

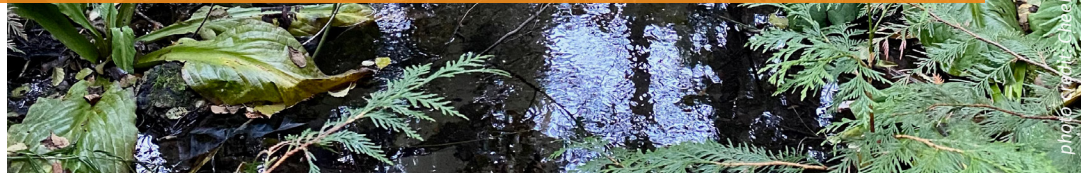
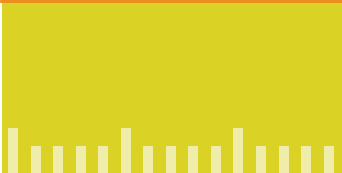


Toward natural asset management in the Resort Municipality of Whistler British Columbia



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 Resort Municipality of Whistler and 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.

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.

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

What is a natural asset inventory?

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 and explained in detail in the Annex, a natural asset inventory is the first component of the Assessment phase. The Assessment phase, in turn, is the first of three phases of a full natural asset management project. 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.

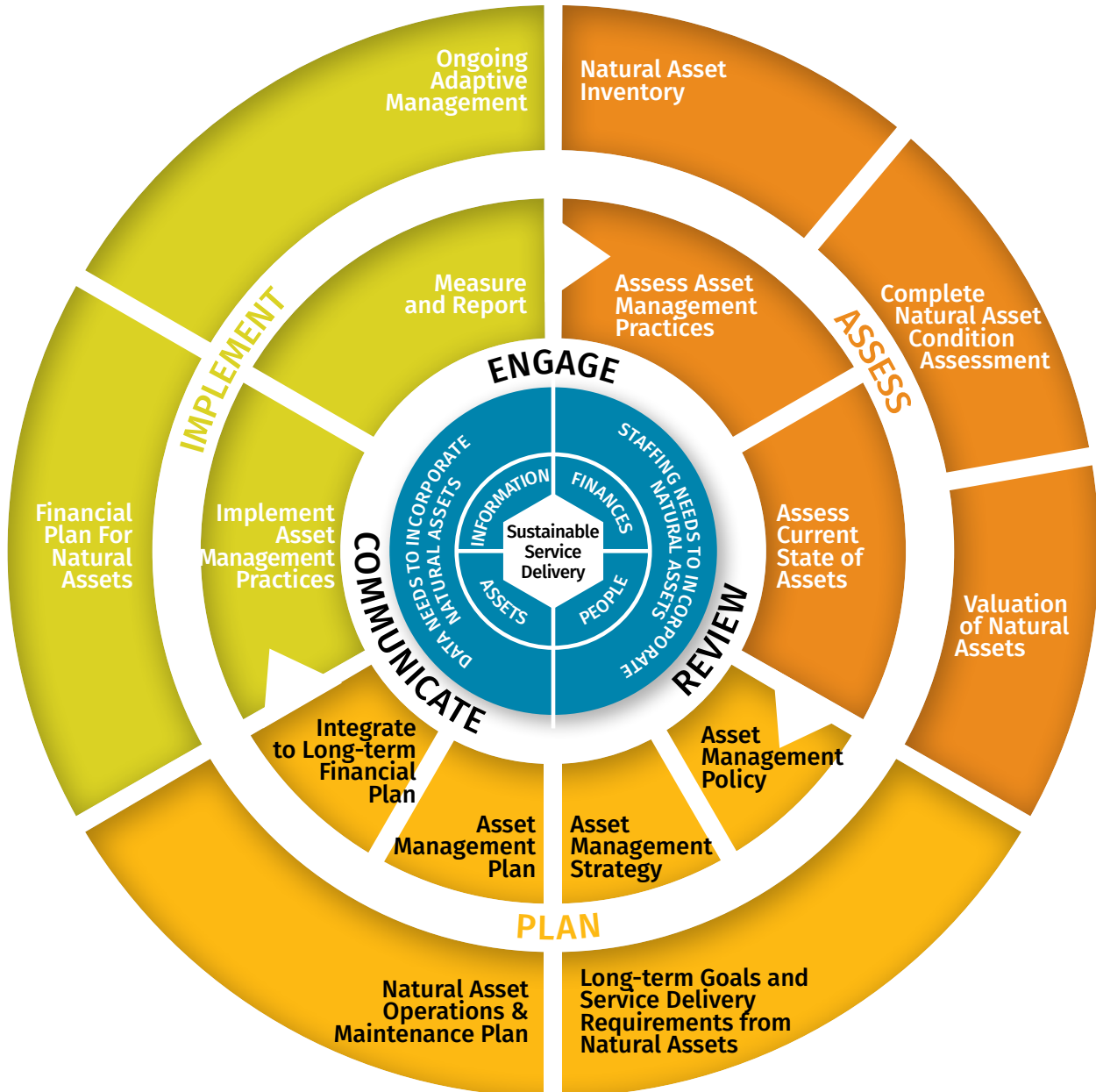


Figure 1: The Asset Management Process. MNAI has adapted this for use with natural assets.

