset management system.

Municipal government: A type of local government comprising local elected authorities who oversee administration of cities, towns, villages, or rural or metropolitan municipalities [24].

Municipal planning: The processes used by municipalities to control or design change and development in physical environments [25].

Municipal planning tools: Processes and instruments used by municipalities to control how land is used [26].

Natural asset management: Management of natural assets using an asset management system [17], [27].

Natural infrastructure: The use of preserved, restored or enhanced elements or combinations of vegetation and associated biology, land, water and naturally occurring ecological processes to meet targeted infrastructure outcomes [28].

Nature-based solutions: Restoration, conservation, and management of wetlands, grasslands, coastlines and forests to mitigate and adapt to the effects of climate change while supporting biodiversity [29].

Watershed: A region or area bounded peripherally by a divide and draining ultimately to a particular watercourse or body of water [30].

3.2 Engagement Participants and Questions

Table 1 lists the 61 participants in the workshops and interviews by organization type and by specific role for municipal representatives. As shown, 72% of the participants were from municipal governments.

Figure 2 shows the representation of participants by province or region, including three organizations categorized as Canada-wide, given their national mandate.

To better understand opportunities for standardization, questions in six topic areas were developed and explored during workshops and interviews, as shown in Table 2. Questions covered during each engagement are denoted with an x. As interviews were open-ended and time-limited, not all interviews covered every question, and participants guided the discussions based on their experience and expertise. Questions not covered are denoted as not applicable (NA).

Table 1: Roles of participants in workshops and interviews.

Category	Count	Percentage
Municipal staff and administration	**44**	**72%**
Not identified	8	
Planning and land use	17	
Engineering, public works	6	
GIS, IT, environmental projects	8	
Emergency and maintenance services	3	
Community development	2	
First Nations	**3**	**5%**
Industry/academia/consulting	**5**	**8%**
Non-governmental organizations	**9**	**15%**
Total	**61**	**100%**

Figure 2: Geographic distribution of workshop and interview participants.

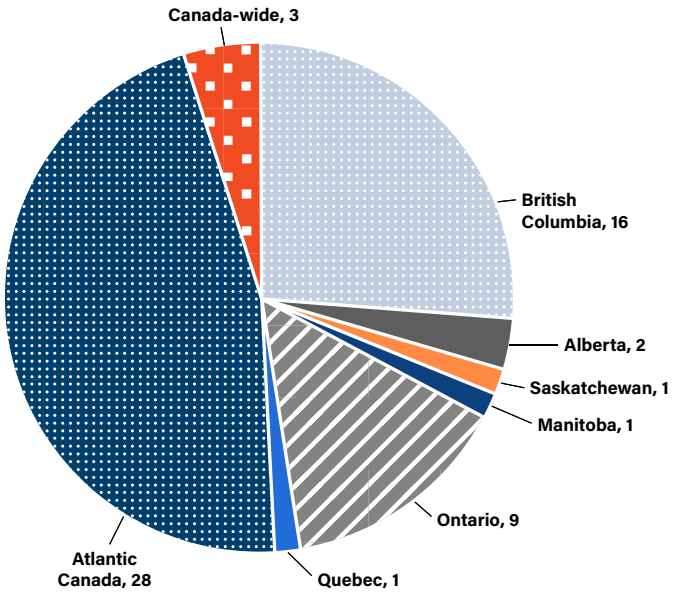


Table 2: Topics discussed during the workshops and interviews.

Topics & questions	Workshop 1	Workshop 2	Interviews
Understanding current practices			
How are natural assets currently accounted for in your municipality's asset management plans (AMPs)?	x	x	x
What planning tools (e.g., zoning bylaws, stormwater management plans) currently support the use of natural infrastructure in your municipality?	x	x	x
Are natural assets included in your asset management system?	x	x	x
Where does your organization look for guidance on integrating natural assets into your asset management program?	x	x	x
Identifying barriers to integration			
What are the biggest challenges in integrating natural assets into existing municipal planning frameworks? (e.g., regulatory, financial, technical, political)	x	x	x
Are there specific policy or governance conflicts that make it difficult to incorporate green infrastructure into your asset management planning processes?	x	x	x
What are the key funding barriers that limit investment in natural infrastructure solutions?	x	x	x
Exploring standardization opportunities			
Which planning tools (e.g., zoning bylaws, AMPs, climate adaptation plans) would benefit most from standardized approaches?	x	x	x
What minimum standards should municipalities adopt to ensure natural assets are protected or managed and incorporated into infrastructure planning?	x	x	x
How could municipalities ensure consistency in natural asset valuation and accounting across regions?	x	x	x
What role should provincial and federal governments play in setting and enforcing standardized planning tools?	x	x	x
Best practices and case studies			
Have you seen any successful municipal examples of natural asset integration? What made them effective?	x	NA	x
What lessons can be learned from municipalities that have adopted green infrastructure solutions?	x	NA	x
How can case studies (e.g., Gibsons, Edmonton, Toronto) be scaled and adapted to other municipalities?	x	NA	x

Topics & questions	Workshop 1	Workshop 2	Interviews
Implementation and collaboration			
How can municipalities collaborate regionally to align policies and planning tools?	x	x	x
What training, resources, or tools would help municipal staff implement standardized approaches?	x	x	x
What incentives or policy mechanisms (e.g., funding programs, tax credits, development requirements) could encourage private sector participation in green infrastructure solutions?	x	x	x
How can municipalities work with Indigenous communities and local conservation groups to improve natural asset management?	x	x	x
Future considerations			
What do you think are the most appropriate land-use planning and policy tools to integrate green infrastructure systems into your community's asset management program?	NA	NA	x

3.3 Grey Infrastructure Asset Management

3.3.1 Defining Grey Infrastructure and Asset Management in Canada

Following the Second World War and through the 1950s and 1960s, Canada saw significant investment in municipal infrastructure [31]. However, in the decades that followed, government investment in maintaining physical infrastructure declined, leading to widespread deterioration [31]. Recognizing a growing deficit between spending and needed investment in infrastructure, federal and provincial governments began to work more closely with municipalities to address the deficit in the early 2000s, acknowledging municipalities' important role as owners of 56.8% of Canada's core public infrastructure [31].

As defined in the 2016 and 2019 Canadian Infrastructure Report Cards (CIRCs), core public infrastructure includes roads, bridges, transit, water, wastewater, stormwater, buildings, and sport and recreation facilities [31]. However, the terms core infrastructure, grey infrastructure, built infrastructure, hard infrastructure, traditional infrastructure, and engineered assets are used interchangeably across literature and organizational guidance and can be broadly defined as built infrastructure, engineered from manufactured materials, often with large volumes of concrete and steel, and typically designed to provide a singular service [23], [32-41]. In the workshops and interviews, each of these terms came up at least once, further validating that there is no singular common term used across the country. Due to the sample size of engagement activities, it was impossible to conclude whether there are links between the terms used and other factors, such as geography or type of practitioner. In this report, the term grey infrastructure is used to describe all types of built infrastructure assets, networks, and facilities that enable the delivery of infrastructure services in communities.

Established with an emphasis on grey infrastructure, asset management is increasingly recognized as an important tool for municipalities to strategically maintain and operate infrastructure to provide essential services to communities. However, the practice is still emerging in Canada [42]. In a survey completed for the 2019 CIRC, 70% of large municipalities in Canada reported having an asset management plan, compared to 29% of small municipalities [42]. This suggests there is a need for financial and technical support to build more asset management capacity, particularly in smaller municipalities [42].



Recognizing this gap in resources, FCM established the Municipal Asset Management Program in 2017 [43]. Continuing through 2024, the program aimed to help municipalities advance municipal asset management processes [43]. The federal government also provides funding and policy guidance for managing municipal infrastructure through programs such as the Investing in Canada Infrastructure Program (ICIP) and the Disaster Mitigation and Adaptation Fund (DMAF) [44], [45]. Housing, Infrastructure, and Communities Canada (HICC) supports best practices in asset management and provides resources for municipalities to develop asset management strategies. This indicates increasing coordination across levels of government to fund and build capacity for the practice.

3.3.2 Requirements for Asset Management in Canada

As mentioned, municipal asset management was initially driven by the need to manage deteriorating grey infrastructure in the context of a growing infrastructure deficit [31]. Two formal requirements were found in the literature related to asset management in Canada: Public Sector Accounting Standard PS 3150, which applies nationally, and *Asset Management Planning for Municipal Infrastructure,* O. Reg. 588/17, which applies only in Ontario.

At a national level, all municipalities in Canada are required to meet PS 3150. Adopted in 2009, the standard requires public agencies to incorporate their tangible capital assets into their financial statements [46, 47] and report on them. Tangible capital assets include non-financial physical assets such as roads, buildings, vehicles, equipment, land, water, dams, canals, bridges, and other utility systems that are important for the delivery of government services (this aligns with the definition of grey infrastructure used in this report) [47]. PS 3150 requires municipalities to track asset acquisition costs, depreciation, and expected lifespan of tangible capital assets [48].

While PS 3150 does not explicitly require asset management, establishing an asset management system can help municipalities demonstrate compliance with the standard [49]. However, the standard does not apply to natural resources or assets not owned by the municipality [47]. This has resulted in less documentation and recognition of the services

provided by natural areas than those provided by grey infrastructure [15] and may also provide an underlying rationale for the continued emphasis on grey infrastructure in municipal asset management.

In 2017, Ontario adopted *O. Reg. 588/17.* It remains the only province with established regulatory requirements for municipal asset management at the time of this writing. *O. Reg. 588/17* requires all municipalities in the province to prepare a strategic asset management policy and an asset management plan for municipal infrastructure assets [50]. These are defined in the regulation as any infrastructure asset, including green infrastructure, that is directly owned or included in the financial statements of a municipality [50]. As of July 1, 2024, all Ontario municipalities are required to develop an asset management plan for their infrastructure assets and update it every five years.

3.3.3 Resources for Asset Management

3.3.3.1 Standards for Asset Management

ISO has developed a suite of voluntary international standards for asset management. These standards apply to all types of assets (including natural assets) and organizations and are targeted at organizations across any industry that owns and operates assets [5]. The series of standards includes:

- ISO 55000, *Asset management – Overview, principles and terminology:* contains concepts and terminology and an overview of asset management principles [5]. ISO 55000 is applicable to any kind of asset or organization of any size;
- ISO 55001, *Asset management – Asset management system – requirements:* specifies the management systems requirements for effective and efficient asset management systems [51]; and
- ISO 55002, *Asset management – Management systems – Guidelines for the application of ISO 55001:* provides guidance on how to implement, maintain, and control the management system [52].

ISO 55000 defines a hierarchy of asset management systems to help organizations develop an asset management program linking its organizational objectives to its day-to-day asset management decisions [5]. It defines the core components of an asset management framework as follows *(Copied by CSA Group with the permission of the Standards Council of Canada (SCC) on behalf of ISO. The standard can be purchased from the national ISO member in your country or the ISO Store. Copyright remains with ISO):*

- *Asset: An item, thing or entity that has potential or actual value to an organization.*
- *Asset management: Coordinated activity of an organization to realize value from assets.*
- *Strategic asset management plan: Documented information that contains and aligns asset management policy, objectives, strategies, and approaches for developing and managing the asset portfolio and asset management system.*
- *Asset management plan: Documented information that specifies the activities, resources, costs and timescales required for an individual asset or a grouping of assets to achieve the organization's asset management objectives.*
- *Asset management system: Management system for asset management.*
- *Asset portfolio: Assets that are within the scope of an asset management system.*
- *Level of service: Parameters, or combination of parameters, which reflect the social, political, environmental and economic outcomes that an organization delivers.*

The ISO 55000 series are sector-agnostic and do not provide technical guidance for managing specific asset types (e.g., buildings, roads) [5].

3.3.3.2 Professional Bodies for Asset Management

A range of international, national, and provincial non-governmental organizations and communities of practice provide technical guidance for asset management. In Canada, there are two notable organizations operating at the national level to provide education, training, and advocacy relevant to asset management:

- **Federation of Canadian Municipalities (FCM):** An advocacy organization for Canadian municipalities. FCM delivered the Municipal Asset Management Program (MAMP) from 2017–2024, which provided funding, resources, guides and training to support advancements in municipal asset management practices [43]; and
- **Canadian Network of Asset Managers (CNAM):** Develops policy, tools, and technologies to improve the level of service for Canadian public infrastructure assets [53].

Internationally, there are two dominant non-governmental organizations that provide practice guides and manuals, education, training, and advocacy for asset management professionals:

- **Institute of Asset Management (IAM):** A not-for-profit professional body established to develop asset management knowledge and best practices for individuals, organizations, and wider societies [54]; and
- **Institute of Public Works Engineering Australasia (IPWEA):** Provides resources for infrastructure asset managers and professionals who deliver public works and engineering services in government and the private sector [55]. Related programming in Canada is delivered by NAMSCanada, an affiliate of IPWEA [56].

In addition to the international and national organizations noted above, there are active communities of practice across the country that provide province-specific guidance related to asset management. These organizations are summarized in Table 3.

