

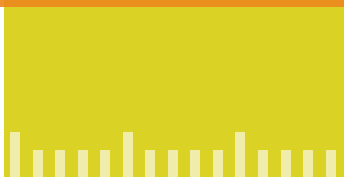
Toward natural asset management in the City of Kelowna

British Columbia



Summary of inventory results and recommendations September 2021

This document features interactive elements! Clicking on a heading or sub-heading in the Table of Contents (ToC) will take you directly to that page. Also, clicking on page numbers in the footer will bring you back to the ToC.



Municipal Natural Assets Initiative





Invest in Nature

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

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1 Purpose

This document summarizes the results of a project to develop a natural asset inventory in the City of Kelowna and documents steps the local government can take to proceed to a full natural asset management initiative.

2 Introduction

What are municipal natural assets

The term *municipal natural assets* refers to the stock of natural resources or ecosystems that a municipality, regional district, or other form of local government could rely upon or manage for the sustainable provision of one or more local government services¹.

Why manage natural assets

A growing number of local governments recognize that it is as important to understand, measure, manage and account for natural assets as it is for engineered assets. Doing so can enable local governments to better provide core services such as stormwater management, water filtration, and protection from flooding and erosion, as well as *additional* services such as those related to recreation, health, and culture. Outcomes of what is becoming known as *municipal natural asset management* can include cost-effective and reliable delivery of services, support for climate change adaptation and mitigation, and enhanced biodiversity.

It is worth noting that Canada's Public Sector Accounting Board (PSAB) currently does not allow public sector entities (including local governments) to recognize natural assets in their financial statements. They are excluded as a tangible capital asset, and therefore do not form part of a financial capital plan.

By excluding the value of natural assets, Canadian public-sector entities may not be providing adequate information about all assets, and users do not, therefore, have information about the state of natural assets, or their potential impairment. This lack of information can lead to the mismanagement of natural assets and the deterioration of the services they provide to the communities and economies over which public sector entities have jurisdiction.

¹ mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf

How to manage natural assets

There are numerous ways for local governments to manage natural assets. The Municipal Natural Assets Initiative (MNAI) uses methodologies and tools rooted in standard asset management and provides a range of advisory services to help local governments implement them. MNAI has developed the methods and tools with significant investments, piloting, refinement, peer review, and documentation of lessons in multiple Canadian provinces. MNAI's mission is to make natural asset management a mainstream practice across Canada, and in support of this, for local governments to accept and use the methodologies and tools in standard ways across the country.

What is a natural asset inventory?

The goal of asset management is sustainable service delivery. Achieving this goal requires asset management processes that consider whole infrastructure systems, recognizing both natural and engineered assets and the interactions between them (Asset Management BC 2019). Within this context, natural asset inventories provide details on the types of natural assets a local government relies upon², their condition, and the risks they face.

As depicted in Figure 1, a natural asset inventory is the first component of the asset management assessment phase, and in MNAI's process typically includes also a condition assessment, as described in more detail below. The Assessment phase, in turn, is the first of three phases of a full natural asset management program. By itself, an inventory will not give a sense of asset value but is an essential first step in the full natural asset management project.

² Note that many local governments rely on services from natural assets they do not own.

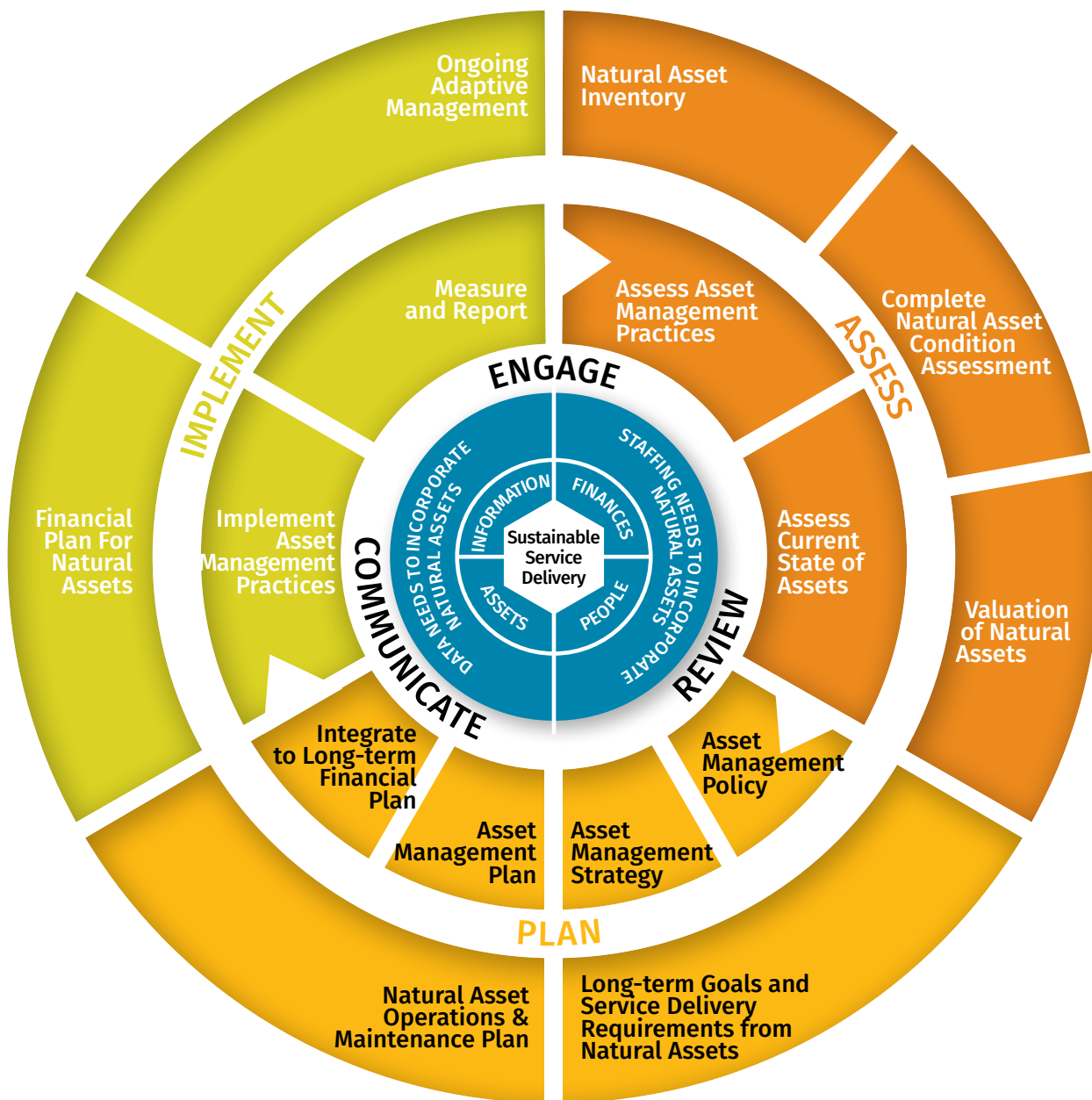


Figure 1: The Asset Management Process. MNAI has adapted this for use with natural assets.

