



Stewards of the river valley corridor

Meewasin Valley-Wide Monitoring Framework

*Strategy for Monitoring within the
Meewasin Valley*

2021-2026

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Treaty 6 Territory and Homeland of the Métis

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Front Cover Photo: Sunset at Beaver Creek Conservation Area (2020)

Back Cover Photo: Northern Harrier captured on wildlife camera positioned at the Northeast Swale (2020)

Meewasin Valley Authority

Created in 1979, the Meewasin Valley Authority (“Meewasin”) is a non-profit organization dedicated to conserving the cultural and natural resources of the South Saskatchewan River Valley. Meewasin’s enabling statute, *The Meewasin Valley Authority Act*, established a partnership between the City of Saskatoon, the Government of Saskatchewan, and the University of Saskatchewan for the joint management of the South Saskatchewan River Basin. Meewasin’s structure reflects a commitment to the goal of having the participating parties accomplish more by working together through a single agency – Meewasin – than could be achieved individually.

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The Meewasin Valley Authority respectfully acknowledges that the lands and the waterbodies in the following report are located on Treaty 6 Territory and the original Homeland of the Métis. Meewasin acknowledges that Indigenous peoples have lived and thrived in relation to the lands within this region for millennia. Meewasin honors and recognizes the immense knowledge held by the traditional caretakers of this land as we do our best to assist in its stewardship. Through this project, Meewasin aspires to broaden and advance regional environmental monitoring practices to include representation of traditional knowledge systems, languages, lived experiences, and worldviews that are specific to Indigenous peoples' understandings of, and relationships to the land.

Meewasin gratefully acknowledges the important guidance and feedback provided by a multitude of experts throughout the drafting stages of this report, including, but not limited to, members of the Meewasin Conservation Advisory Committee, the Monitoring Framework Technical Advisory Committee, and expert input from various City of Saskatoon departments and University of Saskatchewan faculty. Meewasin also acknowledges the ways that existing literature and planning in the areas of natural areas management and ecological monitoring design have informed the methodologies and discussions within this report.

Executive Summary

This document was created to initiate the advancement of an adaptable, community-minded and regionally informed approach to ecological monitoring in alignment with the vision laid out in the *Meewasin Valley-wide Resource Management Plan*. The discussion and successive recommendations included within this document are intended to guide the planning, communication, and execution of monitoring work within the Meewasin Valley region over the next five years. This document identifies methodological approaches to monitoring design, summarizes Meewasin's current approaches to ecological monitoring, and proposes a set of recommendations intended to elevate monitoring practices within the Meewasin Valley region.

Through this project, Meewasin aspires to foster a collaborative network of regional monitoring-related partnerships with the intent of sharing knowledge, expanding observational capacity, and informing best practices. Advancing this network will require ongoing consultation and participation from local community members, conservation groups, traditional knowledge keepers, partner institutions and stakeholders.

This document culminates with a series of recommendations, to be advanced over a five-year period, which serve as the foundation for a Meewasin Valley-Wide Monitoring Framework. The recommendations are numbered in order of application, corresponding with Meewasin's phased project implementation strategy (Appendix A). Recommendations (described in Section 8.0) include the following:

1. Develop protocols for individual monitoring actions, data collection steps, and data entry methods.
2. Ensure that monitoring progress is explicitly detailed within internal reporting mechanisms.
3. Improve internal communication and interdepartmental collaboration on monitoring.
4. Annually review monitoring techniques and actions.
5. Include project monitoring plans within Meewasin's project application review process.
6. Work with Indigenous peoples to advance the integration of traditional ecological knowledge within monitoring design, application, and data interpretation.
7. Advance external communication of monitoring results and information.
8. Advance the centrality, transferability, and accessibility of Meewasin data.
9. Develop a public volunteer program for ecological monitoring.
10. Advance inclusivity within monitoring implementation and planning.
11. Strengthen monitoring-related partnerships within the Saskatoon region and the broader prairie conservation sphere.
12. Develop collaborative minimum standards for monitoring across the Valley region.

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1.0 Introduction

The Meewasin Valley covers approximately 6,700 square hectares of land centered in the City of Saskatoon and the surrounding Rural Municipality of Corman Park. This land connects wildlife movement corridors and it provides the stage for important avian breeding rituals and nesting territory. The land also contains evidence of culturally significant prairie histories, and it offers important habitat for flora and fauna – including rare plant species and several known species at risk. Distinctive prairie landscapes such as remnant fescue prairie, swales, wetlands, floodplains, and stabilized sand dunes are included among the natural areas that Meewasin manages. Meewasin manages and evaluates these areas by utilizing integrated resource management techniques including ecological restoration, prescribed fire, targeted conservation grazing, conservation mowing, and ecological monitoring. Meewasin strives to enhance biodiversity and conserve these unique landscapes while simultaneously promoting year-round accessibility through public programming, interpretation, and the maintenance of public sites and extensive trail networks.

In 2017, Meewasin produced a *Valley-wide Resource Management Plan* (Meewasin RMP), with the purpose of guiding conservation management efforts over a ten-year period. The Meewasin RMP was developed in partnership with the Nature Conservancy of Canada, supported by funding from Environment and Climate Change Canada, and its development was informed by engagement and consultation with the broader prairie conservation community. The Meewasin RMP identifies major conservation targets, assesses and ranks threats, identifies goals and prescribes key conservation actions as integral steps to advancing the plan. Research and monitoring are major areas of focus within the key conservation actions that are identified in the document. Included among the key actions is the call to develop a monitoring framework to supplement the management plan.

This document aims to advance the creation of a framework that will synthesize all known monitoring-related initiatives across the Meewasin Valley into an integrated monitoring network that complements the vision laid out in the Meewasin RMP. The monitoring framework project seeks ongoing consultation and participation from community members, local conservation groups, traditional knowledge keepers, and stakeholders with the intent of expanding knowledge through information sharing and increasing monitoring capacity through local partnerships and collective planning. This document details monitoring and the various ways that monitoring-related information functions within Meewasin, from informing conservation management to guiding ecologically sensitive development and outreach opportunities. The document prescribes future actions such as standardized monitoring protocols, data entry methods, and regular communicative mechanisms that are necessary to aid the advancement of desired framework objectives. This document aims to serve as an adaptable tool to frame and guide the standardization, planning, and communication of monitoring within Meewasin over the next five years.

1.1 Monitoring Objectives

For the purposes of this document, ‘monitoring’ is a term that is broadly used in reference to any process in which information is being gathered about variables within a system or area of interest. The information and data obtained through monitoring initiatives is used to reveal information regarding the status of a system at different points in time for the purpose of assessing the system state and drawing inferences about changes in its state over time (Rao et al. 2009). Importantly, monitoring is a critical component of an informed resource management and development decision-making process.

Within this process, monitoring generally serves to:

- **Inform** land managers on the current state and collective status of a system of interest
- **Evaluate** the effectiveness of management actions within the system of interest
- **Adapt** conservation intervention strategies and priorities to more effectively enhance the status of conservation targets and reduce threats to the system

1.2 Valley-Wide Monitoring Framework Project Vision

The Valley-Wide Monitoring Framework project serves to advance the long-term vision for conservation management and planning within the Meewasin Valley region, as identified in the 2017 *Meewasin Valley-wide Resource Management Plan*. The monitoring framework project aims to provide an adaptable approach to monitoring planning and design that can be applied to future conservation management, development, and educational outreach projects occurring within the Meewasin Valley region over the next five years. The monitoring framework will be progressed through the implementation of a series of recommended actions, detailed in Section 8.0, which collectively aim to improve monitoring-related practices and relationships across the Meewasin Valley region and advance the following overarching project objectives:

- **Continuity** through standardized data management and monitoring procedures
- **Efficiency** in workflow planning, resource allocation, and communication
- **Coordination** of regional monitoring initiatives and tasks
- **Public Engagement** through volunteer opportunities and educational outreach
- **Inclusion** through collaborative planning and community-informed monitoring design
- **Expansion** of knowledge and capacity through cooperative regional partnerships

2.0 Background

The Meewasin Valley is approximately 6,700 hectares in area. This jurisdictional area encapsulates both urban and rural landscapes. The region is centred within the City of Saskatoon and extends bidirectionally along the South Saskatchewan River, moving southwest into the surrounding Rural Municipality of Corman Park and northeast past the Clarksboro Ferry Crossing. Meewasin's conceptual "planning scope" (Figure 1), defined within the *Meewasin Valley-wide Resource Management Plan*, applies an additional 15-kilometer buffer zone onto this existing jurisdictional area to create a conceptual planning area of 294,184 hectares. This framework will follow suit with the Meewasin RMP in contextualizing a hypothetical expansion of the Meewasin Valley area when assessing monitoring-related goals and applications. Utilizing the extended spatial extent of the Meewasin planning scope presents an opportunity for assessing and reporting progress related to the Meewasin RMP document while providing broader opportunities for partnerships and data collection.