3.3.4 Approaches to Municipal Asset Management

Outside of Ontario, there is no set approach to asset management for Canadian municipalities. Instead, approaches are largely driven by voluntary standards and resources. Aligning with the ISO 55000 series is generally accepted as good practice for municipal asset management [57]. However, the ISO standards do not articulate a specific approach or pathway [57]. The professional bodies for asset management in Canada play a role in filling this gap by providing a range of resources and technical guidance, as described in this section. Municipalities generally develop asset management systems to enable evidence-based decision-making that balances levels of service, available resources, and risk [7].

A typical municipal asset management system includes:

- **Asset inventory:** Defining the asset portfolio (i.e., types and components of assets) to be managed within the system based on their role in municipal service delivery [7], [57].

Table 3: Communities of practice for asset management in Canadian provinces.

Jurisdiction	Organization
British Columbia	Asset Management British Columbia (AMBC)
Alberta	Infrastructure Asset Management Alberta (IAMA)
Saskatchewan	Asset Management Saskatchewan (AM Sask)
Manitoba	AMM Asset Management Leadership Committee
Ontario	Asset Management Ontario (AMOntario) Ontario Coalition for Sustainable Infrastructure (OCSI)
Quebec	Centre d'expertise et de recherche en infrastructures urbaines (CERIU)
Atlantic	Atlantic Infrastructure Management Network (AIM)
Newfoundland and Labrador	Building Asset Management NL (BAM! NL)

- **Asset condition assessments:** Assessing condition using a variety of approaches, including in-person visual inspections, field sampling and monitoring, or technology-driven tools like remote sensing, LiDAR scanning, geographic information systems (GIS)-based assessments or predictive modelling to assess infrastructure conditions [58].
- **Level of service frameworks:** Organizations define minimum levels of service for assets in their portfolio (e.g., acceptable road conditions, water quality standards) that aim to balance community expectations, risk, costs, and availability of resources [7]. They are typically measured by an indicator that can be forecasted (e.g., condition state measured by a deterioration curve over time) [7].
- **Lifecycle management:** Assets are managed based on total lifecycle costs from acquisition to disposal, including maintenance, rehabilitation, and replacement planning to minimize long-term costs [7].
- **Risk-based decision-making:** Infrastructure investments are prioritized based on asset criticality, failure risk, and service impacts, which may include consideration for natural hazards, structural deficiencies, financial constraints, and climate change [7], [59].
- **Capital planning and investment strategies:** Long-term capital investment plans, using multi-year capital budgets, help to align infrastructure funding with growth projections and level of service targets, thereby achieving targets, maintenance needs, and financial sustainability [7].

The two important driving factors behind approaches to municipal asset management in Canada are its origins in managing grey infrastructure in the face of a growing infrastructure deficit and compliance with PS 3150, which requires reporting on tangible capital assets (including grey infrastructure but excluding natural assets) [6], [31].

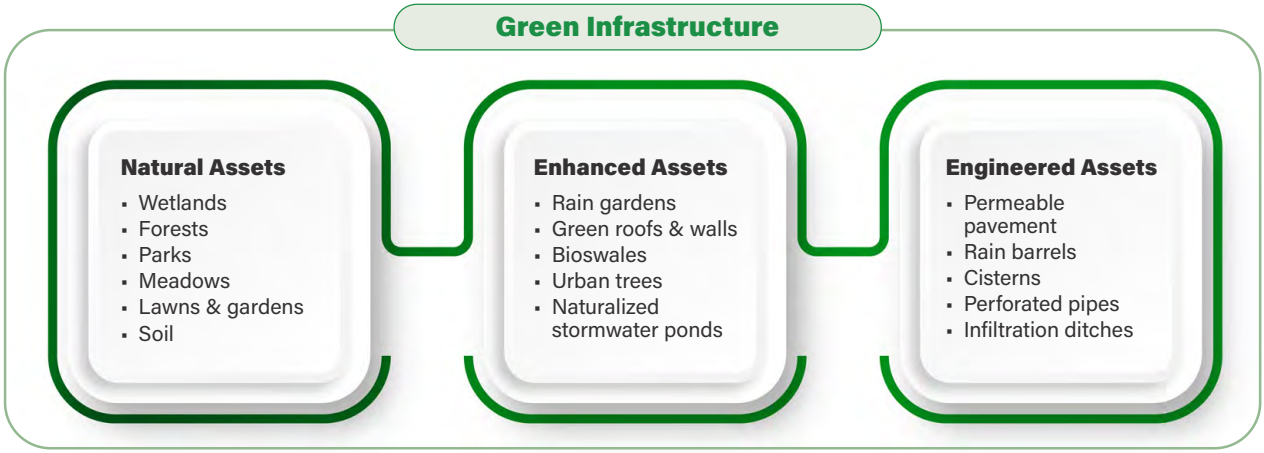
In both workshops and interviews, 80% of participants stated that natural assets are not fully integrated into their asset management systems. These participants described their systems as having a low level of maturity and indicated that managing grey infrastructure is the current focus. The other 20% of participants felt they, or the communities they represented, either partly (18%) or fully (2%) accounted for natural assets in their asset management systems. The communities noted as having partly or fully integrated natural assets alongside grey infrastructure were most often larger and more urban communities. These findings align with the results of the 2016 and 2019 CIRCs that suggest municipal asset management as a whole is still maturing in Canada [31], [42]. The workshop and interview findings also suggest that asset management in Canadian municipalities maintains a focus on managing grey infrastructure, particularly in rural and remote communities.

3.4 Natural Asset Management

The Canadian Council of Ministers of the Environment (CCME) defines natural assets as "preserved, restored, or enhanced elements or combinations of vegetation and associated biology, land, water, and naturally occurring ecological processes to meet targeted infrastructure outcomes, such as coastal hazard management, riverine flood management, local stormwater management, and mitigation of the effects of extreme heat" [21]. Natural assets are a subset of green infrastructure, which are "the natural vegetative systems, engineered and built features, and green technologies that collectively provide society with a multitude of economic, environmental and social outcomes" [21]. Green infrastructure (Figure 3) is an umbrella term that also includes enhanced green assets, which are "assets that have been designed to replicate and function like natural assets," and engineered green assets, which are "engineered or built assets designed to emulate the functions of ecosystems and landscapes" [21]. The terms natural infrastructure and nature-based solutions are used similarly to the term natural assets in the literature [28], [29]. This report focuses exclusively on natural assets.

The CCME definition of natural assets is closely tied to the term natural capital, a term that was broadly used in the 1970s, but emerged in the lexicon in the early 1900s [61]. The value of natural capital is described in terms of ecosystem services [62]. There are three types of ecosystem services that provide a useful framework for understanding the value, in terms of service delivery, that natural assets can provide:

Figure 3: Terms used within the green infrastructure umbrella. Adapted with permission from Green Infrastructure Ontario Coalition [60].



- **Provisioning services:** Tangible material goods created from ecosystems, such as wood, food, or medicine, often viewed as products that can be traded, bought, or sold [62];
- **Regulating services:** Processes that regulate the environment, driven by an ecosystem, in a way that benefits society, such as stormwater management or air quality regulation [62]; and
- **Cultural services:** The ability of ecosystems to fulfill core human needs for connection and growth by invoking positive internal emotional and intellectual experiences in people [62].

There is increasing recognition that natural assets provide value to municipalities by delivering ecosystem services that support public health, wellbeing, and long-term community resilience [17], [22], [63], [64], [65], [66]. Core public infrastructure, or grey infrastructure, included in the CIRC (i.e. roads, bridges, transit, water, wastewater, stormwater, buildings, and sport and recreation facilities) are included because of the essential services they provide; these include access to transportation, water filtration, stormwater management, and public health and wellbeing [31]. The ecosystem services provided by natural assets mirror these essential services and present opportunities to complement, replace, or reduce the need for grey infrastructure, potentially leading to cost savings and environmental benefits [23]. Inherently, natural assets are already providing services to communities that reduce the burden on, and therefore the required capacity of, grey infrastructure. Adequately capturing the value of these services can inform decision-making on municipal infrastructure investment. Some examples of services provided by natural assets that overlap with those provided by grey infrastructure are provided below.

Water filtration and stormwater management: Natural assets support protection of water supplies and deliver water filtration services by absorbing and filtering pollutants, thus reducing the burden on grey infrastructure such as water treatment plants [23]. Erosion control and soil stabilization are additional services provided by natural vegetation. Plant roots help prevent soil loss and stabilize slopes and riverbanks, helping to minimize runoff pollution while reducing the need for built structures like retaining walls and artificial embankments [23], [67].

Public health: Trees and vegetation contribute to air purification and carbon storage by absorbing carbon dioxide and other pollutants [23], [67]. This complements the function of air filtration systems and emissions controls [67]. This is especially valuable in urban areas with higher concentrations of airborne pollutants where urban forests, trees, and vegetation can enhance air quality [67]. Green spaces and forests also provide temperature regulation benefits by

providing shade and facilitating evapotranspiration [23], [67]. This natural cooling effect can reduce the demand for artificial cooling systems such as HVAC units [23], [67]. Moreover, natural assets support biodiversity and pollination, which support environmental health and are essential for agriculture [23], [67]. These services can reduce dependence on agricultural infrastructure such as greenhouses and artificial pollination systems by supporting crop production through natural pollinators [23], [67].

Wellbeing: Natural assets offer significant recreational and mental health benefits. Forests and green spaces provide areas for exercise, relaxation, and community engagement, serving similar functions to sports facilities and community centres [11], [12]. This complements built recreational infrastructure by supporting physical health and contributing positively to mental wellbeing [11], [12].

As recognition of the role of natural assets in service delivery grows, and the opportunity to leverage the services they provide to support grey infrastructure is better understood, municipalities from across Canada are beginning to apply asset management approaches to natural assets within a framework of requirements and voluntary standards and resources, as described in the following sections.

3.4.1 Requirements for Natural Asset Management in Canada

As mentioned above, Ontario is the only province that has requirements related to natural asset management in Canada through *O. Reg. 588/17* [50]. The regulation includes green infrastructure assets in its definition of core infrastructure that must be included in municipal asset management plans [50]. Its definition of green infrastructure includes infrastructure assets "consisting of natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs" [50]. This definition is aligned with the definition of green infrastructure, including natural assets, used in this report and recognizes the services delivered by natural assets.

One Ontario-based interview participant, who works at a non-governmental organization, noted that the green infrastructure requirements in O. Reg. 588/17 have resulted in more awareness of and receptiveness to the role and importance of natural assets in service delivery. However, all eight Ontario-based interview participants indicated that compliance with the requirement is variable. They noted that urban areas are the most advanced in integrating natural assets, whereas rural communities, which tend to have fewer resources and personnel capacity, are less advanced. This suggests that regulation has value in increasing recognition of the importance of managing natural assets but, without consistent enforcement, other approaches may be needed to support implementation and advancement of integrated asset management for municipalities.

3.4.2 Resources for Natural Asset Management

3.4.2.1 Standards for Natural Asset Management

CSA W218, *Specifications for natural asset inventories* provides a standardized approach to developing a natural asset inventory, which is a key step in natural asset management [32]. The standard is applicable to any jurisdictional context and provides requirements for creating and maintaining natural asset inventories, including data collection, structure, and documentation protocols, as well as guidance for ongoing improvement [32]. The standard does not include mandatory requirements for natural asset valuation or condition assessments. However, it provides information on related concepts and techniques should practitioners choose to undertake them [32]. Notably, across all workshops and interviews, CSA W218 was only raised by one BC-based participant as a key source of guidance on natural asset management, suggesting that awareness of the standard may be limited.

3.4.2.2 Professional Bodies and Non-governmental Organizations for Natural Asset Management

The practice and implementation of natural asset management vary across Canadian municipalities, and formal policies and frameworks are beginning to take shape. When asked where their organization looks for guidance on integrating natural assets into their asset



"Ontario is the only province that has requirements related to natural asset management in Canada through *O. Reg. 588/17*. The regulation includes green infrastructure assets in its definition of core infrastructure that must be included in municipal asset management plans."

management systems, 84% of workshop and interview participants identified professional bodies and NGOs. This suggests that these organizations are serving as a key resource for natural asset management in Canada. Two organizations operating at the national level were identified as playing a significant role in providing education, training, and advocacy relevant to natural asset management: FCM, through its Green Municipal Fund program, and the Natural Assets Initiative (NAI).

FCM maintains an asset management library that includes resources specific to natural asset management such as case studies, courses, guidebooks, and reports [68]. These resources cover topics such as how to include natural assets in asset management plans, legal considerations for natural asset management, and the role of natural assets in climate resilience [68]. They also maintain a webpage with project examples and resources related to using natural assets to support climate resilience [69].

More recently, the federal government and FCM announced an initiative called Local Leadership for Climate Adaptation, intended to provide training and capacity-building for municipalities [70]. The initiative covers topics related to climate change resilience, including climate risk assessments, adaptation planning, nature-based solutions, equity, asset management, Indigenous knowledge, and innovative financing models [70]. Partner organizations, such as provincial and territorial municipal associations, educational institutions, Indigenous organizations, and professional and industry associations, can apply for grant funding to develop and deliver training and capacity-building programs and tools on these topics, with the next call for applications expected in 2026 [70].