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

3 Local government context

3.1. General

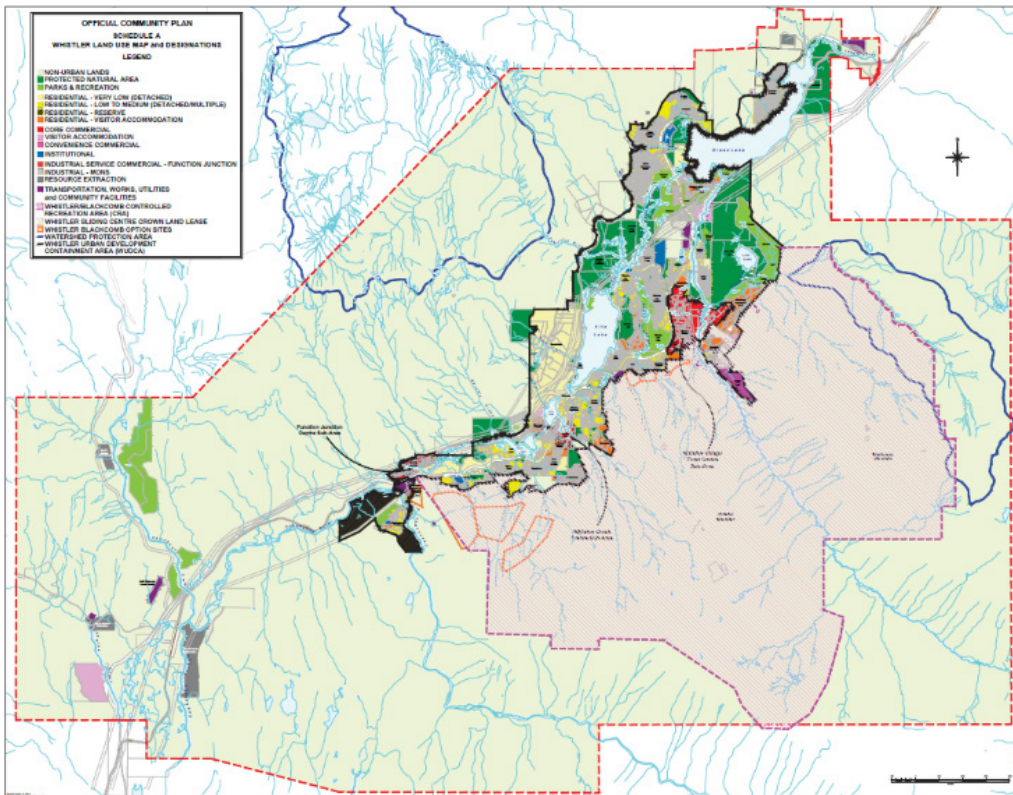


Figure 2: Resort Municipality of Whistler³.

The Resort Municipality of Whistler (RMOW) (population ~12,000) is a municipality in the southern Pacific Ranges of the Coast Mountains in British Columbia⁴.

The RMOW identifies surface and groundwater drinking water supply, flood attenuation and stormwater management as top priority services from natural assets.

The RMOW's goals in undertaking natural asset management are to manage and budget in ways that ensure that natural assets remain healthy and continue providing vital services to the community. This, in turn, will aid in decision-making around property development and land-use planning.

More specifically, the RMOW wants to develop a holistic approach to asset management in which natural assets are an integrated component and there is an effective financial management system for natural assets. This could help tackle increasing risks from recreation, development pressure and climate change.

In support of this approach, the RMOW also wants to disseminate information on the role of natural assets in providing municipal services, reducing reliance on engineered infrastructure, and providing benefits such as recreation, flood reduction, and mitigation to climate change impacts.

³ www.whistler.ca/about

⁴ Official Community Plan. (July 2019). Resort Municipality of Whistler. Retrieved April 2021 from www.whistler.ca/sites/default/files/ocp-schedules/ocp_adopted_version.pdf

Finally, the RMOW wants to understand the role of recreational assets such as trails and parks that are close to rivers, streams and lakes, and how they interact with surrounding engineered infrastructure.

Success in the foregoing areas would support the RMOW's Official Community Plan policy to 'investigate the application and integration of natural capital and municipal natural assets into the municipality's asset management program to recognize and assign value to the role of ecosystem services in the functioning of (its) infrastructure.'

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 tool⁵ 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 RMOW'S readiness assessment indicates it is at an early stage of adopting organization-wide asset management in competency areas such as policy, governance and leadership. It has made more progress in other areas, as demonstrated by a solid data and information foundation for engineered assets and some natural assets, which supports planning and decision-making.

The RMOW's finance department is developing an asset management policy. The policy does not yet formally recognize the role of natural assets in service delivery; however, the Official Community Plan has objectives related to natural assets and recognizes the value, in qualitative terms, of natural assets like lakes and forests in terms of the benefits they provide to the community, including recreation, health and mental well-being. The RMOW has not evaluated or incorporated these benefits into its asset management planning.

The RMOW is also developing an asset management strategy and has funding to support it. The natural asset inventory and readiness assessment will provide the foundation and rationale for developing objectives related to natural assets. While Council is supportive of asset management in principle, the RMOW has relied on grants and external funding to-date. Much of its progress on asset management has been made to strengthen its data and information foundation for engineered assets. With support from consultants, the RMOW has basic inventory data for all engineered assets, with some level of service information,

⁵ See fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf for details

and standardized condition ratings for some critical assets. Consultants also prepared a report on the lifecycle costs of managing engineered infrastructure. The MNAI inventory project is now strengthening natural asset data, building on existing ecosystem and priority habitat mapping.

Competency 2: People & Leadership

In the *people and leadership* competency area of the assessment, the RMOW has formed a cross-functional team and is at an early stage of formalizing terms of reference and designating responsibilities. There is not yet a team member responsible for incorporating natural asset management considerations. The team meets quarterly but does not have specific assignments or deliverables and has relied mostly on consultants for work to-date.

Competency 3: Data & Information

The RMOW has collected baseline data on asset management practices and used indicators to measure the health and performance of its engineered assets. It also conducted a community life public survey and service analysis for assets related to water and energy.

Competency 4: Planning & Decision-making

In terms of competencies in asset management planning and decision-making, the RMOW is at a fairly early stage. Specifically, departments follow a similar but informal asset investment planning approach, and investment needs and priorities are evaluated based on both structured and *ad hoc* practices and criteria. Natural asset management has not yet been formally incorporated into this approach.

The RMOW has draft asset management plans for some asset classes, with forecasted financial needs based on estimated data. These draft plans only include natural assets associated with grey infrastructure such as culverts and ditches. It has operations and maintenance plans for some assets, but there are gaps in terms of forecasting and understanding future needs. That said, the Utilities Department is responsible for a specific 21 Mile Creek Watershed Source Water Protection Plan with a budget based on past practices.

While the RMOW does not have formal asset management plans that include intact natural assets, it has been doing proactive maintenance for some natural areas including the River of Golden Dreams (Alta Creek), Whistler's lakes, and the Sprout Rainbow alpine areas. It has developed some levels of service metrics but they are not comprehensive in terms of all the services the natural assets provide.