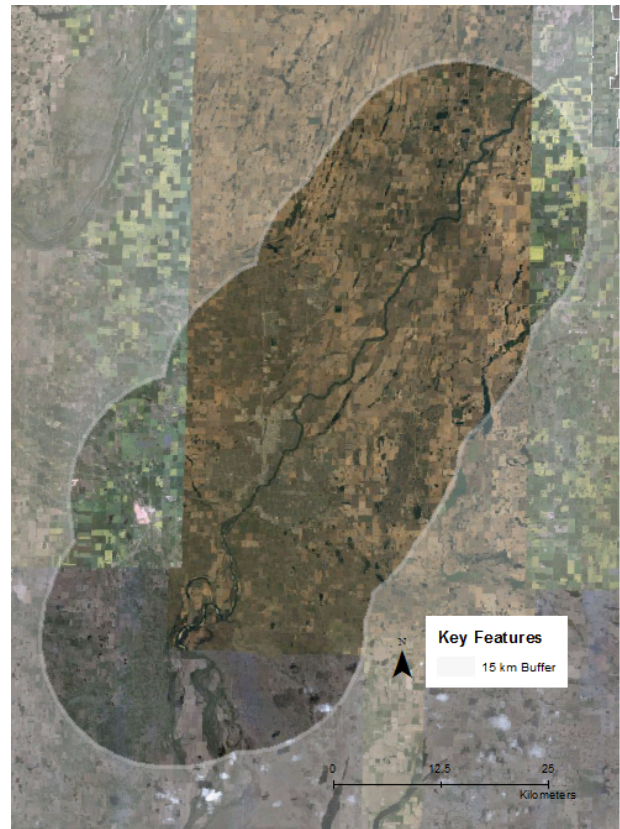


Figure 1. Meewasin Planning Scope

2.1 Valley-Wide Resource Management Plan

In 2017, Meewasin produced the first iteration of a *Meewasin Valley-wide Resource Management Plan* (Meewasin RMP), assisted with funding provided by Environment and Climate Change Canada, with the purpose of guiding conservation management efforts within the Meewasin Valley region over a ten-year period. The Meewasin RMP was developed in partnership with the Nature Conservancy of Canada, and its development was informed by engagement and consultation with the broader prairie conservation community. The plan identifies four broad conservation targets which include native grasslands, hydro-riparian areas (such as the South Saskatchewan River and tributary creeks), post-glacial channel scars (more commonly known as "swales"), and wetlands. The document assesses and ranks phenomena that may pose a threat to the integrity and abundance of identified conservation targets. Invasive species were ranked as the top threat to the Meewasin Valley within the Meewasin RMP, along with other notable stressors such as dams and storm water management, agricultural runoff, suburban development, trespass issues, fire suppression, and regional climate change. The Meewasin RMP culminates in the identification of over 180 key conservation actions recommended to

advance the vision laid out in the document. Included among the key actions is the call to develop a monitoring framework to supplement the management plan.

2.1A Conservation Targets

The 2017 Meewasin RMP identified four main conservation targets including Native Grasslands, Hydro-Riparian Areas, Post-Glacial Channel Scars (“Swales”), and Wetlands. These targets occur at a variety of spatial extents across the planning area and collectively provide necessary habitat for the species at risk documented within the region (Tomlinson et al. 2017). The selected targets represent the major ecosystem types present within the Meewasin Valley region and serve as a basis for evaluating ecological status and success of conservation management across the planning region.

Table 1. Meewasin RMP Conservation Targets (Tomlinson et al. 2017)

Conservation Target	Target Definition	Habitat Types
Native Grasslands	The native grassland target includes moist-mixed prairie, fescue prairie, aeolian grasslands, shrublands with a mixture of native species, and marginal aspen forests. Each of these ecosystems contains a similar set of species, varying mainly by soil texture and landscape complexity.	<ul style="list-style-type: none"> • Grassland – Temperate • Shrubland – Temperate
Hydro-riparian Areas	This target includes rivers, lakes, and creeks as well as the surrounding land and buffer zone areas impacted by water levels including adjacent shores and banks, floodplains, and river valleys. Features captured within this category include: the South Saskatchewan River, named and unnamed streams (established and ephemeral) feeding into the South Saskatchewan River, stream and riverbeds, land and vegetation adjacent to streams and rivers that is influenced by water, and areas that have been converted to agriculture or domestic forages which are or may have historically been influenced by water levels in the hydro-riparian zone.	<ul style="list-style-type: none"> • Rivers, Streams, Creeks – Permanent • Rivers, Streams, Creeks – Seasonal / Intermittent / Irregular • Riparian Areas
Wetlands	The Meewasin Valley contains mostly freshwater wetlands existing among matrices of cultivated fields, domestic pasture, or hay land, and native vegetation. Both permanent and seasonal wetlands are present within the planning scope, with seasonal wetlands being dependent upon yearly local precipitation and snowmelt. Wetlands are dominated in some areas by cattails, sedges, and rushes, with some shrubs in others.	<ul style="list-style-type: none"> • Wetlands – Seasonal / Intermittent Freshwater Pools • Wetlands – Permanent Freshwater Pools • Wetlands – Permanent Saline, Brackish, or Alkaline Pools • Wetlands – Seasonal / Intermittent Saline,

		Brackish or Alkaline Pools
Post-glacial Channel Scars (Swales)	<p>Post-glacial channel scars are defined by depositions of glacial till, resulting in rocky ridges and a high water table, which produces wet depressions in the terrain. These distinct landscapes have resulted from the scouring of glacial drainage passing through ancient spillway channels. These features contain unique mosaic landscapes composed of native prairie and wetland complexes. The rocky, undulating composition of swale landscapes has historically deterred tillage and development, preserving freshwater wetlands and portions of uncultivated prairie. The native prairie portions of these swales may include moist-mixed prairie, fescue prairie, shrublands with a mixture of native species, and marginal aspen forests. The Meewasin planning zone includes multiple swale complexes within the Saskatoon region including the Northeast Swale, the Small Swale, the Hudson Bay Swale, and the West Swale with many Meewasin sites either directly located within, or closely adjacent to portions of these important areas.</p>	<ul style="list-style-type: none"> • Wetlands – Seasonal / Intermittent Freshwater Pools • Wetlands – Permanent Freshwater Pools • Grassland – Temperate • Shrubland – Temperate

2.1B Conservation Threats

The Meewasin RMP identifies and ranks a series of potential threats to the status of the four conservation targets detailed above. The “threats” represent potential hazards which have the ability to compromise the integrity or status of the four conservation targets. Threats were assessed and ranked according to their perceived scope, severity, and irreversibility when applied to the associated conservation targets on a regional scale. Threat rankings correspond with the following categorization metrics, which were created in tandem with the Nature Conservancy of Canada – Saskatchewan, the Conservation Measures Partnership, and Meewasin (Tomlinson et al. 2017):

- **Low:** The threat is likely to slightly degrade, is narrow in scope (1-10% across occurrence), or easily reversed at low cost to restore (0-5 years). These threats can have easily attainable actions or objectives associated with them or may simply become less of a priority for the conservation plan.
- **Medium:** The threat is likely to moderately degrade, is restricted in scope (11-30%) or is reversible with a reasonable commitment to restore (6-20 years).
- **High:** the threat is widespread and will seriously degrade the target (31-70%) or may technically be reversed but may not be practically affordable to restore (21-100 years).

- **Very High:** The threat is pervasive or may destroy the target (71-100%), cannot be reversed and is unlikely to be restored (100+ years).

Table 2. Meewasin RMP Threat Rankings and Monitoring Actions

Conservation Threat	Threat Ranking	Associated Monitoring Actions	Scale of Application
<i>Invasive Species</i>	Very High	Vegetation surveys, terrestrial invasive surveys, aquatic / riparian invasive surveys, distribution mapping	<ul style="list-style-type: none"> • ALL
<i>Climate Change – Regional</i>	High	Plotting gradational changes in baseline data occurring across spatial and temporal intervals	<ul style="list-style-type: none"> • ALL
<i>Dams and Water Management</i>	High	Observed flow rates – externally monitored	<ul style="list-style-type: none"> • Regional
<i>Fire and Fire Suppression</i>	High	Disturbance mapping, fuel load monitoring, grazing utilization, stand density and biomass estimations	<ul style="list-style-type: none"> • Project • Site
<i>Runoff of Pesticides and Fertilizers</i>	High	Water quality monitoring, soil testing	<ul style="list-style-type: none"> • Project
<i>Storm Water</i>	High	Water quality monitoring, external regional monitoring initiatives (micro plastics, storm catchment water quality, municipal waste water monitoring)	<ul style="list-style-type: none"> • Conservation Target • Project • Site
<i>Suburban Development</i>	High	Development Review Process, Land Cover / Land Use analysis / Habitat Patch Size and Connectivity analysis (<i>State of the Valley, Natural Areas Inventory</i>)	<ul style="list-style-type: none"> • Regional • Conservation Target • Project • Site
<i>Trespass Issues</i>	High	Wildlife cameras, issues tracking, ad hoc monitoring	<ul style="list-style-type: none"> • Regional • Site
<i>Acreage and Exurban Development</i>	Medium	Land Cover / Land Use analysis, Habitat Patch Size and Connectivity analysis (<i>State of the Valley, Natural Areas Inventory</i>)	<ul style="list-style-type: none"> • Regional
<i>Commercial and Industrial Development</i>	Medium	Development Review Process, Land Cover / Land Use analysis / Habitat Patch Size and Connectivity analysis (<i>State of the Valley, Natural Areas Inventory</i>)	<ul style="list-style-type: none"> • Regional • Project • Site
<i>Conversion to Agriculture</i>	Medium	Land Cover / Land Use analysis / Habitat Patch Size and Connectivity analysis (<i>State of the Valley, Natural Areas Inventory</i>)	<ul style="list-style-type: none"> • Regional • Conservation Target
<i>Mining and Quarrying</i>	Medium	Observed changes in Land Cover / Land Use (Meewasin RMP)	<ul style="list-style-type: none"> • Regional