One example of a project funded by FCM's initiative is a subsidized training program for Expanded Professional Certification in Asset Management Planning, with a focus on climate resilience, equity, and green infrastructure. This program is delivered in a partnership between NAMS Canada, ClimateWest, and NAI, a national, non-governmental organization that publishes a range of resources, from high-level primers to guidebooks documenting approaches to natural asset management [71], [72]. In 2019, an NAI report noted that planning plays an important role in setting and reforming policy and regulating land use, which collectively present an opportunity to align organizational objectives with natural asset management [73]. It also noted that strategic planning presents an opportunity to increasingly integrate policies that support natural asset management while elevating the concepts, processes, and value associated with natural assets [73].

Table 4 describes other organizations involved in advancing natural asset management in Canada. This selective list demonstrates the volume and range of organizations working in natural asset management and suggests the field is maturing, even in the absence of regulations or mandatory standards for natural asset management.

Table 4: Canadian and international professional bodies and NGOs providing natural asset management resources for Canadian municipalities.

Organization	Jurisdiction	Description of activities
Intact Centre on Climate Adaptation	National	Intact Centre on Climate Adaptation is an applied research institute at the University of Waterloo that conducts research on climate-resilient infrastructure [74]. Their recent publication, Getting Nature into Financial Reporting: Natural Assets Disclosures for Local Government, advocates for the inclusion of natural assets in financial reporting by local governments to demonstrate the value they provide to communities [75].
Asset Management British Columbia **(AMBC)**	British Columbia	AMBC is British Columbia's professional body for asset management [76]. They provide education and resources on integrating natural assets into local government asset management practices, such as the Integrating Natural Assets into Asset Management Primer, part of its broader Asset Management for Sustainable Service Delivery: A B.C. Framework [17], [77].
Partnership for Water Sustainability in BC	British Columbia	The Partnership for Water Sustainability in BC connects water management interest holders in British Columbia [78]. Notably, they developed the ecological accounting process (EAP) to provide a methodology and metrics for financial valuation of stream systems [79].
Engineers and Geoscientists of British Columbia **(EGBC)**	British Columbia	EGBC regulates and governs the professions of engineering and geoscience in British Columbia under the authority of the *Professional Governance Act* [80]. In 2021, they developed professional practice guidelines to guide engineers and geoscientists contributing to local government asset management in British Columbia. The guidelines recognize that natural assets are part of an integrated system and provide services and benefits to communities [81].
Miistakis Institute	Alberta	Miistakis is an applied research institute focused on ecological connectivity, biodiversity, and nature-based solutions [82]. Their 2021 Municipal Natural Asset Inventory report provides a detailed approach for developing such an inventory [83].
Manitoba Association of Watersheds **(MAW)**	Manitoba	MAW supports Manitoba's 14 watershed districts to protect soil, water, habitat, and climate in the province [84]. They lead the Prairie Watersheds Climate Program, which provides funding incentives for implementation of beneficial management practices that support ecosystem health [85].
Ontario's Conservation Authorities	Ontario	Conservation authorities across Ontario are formed under the *Conservation Authorities Act* with support from watershed municipalities who appoint members to the decision-making board [86]. The purpose of conservation authorities is to deliver programs and services that further the conservation, restoration, development and management of natural resources in watersheds in Ontario [86]. As such, conservation authorities monitor watershed conditions, trends, stresses, and risks to inform their programs and services [87]. They also provide resource data and analysis to inform municipal planning and municipal asset management and carry out natural asset and risk assessments on behalf of one or more of their member municipalities [87].
Green Infrastructure Ontario Coalition	Ontario	Green Infrastructure Ontario Coalition is an advocacy organization that supports infrastructure planning and policy development that incorporates green infrastructure independently of or integrated with grey infrastructure approaches [88]. They maintain a green infrastructure resource hub, which inventories a wide range of resources relevant to natural asset management [89].

Organization	Jurisdiction	Description of activities
Greenbelt Foundation	Ontario	The Greenbelt Foundation supports the protection, restoration, and enhancement of natural systems in Ontario's greenbelt to maintain ecosystem functions such as flood mitigation, water purification, and biodiversity, contributing to regional resilience and public wellbeing [90]. They publish research to help municipalities undertake integrated asset management, and a recent webinar highlighted their work on an upcoming report titled Natural Asset Management: Advancing Policy Innovation and Municipal Leadership [91].
Centre d'expertise et de recherche en infrastructures urbaines **(CERIU)**	Quebec	CERIU is a non-profit applied research centre that develops and applies artificial intelligence and data science solutions to support decision-making in areas such as climate resilience, including the use of climate data to inform land and resource management practices [92].
Atlantic Infrastructure Management (AIM) Network	Atlantic Canada	AIM Network is an asset management community of practice that facilitates training, workshops, and peer learning to help municipalities in Atlantic Canada implement asset management approaches, including incorporating natural assets into integrated asset management and service delivery planning [93].
CLIMAtlantic	Atlantic Canada	CLIMAtlantic supports climate adaptation in Atlantic Canada by promoting nature-based approaches that integrate the protection, management, and restoration of natural systems to enhance resilience and deliver ecosystem services [94]. They curate resources and host webinars with information aimed at Atlantic communities, such as a January 2025 webinar titled Balancing Community Needs and Climate Change Within Nature-Based Approaches [95].
Clean Foundation	Atlantic Canada	Clean Foundation plays a role in knowledge mobilization, community engagement, and capacity-building to help local governments advance climate action [96]. They deliver the Municipal Climate Learning Group program, funded by the Government of Nova Scotia to advance municipal climate action. The program includes resources on using nature-based solutions to build resilience [97].
TransCoastal Adaptations	Atlantic Canada	TransCoastal Adaptations is a research centre based at Saint Mary's University that supports climate adaptation through nature-based solutions, including shoreline restoration and sustainable coastal infrastructure, with an emphasis on integrating ecological functions into planning and development [98]. Their ongoing Nature-Based Infrastructure for Coastal Resilience and Risk Reduction project is working to develop a knowledge base and design guide on implementing nature-based infrastructure in coastal communities [99].
New Brunswick Environmental Network **(NBEN)**	Atlantic Canada	NBEN acts as a communication and coordination hub that connects municipalities with tools, data, and partnerships to support climate adaptation and natural infrastructure planning [100]. In summer 2025, they delivered nature-based solutions site visits to provide education on integrating nature-based solutions for climate adaptation [101]. In 2023, they delivered a seven-part webinar series on mapping natural assets and responding to the impacts of climate change, titled Learning from Connected Communities: An In-Depth Look at Nature-Based Climate Solutions in Atlantic Canada [102].
International Institute for Sustainable Development **(IISD)**	International	IISD is a think tank focused on identifying solutions for a stable climate, sustainable resources, and fair economies [103]. They host a nature-based solutions global resource centre that provides data, training, and sector-specific valuations for natural infrastructure [104]. Through their Natural Infrastructure for Water Solutions Initiative, they supported the development of Planning with Nature in the Prairies: A Guide to Integrating Natural Asset Management into Local Government Plans by NAI and Ducks Unlimited [105].

3.4.3 Municipal Natural Asset Management

Due to ISO 55000's broad applicability regardless of sector, it also applies to natural assets. These can be managed using the same systems as grey infrastructure asset management, which include:

- Developing an asset inventory
- Completing asset condition assessments
- Developing level-of-service frameworks
- Lifecycle management
- Risk-based decision-making
- Developing capital planning and investment strategies

As previously stated, Canadian municipalities outside of Ontario can decide which types of assets to include in their asset management systems, including natural assets.

3.5 Challenges and Opportunities for Integrated Asset Management

Including natural assets in municipal asset management systems presents an opportunity for municipalities to complement, replace, or reduce the need for grey infrastructure and may result in cost savings and co-benefits [23], [31]. Further, because natural assets are inherently delivering services that municipalities rely on, explicitly capturing and valuing these services supports their effective management and safeguarding [15]. However, the characteristics of natural assets differ from those of grey infrastructure, and these differences can present challenges for municipalities interested in integrating them into their asset management systems, which have largely been developed with an emphasis on grey infrastructure. At the root of these challenges is the fact that natural assets are dynamic, ecological systems with self-driven feedback loops and complex interdependencies. Mismanagement of these assets can have catastrophic results: for example, altering stream flows can trigger cascading failures in water quality and biodiversity [13], [14]. And unlike grey infrastructure, some natural assets, such as old-growth forests, peatlands, and wetlands, are effectively non-renewable on a human timescale [13], [14]. Their ecological complexity and service functions develop over centuries, making their loss permanent [14]. However, some natural assets, like wetlands and forests, can absorb shocks and self-repair, making them valuable for climate adaptation [13].

The research identified four core challenges impacting the ability of Canadian municipalities to advance integrated asset management. They include knowledge and capacity constraints, access to funding, governance and ownership complexity, and application of service delivery and lifecycle management approaches. Each of these challenges is described in this section.

3.5.1 Knowledge and Capacity Constraints

Limited technical knowledge and staff capacity are a challenge for some municipalities interested in integrating natural assets into asset management systems. Many municipalities lack dedicated staff capacity to develop asset management systems [106]. This can result in limited or inconsistent consideration of natural assets, both within individual communities and across jurisdictions [11].

Across interviews and workshops, 64% of participants said confusion and lack of agreement around key concepts and terminology related to natural assets were limiting their ability to advance integration. This included participants from all provinces, organization types, and role types. These participants also indicated that the range of services provided by natural assets is complex and that available knowledge resources, while extensive, use varied and inconsistent terminology. This can make it difficult to know where to start and can limit collaboration across professional disciplines and jurisdictions. Further, unless an organization has a proactive champion or existing policies for natural asset management, progress on integrated asset management can be stifled by organizational priorities that shift with political cycles.

Another challenge raised by participants was the fact that grey infrastructure management tends to take priority over natural assets when asset management resources are limited within a municipality. Teams in charge of managing infrastructure are resource-strained,

and 16% of participants indicated either that there was a perception that managing natural assets would result in additional responsibility that they do not have capacity for, or that staff at their organization felt natural assets were someone else's responsibility.

Managing natural assets is dependent on location-specific data, but availability of and access to this data is inconsistent [107]. Interviewees from small communities expressed a need for simple, ready-to-use tools to help them understand their natural assets, both in terms of inventories and their service-delivery value. It was also noted that many communities do not fully understand the condition of their assets. Limited availability of appropriate tools to create inventories, assess condition, and manage data restricts the ability of some local governments to manage their natural assets. These issues also affect grey infrastructure management, but are even more challenging for natural assets.

Inconsistent data specifications and the absence of standardized quality or interoperability guidelines further complicate efforts to manage assets systematically [108]. Technology offers promising tools to support asset management strategies, but awareness and understanding of available systems may be limited, particularly in smaller communities [109]. Staff capacity and knowledge gaps, both in general asset management and in the emerging field of natural asset management and application of associated tools and technologies, can make it difficult to implement more integrated approaches [106].

3.5.2 Access to Funding

Canadian municipalities are largely reliant on their property tax base for funding, which limits the funds available for managing assets [110]. Reliance on property taxes has been raised as an issue across Canada [111], and this challenge was further validated during interviews and workshops. Six BC-based participants noted that budget pressures and a focus on minimizing taxes have delayed investment in both grey and natural assets, leading to higher asset lifecycle costs over time. Engagement participants representing rural communities in all provinces shared that natural assets are seen as abundant in their communities, while grey infrastructure is seen as deteriorating and in more urgent need of investment when it comes to prioritizing limited budget dollars.

Provincial and federal government grants are another important funding source for municipalities [110]. Limited and misaligned grant funding was raised by 57% of participants in workshops and interviews as a constraint for integrated asset management. Municipal participants noted that they face a complex and often misaligned funding environment, with grant opportunities that are highly specific, frequently changing, commonly oversubscribed, and not aligned with organizational priorities.

Two municipal participants from British Columbia with more advanced natural asset management systems noted that one driver for advancing their natural asset management programs was anticipating funding requirements and being prepared for future grant opportunities. Smaller municipalities noted that they did not have sufficient staff capacity to track and apply for grants. One BC-based planner noted that they were unable to pursue grant opportunities, particularly for multi-year funding programs, where inflation-related cost overruns would become the responsibility of the municipality.

3.5.3 Governance and Ownership Complexity

Natural assets are ecosystems or components of ecosystems, and proactive management for service delivery necessitates they be managed at the systems level [15], [16]. However, these systems often cross jurisdictional boundaries and have multiple owners (i.e., private, municipal, provincial and/or federal), making them subject to a complex framework of regulations requiring intergovernmental coordination to manage effectively [13], [112], [113], [114], [115]. In workshops and interviews, 62% of participants, including representatives from Atlantic Canada, Ontario, and two non-governmental organizations with a national mandate, noted that sustained collaboration across jurisdictions is challenging. The reasons provided were related to the capacity constraints outlined above: limited funding, staff capacity, time, and shifting organizational and political priorities.