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 RMOW 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 RMOW and GeoBC. 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	PURPOSE
WhistlerBoundary_DataBC	RMOW	Used to determine study area
TEM_RMOW	RMOW	Used to create base natural asset inventory. The ecosystem component site series definitions were used to determine landcover and landcover was assigned to higher level asset types
Dist_Pkg_NonPEM_coast_gdb_201609	GeoBC	Used to fill in gaps in base natural asset inventory as the RMOF TEM dataset does not cover full study area. Dataset was merged with the regional dataset
VRI - 2020 - Forest Vegetation Composite Rank 1 Layer (R1)	GeoBC	Added forest details to natural asset inventory using a spatial join
DoubleRiverBreaklinePoly_RMOW	RMOW	Used to supplement base natural asset inventory (added lakes as water asset type)
ReservoirBreakline_RMOW	RMOW	Used to supplement base natural asset inventory (added reservoir areas as water asset type)
FWA_Assessment_Watersheds_Poly	GeoBC	Watershed boundaries used to split natural assets and assign them to appropriate watersheds. Also used to summarize natural assets by watershed in the dashboard
RoadLine_RMOW	RMOW	Used to perform road density condition assessment
AplineSkiAreaTenure_DataBC	RMOW	Used to determine area of natural assets within ski area tenure
Aquifers_DataBC	RMOW	Used to determine area of natural assets within each aquifer

TABLE 1: SUMMARY OF DATA USED

DATASET NAME	SOURCE	PURPOSE
ConnectivityCorridors_RMOW	RMOW	Used to determine assets within the connectivity corridors
Cottonwoods_RMOW	RMOW	Used to determine assets falling within this area and summarize asset area within
CWHOldGrowth_RMOW	RMOW	Used to determine assets falling within this area and summarize asset area within
EcosystemsAtRisk_RMOW	RMOW	Used to determine assets falling within this area and summarize asset area within
ForestedFloodplain_RMOW	RMOW	Used to determine area of assets in forested floodplain
MunicipalPark_RMOW	RMOW	Used to assign name of parks to assets residing in them and determine asset area within municipal parks
PMBC_Parel_Polygon	RMOW	Used to determine ownership of assets
PriorityHabitats_RMOW	RMOW	Used to assign majority and minority habitat classifications to natural assets
ProvincialPark_DataBC	RMOW	Used to assign name of parks to assets residing in them and determine asset area within regional parks
RecreationArea_DataBC	RMOW	Used to determine assets/asset area within recreation sites
Riparian_RMOW	RMOW	Used to determine which assets are within riparian zones and the asset area within riparian zones
StreamCombined_RMOW	RMOW	Used to summarize length of watercourses within assets
ValleyTrailDouble_RMOW	RMOW	Used to summarize length of trails within assets
TrailXCounry_RMOW	RMOW	Used to summarize length of trails within assets
TrailHiking_RMOW	RMOW	Used to summarize length of trails within assets
TrailSnowshow_RMOW	RMOW	Used to summarize length of trails within assets
TrailBiking_RMOW	RMOW	Used to summarize length of trails within assets
SeaToSkyTrail_TrailsBC	RMOW	Used to summarize length of trails within assets
UnloggedCoreForest_RMOW	RMOW	Used to determine asset area which is considered unlogged
WUDCA_RMOW	RMOW	Used to indicate assets in urban district
WIFBoundary_RMOW	RMOW	Used to indicate assets in WIF area
Zoning_RMOW	RMOW	Used to assign assets their majority zone type (residential, Rural Resource, etc.)
Vegetation_Class4	RMOW	Used to assign mean canopy height to assets
Vegetation_Class5	RMOW	Used to assign mean canopy height to assets

The inventory defined a total of 4,664 individual assets covering 23,247 hectares (ha), as noted in Table 2. The majority of this area was forest cover.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE

NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)
Forests	3,101	17,830
Shrubland	330	1,702
Rock and talus	446	1,767
Ski development	34	690
Water	564	566
Built-up pervious	15	192
Wetland	120	226
Alpine meadows	28	99
Grassland	7	21
Glacier	15	137
Permanent snow	4	19
	4,664	23,247

Figure 3 shows the spatial distribution of the natural assets.

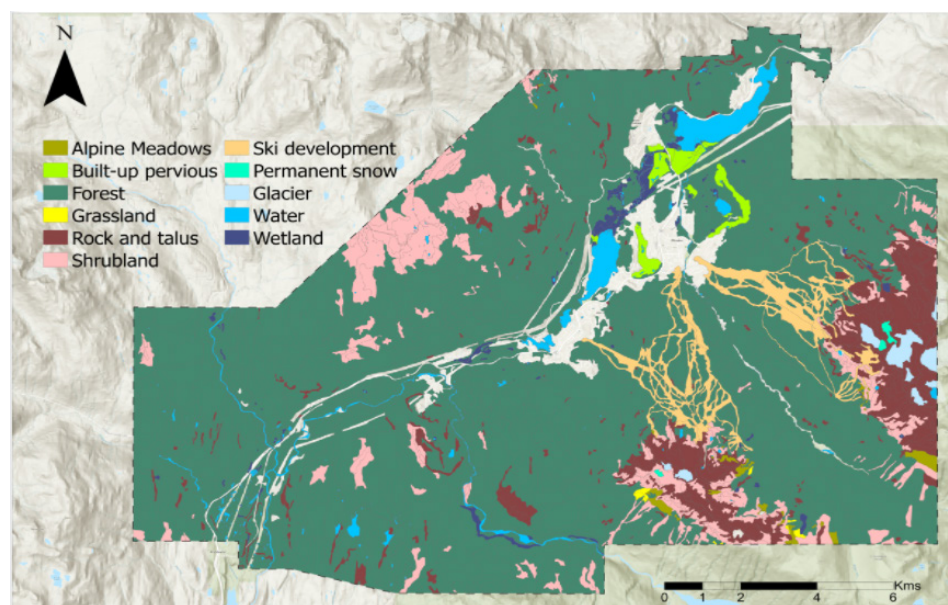


Figure 3: Spatial distribution of natural assets.