<i>Irresponsible Recreation</i>	Medium	Issues tracking, wildlife cameras, ad hoc monitoring	<ul style="list-style-type: none"> • Regional • Site
<i>Recreational Areas</i>	Medium	Development Review Process, Land Use analysis / Habitat Patch Size and Connectivity analysis (<i>State of the Valley, Natural Areas Inventory</i>), trail counters	<ul style="list-style-type: none"> • Regional • Project • Site
<i>Road and Rail</i>	Medium	Development Review Process, Land Cover / Land Use analysis / Habitat Patch Size and Connectivity analysis (<i>State of the Valley, Natural Areas Inventory</i>), wildlife cameras, winter wildlife surveys	<ul style="list-style-type: none"> • Regional • Project • Site
<i>Thermal Pollution</i>	Medium	External monitoring initiatives – unknown	<ul style="list-style-type: none"> • Regional
<i>Unsustainable Grazing Management</i>	Medium	Grazing cages (percent biomass grazing intensity), Robel Pole (standing biomass / visual obscenity estimates), vegetation composition surveys	<ul style="list-style-type: none"> • Conservation Target • Project • Site
<i>Utility and Service Lines</i>	Medium	External monitoring initiatives – unknown	<ul style="list-style-type: none"> • Regional
<i>Light Pollution</i>	Low	Sky quality meters (dark sky light pollution measurements)	<ul style="list-style-type: none"> • Project • Site
<i>Military Exercises</i>	Low	Unknown	<ul style="list-style-type: none"> • Regional
<i>Problematic Native Species</i>	Low	Rangeland health assessments, riparian forest health, ad hoc monitoring	<ul style="list-style-type: none"> • Project • Site
<i>Sound Pollution</i>	Low	Bioacoustics recording devices, breeding bird surveys, grouse lek monitoring, decibel meter levels	<ul style="list-style-type: none"> • Conservation Target • Project • Site
<i>Urban Riverbank Slumping and Slope Instability</i>	Low	Development Review Process, external monitoring initiatives (City of Saskatoon)	<ul style="list-style-type: none"> • Regional • Project • Site

3.0 Valley-Wide Monitoring Framework

The Meewasin Valley-Wide Monitoring Framework project aims to promote adaptability, efficiency, and continuity in the planning, communication, and implementation of monitoring work across the Meewasin Valley region over the next five years. This document provides context for the various ways that monitoring-related information functions within Meewasin, from informing conservation management to guiding ecologically sensitive development and informing outreach opportunities. The document culminates in a series of recommended action items (Section 8.0) intended to enhance internal effectiveness of monitoring and management activities as they are currently applied by Meewasin and externally advance a larger cooperative approach to monitoring throughout the region through the formation of collaborative partnerships. Recommendations within this document serve to alleviate obstacles and incongruences within Meewasin's current monitoring-related efforts and promote best practices moving forward. The recommendations also aim to develop clearer understandings of monitoring practices through the advancement of stronger internal communication mechanisms and the promotion of community-informed planning. Importantly, the initiatives within this project aim to elevate Meewasin's current approach to monitoring through the development of standardized protocols for monitoring actions, data management tasks, project planning, and documentation.

3.1 Project Document Design

The figure below visualizes the planning process for the monitoring framework document. Initial steps within this planning sequence, such as the literary review stage and the critical analysis of internal monitoring practices, provide a foundation for the discussion and strategic direction presented within this document. The discussion draws heavily from relevant academic research as well as the previous and ongoing work of numerous organizations within the broader prairie conservation community. Many external organizations and initiatives influenced the creation of this document including, but not limited to, the Nature Conservancy of Canada – Saskatchewan Region, the Conservation Measures Partnership, Environment and Climate Change Canada – Canadian Wildlife Service, the City of Saskatoon's *Green Infrastructure Strategy*, Saskatchewan Ministry of Environment, Wildlife Conservation Society, Alberta Biodiversity Monitoring Institute, and the Saskatchewan Conservation Data Centre. The planning map for this document moves through various stages of feedback and revision, concluding with project approval through Meewasin's internal review process. In the successive stages of project advancement, this document may be used to thematically guide monitoring planning and communication, provide context as a distributional conversation tool, and supply a retrospective foundation from which to evaluate future progress in advancing recommendations and attaining desired project goals.

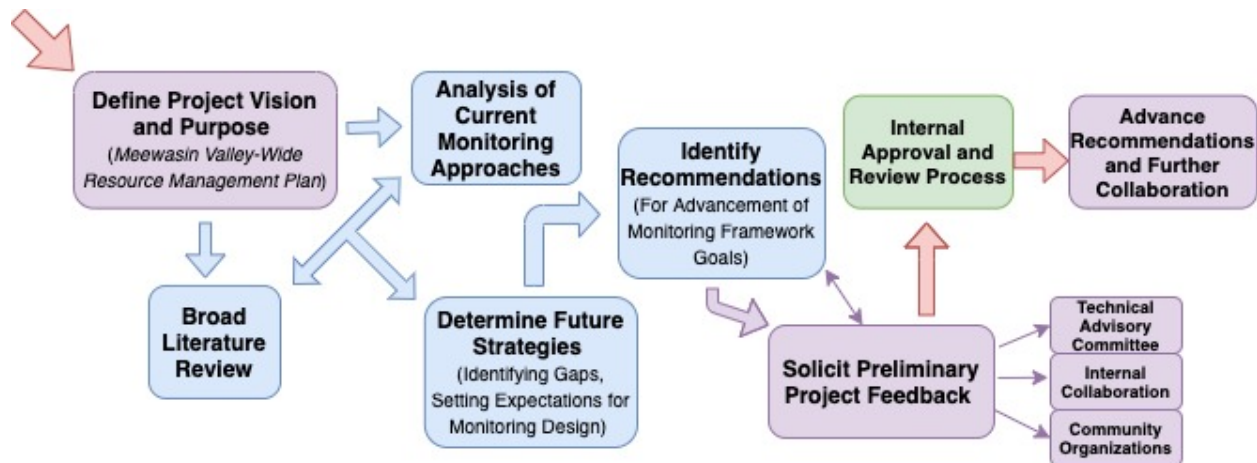


Figure 2. Framework Document Planning Map

3.2 Methodological Review

This subsection details major methodologies and planning tools that provide the basis for the monitoring framework project approach. Meewasin follows the lead of various other planning and conservation organizations that apply the models mentioned within this section. These methods are used to broadly frame planning and project implementation within Meewasin and are successively reflected throughout this document.

3.2A Open Standards Model

The Open Standards for the Practice of Conservation is an initiative of the Conservation Measures Partnership, developed to standardize the process of conservation project management. This model applies standardization to conservation terms and definitions, project components and categories, with the overarching goal of coordinating conservation planning approaches among different organizations (Conservation Measures Partnership 2013). Adapting a standardized methodology that is transferable between different organizations within conservation planning is advantageous because it fosters consistency and clarity within the planning process and creates the opportunity for project plans to be referenced more broadly within the conservation community (Conservation Measures Partnership 2013). Meewasin is included among a growing list of conservation agencies that have adopted the Open Standards model including Conservation International, the Nature Conservancy of Canada, The Nature Conservancy, the United States Fish and Wildlife Service, and the World Wildlife Fund. Meewasin advances the cyclical adaptive management process laid out within the Open Standards Model through resource management planning, implementation, monitoring, and measuring intervention effectiveness.

The Open Standards model follows a five-step process (Figure 3) which includes: (1) assessing project scope, team, purpose, conservation targets, and critical threats; (2) planning interventions and monitoring strategies; (3) implementing actions and monitoring; (4) analyzing data results to inform and adapt strategic planning; and (5) documentation and communication of accumulated knowledge.

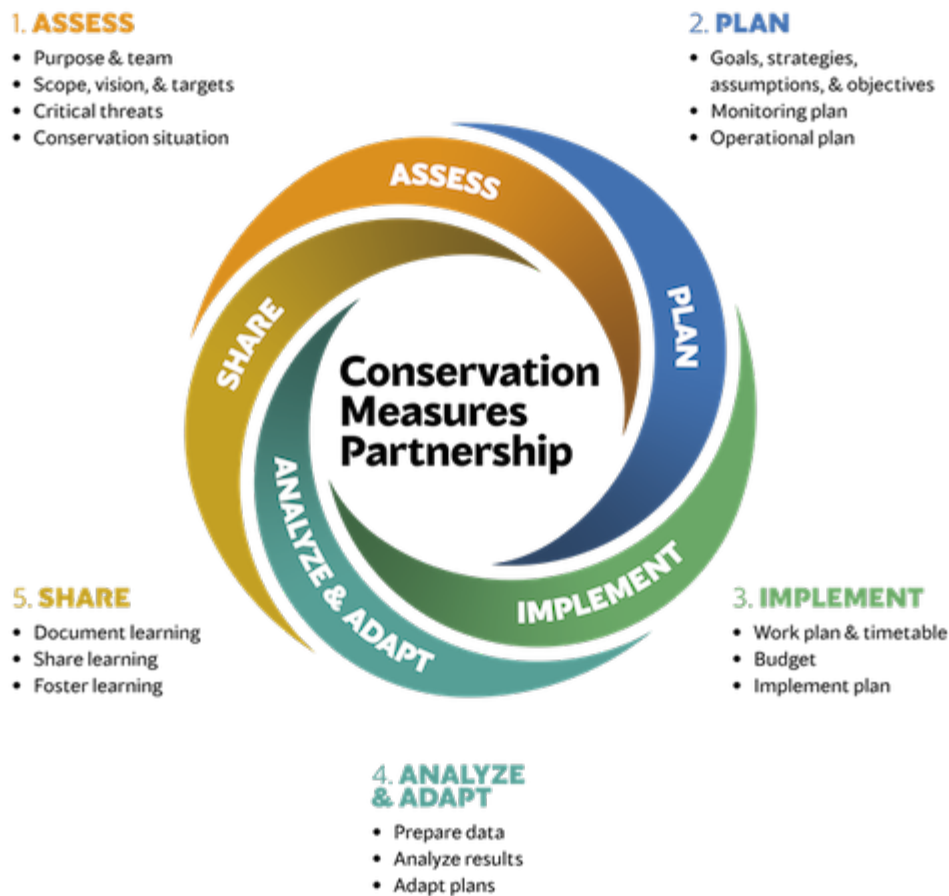


Figure 3. Open Standards Model (Conservation Measures Partnership 2013)

3.2B Miradi Software Tool

Miradi is a software program that complements the Open Standards model, by guiding conservation practitioners through steps of project design, monitoring, and results-based adaptation to effectively meet conservation goals (Miradi 2016). Miradi creates a visual conceptual model that displays threat and result chains within a project plan. The program maps important project components to create an adaptable concept map that conservation practitioners may refer to as a visual aid and planning tool within their project design process (Miradi 2016). The Miradi program is highly adaptable as it allows practitioners to input any level of information and continually update the project plan as it expands and advances in scale and scope (Miradi 2016). This framework specifically encourages the utilization of Miradi as a planning and data analysis tool throughout the process of devising a monitoring plan. Meewasin continues to use this software to adaptively inform management decisions, review progress, and assess management strategies.