Existing asset management approaches were developed for organizations to manage assets that they own. Therefore, a different approach is needed to manage natural assets that are not owned by the municipality or that have multiple owners. Municipalities need to create partnerships and incentives for stewardship to manage natural assets on private land, recognizing that those assets provide services the municipality depends on [116], [117], [118].

Interviewees from BC, Alberta, Ontario and Quebec noted that in larger urban centres, development pressure is very high, and protecting natural assets located on private property is a challenge because developing the land (e.g., with housing) is more profitable than maintaining its natural features. While acquisition of land to preserve its service-delivery value may be an option for larger municipalities with bigger tax bases, smaller communities are often resource-strained and unable to purchase properties containing important natural assets. A BC-based planner noted it is typically unattainable to purchase the natural assets their municipality relies on, and even if funding was available, large tracts of land would be untenable to manage. These complexities emphasize the need for cross-jurisdictional collaboration and support from higher levels of government to protect the natural assets municipalities depend on.

Regional districts, conservation authorities, and watershed organizations have historically managed, and continue to manage, natural resources that cross jurisdictional boundaries in Canada. Leveraging this experience presents an opportunity for municipalities pursuing natural asset management. Their roles include:

- Coordinating land-use planning across multiple local governments;
- Managing watersheds to reduce flooding and erosion and protect drinking water;
- Conserving large-scale ecosystems through protected areas, greenbelts, and wildlife corridors;
- Monitoring environmental trends, issues, conditions, and risks; and
- Providing funding and expertise for green infrastructure projects.

Ontario's conservation authorities are unique in Canada. They operate under the *Conservation Authorities Act* (R.S.O. 1990, c. C.27), with responsibilities defined in section 20 of the Act and related regulations, including O. Reg. 686/21 and O. Reg. 41/24 [86]. These include mandatory programs on a watershed basis for managing natural hazards (e.g., flooding, erosion, drought) and infrastructure related to these risks, as well as source water protection, provincial surface and groundwater monitoring, management

of conservation authority lands, and comments on municipal land-use applications as they relate to natural hazards. Conservation authorities are governed by a board with members appointed by the watershed municipalities [86]. They are responsible for preparing and implementing a watershed-based resource management plan and asset management plans as required by O. Reg. 686/21 [86], [119]. They can also carry out other programs and services on behalf of member municipalities and offer data and expertise relevant to municipal integrated asset management [86].

One example of municipal uptake of integrated asset management supported by the local conservation authority is the Grindstone Creek Watershed Natural Assets Management Project, discussed in Section 3.6.4.5.

While conservation authorities are unique to Ontario, each province has organizations that play a role in watershed management and have the potential to support municipal asset management. A list of these organizations and a description of their roles is provided in Table 5.

Development of supportive policies and governance structures for integrated asset management is influenced by factors like political leadership, community support, and technical knowledge, with community perceptions playing a crucial role in shaping policy direction and measuring success [12], [120]. Challenges establishing these systems were an underlying theme in interviews and workshops.

Table 5: Watershed organizations and roles in Canadian provinces.

Province	Organization type	Description of role
British Columbia	Non-governmental organizations; community watersheds	No watershed-scale organizations with legal authority for integrated watershed management. Community watersheds and non-governmental organizations play a role in watershed management without a legal mandate [121].
Alberta	Watershed planning and advisory councils	Watershed planning and advisory councils are independent, non-profit organizations designated by Alberta Environment and Parks and are responsible for watershed management planning [122].
Saskatchewan	Watershed associations	No statutory or regulatory mandate for watershed management. Watershed associations contribute to planning activities that may inform land-use decisions in a support and advisory capacity [121], [123].
Manitoba	Watershed districts	Watershed districts established under the *Watershed Protection Act* in 2021 function as partnerships between the province and municipalities with a mandate to protect, restore, and manage land and water resources on a watershed basis [124]. Districts can be designated as water planning authorities under the Act, giving them leadership in developing and implementing integrated watershed management plans [124].
Ontario	Conservation authorities	Ontario's conservation authorities operate under the *Conservation Authorities Act* (R.S.O. 1990, c. C.27), with responsibilities defined in section 20 of the Act and regulations including O. Reg. 686/21 and O. Reg. 41/24 [86], [125], [126]. Municipalities within a given watershed appoint members to the decision-making board and carry out mandatory programs on a watershed basis for managing natural hazards (e.g., flooding, erosion, drought) and infrastructure related to these risks, as well as source water protection, provincial surface and groundwater monitoring, management of conservation authority lands, and comments on municipal land-use applications as they relate to natural hazards [86]. The conservation authorities are also responsible for preparing and implementing a watershed-based resource management plan [86]. Conservation authorities prepare asset management plans as required by O. Reg. 686/21 and carry out other programs and services on behalf of their member municipalities by agreement [86], [125].

Province	Organization type	Description of role
Quebec	Watershed organizations (Organismes des bassins versants)	Quebec's Organismes de bassins versants (OBVs) are non-regulatory, non-profit watershed organizations [127]. They are mandated to develop and implement integrated water management plans (plans directeurs de l'eau) at the watershed scale [127]. While they do not own or manage infrastructure, they influence planning and coordination [127].
New Brunswick	Non-governmental organizations	No watershed-scale organizations with legal authority for integrated watershed management. Community-based watershed groups operate voluntarily; a provincial working group recommends formalizing their role [128].
Prince Edward Island	Non-governmental organizations; local watershed groups	No watershed-scale organizations with legal authority for integrated watershed management. Watershed groups are community-led and supported by the province with no regulatory authority [129].
Nova Scotia	Non-governmental organizations	No watershed-scale organizations with legal authority for integrated watershed management. Provincial water resource management strategy guides cross-sectoral collaboration and planning at the watershed scale [130].
Newfoundland and Labrador	Water Resources Management Division	The province's Water Resources Management Division has legal authority under the *Water Resources Act* and oversees water use, flood mapping, dam safety, and water quality. Responsible for direct management of infrastructure like dams, flood systems, and water supply assets [131].

3.5.4 Service Delivery and Lifecycle Management

There are several challenges related to defining the services provided by natural assets. A single natural asset (such as a forest) can deliver multiple services, such as flood control, carbon storage, recreation, and biodiversity support [13], [132], [133], [134], [135]. This can make it challenging to integrate natural assets into asset management systems, including categorizing them within asset inventories, defining level-of-service frameworks, and assigning them a financial value.

In workshops and interviews, 25% of participants, including representatives of municipalities and non-governmental organizations from BC, Ontario, and Canada-wide, noted that the multiple service benefits of natural assets make it challenging to meaningfully value these assets and communicate their benefits to internal and external parties. Two participants, one from BC and one from Ontario, noted that if you value the full range of services a natural asset provides, the figures become large and are not perceived as meaningful. Four interview participants, including a municipal administrator from BC and non-governmental organizations from BC and Ontario, emphasized the need to focus on the primary service delivered by a given natural asset that can be directly compared to a service provided by grey infrastructure.

In terms of lifecycle management, natural assets do not depreciate linearly and have the potential to persist indefinitely with appropriate management and stewardship [13]. Lifecycle management approaches in asset management systems consider total lifecycle costs from acquisition to disposal, including consideration for preventative maintenance, rehabilitation, and replacement planning to minimize long-term costs [7]. There is an inherent assumption in this definition that assets have an end of useful life, which does not align with the characteristic enduring value of ecosystems and their potential for indefinite service delivery [14], [136]. While this challenge is not entirely unique to natural assets (for example, some linear assets like roadways may have very long or indefinite lifecycles), the characteristics of natural assets as ecological systems with self-driven feedback loops and complex interdependencies complicate their management and require a different skillset from managing grey infrastructure.

Another consideration is that the return on investments from natural assets, both from a service-delivery perspective and from other benefits like resilience to natural hazards and improved quality of life, may only be seen over the long term (i.e., centuries) [13], [17]. The timescales for managing natural assets may be out of alignment with current asset management approaches and with municipal political and budget cycles. In Workshop 2, participants noted that issues with grey infrastructure tend to be top of mind for residents and municipal councils; for example, a pothole or broken streetlamp on a main street may be more noticeable in the short term than natural systems that are losing their function over time due to development pressures or changing environmental conditions, and therefore the former more readily gains attention from residents and councils.

While the International Public Sector Accounting Standards Board (IPSASB) has emerging standards for reporting on tangible natural resources that could support municipalities in integrated asset management, challenges remain [137]. Section 3.6 explores how municipal planning tools may play a role in addressing these challenges.

3.5.5 Engagement Findings on Challenges and Opportunities for Integrated Asset Management

To ground the preceding analysis in the experiences of practitioners, this section presents a comparative summary of key challenges and opportunities identified through the workshops and interviews. Notable findings that were discussed across all engagement activities included the following:

- Smaller and rural municipalities face limitations in staff capacity, technical expertise, and resources, resulting in a disconnect between planning and interest in integrated asset management and the ability to progress and implement solutions.
- Financial barriers and fragmented funding programs were recognized as major obstacles; grant opportunities are often misaligned with municipal priorities and difficult to access for communities with limited staff capacity to complete grant applications.
- Jurisdictional complexity and unclear authority over natural assets were common themes, with participants noting the need for improved collaboration across departments, municipalities, and levels of government.
- There was broad agreement that valuing and managing the services provided by natural assets is challenging, particularly due to their complex, multi-faceted benefits and the lack of standardized approaches for lifecycle assessment and reporting.
- Engagement activities demonstrated a need for accessible training, practical guidance, and standardized resources to build staff capacity and support effective knowledge transfer. Models for cross-departmental collaboration and knowledge-sharing would help to strengthen asset management practices and ensure continuity across organizations.

Table 6 highlights both common themes and distinct perspectives on knowledge and capacity constraints, funding limitations, governance and ownership complexity, and service delivery and lifecycle management across each of the engagement activities. The table is followed by a more in-depth discussion of the comments heard during each activity.

Knowledge and capacity restraints

Workshop participants from Atlantic Canada noted that many rural and small municipalities lack sufficient staff capacity, technical expertise, and dedicated roles for asset management and climate adaptation. This results in a disconnect between planning and execution, with plans often "shelved" due to staff turnover, burnout, or lack of continuity. Over-reliance on individual champions means progress can stall if key people leave. Succession planning and knowledge transfer were characterized as a challenge, and participants cited a need for more formal processes and job descriptions to maintain momentum. Fragmented data and documentation, outdated information, and lack of expertise (especially in smaller communities) make it difficult to mobilize existing resources. Accessible training, outreach, and capacity-building programs are needed, including cross-departmental collaboration and knowledge-sharing. There is also a need for improved staff training and capacity-building, as many teams struggle with limited expertise and resources to manage both data and asset inventories effectively.

Table 6: Comparative summary of engagement findings on key challenges to integrated asset management.

Challenge	Workshop 1: Atlantic Canada	Workshop 2: Western Canada	Interviews
Knowledge and capacity constraints	▪ Many rural and small municipalities lack sufficient staff capacity, technical expertise, and dedicated roles for asset management and climate adaptation. ▪ Over-reliance on individual champions. ▪ Insufficient succession planning and knowledge transfer. ▪ Fragmented data and documentation, outdated information, and lack of expertise (especially in smaller communities). ▪ A need for accessible training, outreach, and capacity-building programs, including cross-departmental collaboration and knowledge-sharing.	▪ A need for improved staff training and capacity-building. ▪ A need for consistency in unit costing and data collection methods; current data collection practices are inconsistent and often lack coordination across departments.	▪ Natural asset management is still emerging. ▪ Larger cities and regions with champions or dedicated staff are generally seen as leaders. ▪ There is significant variation in terminology, approaches, and understanding of natural assets across departments and municipalities. ▪ Staff turnover, lack of succession planning, and over-reliance on individual champions. ▪ A need for accessible training, practical guidance, and standardized resources.
Access to funding	▪ Financial barriers are significant, especially for smaller municipalities. ▪ Funding is often tied to specific issues (e.g., climate, housing). ▪ Upfront costs for natural asset projects are seen as prohibitive by some staff and decision-makers.	▪ Cost estimation and budgeting practices vary widely. ▪ Data quality issues and fragmented information systems. ▪ Opportunities to improve funding outcomes by standardizing data formats and reporting.	▪ Funding programs are often fragmented, highly specific, and difficult to navigate. ▪ Natural asset projects are frequently deprioritized in favour of grey infrastructure. ▪ Champions play a critical role in securing funding and advancing initiatives.
Governance and ownership complexity	▪ Jurisdictional issues are common. ▪ There is a need for clearer roles, responsibilities, and alignment between municipal, provincial, and federal policies. ▪ Conflicting priorities and fragmented approaches to integrated planning.	▪ Jurisdictional boundaries and unclear ownership of data. ▪ Lack of standardization in natural asset management processes. ▪ Opportunities to improve governance by developing shared protocols for data integration and asset tracking.	▪ Jurisdictional complexity is a major barrier. ▪ Governance structures are often unclear, with fragmented responsibilities and limited frameworks for defining roles in natural asset stewardship. ▪ Election cycles and shifting priorities disrupt long-term planning and implementation. ▪ A need for clearer protocols, shared language, and alignment of policies.
Service delivery and lifecycle management	▪ A disconnect between the value of natural assets and their consideration in planning and service delivery. ▪ While there is relevant data available from municipal, provincial, and federal sources, mobilizing it for decision-making is challenging. ▪ Legislative enforcement is weak.	▪ Inconsistent data formats and reporting practices. ▪ Need for standardized processes. ▪ Improved collaboration and data-sharing between departments are seen as key opportunities.	▪ Valuing and accounting for the services provided by natural assets is challenging. ▪ Lifecycle costing and condition assessment for natural assets are not fully developed. ▪ Integration of natural assets into asset management plans is inconsistent.