MNAI Approach

MNAI's natural asset methodology is rooted in ISO-based asset management principles and a growing suite of tools and case experience to support governments in the development of natural asset inventories and, based on these, a full natural asset management initiative. MNAI's overall methodology follows the standard asset management *assess, plan and implement* steps, while highlighting novel considerations required for local natural assets and associated services.

To ensure that natural asset management is integrated effectively into standard asset management, inventories share the structure and many of the characteristics as those used for engineered infrastructure assets. Thus, natural asset inventories can be integrated into whatever asset management system the local government is using, whether that is a basic spreadsheet or a more sophisticated software platform.

For natural asset inventories, the MNAI team works with the local government to complete the following steps:

- 1/** Complete a readiness assessment.
- 2/** Define the scope of natural assets.
- 3/** Inventory the natural assets by collecting and organizing existing information about the assets.
- 4/** Conduct a preliminary condition assessment of the assets.
- 5/** Conduct a preliminary risk assessment of the assets.

Each step is described in further detail below.

3 Local government context

3.1. General

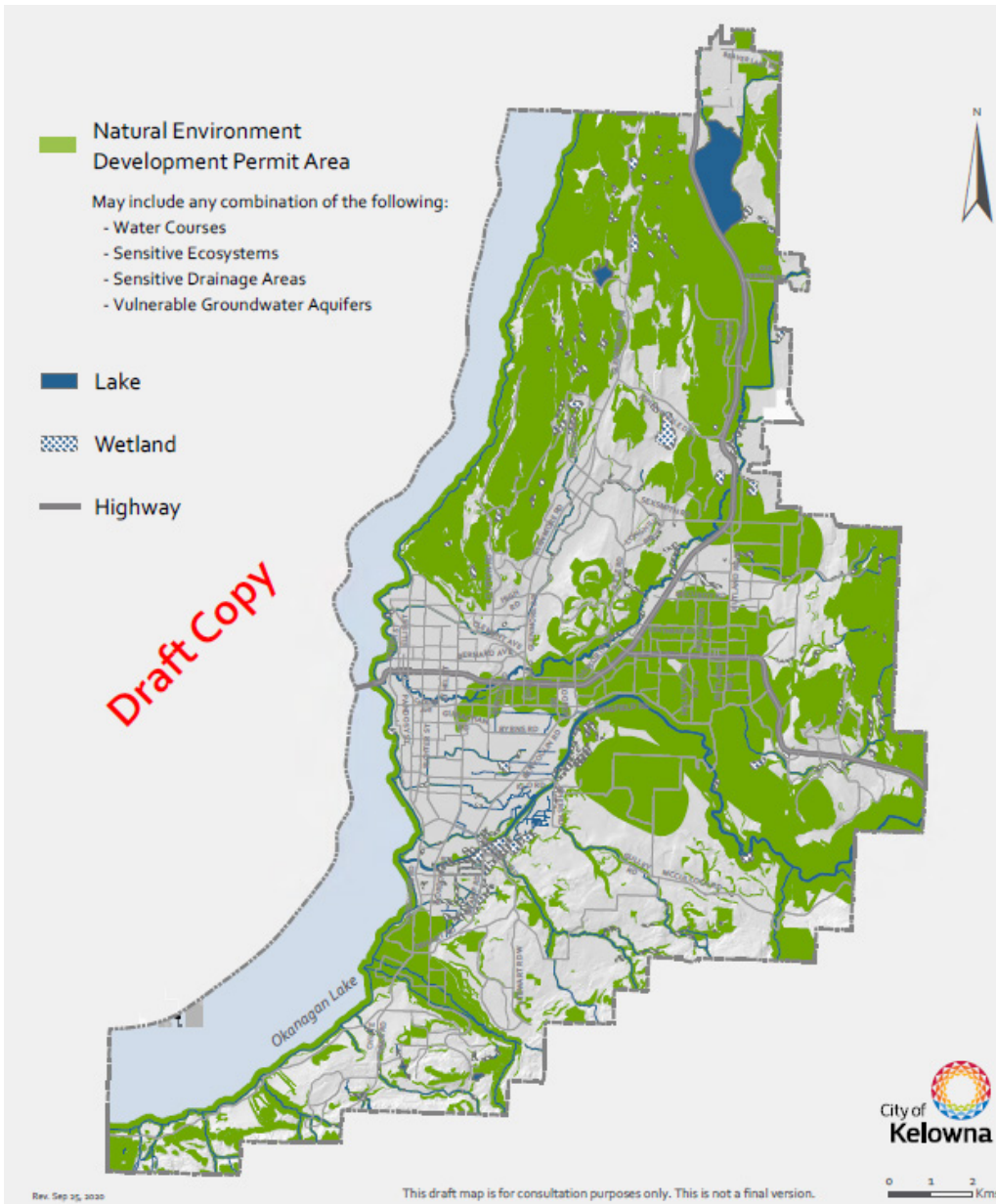


Figure 2: City of Kelowna³.

The City of Kelowna (metro population ~146,127⁴) is adjacent to Okanagan Lake in the southern interior region of British Columbia. It is the largest urban area in the Interior, the seventh largest city in the province, and one of the fastest growing cities in Canada⁵.

The City of Kelowna's interest in natural asset management is three-fold. First, it wants to establish a standard nomenclature and a consistent method to value natural assets, both from monetary and service delivery perspectives.

Second, the City of Kelowna wants to learn about the location and services of natural assets upon which to rely and integrate this knowledge in the decision-making framework. To this end, the inventory will link to the Official Community

Plan, Area-based Watershed Management and Asset Management Planning, and inform long-term policies and practices.

3 Our Kelowna 2040- Draft Official Community Plan. (2020, Fall). City of Kelowna. Retrieved September 2021 from www.kelowna.ca/our-community/planning-projects/official-community-plan

4 Population Estimates – Province of British Columbia. Retrieved September 2021 from www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates

5 Wikipedia. Retrieved April, 2021 from en.wikipedia.org/wiki/Kelowna

Third, the City of Kelowna perceives the inventory as an opportunity to mitigate risks from unintended impacts that the absence of an inventory and a sound knowledge of natural assets could cause. The City of Kelowna also understands that natural assets play a critical role in its climate resiliency and adaptation efforts.

The City of Kelowna has a number of priority natural assets. These include, but are not limited to, Okanagan Lake, streams, creeks, wetlands, natural and urban forests, and grasslands. Many of these natural assets are often interjurisdictionally managed or are owned by the City of Kelowna but are outside its municipal boundary. Services of key concern include drainage, air and water quality, water availability, recreation, and slope stabilization to combat the impacts of flooding, drought, and climate change.

3.2. Asset management readiness assessment

As part of inventory development, MNAI helps local governments determine their overall state of asset management maturity. To do this, MNAI has adapted the Federation of Canadian Municipalities (FCM)'s asset management readiness assessment tool⁶ to help local governments measure their progress on both asset management and natural asset management in four competency areas, with each area describing outcomes based on five levels of progress or maturity.

The completed readiness assessment helps local governments prioritize actions that increase their effectiveness in managing all assets, including natural ones.

Competency 1: Policy & Governance

The City of Kelowna's readiness assessment indicates it has made significant progress on developing asset management competencies, scoring in the intermediate to advanced range in all competency areas. The City of Kelowna is at an early stage of integration of natural asset management, with scores indicating it is in the initiation or early adoption range in all competencies.