3.2C Adaptive Management Process

The Open Standards for the Practice of Conservation and Miradi are complementary ideological modeling tools that advance the practice of adaptive management. “Adaptive management” (Figure 4) is a results-based approach to complex system management, which simultaneously engages practitioners in the processes of active management and reflexive learning (Williams 2011). The feedback between learning and decision-making is a defining feature of this management approach (Williams 2011). Adaptive management provides a framework for learning through the cyclical process of testing assumptions, adjusting management strategies, gaining and sharing experiential knowledge, and communicating results (Holness and Biggs 2011). Retrospective monitoring, effectiveness assessment, and progress informed decision-making practices are advanced within this approach to help management practitioners successfully evolve and adapt to circumstantial changes and shifting variables (Williams 2011).

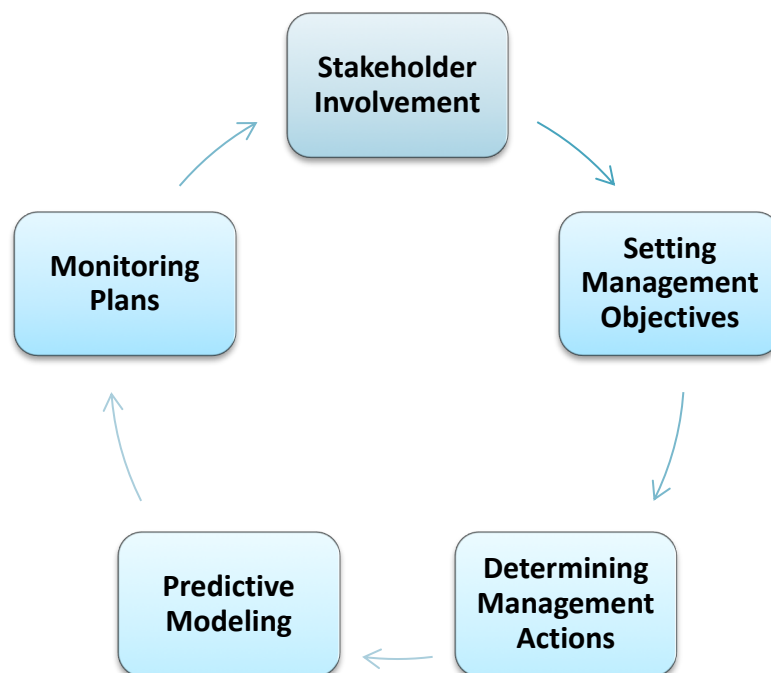


Figure 4. Adaptive Management Components (Williams 2011)

3.3 Advancing Meewasin Guiding Principles

Strong organizational mission and guiding principles have provided the foundation for Meewasin to successfully operate and adapt in conversation with its surrounding environment. Meewasin bridges foundational themes from Raymond Moriyama’s 100-year concept plan (*The Meewasin Valley Project*) with present-day strategies to meet the development demands of a growing urban population, adapt to the challenges of advancing conservation in close adjacency to urban developments, and connect people to nature amid an expanding technological landscape. Relevant academic literature identifies group mission as an important component to the successful creation and implementation of monitoring design (Salafsky and Margoulis 2001). A mission statement provides guiding principles for the vision, long-term desired purpose, and

strategic selection of monitoring system variables (Salafsky and Margoulis 2001). This subsection describes the organizational mission and guiding principles for Meewasin and reapplies these concepts within the context of the Valley-Wide Monitoring Framework project.

3.3A Meewasin Valley Authority Mission Statement

The Meewasin Valley Authority exists to ensure a healthy and vibrant river valley, with a balance between human use and conservation by:

- Providing leadership in the management of its resources
- Promoting understanding, conservation, and beneficial use of the Valley; and
- Undertaking programs and projects in river valley development and conservation for the benefit of present and future generations.

In alignment with the vision statement above, Meewasin continues to apply the following fundamental principles to guide planning, development, and design within the river valley:

- **Accessibility** – ensure the Valley’s resources are accessible to everyone;
- **Conservation** – conserve natural and heritage resources;
- **Balance** – integrate elements of recreation and development balanced with conservation
- **Diversity** – accommodate diverse activities for a varied and changing demographic
- **Participation** – include public participation in decision making

3.3B Applying Meewasin’s Guiding Principles

The Valley-Wide Monitoring Framework Project functions to enhance internal effectiveness of monitoring design, planning, and implementation within Meewasin. This project aspires more broadly to advance a larger collaborative approach to monitoring throughout the Meewasin Valley region through the formation of diverse collaborative monitoring partnerships, the promotion of community-informed planning and design, and the development of educational monitoring-related outreach opportunities. The goals that the monitoring framework project aims to achieve are directly related to the foundational guiding principles of the Meewasin Valley Authority, as exemplified in the table below:

Table 3. Applying Meewasin Guiding Principles to Monitoring Framework Project Aspirations

Guiding Principle	Connection to Monitoring Framework Project Goals and Recommendations
Accessibility	<ul style="list-style-type: none"> • Promoting increased public communication around monitoring through social media and more succinct reporting mechanisms. • Advancing data availability, transferability, and centrality.
Conservation	<ul style="list-style-type: none"> • Advancing the vision laid out in the <i>Meewasin Valley-Wide Resource Management Plan</i> through the completion of action item 8.1.20 (which calls for the development of a monitoring framework)

	<ul style="list-style-type: none"> • Encouraging adaptability and informed planning within monitoring design, in line with the tenants of adaptive management in conservation planning.
<i>Balance</i>	<ul style="list-style-type: none"> • Requiring the submission of individual project monitoring plans within Meewasin's project review process. • Encouraging more efficient interdepartmental planning and collaboration around monitoring-related initiatives.
<i>Diversity</i>	<ul style="list-style-type: none"> • Building community-informed regional monitoring designs with variables that reflect local interests, values, and lived experiences. • Collaborating with Indigenous peoples to advance the integration of traditional ecological knowledge within monitoring design, application, and data interpretation.
<i>Participation</i>	<ul style="list-style-type: none"> • Inviting community members to engage in monitoring through Citizen Science, volunteer experiences, and educational outreach opportunities. • Building strong monitoring-related partnerships across the prairie conservation sphere to aid in cooperative monitoring design and planning.

4.0 Applications of Monitoring

Meewasin relies on an array of monitoring tools, methods, and partnerships to accrue ecological data that informs management strategies, development projects, educational perspectives, and outreach initiatives. This section will discuss the ways in which monitoring is currently applied by Meewasin and present a strategy for the assessment and elevation of monitoring practices moving forward.

4.1 Categorizing Monitoring Initiatives

Monitoring initiatives pursued by Meewasin vary in design, method, purpose, temporal and spatial applications, and a variety of other defining criteria. This subsection contains a theoretical exercise in which the current monitoring initiatives employed by Meewasin have been dissected and categorized according to information output, function, and scales of application. This exercise in deconstructing and categorizing current monitoring applications serves to illustrate the diverse and abundant applications for monitoring and associated considerations for monitoring design.

4.1A Categories of Information Output

Acquiring information is the primary goal of individual monitoring actions. Data collected through monitoring initiatives provides the context for trend analysis, data conversion, and system assessment. Raw data collected through autonomous monitoring instruments, human operated field equipment, and general field survey observations can be categorized generally to fit within one of three broad data collection categories:

- **Spatial Data** – Monitoring methods that convey digital spatial data in raster or vector format, which is used to convey information about a specific spatial location. Vector data is represented by geometric points, lines, and polygons which are used to convey information about the location and parameters of various features. Vector data is typically collected using devices that output x, y geographical coordinates, such as a GPS unit. Raster data consists of various data points located within a dot matrix structure, commonly stored and viewed as pixels in a grid, with each grid cell representing a unified spatial area unit. This type of data is communicated in graphic form and typically conveyed through images or continuous data sets, often produced by scanning or photographing a spatial area or object. Monitoring information that falls within this data category is typically captured in the form of aerial imagery, collected through the use of remote sensing devices such as satellites and drones.
- **Spectral Data** – This category includes various forms of electronic data collected through the use of electronic recording devices that yield audio, visual, and other spectral ranges of digital data output. Some mechanisms that Meewasin uses to collect data within this category include wildlife cameras, bioacoustic noise capture devices, trail counters, and dark-sky quality meters.
- **Miscellaneous Outputs** – This category provides a space for all remaining data collection methods that yield varying outputs which do not fit within the previous two

digital data categories outlined above. Monitoring activities within this category may communicate information related to observations of corporeal nature, collected by humans through various methods of physical sampling, surveying, and assessment. This form of data typically requires additional manual digital summarization, processing, analysis, and interpretation following the data collection period. Examples of capture methods that might fall within this data output category include direct visual and auditory observations, written documentation, structured surveying and ecological assessment techniques, and physical sampling and specimen collection.