Participants from Western Canada identified a gap in consistent unit costing and data collection methods, with several emphasizing the value of shared definitions and approaches to improve reliability and comparability of data. They highlighted the importance of integrating GIS and data systems to support asset management, but noted that current data collection practices are inconsistent and often lack coordination across departments.

Interviewees believed that natural asset management is still emerging, with most municipalities in early stages of adoption and integration. Larger cities and regions with champions or dedicated staff are generally seen as leaders, while smaller and rural communities have seen less advancement due to limited capacity and expertise. There is significant variation in terminology, approaches, and understanding of natural assets across departments and municipalities, resulting in inconsistent practices and siloed teams. Interdepartmental cooperation is improving, but remains a challenge. Staff turnover, lack of succession planning, and over-reliance on individual champions can hinder continuity and progress. Interviewees expressed a need for accessible training, practical guidance, and standardized resources to build capacity and support knowledge transfer.

Access to funding

Workshop participants in Atlantic Canada discussed significant financial barriers, especially for smaller municipalities. There are too many funding programs with ever-changing requirements, making it difficult to navigate and apply successfully. There is limited staff capacity to complete compelling applications. Funding is often tied to specific issues (e.g., climate, housing), leading to fragmented or short-lived initiatives. The lack of flexible, long-term funding options constrains investment in natural assets. Some staff and decision-makers view upfront costs for natural asset projects as prohibitive, and there is a perception that "doing the right thing" costs more, especially when competing with day-to-day operational needs and maintaining aging infrastructure. Cost estimation and budgeting practices vary widely, making it difficult to plan and allocate resources for asset management and natural asset initiatives.

Workshop participants from Western Canada commented on data-quality issues and fragmented information systems that can lead to inefficiencies and missed opportunities to secure funding or demonstrate value to decision-makers. Participants saw opportunities to improve funding outcomes by standardizing data formats and reporting, which would make it easier to justify investments and apply for grants.

Interviewees felt that funding programs are often fragmented, highly specific, and difficult to navigate, especially for smaller municipalities with limited staff resources; short-term grants do not support long-term maintenance or verification; and inflation-related cost overruns further constrain budgets. Natural asset projects are, as believed, frequently deprioritized in favour of grey infrastructure, with financial resources and council attention focused on immediate operational needs. Funding structures that prioritize ongoing support and flexibility would better enable sustained investment in natural assets. Champions play a critical role in securing funding and advancing initiatives, but success is uneven and dependent on local leadership. There is a need for more adaptable financial support and alignment between funding programs and municipal realities.

Governance and ownership complexity

In Atlantic Canada, workshop participants discussed common jurisdictional issues, especially where natural assets are privately owned or span multiple levels of government. Municipalities may lack authority over assets that provide essential services, such as watersheds, leading to coordination and management challenges. Policy shifts, political instability, and lack of standard processes mean priorities can change rapidly, disrupting long-term strategies. Participants expressed a need for clearer roles, responsibilities, and alignment between municipal, provincial, and federal policies. Siloed thinking within municipal departments and between staff and elected officials leads to conflicting priorities and fragmented approaches to integrated planning.

Participants in Western Canada said a lack of standardization in natural asset management processes created challenges for collaboration

between departments and across municipalities. They cited jurisdictional boundaries and unclear ownership of data and assets as barriers to effective management and, like participants in Atlantic Canada, noted the need for clearer roles and responsibilities. They saw opportunities to improve governance by developing shared protocols for data integration and asset tracking, which would facilitate better decision-making and accountability.

Echoing Atlantic workshop participants, interviewees also cited jurisdictional complexity as a major barrier, particularly where natural assets are privately owned or span multiple levels of government. They said municipalities often lack authority to manage or protect these assets, and policy misalignment between provincial and municipal governments further complicates integration. Governance structures are often unclear, with fragmented responsibilities and limited frameworks for defining roles in natural asset stewardship. Election cycles and shifting priorities disrupt long-term planning and implementation. Siloed thinking and inconsistent definitions of natural assets across departments hinder coordinated action. There is a need for clearer protocols, shared language, and policy alignment to support effective governance and ownership.

Service delivery and lifecycle management

In Atlantic Canada, workshop participants noted a disconnect between the value of natural assets and their consideration in planning and service delivery. Natural assets are hard to replace and often not considered in asset management discussions, especially in rural areas where they are seen as abundant. Data collection and inventory efforts are ongoing, but mobilizing this information for decision-making is challenging. The lack of standard valuation methods and lifecycle assessment for natural assets makes it difficult to compare them with grey infrastructure. Legislative measures exist to protect natural assets, but enforcement is weak due to monitoring challenges. There is a need for more formal integration of natural assets into asset management policies, financial planning, and strategic goals.

Participants at the Western workshop believed inconsistent data formats and reporting practices hinder performance measurement and lifecycle analysis, making it difficult to assess the long-term value and condition of assets. They identified the need for standardized processes to enhance efficiency, support evidence-based decision-making, and improve the accuracy of service delivery reporting. Improved collaboration and data-sharing between departments were seen as key opportunities to strengthen lifecycle management and ensure assets, including natural assets, are maintained and replaced appropriately.

Interviewees said valuing and accounting for the services natural assets provide is challenging because their benefits are long-term, multi-faceted, and not easily measured against traditional infrastructure. Existing valuation models often produce large, abstract numbers that are difficult to communicate. Lifecycle costing and condition assessment for natural assets are not fully developed, making it difficult to compare them with built assets and justify investment to decision-makers. Standardized approaches and practical case studies are needed to support evidence-based decision-making. Integration of natural assets into asset management plans is inconsistent, with larger municipalities making more progress. There is growing recognition of the need to link service delivery, risk management, and financial planning to natural asset management, but practical tools and guidance remain limited.

3.6 Municipal Planning and Integrated Asset Management

Municipalities have a unique role in integrated asset management due to their responsibilities for municipal planning, which guides the allocation and regulation of land [19]. While there are many interest holders in this field, including all levels of government, watershed organizations, and private landowners, municipalities own approximately 60% of public infrastructure and are directly accountable for managing those assets to meet community needs [2], [3].

Municipal planning tools are the mechanisms that municipalities use to meet their planning responsibilities, guide land use and development, and articulate their organizational objectives. In other words, these tools define the organizational objectives that asset management systems are designed to support and reflect, while shaping demand on existing assets and driving the creation of new ones [1].

Based on a comparative review of provincial planning legislation across Canada, five commonly used types of municipal planning tools have been identified, recognizing that terminology and implementation mechanisms vary by province [138 - 147]:

- **Regional strategies:** Coordinate regional land-use planning, environmental stewardship, and service delivery;
- **Official or municipal plans**: Guide long-term land use, infrastructure, housing, and community development;
- **Zoning or land-use bylaws:** Regulate land use, building form, density, and location;
- **Subdivision controls or approvals:** Manage land division and ensure compliance with servicing and design standards; and
- **Development permits or regulations:** Control development activities and ensure compliance with planning objectives.

Embedding and prioritizing natural assets within organizational objectives at the municipal planning level has the potential to facilitate their improved integration into asset management systems by shaping the asset portfolio and organizational objectives (Figure 4).

This section focuses on municipalities and their planning functions. It defines the municipal planning tools commonly used by Canadian municipalities and explores their potential role in integrated asset management.

3.6.1 Defining Municipal Planning

Professional planning in Canada refers to "the planning of the scientific, aesthetic and orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and wellbeing of urban and rural communities" [148]. This section is focused on municipal planning, meaning professional planning carried out by municipalities. It explores municipal planning tools as a means to guide the allocation and regulation of land and resources, recognizing that natural assets are preserved, restored, or enhanced elements of that land and those resources, and that there is a strong link between managing land and resources and delivering services to communities [19], [21], [23].

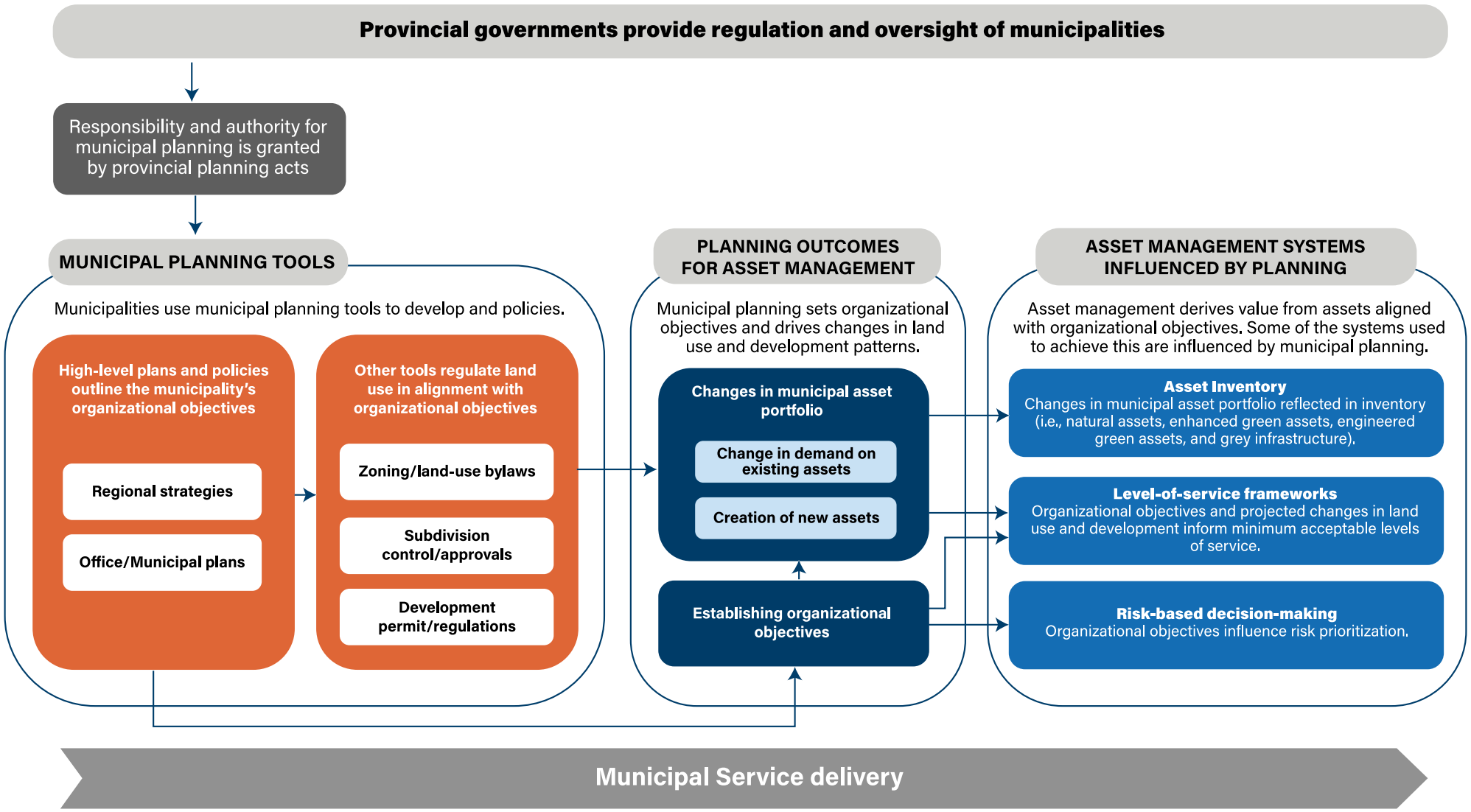
In addition to guiding land allocation and development, municipal planning tools are also used to establish expectations for infrastructure servicing that accompanies development. These tools define the spatial distribution of municipal development and the infrastructure (including grey infrastructure and natural assets) required to support that development. In this way, municipal planning results in the creation of new infrastructure assets. By undertaking municipal planning in a way that embeds the service delivery value of natural assets alongside grey infrastructure, there is an opportunity to advance toward integrated asset management.

3.6.1.1 Linking Indigenous Planning and Municipal Planning

Municipal planning in Canada is increasingly informed by Indigenous planning principles and knowledge systems, which emphasize stewardship, respect for the land, and holistic governance approaches that recognize the interconnectedness of people, nature, and place [149], [150]. Indigenous planning is grounded in long-term sustainability, accountability, and the wellbeing of both current and future generations [151]. As municipalities advance integrated asset management, collaboration with Indigenous communities provides opportunities to enrich planning processes through traditional teachings, storytelling, ceremony, and place-based knowledge [149], [150], [152].