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 an excerpt from the RMOW's registry showing natural asset characteristics and details.

TABLE 3: EXCERPT FROM THE REGISTRY

Natural Asset Registry																				
Asset ID	Asset Type	Asset Area (ha)	Asset Area by Watershed (ha)	Watershed	Source	Municipal Park Area (ha)	Municipal Park Name	Majority Habitat Class	Riparian Area (ha)	Majority Zone Type	Flood Model Results	Vegetation Class4 Average (m)	Vegetation Class5 Average (m)	Interior Forest Area (ha)	Interior Forest %	Adjacent Land Use Score	Permeability Score	Relative Size Score	Road Density Score	Total Score
WET99	Wetland	1.58	1.58	Alta Creek	TEM_RMOW	1.58	Beaver Lake Park	2	0.75	Leisure		9.74	25.19	0.00	0	9	10	1	10	30
WET98	Wetland	0.35	0.35	Green River b	TEM_RMOW	0.28	Parkhurst	1	0.25	Residential		8.08	25.00	0.00	0	10	10	1	10	31
WET97	Wetland	0.25	0.05	Blackcomb Creek	TEM_RMOW	0.05	Lost Lake Park	2	0.00	Leisure		9.39		0.00	0	10	10	1	10	31
WET97	Wetland	0.25	0.20	Fitzsimmons Creek	TEM_RMOW	0.20	Lost Lake Park	2	0.06	Leisure		10.43		0.00	0	10	10	1	10	31
WET96	Wetland	0.29	0.29	Millar Creek	TEM_RMOW	0.00		1	0.13	Rural Resource		8.41		0.00	0	10	10	1	10	31
WET95	Wetland	0.22	0.22	Millar Creek	TEM_RMOW	0.22	Rocky Knoll Park	2	0.20	Leisure		11.44	25.61	0.00	0	10	10	1	1	22
WET94	Wetland	0.26	0.26	Green River b	TEM_RMOW	0.00		2	0.00	Rural Resource		12.19	26.58	0.00	0	10	10	1	10	31
WET93	Wetland	1.26	0.42	Alta Creek	TEM_RMOW	0.30	Dream River Park	2	0.42	Rural Resource	FitzCrabAlt a 100yr Clear	9.17		0.00	0	10	10	1	1	22
WET93	Wetland	1.26	0.84	Green River b	TEM_RMOW	0.30	Park	2	0.16	Leisure	FitzCrabAlt a 100yr Clear	7.35		0.00	0	10	10	1	1	22
WET92	Wetland	0.69	0.69	Millar Creek	TEM_RMOW	0.00		<1	0.00	Residential		5.84		0.00	0	10	10	1	1	22
WET91	Wetland	3.07	3.07	Alta Creek	TEM_RMOW	3.07	Golden Dreams Conservation Area	3	3.07	Leisure	FitzCrabAlt a 100yr Clear	9.46	28.11	0.00	0	9	10	5	1	25
WET90	Wetland	1.17	1.17	Brandywine Creek	TEM_RMOW	0.00		4	1.17	Rural Resource		14.15	28.47	0.00	0	10	10	1	10	31
WET9	Wetland	0.89	0.89	Fitzsimmons Creek	TEM_RMOW	0.00		1	0.03	Residential		11.90	25.41	0.00	0	6	10	1	1	18
WET89	Wetland	0.37	0.37	Millar Creek	TEM_RMOW	0.16	Millar's Pond Park	3	0.13	Leisure		10.14	27.14	0.00	0	7	10	1	1	19
WET88	Wetland	1.16	1.16	Alta Creek	TEM_RMOW	0.78	Rainbow Park	2	0.00	Rural Resource		7.92	25.82	0.00	0	8	10	1	1	20
WET87	Wetland	0.83	0.83	Millar Creek	TEM_RMOW	0.00		3	0.70	Residential		12.00	26.79	0.00	0	10	10	1	10	31
WET86	Wetland	0.35	0.35	Alta Creek	TEM_RMOW	0.00		2	0.00	Residential		10.59	25.23	0.00	0	10	10	1	1	22
WET85	Wetland	1.70	1.70	Callaghan	TEM_RMOW	0.00		3	0.94	Rural		8.01	26.94	0.00	0	9	10	1	1	21
Total		29,753.09	23246.99			597.20			4,288.51					10,899.46						

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 asset. Figure 4 is a screenshot from the dashboard that MNAI provided to the RMOW. The full version can be accessed at go.greenanalytics.ca/Whistler.

Whistler Natural Asset Inventory

[Summary](#)
[Asset Registry](#)
[Condition](#)
[Decomposition](#)

This asset inventory summarizes natural assets within Whistler, BC, by watershed and asset type. A range of local/provincial datasets, and condition variables were incorporated into this inventory to further characterize the natural assets. [Click an area of interest on the map below to filter natural assets by watershed.](#)