4.1B Function of Monitoring Activity

Meewasin generally conducts observational activities in relation to six major monitoring functions. The functional categories below reflect relational trends and areas of ecological understanding that monitoring initiatives serve to broaden. These categories reference the specific goals of monitoring or areas where information is intended to be collected. The categories in this section are not mutually exclusive and information collected in association with a particular functional category is often used to supplement larger-scale monitoring efforts. The identified functional categories include:

- **Wildlife Behaviour Monitoring** – Any data collection effort that is relevant to understanding general wildlife behaviour, movement patterns, presence, abundance, and survivorship. Meewasin conducts wildlife monitoring initiatives to gain insight on things such as wildlife interactions with infrastructure, presence and abundance of specific wildlife species, locations of important wildlife habitat, landscape fragmentation and movement corridors, and wildlife behaviours during seasons of heightened activity such as breeding and migration.
- **Invasive Species Monitoring** – Initiatives to chronicle the occurrence, abundance, spread, and concentration of invasive species. This includes targeted efforts to locate, document, and control populations of particular aggressive or problematic non-native species. This monitoring category informs invasive control and other integrated resource management intervention strategies.
- **Vegetation Composition Monitoring** – Monitoring activities that are relevant in assessing abundance, presence, and composition of vegetation in plant communities. Meewasin emphasizes mapping and documentation of native, rare, and at-risk plant species to inform conservation management efforts and development strategies.
- **Environmental Condition Monitoring** – Initiatives within this category relate to the status of an environmental variable or natural feature that can be used to build datasets and form hypotheses about larger climatic trends within a system or area of interest. Efforts within this category include the study and documentation of pollutants and other variables that indicate adverse compositional changes linked to human behaviour, infrastructure development, and climate change.
- **Human-Site Interaction Monitoring**: Collection of information that relates to human activities, access, and interactions within the Valley on sites and infrastructure. This information is important for identifying accessibility issues, demands for infrastructure development, cultural and historical significance, and threats that human

activity poses to the natural environment. This category includes mechanisms for capturing, reporting, and documenting human activities.

- **Collectively Powered Monitoring Networks:** This category includes major partnership fueled, information-generating projects, which produce monitoring data such as large scale (national, regional, provincial) data collection efforts, Citizen Science networks and publicly sourced databases. The data gathered from these networks informs many of the categories summarized above.

4.1C Project Monitoring Timelines

Some monitoring initiatives are performed singularly in a non-sequential manner, while other initiatives are frequently repeated across broad temporal intervals. This section provides two categories in which to sort monitoring initiatives based on monitoring project longevity. The categories are as follows:

- **Short-term Monitoring:** Refers to ad hoc or incidental observations and projects that occur within a single season without the intent of repetition or spatial and temporal continuity. These projects collect detailed information, for project-specific purposes. Short-term monitoring efforts are typically conducted a single time or within a single season and used to inform specific decisions, answer specific feature-related questions, and retrospectively assess management interventions.
- **Long-term Monitoring:** Refers to projects in which collected monitoring data adds to a larger project database, recollected at specific temporal and spatial intervals, and repeated in future seasons. Data collected in association with long-term projects directly contributes to larger data collection efforts. Long-term projects are typically associated with a network of information, long-term trends, or repeated studies of a specific monitoring area as it changes over time.

4.1D Scale of Application

Objectives, analysis, and application of monitoring work can be applied on various spatial scales, with corresponding differences in the levels of detail. As the spatial area of monitoring initiatives increases in size, the level of detail associated with the monitoring effort decreases. Monitoring that is concentrated within a small spatial area is therefore more complex as it has the potential to encompass multiple variables and methods of observation. Conversely, monitoring projects that cover broader spatial areas are less detailed, involving fewer variables and methods of monitoring. This inverse relationship between spatial scale and detail exemplifies the trade-offs that must be made within the process of determining the scope for a particular monitoring project.

For the purpose of classifying spatial scale of internal monitoring, initiatives will fall within at least one of five categories related to scale of application:

1. **Project Level Monitoring:** This scale relates to project-specific monitoring initiatives that involve small focus areas with detailed monitoring applied to multiple variables. Initiatives that fall within this scope might include donor funded projects, infrastructure development related monitoring, programmatic projects (e.g. prescribed fire, targeted grazing), and rare or special interest monitoring.

2. **Site Level Monitoring:** This level of monitoring is associated with initiatives that provide an indication of the status of a site, or property that Meewasin manages. These types of projects generate information used to make inferences regarding ecological condition and areas for further management or development.
3. **Target Level Monitoring:** Monitoring at this level involves assessing various patterns occurring across similar features or landscape groupings that contain similar characteristics. For advancing work within the Valley, feature classes within this spatial monitoring level will correspond with the conservation targets identified within the *Meewasin Valley-wide Resource Management Plan* (Section 2.1). The four Meewasin RMP conservation targets are representative of the unique landscapes managed within the Valley and can be assessed as groupings with comparable ecological characteristics, threats, and indicators. The four Meewasin RMP targets within this level include Native Grasslands, Hydro-Riparian Areas, Wetlands, and Swales. See Section 2.1 (Table 1) for target definitions.
4. **Regional Level Monitoring:** Regional level projects involve pattern assessment and data trend analysis that spans across the entire Meewasin Valley planning zone (with a 15 kilometer buffer applied). This level predominantly contains projects that are post-analytical in nature, pertaining to use, mapping, and analysis of retrieved data.
5. **Provincial and/or National Level Monitoring:** Largest spatial extent concerned predominately with large-scale collective partnership projects and databases.

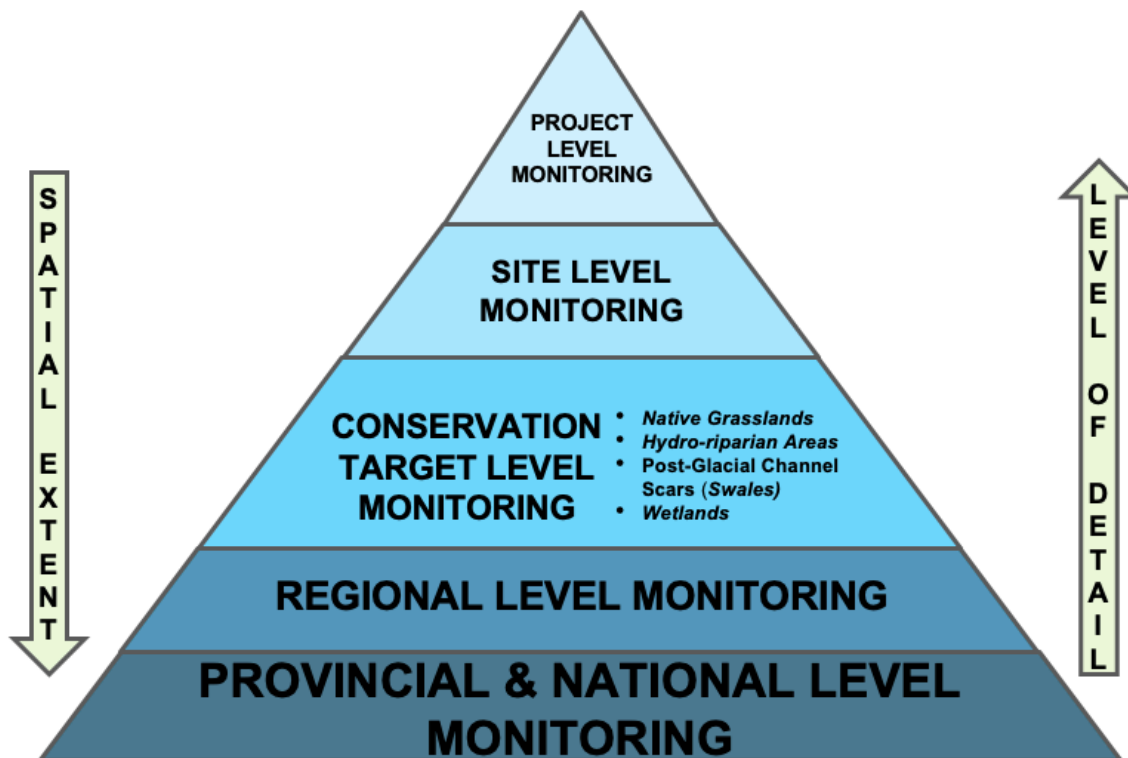


Figure 5. Multiscale Monitoring Applications

4.2 Current Monitoring Methods

Meewasin conducts various monitoring-related initiatives across the Valley region throughout the year. The information retrieved through monitoring is used internally to inform management decisions and conservation goals. The following table provides an inventory of the monitoring methods and initiatives employed by Meewasin at the time of drafting this report. Individual monitoring initiatives have been positioned within the table corresponding with the categories identified above in section 4.1. Citizen Science databases, ad hoc surveying, and incidental observational data are used to build the inventories of all monitoring categories shown within this section. To simplify this inventory, the methods of monitoring have been singularly listed within a broadly representative category, without acknowledgement of multi-purpose monitoring functionality.