In 2019, the Canadian Institute of Planners (CIP) adopted its Policy on Planning Practice and Reconciliation, which is intended to align the future of planning in Canada with the Truth and Reconciliation Commission's 94 Calls to Action for reconciliation and the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) [149]. It asserts that municipal planning should be guided by a commitment to respectful, early, and ongoing engagement with Indigenous communities [149]. This includes honouring Indigenous rights, governance, and communication protocols and fostering cultural competency among municipal staff [149].

Figure 4: Asset management systems in the context of municipal planning [5], [77], [138-147].



By supporting shared stewardship and co-governance, municipalities can work collaboratively with Indigenous peoples to achieve sustainable outcomes for land and water systems [149]. The CIP policy notes that regular review and accountability mechanisms are essential to ensure that engagement practices remain effective and responsive to Indigenous communities' needs and aspirations [149]. Several of the provincial institutes and associations for professional planning in Canada have established working groups or developed resources related to the role of professional planners in reconciliation, as shown in Table 7.

Recent policy developments, such as Ontario's 2024 Provincial Planning Statement, instruct municipalities to engage early and meaningfully with Indigenous neighbours when creating land-use plans and making decisions that impact Indigenous or treaty rights [157]. The UNDRIP and the Truth and Reconciliation Commission recommendations further reinforce the need for respectful consultation, accommodation, and co-governance in planning processes [158]. These policies and practices demonstrate a growing recognition that Indigenous perspectives are an important consideration in municipal planning. Requirements for collaboration with Indigenous governments in municipal planning vary across provinces, as described in Section 3.6.2.

3.6.2 Municipal Planning Requirements and Tools by Province

Municipal planning is governed by provincial legislation because local governments, and therefore municipalities, fall under provincial jurisdiction according to the Constitution Acts 1867–1982 [18]. Municipalities are granted powers and responsibility through provincial planning acts and specific requirements and tools [18].

3.6.2.1 British Columbia

In British Columbia, the role of municipalities in planning and land-use management is defined in Part 14—Planning and Land Use Management of the *Local Government Act* [138]. Through the Act, municipalities are authorized to use the following municipal planning tools:

Table 7: Initiatives and commitments on Indigenous inclusion in planning by provincial institutes and associations for professional planning in Canada.

Organization	Initiatives and commitments
Planning Institute of British Columbia (PIBC)	PIBC established the Planning Practice & Reconciliation Committee to guide the planning profession in BC and Yukon toward truth and reconciliation, decolonizing planning practices, and supporting members in this work [153]. The committee works continuously to promote awareness, acknowledge harm, and recommend changes for more equitable planning [153].
Alberta Professional Planners Institute (APPI)	APPI has articulated a recognition of the responsibility of planners to understand and play a role in reconciliation and has published a list of resources for learning and awareness on the topic [154].
Ordre des urbanistes du Québec (OUQ)	The OUQ adopted a declaration outlining the role of urban planning in shaping a new relationship with Indigenous peoples [155]. The document reflects a process of consultation and discussion with experts and Indigenous organizations and signals an intent to evolve planning practices [155].
Ontario Professional Planners Institute (OPPI)	OPPI is advancing Indigenous involvement in planning through several initiatives. It established the Indigenous Planning Advisory Committee (IPAC) to implement recommendations from the 2019 Indigenous Planning Perspectives Task Force Report [150]. IPAC emphasizes the importance of Indigenous leadership, treaty education, and relationship-building in planning practices. Additionally, OPPI is integrating Indigenous co-facilitation into professional development courses to support inclusive and culturally informed planning education.
Atlantic Planners Institute (API) and New Brunswick Association of Planners (NBAP)	API and the NBAP Statement on Equity acknowledge systemic discrimination in planning and are committed to promoting social equity through education, partnerships, and inclusive practices [156]. Their initiatives include professional learning focused on Indigenous communities, curriculum development, scholarships for diverse students, and advocacy for equity in national planning standards [156].

- **Regional growth strategies:** Regional districts, which are local governments that serve a geographic area made up of multiple municipalities and unincorporated (rural) areas in British Columbia, are authorized to develop regional growth strategies [138]. They are voluntary, but binding upon municipalities once accepted by the municipalities in the regional district [138].
- **Official community plans:** Municipalities can develop and adopt official community plans that outline long-term visions for land use, housing, transportation, infrastructure, and environmental protection [138].
- **Zoning bylaws:** Municipalities can enact zoning bylaws to regulate land use, density, building form, and siting [138].
- **Development permit areas:** Municipalities can designate development permit areas for specific purposes such as environmental protection, hazard mitigation, or revitalization [138].
- **Subdivision and servicing requirements:** Municipalities can establish subdivision and servicing requirements through bylaws, including parkland dedication and infrastructure standards [138].

The Act outlines specific procedural requirements for public hearings and consultation when adopting or amending bylaws. Municipalities are expected to incorporate sustainability principles by aligning land use with transportation, infrastructure, and environmental stewardship objectives. Collaboration with regional growth strategies, other jurisdictions, and Indigenous governments is encouraged [138].

3.6.2.2 Alberta

In Alberta, municipal planning is governed by the *Municipal Government Act* [139]. The Act defines the following municipal planning tools:

- Municipal development plans: Municipalities with populations over 3,500 are required to develop municipal development plans, which are long-term plans for land use, infrastructure, and community services [139].
- Area structure plans (ASPs) and area redevelopment plans (ARPs): Municipalities are authorized to develop more detailed plans for specific areas [139].
- Land-use bylaws: Municipalities are required to develop land-use bylaws to regulate zoning, development permits, and subdivision approvals [139].

The Act requires municipalities with a common boundary to create an intermunicipal collaboration framework to enable integrated delivery of intermunicipal services, allocate scarce resources efficiently, and ensure all municipalities contribute funding to services that benefit their residents [159].

3.6.2.3 Saskatchewan

In Saskatchewan, municipal planning is governed by the *Planning and Development Act* [140]. Municipal planning tools outlined in the Act include:

- **Intermunicipal development agreements:** Groups of municipalities can formalize intermunicipal partnerships focused on managing development or shared infrastructure and servicing [140].
- **Official community plans:** Municipalities are required to develop an official community plan to guide long-term development in order to engage in land-use planning [140].
- **Zoning bylaws:** Municipalities can use zoning bylaws to regulate land use and density in order to implement official community plans [140].
- **Subdivision control and development permits:** Municipalities are authorized to approve subdivision applications and development permits and are required to ensure they are in compliance with the official community plan and zoning bylaws [140].
- **Heritage and environmental protection areas:** Through the official community plan and zoning bylaws, municipalities can designate and protect areas of heritage or environmental significance to restrict development or require environmental assessments or mitigation measures [140].

The Act requires public consultation and encourages coordination with regional planning authorities and Indigenous communities when making changes to plans and bylaws [140].

3.6.2.4 Manitoba

In Manitoba, municipal planning is governed by the Planning Act [141]. It outlines the responsibilities of municipalities through the following tools:



- **Planning districts:** Two or more municipalities may establish a planning district by applying to the province in order to facilitate regional land-use planning and development [141].
- **Development plans:** Municipalities are required to create development plans to guide long-term land use and infrastructure [141].
- **Secondary plans:** Municipalities can use secondary plans to provide detailed planning for specific areas [141].
- **Zoning bylaws:** Municipalities can use zoning bylaws to regulate land use, building form, and density [141].
- **Subdivision approvals:** Municipalities can administer subdivision approvals, including for infrastructure and public service requirements [141].

The Act mandates public hearings and promotes sustainable development and intergovernmental collaboration. Planning at the regional or municipal level must be aligned with provincial land-use policies [141].

3.6.2.5 Ontario

In Ontario, municipal planning is governed by the *Planning Act* [142]. It provides municipalities with the authority to manage land use through the following tools:

- **Official plans:** Municipalities are required to adopt official plans that guide long-term land use, housing, infrastructure, and community development [142].
- **Zoning bylaws:** Municipalities are required to enact zoning bylaws to regulate land use, density, and the form and location of buildings [142].
- **Site plan control:** Municipalities can require site plan approval to ensure that development proposals meet local design and servicing standards [142].
- **Subdivision control:** Municipalities are required to regulate land division through subdivision approvals, including conditions for servicing and parkland dedication [142].

The Act mandates public consultation and requires consistency with the 2024 Provincial Planning Statement[142], which provides province-wide direction on land-use planning. It is intended to enable municipalities to support housing development, align growth with infrastructure, foster economic development, protect natural and agricultural systems, engage with Indigenous communities, and avoid development in hazard-prone areas [157].

3.6.2.6 Quebec

In Quebec, municipal planning is governed by the *Loi sur l'aménagement et l'urbanisme* [143]. It provides municipalities with the following tools:

- **Schémas d'aménagement et de développement (management and development plans):** Regional county municipalities, which represent groupings of municipalities in a geographic region, are responsible for adopting management and development plans that guide regional development [143].
- **Règlements d'urbanisme municipaux (municipal bylaws):** Local municipalities are responsible for adopting zoning, subdivision, and construction bylaws that align with the land-use and development plans established by regional county municipalities [143].

- **Programme particulier d'urbanisme (special planning programs):** Municipalities are authorized to develop special planning programs to allow for detailed planning in specific sectors [143].
- **Programme d'intégration architecturale et d'implantation (site planning and architectural integration programs):** Municipalities can undertake site planning and architectural integration programs to regulate the design, aesthetics, and integration of new developments into their surroundings [143].

The Act emphasizes coordination between levels of government and public participation [143].

3.6.2.7 New Brunswick

In New Brunswick, municipal planning is governed by the *Community Planning Act* [144]. The Act outlines the following tools available to municipalities:

- **Regional land-use plans:** Regional service commissions may develop regional land-use plans to facilitate collaboration across municipalities [144].
- **Municipal plans:** Municipalities are required to adopt municipal plans that establish long-term goals for land use, infrastructure, and community development [144].
- **Zoning bylaws:** Municipalities can enact zoning bylaws to regulate land use, building height, density, and setbacks [144].
- **Subdivision approvals:** Municipalities are required to approve subdivisions in accordance with servicing and design standards [144].
- **Development schemes:** Municipalities can adopt development schemes to guide detailed planning for specific areas [144].

The Act emphasizes public participation and coordination with regional service commissions and Indigenous communities [144].

3.6.2.8 Prince Edward Island

In Prince Edward Island, municipal planning is governed by the *Planning Act* [145]. The Act enables municipalities to use the following tools:

- **Official plans:** Municipalities are required to adopt official plans that guide long-term land use, infrastructure, and environmental management [145].
- **Zoning bylaws:** Municipalities are required to enact zoning bylaws to regulate land use, building form, and density [145].
- **Subdivision control:** Municipalities are required to manage subdivision approvals, including servicing and parkland dedication [145].

The Act supports public consultation and alignment with provincial land-use objectives [145]. The Province may enable regional planning through the designation of special planning areas that include multiple municipalities [145].

3.6.2.9 Nova Scotia

In Nova Scotia, municipal planning is governed by the *Municipal Government Act* [146]. The Act authorizes municipalities to use the following planning tools:

- **Municipal planning strategies:** Municipalities are required to adopt municipal planning strategies that outline long-term goals for land use, housing, infrastructure, and environmental protection [146].
- **Land-use bylaws:** Municipalities are required to enact land-use bylaws to regulate zoning, density, and development standards [146].
- **Secondary planning strategies:** Municipalities can adopt secondary strategies to provide more detailed planning for specific areas [146].
- **Subdivision bylaws:** Municipalities are required to regulate land division and servicing through subdivision bylaws [146].

The Act mandates public consultation and requires municipalities to review their planning documents at least every 10 years [146]. It encourages alignment with provincial priorities and coordination with Indigenous communities and other jurisdictions [146]. Municipalities are required to formally adopt a policy for engaging with neighbouring municipalities [146].

3.6.2.10 Newfoundland and Labrador

In Newfoundland and Labrador, municipal planning is governed by the *Urban and Rural Planning Act* [147]. It authorizes municipalities to use the following tools:

- **Regional plans:** Regional authorities may be established by the province if a need for coordinated planning across municipalities is identified; in that

case, the regional authority is mandated to prepare a regional plan to guide land use, development, and infrastructure across the region in alignment with provincial land-use policies [147].

- **Municipal plans:** Municipalities are required to adopt municipal plans that guide long-term land use, infrastructure, and community development [147].
- **Development regulations:** Municipalities are required to enact development regulations that implement the municipal plan, including zoning, density, and building standards [147].
- **Subdivision control:** Municipalities are responsible for approving subdivisions in accordance with servicing and design standards [147].

The Act requires public consultation and registration of all planning documents with the Department of Municipal and Provincial Affairs [147]. It encourages coordination with provincial agencies and Indigenous governments [147].

3.6.3 Municipal Planning Tools for Integrated Asset Management

This section analyzes municipal planning tools in the context of grey infrastructure and natural asset management approaches, with the goal of identifying opportunities to leverage these tools in support of integrated asset management.