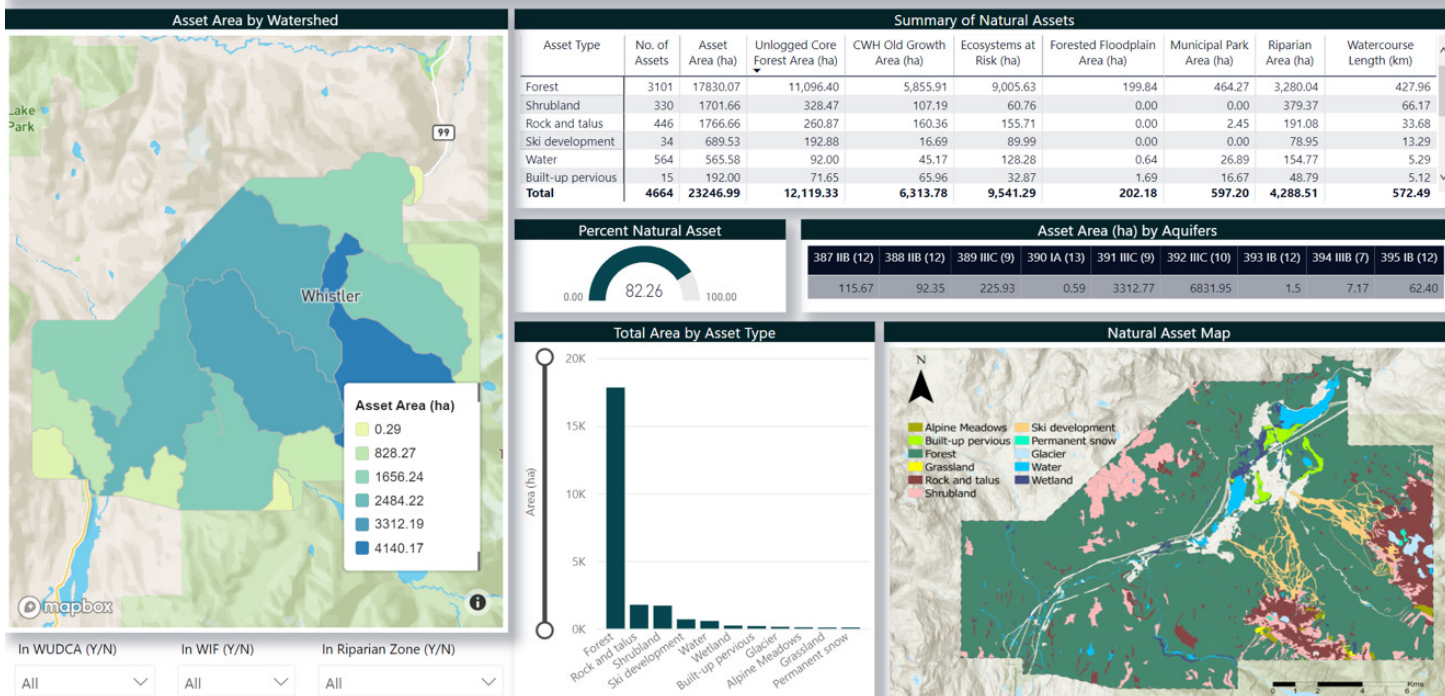


Figure 4: Screenshot of main inventory summary.

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.

MNAI completed a desktop-based condition assessment using RMOW GIS data and built it into the inventory to provide an initial understanding of the status of the natural assets for the RMOW. Table 4 summarizes the condition assessment steps and indicators.

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator*
		Natural asset inventory
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	<p>The permeability of surfaces is ranked on a scale of nil to high depending on the type of landcover present.</p> <p>Urban areas, roads and industrial areas are ranked as nil. Assets within impervious surfaces are assigned as low permeability.</p> <p>Agriculture and shrublands are ranked as medium.</p> <p>Wetlands, waterbodies and forests are ranked as high.</p>	<p>Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made Impervious Surfaces Dataset from NASA</p> <p>data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3</p>
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

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**

Figure 5 summarizes the natural asset condition assessment results per the online dashboard.

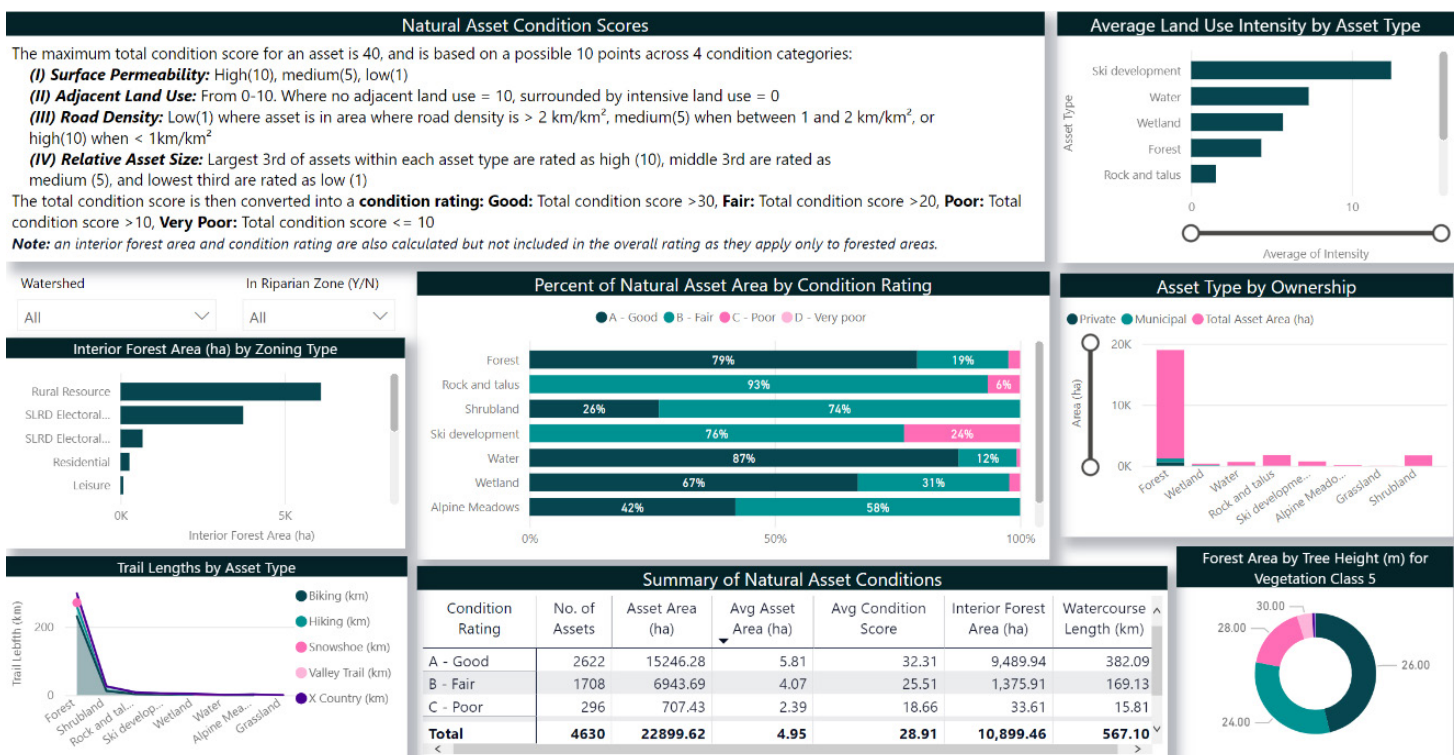


Figure 5: Screenshot of main inventory summary.