The City of Kelowna developed an asset management policy, strategy and framework in accordance with Asset Management BC best practices. The organization's senior leadership has endorsed these documents, although they focus on engineered assets. The asset management policy could be strengthened to more explicitly include natural assets.

The City of Kelowna's Asset Management Strategy and Framework includes a roadmap that it's currently updating to include all the organization's asset management plans (for engineered assets). These documents are connected to their Official Community Plan, Climate Action Plan, Urban Forestry Strategy, and Community Wildfire Resiliency Plan. None makes direct linkages to natural asset management yet.

⁶ See fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf for details

The City of Kelowna is quite advanced on measuring and monitoring its asset management practices with dashboards that monitor performance for engineered assets. Monitoring of natural assets is limited to tree canopy and parkland and is based on the City's data. Wetlands and riparian areas are protected through the Development Permit Process and additional asset inventories are compiled from provincial data.

Competency 2: People & Leadership

With respect to people and leadership, the City of Kelowna has a permanent, cross-functional asset management team that is guiding the process. The team's approach has not yet extended to natural assets and no one on the team is specifically designated to help advance and integrate natural asset management. Natural asset management is currently decentralized across many departments and staff responsible generally work cross-functionally to complete focused activities.

The City of Kelowna has demonstrated strong accountability for asset management. It has a defined governance team outlined in its Asset Management Policy that flows from Council to a steering committee that includes senior leaders, infrastructure managers, civic operations and finance managers, and asset stewards/service area planners. Job descriptions include asset management responsibilities with some positions situated in operations departments. That accountability does not yet include someone specifically responsible for natural asset management.

Council identifies asset management as a priority and is engaged in understanding the infrastructure deficit and what can be done to address it. To-date, Council has supported investment into tools such as *Cityworks* Asset Management System, a computerized maintenance management system, to understand activities and report on asset performance metrics. Council is not yet aware of the resourcing that would be needed to support natural asset management on an ongoing basis but has supported some individual projects.

Competency 3: Data & Information

The City of Kelowna has an inventory of its engineered assets with standard age-based condition calculated and presented in asset management plans. Most engineered assets have been captured in the corporate GIS system. While some spatial data is regional or has been internally created, most of its natural asset inventory is based on provincial data which may be coarse and thus not capture smaller natural assets or recent changes such as developments. This MNAI project has supported the City of Kelowna in creating a baseline understanding of the natural assets that deliver services to the community.

The City of Kelowna's performance data is at an earlier stage of maturity. This is primarily because assets identified in asset management plans are assigned a condition rating based on age alone although some service areas are beginning to use condition assessments where possible. Activities are currently underway to present information on condition and levels-of-service to Council in a more meaningful way.

Competency 4: Planning & Decision-making

The current replacement values have been developed for all service areas in the 10-Year Capital Plan and in the City of Kelowna's most recent asset management plans. The City of Kelowna has also developed a formal process for asset investment and decision-making criteria in a consolidated organizational document. Some natural assets have been included in this, for example, improvements in the Mill Creek area. While some natural assets have been considered in the capital plan, natural asset management has not been formalized in budgeting and financial planning.

4 Natural asset inventory

4.1. Inventory overview

MNAI's natural asset inventories have two main components to express natural asset information: an asset registry (which is a tabular representation of the data) and an online dashboard. MNAI provided the registry to the City of Kelowna in an Excel file and the dashboard as a website address. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

4.2. Inventory data

To establish the inventory, MNAI obtained data from the City of Kelowna, GeoBC and British Columbia Ministry of Agriculture. MNAI combined the spatial data layers to establish a comprehensive depiction of natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

TABLE 1: SUMMARY OF DATA USED

DATASET NAME	SOURCE	YEAR	PURPOSE
Cityboundary_20210330	City of Kelowna	2021	Used to delineate study area.
Waterbody_20210330	City of Kelowna	2021	Used to classify water and wetland asset types.
Parks_IncFuture_20210330	City of Kelowna	2021	Used to classify beaches and green spaces within City limits.
BC_ALUI_COV (v101)	BC Ministry of Agriculture, Food and Fisheries	2014	Used to classify landcover within Kelowna's Agricultural Reserve Lands. Used List_codes_cover
SEI_2009	via City of Kelowna	2009	and List_codes_covtype tables to define land cover.
VRI - 2020 - Forest Vegetation Composite Rank 1 Layer (R1)	City of Kelowna	2020	Used as one source of landcover data for base inventory where ALUI coverage not available.
WSA - Third-Order and Greater Watersheds (50,000)	GeoBC	2021	Used to create base landcover dataset for 500m radius outside of the City of Kelowna boundary.
Road_Centerline_20210330	GeoBC	2021	Used to summarize natural assets by watershed.
Kelowna_Tree_Points	City of Kelowna	2021	Used to perform road density condition assessment.
ALR_20210330	City of Kelowna	2021	Used to summarize count of trees by natural asset type.
Aquifers	City of Kelowna	un-known	Used to summarize asset area within the ALR by asset type.
Government Properties_20210330	City of Kelowna	2021	Used to indicate natural assets within aquifers and sum asset area within them.
ParkTrails_20210412	City of Kelowna	2021	Used to indicate which assets overlap with government lands and summarize asset area owned by government.
WaterCourse_20210331	City of Kelowna	2021	Used to summarize length of trails within natural assets.
Zoning_20210412	City of Kelowna	2021	Used to summarize length of watercourses within natural assets.
OCP2040_Districts	City of Kelowna	un-known	Used to assign majority zoning code to natural assets based on percentage of asset covered by the relevant zoning code.
Soil Mapping Distribution Packages	City of Kelowna	2016	Used to assign natural assets to appropriate district and to summarize assets by district.
	City of Kelowna		Used to assign soil characteristics to natural assets based on area overlap.

The inventory project defined a total of 10,982 individual assets, covering 17,667 hectares (ha), as noted in Table 2. An asset is defined as a continuous area of the same land cover type. For example, an intact forested area would be defined as one asset, but a forested area that is bisected by a road would constitute two assets. The majority of the area under consideration is agriculture, followed by water and forest assets.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE

NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)	AVERAGE ASSET AREA (HA)
Agriculture	6,163	5,346	0.87
Beach/Rock	14	9	0.66
Forest	2,270	4,622	2.04
Grassland	1,451	2,393	1.65
Riparian	259	191	0.74
Shrubland	104	126	1.21
Water	236	4,730	20
Wetland	485	250	0.52
Total	10,982	17,667	1.61

Table 3 defines the asset types identified through this inventory project. The definitions are generic definitions created by MNAI to classify the landcover data that was provided by the City of Kelowna and obtained through other sources.

TABLE 3: ASSET TYPE DEFINITIONS

ASSET TYPE	DEFINITIONS
Agriculture	Agricultural fields, including hay, pasture, orchards, vineyards, and perennial crops.
Beach/Rock	Rocky or sandy areas subject to active shoreline processes.
Built-up Impervious	Residential, industrial, commercial, and civic areas. Includes transportation depending on datasets included in inventory.
Built-up Pervious	Urban recreation areas such as golf course, ball diamonds, and playing fields, as well as manicured grass.
Forest	Includes all forest landcover classifications, including coniferous, deciduous, and mixed-wood forests.
Grassland	Vegetation is dominated by a nearly continuous cover of grasses.
Riparian	Features occurring along watercourses and waterbodies that are distinguished by unique soil and vegetation types.