3.6.3.1 Regional Strategies

Regional strategies articulate a shared vision for land use, infrastructure, and environmental stewardship across multiple municipalities or jurisdictions [138], [140 -147], [159]. They are designed to coordinate planning efforts at a broader geographic scale, supporting growth, development, and resource management across communities [138], [140-147], [159]. Regional strategies often address cross-boundary issues such as transportation corridors, waste management, watershed protection, and economic development [138 -147], [159].

While the structure and authority of regional strategies vary by province, they commonly support intermunicipal collaboration and alignment with provincial land-use priorities, and are referred to by the following names across Canada [138], [140-147], [159]:

- Regional growth strategies (BC)
- Intermunicipal development plans (AB)
- Intermunicipal development agreements (SK)
- Planning district development plans (MB)
- Upper-tier official plans (ON)
- Land-use and development plans by regional county municipalities (QC)
- Regional land-use plans (NB)
- Special planning areas (PEI)
- Intermunicipal engagement policies (NS)
- Regional plans by regional authorities (NL)

Regional strategies, while not explicitly municipal planning tools, are often used to manage infrastructure service delivery across a region and are therefore well-placed to play a role in integrated asset management, particularly where natural assets have multiple municipal owners. Capturing the service delivery benefits of natural assets at a regional scale creates an opportunity to better integrate these assets into service delivery frameworks.

Regional authorities may also play a role in mapping or designating sensitive environmental areas, facilitating data collection and sharing, and limiting urban sprawl by designating urban containment boundaries [160].

3.6.3.2 Official or Municipal Plans

Official or municipal plans articulate the long-term vision and growth management strategy for a community, typically over a 20-year or greater period [138-147]. They coordinate land-use practices to manage growth and development and promote sustainability and livability [138-147]. Additionally, official or municipal plans support infrastructure planning by determining what essential services are necessary to achieve the community's vision and values [138-147].

Official or municipal plans are referred to by the following names across Canada [138-147]:

- Official community plans (BC, SK)
- Municipal development plans (AB)
- Development plans (MB)
- Official plans (ON, PEI)

- Land-use and development plans (QC)
- Municipal planning strategies (NS)
- Municipal plans (NB, NL)

Official or municipal plans can support integrated asset management by setting high-level policy objectives that recognize the role of natural assets in delivering community services. This can be achieved by identifying high-value open spaces and environmental areas, recognizing these areas as natural assets, defining their role in service delivery, and committing to prioritizing natural assets in infrastructure service-delivery planning [27], [161]. This can help natural assets to be recognized as infrastructure that is comparable to grey infrastructure. Since official or municipal plans are the legal and policy foundation for regulatory municipal planning tools, articulating the value of natural assets at this stage is an important component of supporting integrated asset management using these tools [19], [27].

Prioritizing natural assets at the official or municipal plan level also embeds them as a priority in organizational objectives, which may help to maintain natural assets as a priority through political cycles, a challenge raised by 11% of engagement participants. In interviews and workshops, 11% of participants, all representing municipalities, also said standardized approaches to including natural assets in official or municipal plans would be helpful. One participant noted that professional planning inherently protects natural systems; however, framing this protection in terms of service delivery in a way that intentionally feeds into integrated asset management is less common. A standardized approach could help municipalities reframe their policies to address this challenge.

3.6.3.3 Zoning or Land-Use Bylaws

Zoning or land-use bylaws are the primary mechanisms that municipalities use to implement official or municipal plans. While these plans apply to the entire municipality, zoning and land-use bylaws may apply at various scales within the jurisdiction. They translate the overarching plan's objectives and policies into specific and enforceable regulations and manage growth by controlling land use and future development patterns. Zoning bylaws are also used to support the health, safety, and livability of communities by informing urban design that considers human interaction with the built form and by avoiding conflicting or dangerous land-use patterns. As well, they regulate development on private property by specifying allowable building sizes, densities, heights, and setbacks, allowing local governments to shape and adapt the function of neighbourhoods.

Zoning or land-use bylaws are referred to by the following names across Canada:

- Zoning bylaws (BC, SK, MB, ON, NB, PEI)
- Land-use bylaws (AB/NS)
- Municipal planning bylaws (QC)
- Development regulations (NL)

Zoning or land-use bylaws are enforceable tools that can be used to restrict development, and can therefore play an important role in protecting natural assets, potentially including those on private land. Zoning can be used to designate buffer zones between sensitive environmental areas and development or to prevent polluting activities from occurring near sensitive areas [160]. It may also regulate site-specific characteristics such as site permeability, which can support stormwater management infrastructure by reducing runoff [160]. Zoning or land-use bylaws may also include tree preservation bylaws (for example, requiring tree removal to be matched with replanting), runoff control bylaws that require onsite stormwater management, or watercourse protection bylaws [162].

In workshops and interviews, 59% of participants indicated that standardized or template bylaws would be a helpful resource for municipalities. One participant noted that zoning bylaws are an important tool to manage natural assets on private land. Another Ontario-based participant from a non-governmental organization noted that bylaws are only effective if they are enforced, so clear enforcement mechanisms and communication of the consequences for violations are important.

3.6.3.4 Subdivision Controls or Approvals

Subdivision controls or approvals are used to guide the division of land in a way that supports orderly development, infrastructure coordination, and public interest. These processes are governed by provincial planning legislation, which typically mandates that subdivisions align with broader land-use plans and zoning regulations to prevent fragmented or uncoordinated growth [139], [140], [141].

A key purpose of subdivision control is to ensure that new lots are adequately serviced with infrastructure such as roads, water, sewer, and drainage systems. This helps municipalities manage the costs and logistics of extending services and ensures that development occurs in a sustainable and efficient manner [144], [146], [147].

Subdivision approvals may also play a role in protecting environmental and cultural resources by requiring assessments or mitigation measures in sensitive areas, such as wetlands, floodplains, or heritage sites [145]. Additionally, subdivision controls provide legal clarity and consistency in land ownership and development rights by requiring that new parcels be surveyed, registered, and compliant with applicable bylaws. Public consultation is often a required part of the process, allowing communities to provide input and ensuring transparency in decision-making.

Subdivision controls or approvals are referred to by the following names across Canada:

- Subdivision and servicing requirements (BC)
- Subdivision approvals (AB, MB, NB)
- Subdivision control and development permits (SK)
- Subdivision control (ON, PEI, NL)
- Subdivision bylaws (NS)
- Subdivision bylaws (QC)

Subdivision controls or approvals may support integrated asset management by requiring protection, enhancement, or stewardship of natural assets as part of the development approval process. This could include watercourse and vegetation protection requirements, stormwater and drainage standards, tree and soil standards, and landscaping design requirements to protect or enhance ecological connectivity or protect natural areas [160], [162].

3.6.3.5 Development Permits and Regulations

Development permits and regulations are used by municipalities to control the form, location, and impact of new development; implement official or municipal plans at the site level; and ensure developments comply with zoning bylaws, environmental standards, and infrastructure capacity. Development permits and regulations may also address site-specific issues such as hazard mitigation, environmental protection, and servicing requirements. They often include technical standards for grading, drainage, erosion control, and infrastructure design, and may require professional certification or environmental assessments, depending on the context.

Development permits or regulations are known by the following names across Canada:

- Development permit areas (BC)
- Development permits (AB, ON, NS, NL)
- Development regulations (NL)
- Site plan control (ON)

Development permits or regulations can support integrated asset management by enabling municipalities to require development that protects and enhances the ecological function of natural assets [19], [160], [163]. This tool can be used to reinforce the recognition of natural assets as essential infrastructure that delivers services to communities while avoiding site-specific impacts to these assets that could result in impacts to existing grey infrastructure (e.g., reduced site permeability leading to increased runoff and demand on grey stormwater infrastructure) [27], [160], [164].

In workshops and interviews, 15% of participants said development permits or regulations can be useful, and combining them with other strategies, such as waiving development charge fees or granting density bonuses or variances to zoning bylaws, can be particularly effective ways to incentivize protection or restoration of natural assets.



3.6.4 Canadian Case Studies on Planning for Integrated Asset Management

There are numerous examples across Canada of successful natural asset management programs and their tangible benefits. A selection of case studies from jurisdictions around the country is described in this section, highlighting some leading examples of municipal natural asset management and identifying the municipal planning tools used to support the programs.

Local population numbers are provided for each case study; while urban areas are typically more advanced in asset management (both grey and natural), there are notable examples of smaller communities showing leadership, suggesting that the ability to undertake natural asset management is not necessarily based on the size of the community (see Table 8) [42].

3.6.4.1 Gibsons, British Columbia

The Town of Gibsons is widely recognized as a trailblazer in natural asset management [165]. With a population under 5,000, it became the first municipality in Canada to formally recognize natural assets as municipal infrastructure in 2014, and defines the term natural assets broadly to include the stock of natural resources and ecosystems that provide benefits to people [165]. These assets were valued alongside grey infrastructure [165]. The Town of Gibsons asserts that including natural assets in asset management plans is essential when they provide services that residents rely on [166].

Gibsons developed a natural asset management strategy that integrates these assets into its financial planning and asset management systems [166]. This approach has helped the town avoid costly engineered alternatives, improved service delivery, and enhanced climate resilience [166].

One insight from Gibsons' approach is the distinction made between financial planning, which is used for budgeting and investment, and financial reporting, which tracks asset value and performance [166]. While challenges exist in valuing and accounting for natural assets, Gibsons concluded that these hurdles are manageable and should not deter action [166].

They also highlighted how natural asset management can help close the gap between the services local governments want to provide and what they can afford to maintain, especially in new developments [166]. Gibsons leveraged its development cost charge bylaw to secure funding for the enhancement and rehabilitation of natural assets. They achieved this by recognizing the direct and indirect drainage services that natural assets provide to a development site and applying development cost charges to the developer whose site will receive the services [166]. This is authorized under BC's *Local Government Act* [138].

Gibsons has embedded natural assets in several of its municipal planning documents. Importantly, in the Town's 2015 official plan, natural assets are mentioned 13 times, including a commitment to nurturing natural assets in its vision statement, preserving natural assets as one of the goals, and a recognition of their role in service delivery [167]. The plan is currently being updated, and a draft version includes protection of the natural systems that sustain life in Gibsons [168]. In BC, all bylaws and work undertaken in municipalities must be consistent with the official community plan, and therefore Gibsons demonstrates a strong commitment to protecting and managing its natural assets for service delivery [168], [169].

3.6.4.2 Edmonton, Alberta

The City of Edmonton, with a population of 1.2 million, has taken a long-term, strategic approach to natural asset management by embedding ecological infrastructure into its planning and asset management systems [170]. Since the adoption of its 1990 naturalization master plan, the City has steadily expanded its naturalized parkland, with nearly 280 hectares converted since 2014 [171]. This work is guided by the urban forest asset management plan, which outlines a 50-year strategy for managing Edmonton's extensive urban forest, including over 796,000 maintained trees and thousands of hectares of naturalized and wooded areas [170]. These efforts are aligned with the City's broader sustainability goals, including a target to plant 2 million trees by 2050 and reduce greenhouse gas emissions by 35% by 2035 [170].

A key strength of Edmonton's approach is its integration of natural assets into financial and operational systems. The City assigns condition ratings and values to green infrastructure, including natural assets, enabling them to be managed alongside grey infrastructure [170]. This allows for full-cost accounting and lifecycle planning, which supports more sustainable budgeting and investment decisions. Edmonton also uses municipal planning tools, including its zoning bylaw, environmental reserves, and land acquisition strategies, to protect and enhance its natural infrastructure [171], [172]. These tools are embedded in their city plan, which prioritizes ecological connectivity and biodiversity [173].

Edmonton's experience offers several lessons for other local governments. First, institutionalizing natural asset management through strategic alignment and policy integration ensures long-term support and coherence across departments. Second, data-driven planning, supported by detailed inventories and performance metrics, enables evidence-based decision-making. Finally, recognizing the co-benefits of natural assets, such as urban cooling, air quality improvement, and recreational opportunities, helps build public and political support. Edmonton's model demonstrates how cities can scale up natural asset management to meet climate resilience and sustainability goals while maintaining fiscal responsibility.

3.6.4.3 Saskatoon, Saskatchewan

The City of Saskatoon, with a population of approximately 266,100, has taken steps to integrate natural assets into its municipal planning and climate resilience strategies [174], [175]. With funding from the FCM's Municipal Climate Innovation Program (MCIP), Saskatoon launched a natural capital asset valuation pilot project to assess the measurable value of its natural assets [174]. The inventory of natural assets within the municipal boundary includes over 1,400 wetlands, portions of the South Saskatchewan River, extensive grasslands, and forested areas. These assets were evaluated for their ecosystem services, including carbon storage, flood mitigation, and recreational value [174]. The study estimated that Saskatoon's natural assets provide approximately $48.2 million in annual services, highlighting their substantial contribution to municipal sustainability and cost avoidance [174].

This work is closely aligned with Saskatoon's broader climate action framework, which includes the low emissions community plan and the corporate climate adaptation strategy [176], [177]. These plans emphasize the importance of nature-based solutions and the integration of green infrastructure into the City's asset management systems [176], [177]. The City's green infrastructure strategy, supported by the Pathways for an Integrated Green Network implementation plan, aims to ensure that natural assets are treated on par with grey infrastructure like roads and buildings [178], [179]. This includes defining service levels, assigning financial value, and prioritizing investments in green infrastructure [179].