Overall, about 15,246 ha (or 67 per cent) of natural assets were assessed in good condition and 6,944 ha (or 30 per cent) were assessed in fair condition.

All natural asset classes were largely in good or fair condition. Forest, alpine meadow, grassland, water and wetland assets were in the best condition.

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

TABLE 5: SUMMARY OF NATURAL ASSET CONDITION RATINGS

Condition Rating	Number of Assets	Total Area (ha)	Average Condition Score
Good	2,622	15,246	32.31
Fair	1,708	6,944	25.51
Poor	296	707	18.66
Very poor	4	2.21	9.00
Total	4,630	22,900	28.91

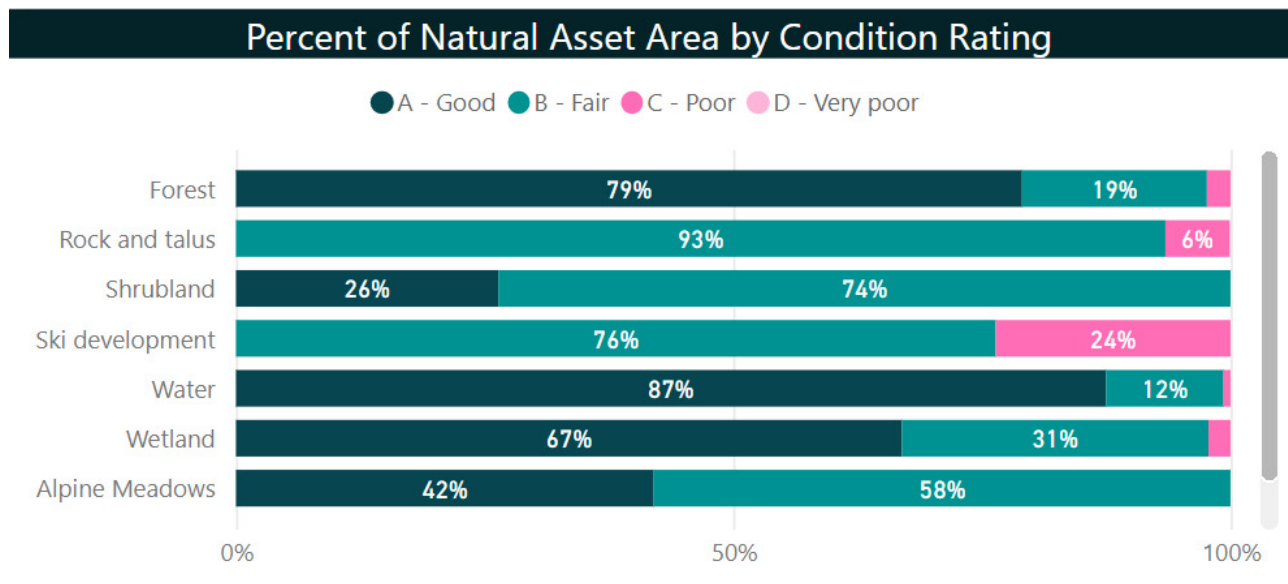


Figure 6: Summary of condition rating by natural asset type

4.6. Maintaining the inventory

Inventories are not static. Both the registry and the dashboard can be expanded as new information becomes available. For example, 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 and subsequently in the online dashboard as it becomes available. 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 RMOW 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 RMOW considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including.

- Overuse of trails
- Flooding (current and future)
- Forest fire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources
- Drought (current and future)
- Erosion
- Absence of flood hazard mapping
- Absence of land management plans

- Absence of monitoring reports
- Construction activity
- Political policy change

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 RMOW 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

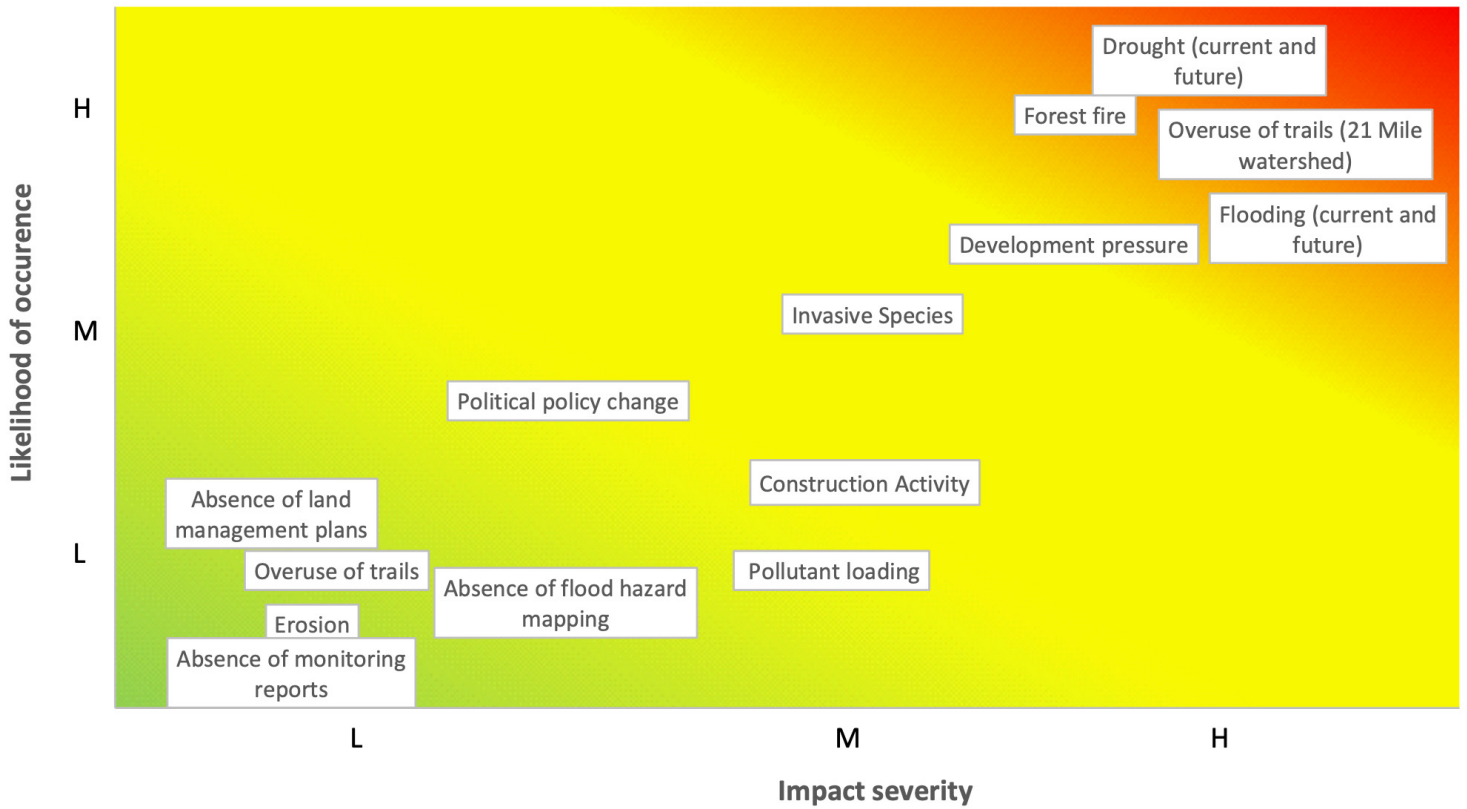
The risk identification process revealed⁶:

- 2 high-level risks (forest fire and drought; overuse of trails/dumping was noted as a high risk in 21 Mile watershed)
- 2 moderate-high level risks (flooding and development pressure)
- 2 moderate-level risks (invasive species and construction activity)
- 2 low-moderate level risks (pollutant loading and political policy change)
- 5 low-level risks (overuse of trails/dumping, erosion, absence of flood hazard mapping, absence of land management plans, and absence of monitoring reports)

In terms of scope, the identified risks affect natural assets across the RMOW, particularly those in urban areas and the 21 Mile Creek Watershed. The risks identified have the potential to negatively impact engineered assets (both those the RMOW owns and does not own), personal health and safety, and the local economy.

⁶ Risk rankings provide an initial indication of risk levels. They do not imply that all risks grouped within a level pose an equal degree of risk. For instance, forest fire may be infrequent but catastrophic over the long-term whereas overuse of trails may be an immediate, yet manageable risk. Both are identified as high-level risks, yet they are unequal.

Risk Matrix



LEGEND Minor Moderate Major Severe

Figure 7: Results of risk management process

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) potential priorities for the local government (b) possible actions for the further development of the inventory, and (c) steps the RMOW can consider to advance to a full natural asset management initiative.

6.1. Potential priorities for the local government

Combining the results of the condition assessment with the outcomes of the risk identification highlights priorities on which the RMOW could focus natural asset management efforts. These are:

- **Drought (current and future):** Current and future drought was identified as a high-level risk that can impact irrigation systems, groundwater aquifers and surface water supply in the 21 Mile Watershed. The RMOW's wetlands and aquifers provide water under drought conditions. The latter can affect municipal parks and the village landscape. In response, the RMOW has a variety of plans and projects to manage water supply including the Source Water Assessment, which was completed in 2015 and is now being updated; the Source Water Protection Plan; and, the South Whistler Water Supply Project, which is currently underway. Water conservation initiatives include the cross-connection control program, the once-through cooling bylaw, water metering, emergency back-up power supplies; and a water conservation bylaw to address outdoor potable water usage⁷. On-going aquifer monitoring could be considered as a next step in managing water supply.
- **Forest fire:** Forest fire is a high risk and can impact all natural assets, public and private infrastructure, transportation networks, the health and safety of residents and visitors, and the local economy. The RMOW has a Community Wildfire Protection Plan and is in the process of updating the Community Wildfire Resiliency Plan. In addition to fuel management, the RMOW could consider allowing ecosystems to burn and recover from fires in low-risk areas. This can maintain critical natural processes and functions such as nutrient cycling and promote structural diversity. Additional indicators of forest resilience (e.g., presence of native, drought-tolerant species and canopy density) could also be explored.

⁷ Resort Municipality of Whistler, 2018.

- **Overuse of trails in the 21 Mile Watershed:** Although the overuse of trails is ranked low, those in the 21 Mile Watershed trail system have been singled out as being at high risk of overuse from activity such as summer hiking and camping. Overuse may damage natural resources, diminish air quality, degrade water, reduce wildlife, and cause a decline in trail experience and solitude. In addition to regular trail maintenance, the promotion of *Leave No Trace* principles⁸ is vital to preserving natural assets in the vicinity of trails.
- **Development pressure:** Development pressure was identified as a moderate-high-level risk and is included as a priority due to the likelihood of it becoming a highlevel risk in the future. Locations of concern include the lower valley bottom from Cheakamus Crossing in the south to Emerald Estate in the north. A portion of the remaining green spaces of the RMOW are within the Whistler Urban Containment Area (WUDCA), but existing policies are anticipated to come under pressure as prescribed limits approach (e.g., bed unit cap) and as real estate prices rise, which will increase demand for affordable housing for locals and seniors. Further development, particularly development that fragments natural assets and habitats, can exacerbate existing risks such as drought and forest fire. It may also diminish tourism revenue if done poorly. Table 6 lists and provides brief descriptions of risk mitigation strategies. These can be addressed in future stages of the MNAI process.

Table 6 lists and provides brief descriptions of risk mitigation strategies.

TABLE 6: 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

8 Int.org/why/7-principles

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

The RMOW is at a relatively early stage of formalizing asset management as an organization-wide business process, which presents opportunities for the incorporation of natural asset management. As a first step, the RMOW could recognize in its asset management policy the role of natural assets in service delivery and the tourism economy. This, in turn, would help ensure that natural asset considerations are incorporated into planning and decision-making processes.

Council is not yet aware of the resourcing or commitments required for natural asset management to be integrated into organization-wide asset management practices. Staff noted that once this inventory is complete, they should share project results with Council. Such efforts to build awareness of the benefits of, and requirements for, proactively managing and protecting natural assets can help ensure that resources are allocated accordingly.