Meewasin regularly acquires data and monitoring-related information through publicly accessible databases, collaborative monitoring initiatives, and information sharing partnerships. It is through the collaborative efforts of local institutions and organizations, research partnerships, engaged citizens, and public data collection networks that monitoring information is communicated and advanced across the Meewasin Valley and surrounding region. Although the organizations and individuals responsible for advancing the growing body of monitoring-related information within the Valley region are too numerous to mention, Meewasin would like to acknowledge the ongoing contributions from important local non-profit, citizen-led and volunteer-powered organizations such as the Saskatoon Nature Society and its dedicated members, the Native Plant Society of Saskatchewan, Wild About Saskatoon, the Entomological Society of Saskatchewan, Trout Reach Saskatchewan, the South Saskatchewan River Watershed Stewards, and the many contributions of various University of Saskatchewan faculty and students.

Table 4. Current Meewasin Monitoring Initiatives

Category of Understanding	Monitoring Method	Monitoring Mechanism	Monitoring Indicators	Project Timeline	Application Scales	Monitoring Equipment	Associated Parties
Wildlife Behaviour Monitoring	Wildlife presence and behavior	Wildlife cameras	Presence / absence, observed behaviours	Short to Long-term	All Scales	Various models of Wildlife Cameras	Meewasin, UWIN ¹
	Autonomous Acoustic Recorders	Passive and active bioacoustics technology	Capture of wildlife vocalizations (bird calls,	Short-term	Project, Site	Wildlife Acoustic Song Meter SM3, Echo Meter	Meewasin

¹ Urban Wildlife Information Network

			ultrasonic bat vocals, others)			Touch 2 Pro, accessories	
	Amphibian Surveys	Northern Leopard Frog (<i>Lithobates pipens</i>)	Identification, presence, location	Short-term	Project, Site	Wildlife Acoustic Song Meter SM3, GPS ² unit	Meewasin, SNS ³
		Western Tiger Salamander (<i>Ambystoma mavortium</i>)	Identification, presence, location	Short-term	Project, Site	Hip waders, GPS unit	Meewasin, SNS
	Benthic Macroinvertebrate Sampling	Retrieving specimen from wetlands	Presence, identification, location	Short-term	Project, Site	Hip waders, sampling equipment	Meewasin
	Winter Wildlife Track Surveys	Wildlife snow track identification and observations	Presence, identification, abundance, behavioural observations	Short-term	Project, Site	Snowshoes, ruler, camera, GPS unit	Meewasin; SNS
	Bird Monitoring	Breeding Bird Surveys	Point Count procedure SK BBA	Long-term	Project, Site	Handheld bioacoustics recorder, binoculars	Meewasin
		General Bird Surveys and Sighting Confirmations	Species identification, presence, time and location	Short-term	Project, Site	Camera, binoculars, Wildlife Acoustic Song Meter SM3	Meewasin, SNS
		Sharp-tailed Grouse (<i>Tympanuchus phasianellus</i>) Lek Monitoring	Presence, abundance, time and location, observed activity and wildlife interactions	Short-term	Conservation Target, Project, Site	Handheld decibel level meter, wildlife cameras, binoculars	Meewasin, SNS
		Nesting Cavity Surveys	Evidence of cavity nesting	Short-term	Project, Site	Binoculars, GPS unit	Meewasin, SNS

² Global Positioning System

³ Saskatoon Nature Society

			in forest stands				
	Insect Monitoring	Bioblitz ⁴ Activities	Capture and identify specimen	Short-term	Project, Site	Sweep nets, sticky traps, pitfall traps	Meewasin, SNS, WAS ⁵
		Wetland Insect Monitoring	Capture and identification	Short-term	Project, Site	Stick traps, pitfall traps	Meewasin
		Gibson's Giant Tiger Sand Beetle (<i>Cicindela formosa gibsoni</i>)	Presence, location, abundance	Short-term	Project, Site	GPS unit	Meewasin, SNS
	Small Rodent Monitoring	Bioblitz Activities	Presence, capture, and identification	Short-term	Project, Site	Live traps	Meewasin, SNS, WAS
Invasive Species Monitoring	Terrestrial Invasive Plant Surveying	Dame's Rocket (<i>Hesperis matronalis</i>)	Identification, presence, abundance, location	Short-term	Regional, Conservation Target, Project, Site	GPS unit	Meewasin
		Nodding Thistle (<i>Carduus nutans</i>)	Identification, presence, abundance, location	Short-term	Regional, Conservation Target, Project, Site	GPS unit, shovels	Meewasin
		European Buckthorn (<i>Rhamnus cathartica</i> L.)	Identification, presence, abundance, location	Short to Long-term	Regional, Conservation Target, Project, Site	GPS unit, hand saws, herbicide	Meewasin
		Leafy Spurge (<i>Rhamnus cathartica</i> L.)	Identification, presence, abundance, location	Short to Long-term	Regional, Conservation Target, Project, Site	GPS unit, herbicide, biocontrol	Meewasin
		Common Tansy (<i>Tanacetum vulgare</i>)	Identification, presence, abundance, location	Short-term	Regional, Conservation Target, Project, Site	GPS unit, herbicide	Meewasin

⁴ Intense period of biological surveying by groups of volunteers coordinated through Meewasin-led "EcoScavenger Hunt" events, commonly known as "BioBlitzes"

⁵ Wild About Saskatoon

		General Invasive Plant Surveys and Site Inventories	Identification, presence, abundance, location	Short-term	Regional, Conservation Target, Project, Site	GPS unit	Meewasin
	Aquatic Invasive Species Monitoring	Flowering Rush (<i>Butomus umbellatus</i>)	Presence, location	Long-term	Provincial, Regional	GPS unit, shovel, bags, canoe	Meewasin, NPSS ⁶ , SSRWS ⁷ , SK Agriculture ⁸
		Zebra Mussel (<i>Dreissena polymorpha</i>)	Presence, location	Long-term	Provincial, Regional	Substrate samplers	Meewasin, SK Environment ⁹
		Prussian Carp (<i>Carassius gibelio</i>)	Presence, location	Long-term	Provincial, Regional	GPS unit, drift nets	Meewasin, SK Environment, UofR ¹⁰
	Diseases and Pests	Dutch Elm Disease	Presence, location	Long-term	Provincial, Regional	GPS unit	Meewasin, CoS ¹¹ , SK Environment
		Emerald Ash Borer	Presence, location	Long-term	Provincial, Regional	GPS unit	Meewasin, CoS, SK Environment
Vegetation Composition Monitoring	Grazing Intensity Monitoring	Grazing cages	Percent Utilization	Short-term	Project, Site	Grazing cages, quadrat, clippers, bags	Meewasin
	Standing Vertical Height Density	Robel Pole	Height and vertical density	Short-term	Project, Site	Robel pole, grazing cage	Meewasin
	Riparian Shoreline Vegetation Surveys	Riparian Health Assessment	Species identification, health, vegetation community composition	Short-term	Project, Site	Quadrat, GPS unit, assessment guides	Meewasin

⁶ Native Plant Society of Saskatchewan

⁷ South Saskatchewan River Watershed Stewards

⁸ Government of Saskatchewan – Ministry of Agriculture

⁹ Government of Saskatchewan – Ministry of Environment

¹⁰ University of Regina

¹¹ City of Saskatoon

	Rangeland, Native Grassland and Forest Assessments	Rangeland Health Assessment	Species identification, health, community composition	Short-term	Project, Site	Quadrat, GPS unit, assessment guides	Meewasin, USask
	SAR / Rare Plant Species Surveying	Crowfoot Violet (<i>Viola pedate</i>)	Identification, presence, location	Short-term	Project, Site	GPS unit	Meewasin, SNS, NPSS
		Smooth Goosefoot (<i>Chenopodium subglabrum</i>)	Identification, presence, location	Short-term	Project, Site	GPS unit	Meewasin, NPSS
		General surveying and inventorying	Identification, presence, location	Short-term	Project, Site	GPS unit	Meewasin, NPSS
	Vegetation Composition Surveying	Various physical survey methods	Identification, community composition	Short-term	Project, Site	GPS unit, quadrat	Meewasin
	Post-disturbance Vegetation Surveying	Various physical survey methods	Identification, community composition	Short-term	Project, Site	GPS unit, quadrat	Meewasin
Environmental Condition Monitoring	Noise Level Monitoring	Automated recording units	Decibel range	Short-term	Project, Site	Handheld sound level meter, portable ARU ¹²	Meewasin
	Water Quality Sampling	Field sampling and lab analysis	Variable ranges	Short-term	Project, Site	Hip waders, field sampling equipment, PPE ¹³ , lab equipment	Meewasin, SRC ¹⁴
	Light Pollution Monitoring	Sky Quality Meters	Sky glow or light pollution	Short-term	Project, Site	SQM-L dark sky meters	Meewasin

¹² Autonomous Recording Device

¹³ Personal Protective Equipment

¹⁴ Saskatchewan Research Council

	Stormwater Contamination and Micro Plastic Monitoring	Field sampling and lab analysis	Presence and concentration	Short-term	Project, Site	Field sampling and lab testing equipment	Meewasin, SSRWS, Dr. Markus Brinkmann USask
	Permanent Plot Monitoring	Various field surveying	Observations, data trend analysis	Long-term	Site	Monitoring posts, quadrats, wildlife, GIS ¹⁵ cameras, bioacoustics recorders	Meewasin
Human-Site Interaction Monitoring	Site Incidents	Dated text-file inventories	Observations of human-related issues	Short to Long-term	Site	Excel	Meewasin
	Trail Activity	Trail counters	Motion-triggered, numeric count data	Short to Long-term	Site	Trail counters	Meewasin
	Intercept Surveying	Public surveying	Perceptions, site usage	Short-term	Project, Site	Public Survey	Meewasin
	Anthropological Surveying	Informal and Formal Efforts	Presence, identification, location, interpretation / observations	Short-term	Project, Site	GPS unit	Meewasin, USask ¹⁶
	<i>State of the Valley, Natural Areas Inventory</i> reports	Data analysis and interpretation	Accessibility to river, trails, and sites, public use survey results	Short to Long-term	Regional	GIS	Meewasin
Partnership Powered	Urban Wildlife Information Network	Wildlife cameras	Wildlife presence, identification, observations	Long-term	National, Regional, Project	Wildlife cameras	Meewasin, UWIN, USask, WAS, SFF ¹⁷