TABLE 3: ASSET TYPE DEFINITIONS

ASSET TYPE	DEFINITIONS
Shrubland	Mixture of shrubs, young trees, grasses, and wildflowers.
Water	Aquatic communities of generally deeper, permanent water with little to no vegetation cover.
Wetland	Areas of land where water collects long enough to promote wetland processes. May include swamps, treed thicket swamps, marshes, bogs, fens.

Figure 3 shows the spatial distribution of the natural assets presented in Table 2 and Table 3.

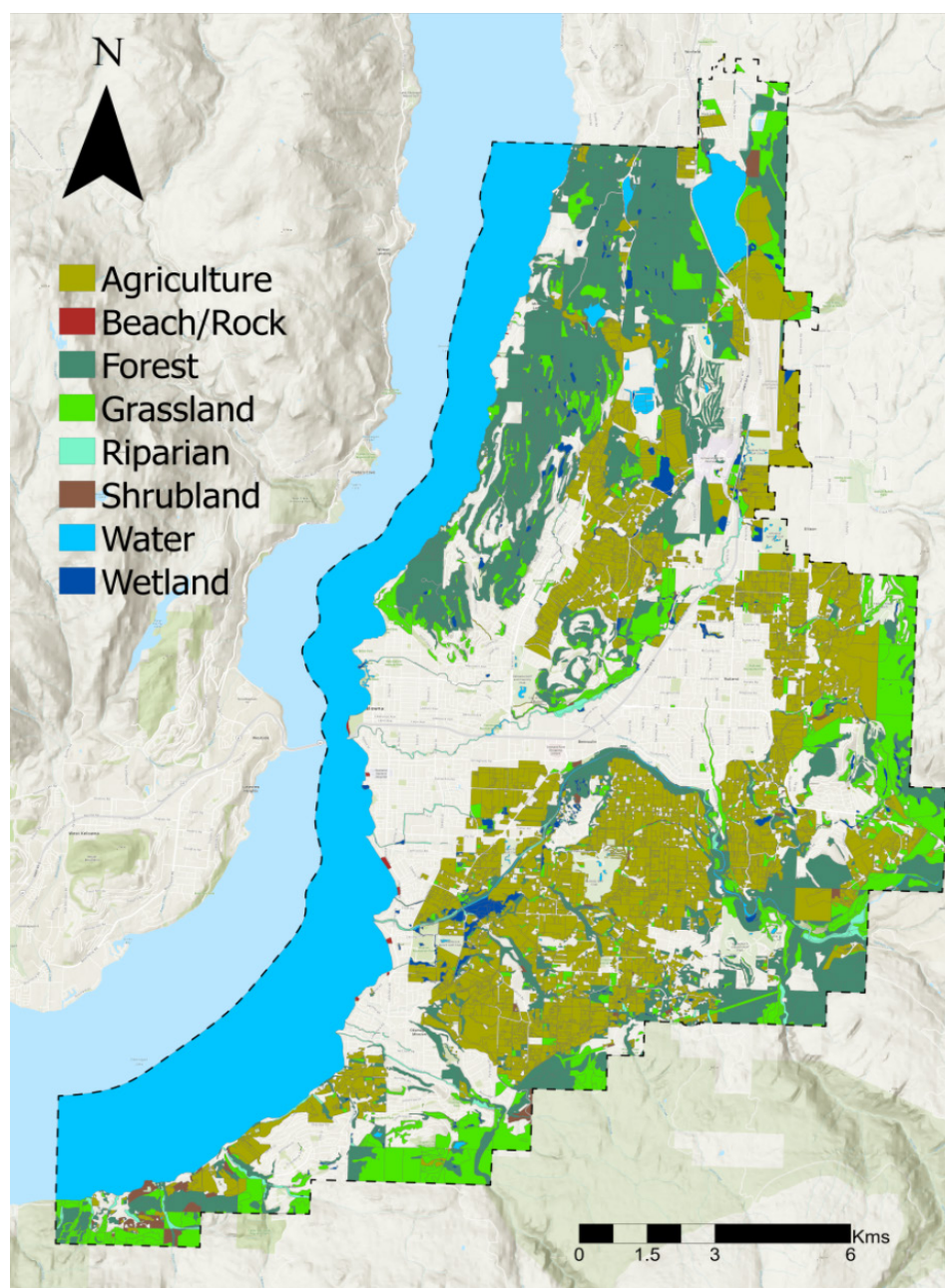


Figure 3: Spatial distribution of natural assets.

4.3. Asset registry

Each asset within the inventory has a unique identification number that allows individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. Information on each asset is housed in an asset registry. Table 3 is sample of some of the information housed within the City of Kelowna's registry. Additional detail is provided in the online dashboard (e.g., a series of attributes for each asset contained within the inventory).

TABLE 4: EXCERPT FROM THE REGISTRY

Natural Asset Registry

Asset ID	Sub-Asset ID	Asset Type	Watershed	Asset Area (ha)	Asset Area in Watershed (ha)	District Name
▼						
WET99	WET99-1	Wetland	Mission Creek	0.03	0.030	Rural
WET98	WET98-1	Wetland	Okanagan River	0.01	0.015	Rural
WET97	WET97-1	Wetland	Okanagan River	0.06	0.062	Rural
WET96	WET96-1	Wetland	Okanagan River	0.01	0.006	Rural
WET95	WET95-1	Wetland	Mission Creek	0.18	0.146	Rural
WET95	WET95-2	Wetland	Priest Creek	0.18	0.030	Rural
WET94	WET94-1	Wetland	Priest Creek	0.29	0.289	Rural
WET93	WET93-1	Wetland	Priest Creek	0.15	0.149	Rural
WET92	WET92-1	Wetland	Mission Creek	0.03	0.034	Rural
WET91	WET91-1	Wetland	Mission Creek	0.17	0.175	Rural

4.4. Online dashboard

Inventories may provide more insights when characterized visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can quickly filter the data to focus on that particular group of assets. The dashboard for the City of Kelowna is available at go.greenanalytics.ca/Kelowna.

4.5. Condition of natural assets

Documenting the condition of natural assets is a key aspect of natural asset inventories. A natural asset condition assessment provides an understanding of both the ecological health of natural assets and the ability of natural assets to provide services. This information, in turn, can support the effective management of natural assets, be reflected in the registry and the dashboard, and updated over time. It can also help inform management decisions and prioritization of management actions.

MNAI completed a desktop-based condition assessment and built it into the inventory to provide an initial understanding of the status of the natural assets for the City of Kelowna. As part of a full natural asset management project, MNAI would expand this assessment to include additional metrics related to condition (e.g., relative biodiversity, riparian and wetland health, soil condition, connectivity, and others), and could also employ site visits to confirm and verify the condition ratings.