Key lessons from Saskatoon's experience include the importance of quantifying ecosystem services to support evidence-based decision-making and the need for cross-departmental collaboration to embed natural assets into long-term planning. The City also identified knowledge gaps, particularly around data availability and valuation methodologies, which it is working to address through ongoing research and policy development. Saskatoon's approach demonstrates how mid-sized municipalities can lead in natural asset management by aligning ecological stewardship with fiscal responsibility and climate resilience goals.

3.6.4.4 Selkirk, Manitoba

The City of Selkirk, with a population of approximately 10,700, provides an example of how small municipalities can undertake natural asset management by considering these assets a part of core municipal systems [180], [181]. Selkirk began its journey by recognizing that infrastructure planning often overlooks the value of natural assets like wetlands, forests, and waterways [180]. To address this, the City completed a pilot project that integrated natural assets into its asset management and financial planning frameworks [180]. This pilot helped Selkirk identify, inventory, and begin valuing its natural assets using the same principles applied to its grey infrastructure [180].

A key element of Selkirk's success has been its commitment to aligning natural asset management with its broader strategic goals [180]. The City's approach is grounded in practical implementation, ensuring that natural assets are not only recognized, but also maintained and enhanced through existing municipal processes. For example, Selkirk has incorporated natural assets into its capital asset management program and is working to ensure that these assets are considered in long-term financial planning [182]. This integration supports better decision-making, particularly in the face of climate change and infrastructure renewal needs [180].

Selkirk's experience also highlights the importance of leadership and collaboration. The City's participation in the Canadian Network of Asset Managers (CNAM) and its willingness to share lessons learned have positioned it as a mentor for other communities [180]. Selkirk emphasizes that natural asset management is not about creating new systems from scratch, but about adapting existing tools and processes to include nature [180].

3.6.4.5 Grindstone Creek Watershed, Ontario

The Grindstone Creek watershed project was Ontario's first cross-jurisdictional project to integrate natural assets into financial planning and infrastructure management [183]. Launched in 2019 with support from the Greenbelt Foundation, the project brought together Conservation Halton, the City of Hamilton, the City of Burlington and the Royal Botanical Gardens (representing a total population of approximately 770,000) to assess the role of natural assets in addressing stormwater management and climate pressures [184]. This project demonstrated the important role that watershed authorities can play in natural asset management, as Conservation Halton played a key role in data collection and modelling for the project [184].

Using scenario-based modelling in a valuation exercise to estimate the value of stormwater management service delivery as compared to grey infrastructure performance, the project estimated that the watershed's ecosystem services, such as flood mitigation, water purification, and habitat provision, are worth approximately $34 million annually, with a replacement value of $2 billion for stormwater management services alone (in 2022 dollars) [184]. These findings underscore the significant cost-saving potential of preserving and enhancing natural infrastructure.

A key innovation was the project's exploration of the common asset trust (CAT) model, a governance and financing framework designed to support long-term investment in shared natural resources [183]. The resulting initiative proposes a hybrid CAT model tailored to the Grindstone Creek context, offering a replicable approach for other regions seeking to align ecological health with fiscal sustainability [183]. This project is an example of how the strategic role of natural assets can be quantified to make the case for pursuing integrated asset management.

Table 8: Municipal planning tools used to support integrated asset management in case study communities.

Municipality	Approximate population	Municipal planning tools
Gibsons, British Columbia	4,750	Gibsons formally recognized natural assets as municipal infrastructure and embedded them in its official community plan and financial planning, using tools like the development cost charge bylaw to fund natural asset enhancement and requiring all municipal bylaws to align with the protection and management of these assets [166], [167], [168].
Edmonton, Alberta	1,200,000	Edmonton integrated natural assets into its city plan and urban forest asset management plan, using zoning bylaws, environmental reserves, and land acquisition strategies to protect and manage ecological infrastructure alongside grey infrastructure [170], [171], [172].
Saskatoon, Saskatchewan	266,000	Saskatoon incorporated natural assets into its green infrastructure strategy and climate action plans, using municipal planning tools to inventory, value, and prioritize natural assets for service delivery and climate resilience [174], [176], [177].
Selkirk, Manitoba	10,700	Selkirk adapted its capital asset management program and long-term financial planning to include natural assets, integrating them into its existing municipal processes and asset management frameworks [180].
Grindstone Creek Watershed, Ontario	770,000	The Grindstone Creek project used cross-jurisdictional planning and scenario-based modelling to integrate natural assets into financial planning and infrastructure management, piloting a common asset trust model for long-term stewardship [183].
Sackville, New Brunswick	6,000	Sackville's municipal plan and corporate climate change action plan prioritized the protection of natural areas, and the town completed a comprehensive natural asset inventory to inform future asset management [185].

3.6.4.6 Sackville, New Brunswick

The Town of Sackville, with a population of approximately 6,100, recognizes the importance of protecting natural areas in both its municipal plan and its 2016 corporate climate change action plan [185], [186]. The action plan emphasizes the town's vulnerability to climate change, particularly freshwater and coastal flooding, and identifies maintaining natural buffers to floods, including wetlands and stream vegetation, as an important adaptation strategy [185].

In 2022, Sackville completed a comprehensive natural asset inventory, which aimed to identify and assess the town's natural features that provide essential services like stormwater retention, flood mitigation, and water purification [187]. The inventory serves as a basis for potential future asset management activities, including understanding the role of natural assets in providing priority services, further evaluation of priority asset conditions, and inclusion of natural assets in asset management [187]. It represents a step toward including the services, recognized as valuable in Sackville's municipal planning documents, in its asset management activities.

4. Recommendations for Standardization

Creating standardized approaches to integrating natural assets into the full range of municipal planning tools presents an opportunity to elevate these assets as an essential component of municipal service delivery. Each of the planning tools presented in this report has potential to support integrated asset management in different ways, as summarized in Table 9.

Forty-nine percent of engagement participants said a consistent, familiar framework and common approaches for integrating natural assets into municipal planning processes across all the municipal planning tools

Table 9: Municipal planning tools and opportunities to support integrated natural asset management.

Municipal planning tool	Opportunities to support integrated asset management
Regional strategies	Coordinate service delivery from natural assets that cross municipal boundaries. Designate and protect environmentally sensitive areas.
Official or municipal plans	Establish organizational objectives that explicitly value natural assets as infrastructure that delivers municipal services [27], [161]. Embed natural asset outcomes in long-term planning [19], [27].
Zoning or land-use bylaws	Develop enforceable regulations for land use that protect natural assets, such as prohibiting development in environmentally sensitive areas, creating tree protection and replacement bylaws, and implementing requirements for site permeability [160], [162].
Subdivision controls or approvals	Require protection and enhancement of natural assets when land is divided into new parcels [160], [162]. Prioritize use of existing natural assets to meet servicing requirements for new parcels [160], [162].
Development permits or regulations	Enforce site-level protection and enhancement of natural assets and incentivize restoration of natural areas by leveraging legal instruments (e.g., density bonusing, waiving development cost charges) [27], [160], [164].

identified would be valuable. These tools are designed to guide land-use planning and development, from setting organizational objectives for the jurisdiction to controlling development specifics on an individual site. Outcomes from all levels of planning should align with one another, describing how government policies will be delivered.

Integrating natural assets across the full range of planning tools available to municipal governments would provide a strong foundation for integrated asset management. This could be particularly impactful for the 71% of municipalities in Canada that currently do not have an asset management plan, providing a pathway to integrated asset management at the outset of their asset management system development process [42].

A wide range of resources, tools, grant programs, and organizations support the advancement of municipal asset management, including natural asset management. However, there is currently no unified Canadian approach for using municipal planning to support integrated asset management. Therefore, **the main recommendation resulting from this report is to develop a single, integrated common approach for using municipal planning tools to facilitate integrated asset management,** including the key components outlined below. Such a standardized approach could help to fill knowledge gaps in organizations; provide consistent, clear information to municipalities with limited capacity; clarify approaches to natural asset management across jurisdictions; and allow for earlier definition of the service delivery benefits of natural assets to facilitate lifecycle management approaches at the asset management stage.

It is recommended that a Municipal Planning for Integrated Asset Management standard be developed that:

- Applies to all municipalities, regardless of size. Enabling a consistent approach for all municipalities would facilitate peer-to-peer learning across jurisdictions and support improved collaboration;
- Defines key terminology related to integrated asset management;
- Defines the role of municipal planners in asset management;
- Explains how to recognize the service delivery benefits of natural assets within municipal planning tools;
- Recognizes legislative differences across the provinces and highlights aspects of available tools that are similar for all provinces; and
- Includes template language that municipalities can use in each of the five municipal planning tools analyzed in this report.



"Integrating natural assets across the full range of planning tools available to municipal governments would provide a strong foundation for integrated asset management."

While there is value in providing standardized content on natural assets for each of these planning tools, the research findings clearly demonstrated a need for improved clarity on the process of incorporating natural assets into all aspects of local government planning, policy, and processes.

This report also highlights areas where additional research could support the integration of natural assets into infrastructure and asset management practices. One area of need is the development of a consistent approach for valuation, condition assessment, and performance measurement. Many local governments remain focused on inventorying natural assets, but without clear methods to understand their value and function, it can be difficult to integrate them meaningfully into planning and decision-making processes.

There is a need to better understand how Indigenous knowledge systems and governance approaches can inform natural asset management. Indigenous peoples have served as stewards of the land since time immemorial, guided by traditional teachings, storytelling, ceremony, and deep connections to their ancestral territories [152]. This stewardship honours the interconnectedness of all living things and reflects a responsibility to care for the environment for present and future generations [152]. Stewardship is rooted in respect and accountability for the wellbeing of nature and its creatures [152]. These values are embedded in Indigenous languages, cultural practices, and oral traditions, and have been passed down through generations [152]. Further research could explore opportunities for collaboration that respect Indigenous rights and support shared stewardship of land and water systems.

Another area for further exploration is how existing communities of practice can better support integrated asset management and where new communities of practice may be needed. When considering natural asset management, many local governments are unsure where to begin or who to consult, suggesting that they are not yet connected with the right communities of practice. Research into effective models for peer learning and knowledge exchange could help address this gap and build capacity across regions.

Improved access to data is another area where further research could be beneficial. Sharing data across jurisdictions may help reduce duplication of effort and support more consistent approaches. This includes examining governance models, privacy considerations, and technical infrastructure for data sharing.

Finally, the role of provincial and federal governments warrants further study. While implementation often occurs at the local level, higher levels of government influence policy, funding, and regulatory frameworks. Research could help clarify how these roles support or constrain integrated asset management and identify opportunities for better alignment across levels of government.

5. Conclusions

There are established approaches for asset management in Canada, guided by the ISO 55000 standards series, Public Sector Accounting Standard PS 3150, and a range of professional bodies and non-governmental organizations. These approaches are sector-agnostic and can be applied to all asset types, including grey and natural assets. Further, there is a growing body of resources aimed specifically at helping organizations undertake natural asset management. However, given the foundation of asset management in grey infrastructure and the unique characteristics of natural assets, Canadian municipalities still face challenges in working toward integrated asset management.

Key barriers to integrated asset management for municipalities identified in this report included:

- **Knowledge and capacity constraints:** Many municipalities lack the technical expertise, staff capacity, and consistent terminology needed to integrate natural assets into their asset management systems. This results in fragmented approaches, limited collaboration, and a reliance on grey infrastructure due to resource constraints and unclear responsibilities. While there are communities of practice and other organizations aiming to build capacity, there is still room for improvement.
- **Access to funding:** Municipalities face funding limitations due to reliance on property taxes and misaligned or oversubscribed grant programs. Smaller communities struggle to pursue natural asset initiatives without dedicated staff or financial flexibility, while some larger municipalities advance integration by anticipating future funding requirements.
- **Governance and ownership complexity:** Natural assets often span multiple jurisdictions and ownership types, requiring complex intergovernmental coordination. Municipalities need partnership and stewardship models to manage assets on private land and can benefit from leveraging watershed organizations and conservation authorities to support cross-boundary planning and service delivery.
- **Service delivery and lifecycle management:** Natural assets deliver multiple services and have non-linear, potentially indefinite lifecycles, making them difficult to categorize, value, and manage within conventional asset frameworks. Their long-term benefits are often misaligned with short-term political and budget cycles, requiring new approaches to lifecycle planning and service valuation.

The research findings suggest there is a role for standardization of municipal planning tools to help municipalities overcome these challenges, using the five main municipal planning tools available to Canadian municipalities: regional strategies, official or municipal plans, zoning or land-use bylaws, subdivision controls or approvals, and development permits or regulations. These tools offer opportunities to embed natural assets into organizational objectives and infrastructure decision-making by considering the service delivery role of natural assets in municipal planning. When used strategically, they can help municipalities recognize, protect, and enhance natural assets as essential infrastructure in their policies, supporting integrated asset management.

Based on the findings, it is recommended that a unified approach for integrating natural assets into these five municipal planning tools be developed.

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