¹⁵ Geographic Information System (Esri ArcMap)

¹⁶ University of Saskatchewan

¹⁷ Saskatoon Forestry Farm and Zoo

Monitoring Networks	Saskatoon Nature Society Bird Counts	Spring Bird Count	Identification, presence, location	Long-term	National, Provincial, Regional	Binoculars, GPS Unit	Meewasin, SNS
		Christmas Bird Count	Identification, presence, location	Long-term	National, Provincial, Regional	Binoculars, GPS Unit	Meewasin, SNS
	Citizen Science Data and Data-sharing Partnerships	Access to variety of observational digital data	Identification, location	Long-term	National, Regional, Site	Database access	iMapInvasives, eBird, Bird Atlas, iNaturalist, HABIsask, CDC ¹⁸

4.3 Elevating Monitoring Practices

Included among the recommendations in Section 8.0 is the suggestion to routinely evaluate monitoring strategies on an annual basis, prior to subsequent field season planning, budgeting, and resource allocation. This routine assessment of monitoring methods will serve as an opportunity to revisit data collected during the previous field season, assess progress towards meeting conservation goals, and illuminate inefficiencies in monitoring design and implementation.

To supplement the process of annually evaluating current monitoring methods, Meewasin will continually reference and build upon an inventory of potential monitoring practices, partnerships, and data collection methods that are not currently utilized by the organization. This inventory will highlight advancements in monitoring-related technology, identify prospective regional monitoring partnerships, and recognize opportunities for public involvement and volunteerism. The inventory will serve to highlight areas lacking adequate data capture and provide a suite of potential monitoring methods to be referenced in planning for subsequent field seasons.

See Appendix B for Meewasin's working inventory of prospective monitoring methods, potential partnerships, and aspirational monitoring-related initiatives.

¹⁸ Saskatchewan Conservation Data Centre

5.0 Planning for Project Monitoring

Monitoring facilitates the process of reviewing assumptions regarding how, where, and why we intervene (Rao et al. 2009). This process is fulfilled by evaluating causal linkages between the intervention strategies, threats, and conservation targets within a project. Developing a monitoring plan that outlines these assumptions and causal linkages provides a mechanism for advancing best practices, strategic allocation of resources, accountability, and adaptability within project planning.

5.1 Monitoring Plan Components

This framework aims to promote planning for monitoring within the conceptual stages of project design. Recognizing the specific resources and commitments that are required to meet monitoring demands prior to project implementation will reduce the need for reactive solutions in the event that a project produces negative consequences. This section presents a methodological approach for project planning that focuses on monitoring. The process detailed within this section is largely informed by the work of the Wildlife Conservation Society (Rao et al. 2009). This process also mirrors the cyclical design of the Open Standards Model, and advances the general tenets of adaptive management planning models.

The components included within monitoring design are as follows:

1. **Define project context** including current system status (may require baseline assessment), conservation targets, threats, and primary objectives.
2. **Conduct a literature review** to broaden the approach and set of variables associated with the project. This step may lead to the identification of secondary targets or desired outcomes of project implementation that were not initially captured within the primary project objectives.
3. **Determine approach and measures of success.** This includes selecting the most desired approaches to intervention or development, identifying alternative action strategies, outlining duties for individuals involved, setting expectations for desired state of targets, and identifying temporally situated benchmarks for evaluating success.
4. **Collect and analyze data.** Data analysis is ongoing and includes the use of conceptual modeling to identify causal links, target spatial applications, and create a visual hierarchy of approaches. Data analysis is used to inform successive decision-making and information gathered throughout all stages of project execution will feed into this process.
5. **Implement actions and monitoring.** Apply monitoring protocols, collect data, and report all system state changes – including variables that are incidentally captured.
6. **Review progress and revise approach.** Analyze monitoring data, draw conclusions about current trajectory and system impact, and modify the plan to curb the process towards a more successful outcome as needed. Evaluate whether project implementation methods are successful and resource effective. This step culminates with the communication of results and a return to the initial cycle step, which calls for a status assessment of the system of interest.

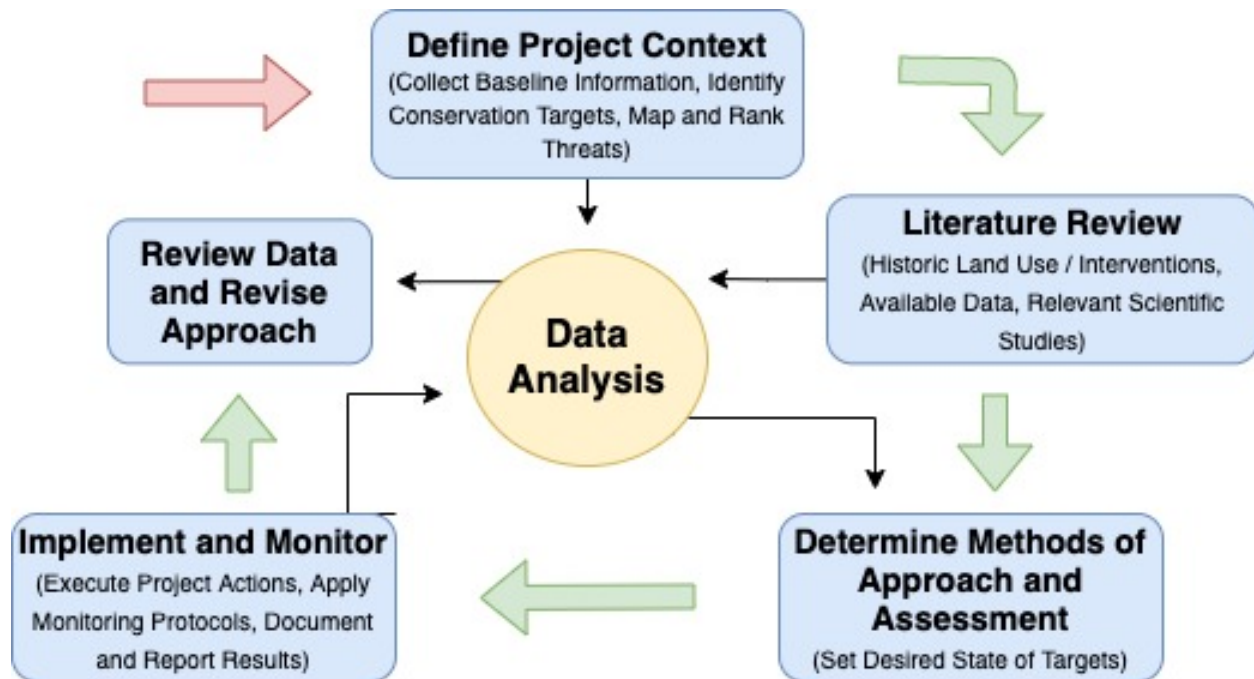


Figure 6. Monitoring Plan Components

5.2 Setting Monitoring Parameters

Clear objectives, appropriate indicators and effective monitoring methods are critical to the successful design and implementation monitoring (Salafsky and Margoulis 2001). It is impossible to monitor every intervention, threat, and conservation target at the same intensity or level of precision, therefore setting priorities becomes important while allocating resources and workflow for monitoring (Rao et al. 2009). When setting parameters for monitoring, it is important to consider what information is required to fulfil donor and institutional demands, the level of precision needed to ensure that results can be effectively used to influence decision-making, and any information that would be useful to collect in the scenario that additional monitoring funding or capacity is secured (Rao et al. 2009).

5.2A Setting Clear Monitoring Objectives

'Objectives', in the context of monitoring work, refers to benchmark quantitative outcomes derived from a management action or project implementation (Salafsky and Margoulis 2001). Monitoring objectives will reference the desired sequential stages of system rejuvenation following a management intervention or development project. Setting clear, measurable, and agreed-upon objectives at the beginning of a monitoring plan will help to guide decision-making and assess progress in successful project implementation (Williams 2011).

The types of monitoring objectives that a practitioner is generally looking to define within a monitoring project include the following (Rao et al. 2009):

- **Conservation Target Monitoring Objectives:** These objectives help to determine the system status that will be attained over a defined period of time. The

monitoring actions that are used to assess these objectives pertain to conservation targets identified in the Meewasin RMP (see section 2.1A of this report).

- **Conservation Threat Monitoring Objectives:** These objectives specify the degree to which the threat will be reduced over a defined time period. Potential threats observed within this category are identified in the Meewasin RMP and include variables such as invasive species, regional climate change, and urban development (see section 2.1B of this report).
- **Conservation Intervention Monitoring Objectives:** These objectives relate to retrospective system analysis following the implementation of an intervention action or strategy. These benchmarks reflect whether an intervention (i.e., prescribed fire, targeted grazing, targeted mowing, herbicide application, restorative planting) has triggered the desired response in terms of landscape feature composition.

All selected monitoring objectives must meet the following criteria:

- **Impact Oriented** – Objectives must demonstrate an observable change in condition or system state.
- **Measurable** – Objectives must be measurable with the ability for changes in target condition or system status to be compared against a baseline or positioned along a standard scale representing gradational change.
- **Temporally Defined** – Objectives must be achievable within a specified period of time.