The desktop exercise completed as part of this inventory is a reasonable first step in assessing condition and can be used as a foundation for future work in this area. Table 5 summarizes the condition assessment steps and indicators. MNAI chose these indicators for their relative ease of measurement (given time and budget constraints) and for their relevance to measuring the ecological health and service delivery capabilities of natural assets. They are proxy metrics for these broader condition considerations. For example, larger asset size implies more connectivity of natural areas, higher road density implies more fragmentation and higher hydrologic impairment of water flows, and more permeability implies greater ability to store water which means more effective stormwater management. The adjacent land use metric measures and distinguishes natural assets that are next to other natural assets, from natural assets that are next to built infrastructure. How and the extent to which a given natural asset is influenced by the drainage in the adjacent landscape varies depending on factors such as the local topography and soils, orientation (e.g., upland versus lowland, position in the watershed) and the size and nature of the feature itself. However, it is well-established that the condition of a natural asset in an urban context tends to be negatively impacted when more of the surrounding land uses are impervious (i.e., paved, concrete or buildings) because this tends to alter pre-existing drainage and infiltration pathways, which can cause a natural area to receive much more or much less drainage than prior to

being in an urban context. Urban runoff also typically carries a host of sediments and contaminants, and when such runoff is directed to natural areas and not properly treated, it can negatively impact the feature and its functions for plants and wildlife.

TABLE 5: CONDITION ASSESSMENT APPROACH AND INDICATORS

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator*
Relative asset size	For each natural and semi-natural asset type, total area is calculated, and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a 3, those within the middle third of the ranking received a 2, and those within the bottom third of the ranking received a 1.	Natural asset inventory
Road density	Measures the density of the roads in and around the assets according to high density (assets with more than 2km of roads per km squared), medium density (assets with between 1km and 2km of roads per km squared) and low density (assets with less than 1km of road per km squared).	Natural asset inventory plus spatial representations of roads
Surface permeability	The permeability of surfaces is ranked on a scale of nil to high depending on the type of landcover present. Urban areas, roads and industrial areas are ranked as nil. Assets within impervious surfaces are assigned as low permeability. Agriculture and shrublands are ranked as medium. Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made Impervious Surfaces Dataset from NASA data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3
Adjacent land use	Considers the distance to, and the nature of, the area surrounding natural assets. Intense land uses (e.g., airports) in close proximity to natural assets result in a poor rating, while distant land uses that are less intense (e.g., agriculture) result in a good rating. If there are no human land uses within 100 m of the assets, the assets are scored 10. If there are intensive land uses within 100 m of the assets, the score is 0.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses

* Data sources provided in Table 1 unless noted here.

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density as low (10), medium (5) or high (1).
- Surface permeability rated as high (10), medium (5), low (1), or nil (0).
- Adjacent intensive land use (0 for intense land uses, otherwise 10).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- **Good** - assets with a score of 30 or higher
- **Fair** - assets with a score between 20 to 29
- **Poor** - assets with a score between 10 to 19
- **Very Poor** - assets with a score lower than 10
- **No Rating**

Overall, 7,568 ha (or 43 per cent) of natural assets were assessed in good condition and 5,466 ha (or 31 per cent) were assessed in fair condition. Table 6 summarizes condition ratings demonstrating the number of assets and associated areas across the condition ratings.

Table 5 summarizes condition ratings and Figure 6 summarizes condition by natural asset type.

TABLE 6: SUMMARY OF NATURAL ASSET CONDITION RATINGS

Condition Rating	Number of Assets	Total Area (ha)	Average Condition Score
Good	748	7,568	31.57
Fair	3,867	5,466	24.36
Poor	6,354	4,630	14.91
Very poor	13	3	9.38
Total	10,982	17,667	19.36

Figure 4 summarizes condition by natural asset type. The forest, wetland and riparian assets largely ranked good or fair. Those that ranked poor were due to a combination of being relatively small with high road density. The fair ratings for these assets are due to lower road densities. Additional insights on the condition results can be obtained through the “Decomposition” tab of the online dashboard.

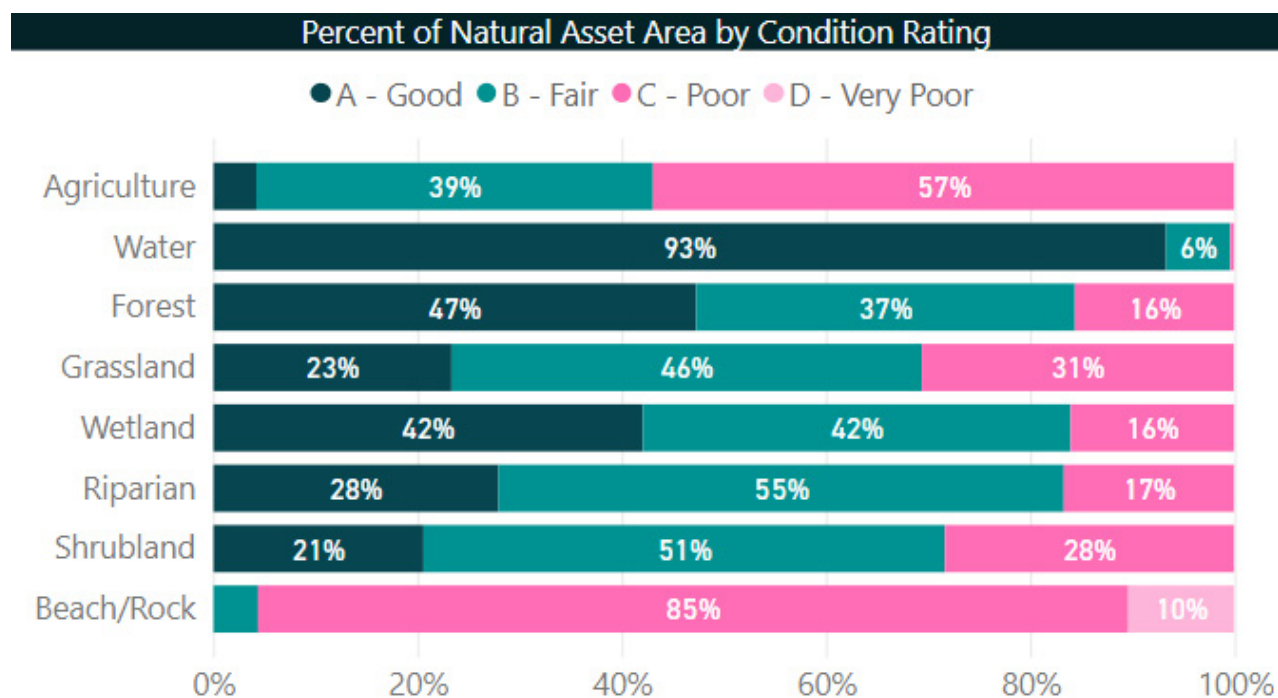


Figure 4: Summary of condition rating by natural asset type

4.6. Maintaining the inventory

Inventories are not static. With the information that MNAI provided to the City of Kelowna (e.g., asset registry, GIS outputs and the online dashboard), both the registry and the dashboard can be updated as new information becomes available. For example, natural asset condition might improve as a result of restoration efforts, or new studies may add insights on the condition of the assets. New data can be reflected in the asset registry by updating or adding attributes to existing assets or adding new assets to the inventory. Such changes can then be reflected in the online dashboard. Furthermore, the level of desired detail may evolve as asset management readiness increases or as areas of natural asset management focus emerge. However, inventories should grow in detail and sophistication only insofar as they remain aligned with the capacity of the communities to maintain them, and the uses to which they will be put. Their evolution and development should be a function of the monitoring, reporting and lessons of the asset management cycle and be driven by the imperative of ensuring sustainable, cost-effective delivery of services to the community, which is the core of asset management.