The RMOW's asset management team has not yet been formalized with roles, responsibilities or deliverables, and much of the progress to-date has been made with consultant support. As the RMOW formalizes roles for the team, it will be important to ensure that a member is responsible for natural asset management. This will help ensure that natural asset management is included in plans for multiple service areas.

Staff noted that the inventory will strengthen the data and information foundation for natural assets. They also noted that levels of service for new natural asset management priorities will need to be determined for the areas currently being managed, including the River of Golden Dreams, Whistler's lakes, and the Sproatt Rainbow alpine areas.

6.2. Possible actions for the further development of the inventory

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

- Expand the risk identification to include field verification of results.
- Determine acceptable levels of risk to the RMOW's risk mitigation strategies (see Table 6).
- Further develop the condition assessment and risk assessment using local climate projections, land use modelling, and other data already at their disposal.
- Identify linkages between services and assets and assess the condition of, and risks to, the assets from the perspective of their ability to deliver services.
- Share the inventory with adjacent local governments to stimulate collaboration within the watershed.

- Add more condition ratings - for example, canopy cover, which also links to water supply services.
- Initiate or enhance monitoring - for example, implementing groundwater monitoring to improve understanding of trends, feed into condition ratings of aquifers, 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.

6.3. Steps to a full natural asset management project

If the RMOW wishes to proceed with a full natural asset management project, including implementation, it will need to consider the following steps:

- 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 scenarios, 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, changes in service levels can be understood and quantified. Corresponding values can also be determined 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 planning (e.g., building maintenance costs into annual budgets), 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 project 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.

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Annex: Results of the Resort Municipality of Whistler's risk identification

This Annex contains the results of the Resort Municipality of Whistler's use of MNAI's risk identification tool, which they self-administered with guidance from MNAI. Table 1 was the main product that RMOW personnel developed from the exercise.

Step 1: Identification of risks

Common Risks to Natural Assets:

- Overuse of trails/dumping
- Flooding (current and future)
- Forest fire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Drought (current and future)
- Erosion
- Ice jams
- Storm surge
- Lack of flood hazard mapping
- Lack of land management plans
- Lack of monitoring reports
- Construction activity
- Political policy change

Step 2: Complete survey

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
1. Overuse of trails/ dumping	Low; high risk in 21 Mile watershed	Municipal & other approved trails.	Everywhere (get map)	Mainly overuse, not significant dumping (seen near Wedge). 21 Mile Watershed trail system – snowmobiles infrequently.
2. Flooding (current and future)	Moderate-high	Private property; 21 Mile water intake affected by turbidity and needs to go offline. Day lots – drinking water community wells and pump stations could go offline.	Village, Tapleys neighbourhood, other higher risk areas along Green Lake (lift stations and sanitary sewer manholes not far from high water mark)	Good protection in place for vulnerable areas. Low probability but high consequence. Sewage lift stations in Tapleys in particular. Could mean localized repairs, loss of sanitary system in the collection area.
3. Forest fire	High	Everything	Everywhere	Wildfire mgt program including FireSmart mitigating risk.
4. Invasive species	Moderate	Private and municipal properties	Predominantly along trails and roads, plus some aquatic plants (e.g. yellow flag iris). Goldfish recently introduced to Alta Lake.	Looking ahead to climate modelling showing hotter drier summers will allow invasives that currently survive here to thrive and expand. E.g., Japanese knotweed, hogweed.
5. Development pressure	Moderate-high	Remaining green spaces within Whistler Urban Development Containment Area (WUDCA)	Lower valley bottom from Cheakamus Crossing in the south to Emerald Estates in the north. ~20km distance between the two.	Bed unit cap, Whistler Urban Development Containment Area (WUDCA), OCP policy to maintain the development footprint and prevent sprawl. Development will stay within a defined footprint as long as bed unit cap maintained. Some pressure to develop all green spaces within WUDCA. As the bed unit cap is neared and real estate prices surge, risk grows for further development. E.g., for affordable, locals housing or seniors housing. It's all development.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
6. Pollutant loading	Low-moderate	Streams, forests		Most significant pollutant loading is hydrocarbons into waterways. No heavy industry here and water quality is generally good. More people visiting and recreating in natural areas is resulting in more litter. Some infrastructure is risky to the environment. For example, the sanitary line running along rail line next to Alpha Lake. If it breaks, access is very difficult and sewage would get into lake.
7. Drought (current and future)	High	Irrigation systems; groundwater aquifers (5); surface water supply (21 Mile)	Municipal parks, village landscapes	ROGD wetlands and aquifers providing ground water could be affected.
8. Erosion	Low	Trails getting eroded by heavy use	Trails throughout valley. 21 Mile Creek water supply intake infrastructure.	21 Mile Creek has an eroding area above the water intake; intake needs to be cleaned out regularly because it fills with natural sediment. Increased erosion due to drought or flooding will increase maintenance needs and costs. Community Energy & Climate Action Plan (CECAP) Trail Hardening project underway to upgrade trails and reduce erosion. A major flood in 21 Mile with the accompanying erosion is a concern.
9. Lack of flood hazard mapping	Low		All low-lying areas	Flood Plain Mapping is complete and has been sent to the Province. The maps are a tool for reviewing development sites, identifying actual flood elevations for a site.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
10. Lack of land management plans	Low			Source Water Management Plans for surface and groundwater sources. No specific flood management plans for utilities infrastructure. RMOW is diking authority with a management plan for Fitzsimmons Creek. Official Community Plan contains policies. Recreation & Leisure Master Plan, Parks Master Plan both consider Development Permit guidelines to identify flood hazard areas and address.
11. Lack of monitoring reports	Low			Water quality monitoring is done on lakes and streams; all drinking water sources are regularly monitored. Ecosystem Monitoring Program monitors indicator species to identify trends.
12. Construction activity	Moderate			WUDCA keeps development in defined area. No bylaws speak to keeping sediment etc. on site and out of natural areas. Soil Deposit Bylaw is out of date and not useful.
13. Political policy change	Low-moderate			History shows Council protects environment. Future could change demographics (more wealthy second-homeowners with little personal stake in the community) and place more pressure on allowing development. More second-homeowners interested in increasing property values rather than protecting natural environment.

Municipal Natural Assets Initiative