5 Risk identification

5.1. Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance in self-administering it.

Risk management is a four-stage process that includes risk identification, analysis of probability and consequence, development of risk mitigation strategies, and control and documentation. The use of the risk identification tool informs the first and second stages of risk management through the identification of top risks to natural assets and their associated services, and a high-level analysis of impacts and consequences.

Risk types relevant to natural asset management typically include:

- **Service risk:** the risk of an asset failure that directly affects service delivery.
- **Strategic risk:** the risk of an event occurring that impacts the ability to achieve organizational goals.
- **Operations and maintenance risk:** risks related to poor asset controls and oversight, which can lead to poor record-keeping and poor monitoring of asset.
- **Financial risk:** risks related to the financial capacity of the City of Kelowna to maintain municipal services.
- **Political risk:** risks related to the nature of municipal politics and in some cases Provincial governance and regulation.

5.2. Using the risk identification tool

Using the risk tool, the City of Kelowna considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including the following. Not all these risks affect all natural assets to the same degree.

- Overuse of trails
- Flooding (current and future)
- Wildfire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources
- Drought (current and future)
- Erosion
- Ice Jams/Mud flows

- Storm surge
- Illegal dumping
- Policy & Procedure
- Political changes (external forces)
- Construction activity

Each risk was then ranked low, medium or high according to the probability of an impact occurring, and the relative magnitude of its negative consequences. To assess impact and consequence, the City of Kelowna considered four questions:

- 1/ what impact is likely to happen?
- 2/ what is the consequence of that impact happening?
- 3/ what can be done to mitigate the probability of impact and/or consequence?
- 4/ what cues will signal the need for mitigation?

5.3. Results of the risk identification process

The risk identification process revealed:

- 4 high-level risks (flooding, wildfire, development pressure, and drought)
- 8 medium-level risks (overuse of trails, invasive species, pollutant loading, erosion, illegal dumping, policy & procedure, political changes, and construction activity)
- 2 low-level risks (ice jams/mud flows and storm surge)

In terms of scope, the identified risks affect natural assets across the City of Kelowna particularly those in the vicinity of the many creeks, Okanagan Lake, and urban areas. The risks also have the potential to negatively impact engineered assets (both city-owned and non-city-owned), personal health, and safety.

Risk Matrix

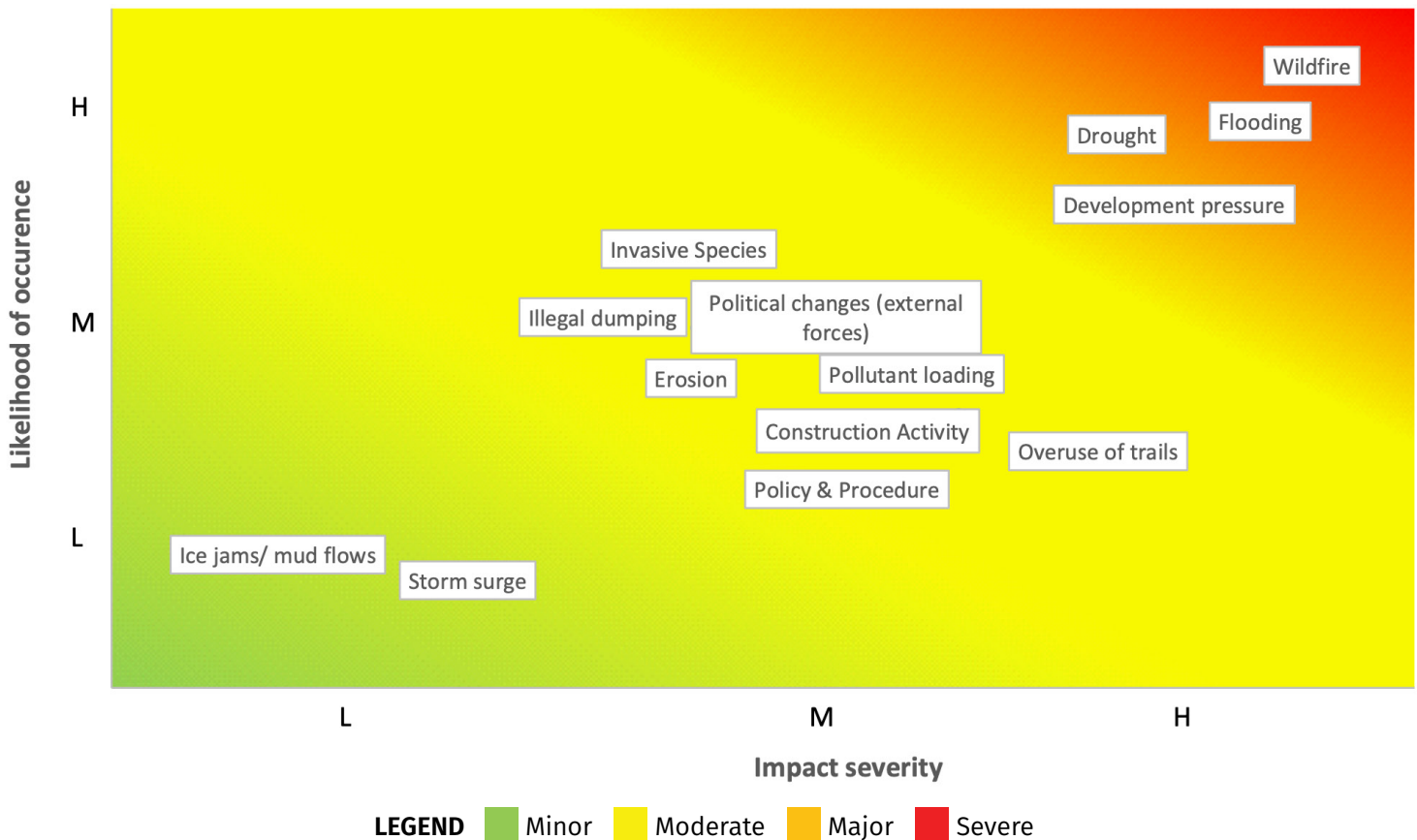


Figure 5: Results of risk management process

Potential priorities for the local government

The outcomes of the risk identification process highlight potential priorities on which the City of Kelowna could focus their natural asset management efforts. Where possible, these are also informed by the condition assessment. These are:

- Flooding:** Increased flooding associated with climate change can affect agricultural lands, beaches, forests, grasslands, riparian areas, shrubland, and water-related natural assets in the City of Kelowna. Extensive flood mapping indicates that several of the City's creeks (Mill Creek, Mission Creek, Brandt's Creek, Priest Creek, Robert Lake, Gopher Creek, and Vernon Creek) and the Okanagan Lake foreshore area are susceptible to flooding. In addition, flooding can bring economic impacts, stress infrastructure, damage private property, and risk human health and safety. The City of Kelowna's landfill, Heimlich Road at Rumohr Creek, and the airport (specifically where Mill and Scotty Creeks converge) are recognized as high-risk areas. Mitigation measures the City of Kelowna has proposed include Hazardous Condition Development Permit Areas, maintaining up-to-date flood data, consulting local Indigenous organizations for expertise, retrofitting critical infrastructure, and repurposing public infrastructure (such as parks and trails) to

minimize impacts⁷. Of course, while flooding is a risk to natural assets, natural assets can also play a key role in mitigating the impacts of flooding.

- **Wildfire:** Wildfires are a hazard to the City of Kelowna's ecosystem and are anticipated to increase under climate change. Agricultural lands, forests, grasslands, riparian areas, shrubland, waterways, and wetlands face risks related to wildfire, particularly in Wilden/Glenmore Highlands, the Southeast region of the city, McKinley, and Kettle Valley. The City of Kelowna has a Community Wildfire Protection Plan⁸ and Wildfire Development Permit Areas; these plans and policies should continue to be regularly updated as development continues and ecological conditions change.
- **Development pressure:** Development is substantially impacting natural assets across the City of Kelowna. Increasing impervious areas, hillside development, and reductions to tree canopy and green space are contributing to increased flood risk, erosion, and potentially urban heat island. Development and construction in forest areas can expose residents to wildfire risk and increase water scarcity. The loss of riparian areas can reduce water quality and wildlife habitat. Development is growing in Black Mountain, North Glenmore, Southeast Kelowna, Upper Mission/Kettle Valley, Kirschner Mountain, McKinley, Wilden, and the Gateway. Densification strategies should be paired with the protection of large, connected and intact natural spaces to maximize ecological services and minimize the need for built infrastructure. Over the next 20 years, the draft 2040 OCP projects that most new housing units will be accommodated in areas like Urban Centres and the Core Area, which will help preserve the City's natural assets.
- **Drought:** Drought is a high risk to all waterways, forests, grasslands, wetlands, street trees, and sensitive ecosystems in the City of Kelowna. This risk will increase as the climate changes. In addition to placing stress on water supply and water quality, drought may also threaten fish spawning and habitat in streams with environmental flow needs. To address this risk, the City of Kelowna has proposed water conservation tools such as water metering, equitable rate structures, improved irrigation strategies, public education campaigns and planting of indigenous, drought-tolerant vegetation and riparian buffers in the 2040 draft Official Community Plan. An integrated water supply plan is also being implemented⁹.

7 City of Kelowna, 2021.

8 www.kelowna.ca/sites/files/1/docs/homes-building/11-05-11_dhc_report_-_kelowna_cwp_electronic.pdf

9 City of Kelowna, 2017.

Table 7 lists and provides brief descriptions of risk mitigation strategies. These can be addressed in future stages of the MNAI process.

TABLE 7: RISK MITIGATION STRATEGIES	
Condition Rating	Number of Assets
Accept	Risk may be acceptable if probability and consequences are small
Minimize	Risk under local government's control that warrants exposure reduction
Share	Partners in a project permit the sharing of larger risks to reduce it for each
Transfer	Insurance, fixed price contracts, and other risk transfer tools

6 Recommendations

This section provides insights that can be gained from considering both the inventory - including the condition and risk assessments - and the asset management readiness assessment. It is divided into (a) opportunities to strengthen natural asset management at an organization-wide level (b) possible actions for the further development of the inventory, and (c) steps the City of Kelowna can consider to advance to a full natural asset management initiative.

6.1. Opportunities to strengthen natural asset management at an organization-wide level

The City of Kelowna has indicated that completing the MNAI Inventory Project will provide valuable insights and guidance to establishing natural asset priorities. They identified the need to update the Asset Management Policy, Strategy & Framework documents to include natural assets and have Council endorse the documents. The City of Kelowna also identified the need to further integrate natural asset management responsibilities on its asset management team and to ensure accountability for natural asset management in its governance framework. Furthermore, this information can also be used to help inform a Climate Change Vulnerability Assessment to better understand how climate change is impacting natural assets.

City of Kelowna staff also identified opportunities to better integrate natural assets into planning documents and improve reporting mechanisms on progress. That would include developing additional natural asset performance measures in planning documents and improving the understanding of natural asset-related indicators. The City of Kelowna sees the need to improve availability of data on natural assets to enable increased monitoring.

For asset management in general, the City of Kelowna noted that further work with Council is needed to help build understanding of the ongoing, evolving nature of asset management. They also noted other areas of continuous improvement, including incorporating risk into their evaluation of asset management needs, expanding lifecycle investment capabilities, and increasing regional data capture for their natural assets inventory. They are also interested in communicating levels of service to Council for all service areas and would like to work towards using actual condition data instead of age-based condition data, where possible.

For natural asset management specifically, City of Kelowna staff expressed interest in understanding and defining differences between costs and values of natural/green assets and developing financial information. This improved capacity and understanding could enable the City of Kelowna to formally communicate trade-offs between various implementation options and projects. They would like to incorporate natural assets into asset management plans, analyze critical natural assets and identify a risk management strategy for each.

Finally, staff would like to formally identify natural assets in budgets and financial planning. In this context, staff would like to improve the City of Kelowna's ability to adapt planning approaches, for example, by developing a matrix that describes all assets that are providing services, to support decision-making.

6.2. Possible actions for the further development of the inventory

Based on the inventory, the City of Kelowna could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Collect additional data to enhance the asset inventory. This could include refining the forest category according to dominant species (e.g., Red Maple, Norway Maple, Beech) and wetland category according to types (e.g., palustrine, isolated, riverine wetlands). This information can inform risk (e.g., what invasive species threaten which tree species?), and the provision of ecosystem services (e.g., riverine wetlands are not as efficient at filtering water as other types of wetlands).
- Expand the risk identification to include field verification of results.
- Determine acceptable levels of risk to the City of Kelowna's risk mitigation strategies (see Table 7).
- Further develop the condition assessment and risk assessment using local climate projections, land use modelling, possible field verification and other data already at their disposal.
- Identify linkages between risks. For example, development in floodplains can increase flooding and erosion and drought can exacerbate wildfires.

- Share the inventory with adjacent local governments to stimulate collaboration within the Okanagan Lake watershed.
- Add more condition ratings - for example, canopy cover, which also links to stormwater management services.
- Initiate or enhance monitoring - for example, using gauges, water level sensors, and loggers to improve understanding of trends, feed into condition ratings of assets, and gather information for modelling.
- Schedule regular updates (e.g., every 3-5 years) of the inventory, condition assessment and risk identification to understand trends.
- Maintain interest and momentum in natural asset management to move towards a full natural asset management project.
- Expand natural asset condition through additional metrics, field verification, and enhanced monitoring of natural assets (e.g., water quality monitoring at key confluence areas/points).

6.3. Steps to a full natural asset management project

If the City of Kelowna wishes to proceed with a full natural asset management project including implementation, it will need to consider the following steps in a future project:

- 1/ Confirm scope, roles and responsibilities.** Undertake a meeting or workshop to confirm (a) assumptions [for example, that water management and development pressure are the primary services of concern] (b) roles, responsibilities, and capacities (c) community capacity to undertake a larger project.
- 2/ Fill essential knowledge gaps.** If discussions on scope and certainty and related data needs for modelling indicate the need for additional data, these could be filled.
- 3/ Modelling.** Modelling the levels of service that natural assets currently provide and the levels of service under different potential management, local climate change projections, and rehabilitation or restoration scenarios, is central to natural asset management as it gives communities the ability to explore how different actions will affect the health and corresponding performance of natural assets.
- 4/ Economic assessment.** The economic assessment component provides a market-based indication of (a) the current value of the services from natural assets if they had to be provided by an engineered means, and (b) the costs and values of different interventions in terms of service delivery.

- 5/ Planning.** This step allows local governments to explore different scenarios such as “what happens to the services provided by the wetland if there is significant building upstream?” or “what happens to the services if the forest is restored?” Using modelling, local governments can understand and quantify changes in service levels. They can also determine corresponding values through continued economic assessment. Based on the foregoing, local governments can begin to consider and prioritize actions ranging from status quo to planning, regulatory, financial operations, maintenance, acquisition, and monitoring interventions.
- 6/ Implementation.** MNAI can provide ongoing advice / guidance on policy pieces and integration of the above information for 12-18 months. After that, the local government, together with local partners and service providers, would ideally have the capacity to continue these efforts on their own.
- 7/ Ongoing monitoring.** It is essential to continue monitoring the natural asset management project results to learn whether interventions are working and to share lessons and learnings from other communities undertaking natural asset management. MNAI would typically stay involved with the community for three years through a monitoring arrangement to be established with the communities.

MNAI can discuss these and other possible steps with staff.

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Annex: Results of the City of Kelowna's risk identification

This Annex contains the results of the City of Kelowna's use of MNAI's risk identification tool which they self-administered with guidance from MNAI. Table 8 was the main product that personnel developed from the exercise.

Step 1: Identification of risks

Common Risks to Natural Assets:

- Overuse of trails
- Flooding (current and future)
- Wildfire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources
- Drought (current and future)
- Erosion
- Ice jams/mud flows
- Storm surge
- Illegal dumping
- Policy and procedure
- Political changes (external forces)
- Construction activity

Step 2: Complete survey

TABLE 8: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
1. Overuse of trails	M	Forest, Beach, Grasslands, Riparian, Wetland, Shrubland, Water	Knox Mountain, Dilworth Mountain, Mission Creek, Rail Trail, Myra-Bellevue, Linear Pedestrian Trails, Robert Lake, Munson Pond	Particularly detrimental when trail users leave designated trail.
2. Flooding	H	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Mill Creek; Mission Creek; Okanagan Lake & surrounding shoreline; Brandt's Creek; Priest Creek; Robert Lake; Gopher Creek; Landfill (localized to site); Heimlich Rd./Rumohr Creek; Airport (@ Mill & Scotty Creeks), Vernon Creek (at N. end of City).	Extensive Flood Mapping has been completed.
3. Wildfire	H	Agriculture, Forest, Grasslands, Riparian, Shrubland, Water, Wetland	Wilden/Glenmore Highlands including Clifton Rd.; SE Kelowna; McKinley; Kettle Valley/Upper Mission (former burn areas).	As identified on the Wildfire Hazard Map (in Community Wildfire Protection Plan & Wildfire DPA).
4. Invasive species	M	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	All roadsides; all wetlands; Fraser Lake; Riparian areas; Brandt's Creek; Reidlich Pond; Munson Pond; hillside developments (fill slopes); Agricultural lands; sites disturbed by any type of construction.	<ul style="list-style-type: none"> Land: Invasive weeds (grasslands), Kudzu (urban), mountain pine beetle (forest), rats, grey squirrels, elm trees Water: Zebra & Quagga Mussels (esp. in Okanagan Lake), Milfoil, goldfish, non-native turtles.

TABLE 8: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
5. Development pressure	H	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Hillside developments/forest interface areas; growing areas such as Black Mountain, North Glenmore, SE Kelowna, Upper Mission/Kettle Valley, Kirschener, McKinley, Wilden, Gateway; Riparian areas in urban centres; Industrial area along Brandt's Creek; Downtown creek outfalls, Lakefront areas.	Densification of core areas/urban centres has pressure on our tree canopy and impervious areas. Produces reduction of flood attenuation resulting in higher flows and damaging velocities downstream. Tall buildings downtown and how that affects green space.
6. Pollutant loading	M	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Industrial areas around Mill Creek, north end of City that outlets to Vernon Creek, & Chichester Wetland; Well systems (some still unknown); Agricultural areas adjacent to waterways; WWTF outfall; Storm outfalls; areas with septic systems/ no sewer; storm ponds; Highways & major arterials (road salts); Rutland (dry well open systems, septic, recharge); Kirschner storm outfall to Ritchie Brook (then flows to Mill Creek); Bennett Bridge.	Includes point & non-point sources. Storm system relies on ground recharge, putting pollutants potentially into groundwater. Upstream agricultural lands can result in nutrification of the lake. Bennett Bridge due to accidents/spills.
7. Drought	H	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	All waterways, forests, grasslands, wetlands, street trees, and sensitive ecosystems.	Detrimental to any stream with specific flow needs to support fish habitat & spawning. Further stress on water supply (potable and non-potable for irrigation). Reduces stream water quality.
8. Erosion	M	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Bellevue Creek pathway; Black Mountain; Kirschner Mountain; McKinley Beach; Riparian areas; Okanagan Lake shoreline; major creeks; steep slopes.	Hillside developments and cut & fill slopes.

TABLE 8: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
9. Ice jams/Mud flows	L	Riparian, Water, Wetland	All bridge crossings.	Occurs irregularly; linked to erosion. Past eco-hydraulic studies of Mission Creek have shown that dredging activities can induce an erosional surface in the streambed that results in additional deposits downstream at the Creek mouth.
10. Storm surge	L	Beach, Riparian, Water, Wetland	Okanagan Lake foreshore; dams & dykes.	Surges and seiches can occur in large lakes. OBWB includes a 200-yr return period wave action event in their flood mapping.
11. Illegal dumping	M	Forest, Beach, Grasslands, Riparian, Water, Wetland, Shrubland	Upper Mission/Kettle Valley, Dilworth Mountain, Mill Creek after the Airport to the mouth & riparian area, Brandt's Creek, Downtown shoreline, Wilden (near undeveloped parcels), Vacant land, Rail Trail, Gulley Rd.	Primarily occurs in rural areas and vacant land.
12. Policy & procedure	M	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Entire city.	Internal control measures. Commitment to enforcement of bylaws & policies critical to long-term natural asset stewardship (such as Bylaw 7900).
13. Political changes (external forces)	M	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Water courses under Provincial & Federal jurisdiction; Agricultural Land Reserve; overlapping areas of RDCO.	Regulatory authorities outside of the control of the City of Kelowna.
14. Construction activity	M	Agriculture, Beach, Forest, Grasslands, Riparian, Shrubland, Water	Wilden; McKinley; active construction sites.	Any large development within an Area Structure Plan.

Municipal Natural Assets Initiative