5.2B Selecting Appropriate Monitoring Indicators

An 'indicator' refers to a variable or parameter that is measured over time to determine whether the status of a target or project is progressing towards set objectives (Rao et al. 2009). Monitoring actions collect information about variables; the accumulation of these measurements or observations is used to derive information about a feature or system of interest. Indicators are the variables that reveal information and form trends specific to set targets and objectives within the monitoring design.

All selected monitoring indicators must meet the following criteria:

- **Measurable** – Indicators must be defined in qualitative or quantitative terms. For an indicator to be measurable, it does not have to be numerically expressed but there must be a way of categorically defining, and interpreting the variable through metrics such as grouping, comparing, or counting.
- **Precisely Defined** – Selected indicators have associated parameters which allow little room for faulty interpretation.
- **Consistent Over Time and Applications** – Indicators are representative of a reliable measurement of change in a factor of interest. These measurements will remain consistent and relevant into the future with an ability to be applied consistently across projects.

5.2C Determining Effective Monitoring Methods

'Methods' in the context of monitoring refers to detailed processes which include protocols describing how monitoring actions are to be carried out (Rao et al. 2009). For every indicator identified, there must be at least one recognized monitoring method. Methods for retrieving information about variables may change over time with fluctuations in organizational capacity, funding, technological advances, and project scope.

It is important that the monitoring methods exemplify the following factors:

- **Cost-effectiveness** – Monitoring methods should be efficient in terms of resource investment with consideration made to alternative methods for retrieving information that are less expensive and time-consuming.
- **Feasibility** – Methods are selected with consideration of whether the project team has the resources and capacity to properly conduct the specified method.
- **Repeatability** – Monitoring actions are easy to repeat with accuracy and consistency.

5.3 Measuring Success

Monitoring and evaluation is used to assess strategy effectiveness and reveal the conditions under which a conservation action is likely to succeed or fail (Stem et al. 2005). Effectiveness monitoring is a cyclical process that serves as an early warning system for potential problems and allows practitioners to adapt implementation strategies to account for identified shortcomings and appropriately address difficulties as they arise. This subsection elaborates on the three forms of assessment that Meewasin practices within project implementation. Figure 7 visualizes the cyclical application of the assessment mechanisms and positions them within the context of adaptive management. Evaluation is a core component within the Open Standards model (discussed in section 3.2B) which is used to guide project analysis and adaptation.

5.3A Baseline Monitoring: Status Assessment

Status assessment is the process of examining and inferring information about a system of interest at a particular point in time (Stem et al. 2005). This process provides a reading of where a conservation target or threat is at a defined stage. This procedure is conducted prior to implementing development or intervention strategies, to provide a baseline assessment of the system. Actions within this category of assessment may include measuring variables associated with the conservation target or status of conservation threats within a system of interest. This information is valuable to the process of determining what management actions are necessary, target areas of application, and provide a control or set of baseline conditions to be used in future comparisons.

5.3B Measure of Success: Implementation Assessment

Implementation assessment is a form of effectiveness monitoring in which success is evaluated through the implementation of actions. In this assessment, practitioners revisit project actions and objectives to compare planned project approaches with actual implementation and observed system status. This assessment process is used to evaluate the effectiveness of management

implementation and determine whether selected approaches are successful in attaining or advancing desired objectives (Williams 2011). The assessment may reveal inadequacies in selected approaches, resulting in the need for an alternative strategy, or it may reveal inconsistencies in implementation, indicating the need for alternate role distribution, procedural changes, or reassessment of project team capacity. This process involves measuring how a given factor changes as a result of project activities, communicating the observed changes, identifying causal connections, and adaptively altering management strategies to curve the project trajectory towards set project objectives.

5.3C Measure of Success: Effectiveness Assessment

Effectiveness assessment is a form of retrospective analysis used to help evaluate the impact of a management intervention or development project. This process comprises a series of follow-up monitoring techniques used to track resource changes and responses to management through time (Williams 2011). Effectiveness assessment is applied over a specified time period following the completion of project implementation to determine how well the project performed (Stem et al. 2005). This monitoring process helps to inform practitioners on the results associated with the management intervention or development project and gain perspective on the condition of the surrounding system. This assessment may reveal unintended consequences or degradation to variables within the system of interest occurring as a result of management actions. Negative system changes are interpreted as the signal to reenter the project planning cycle to determine next steps and subsequent monitoring methods and objectives. The effectiveness assessment is complete once project monitoring has been applied in alignment with the timeline and repeatability specified within the monitoring design.

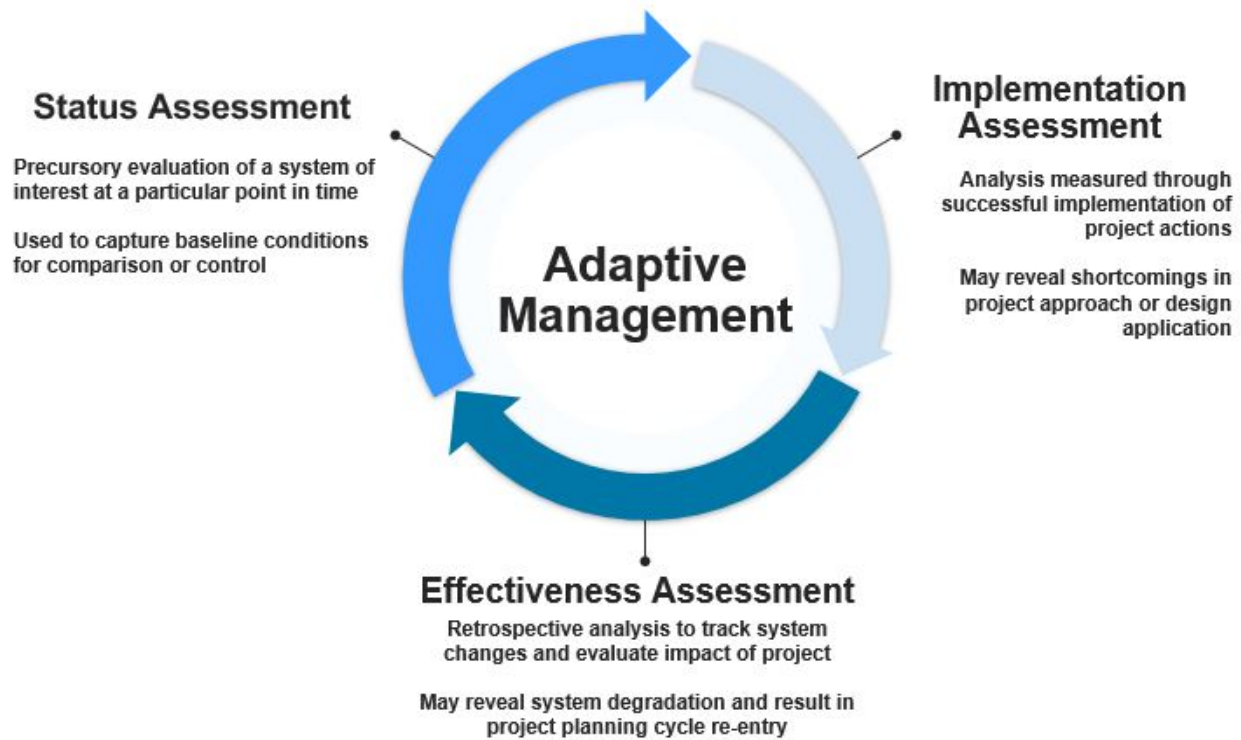


Figure 7. Approaches to Effectiveness Monitoring

5.4 Project Monitoring Planning Template

The following table incorporates concepts previously defined within this section into an adaptable planning tool for project monitoring. This tool will serve as a reporting device and preliminary budgeting tool within the planning stages of project design. Formalizing an approach to planning and reporting on project monitoring increases workflow efficiency and responsiveness through the process of predicting possible project consequences prior to beginning project implementation.

Table 5. Project Monitoring Planning Template

Conceptual Component	Monitoring Objective	Indicators	Monitoring Methods	Resources Required	Timing	Repeatability	Measures of Success Implementation (MOS-I)	Measures of Success Effectiveness (MOS-E)	Lead Organizations
Conservation Targets									
Conservation Threats									
Actions (Intervention/ Development/ Outreach Activities)									

Monitoring planning template adapted from the Wildlife Conservation Society (Rao et al. 2009)

The first column in Table 5 details conservation targets, threats, and management intervention strategies associated with the project. This column will be largely informed by the targets and threats laid out in the Meewasin RMP. The following column requires at least one associated monitoring objective to be selected for each identified project component. The subsequent two columns detail the indicator (system variable connected to the system condition which the objective strives towards), and method for monitoring variables connected to the indicator. Monitoring objectives, methods, and indicators selected should be consistent with the monitoring parameter criteria laid out in section 4.2.

The “Resources Required” column will detail the materials necessary for completing the specified monitoring actions. Resources may include essential staff numbers and time, personal equipment, and necessary technical equipment and sample analysis. The next two columns specify “Timing” of monitoring activity implementation and “Repeatability” or number of subsequent applications to fulfill the selected monitoring objective. This is an initial estimation for the temporal extent of monitoring within the project and may be subject to changes once the project commences.

The complementary “Measures of Success” columns serve as areas to document anticipated project results to be observed during stages of effectiveness measurement (see Section 5.3). These columns are largely reiterative of information detailed within the preceding columns and can be filled with reference to the desired method of implementation and idealized status of monitoring objectives. The implementation column (MOS-I) relates to results that will be captured during the evaluative process of implementation assessment (detailed in section 5.3B) and the effectiveness column (MOS-E) relates to retrospective analysis results captured through effectiveness assessment (detailed in section 5.3C).

The final column indicates the “Lead Organizations” responsible for conducting the activities summarized in preceding columns. This column may include a single organization, with the inclusion of role division amongst participating individuals, or it could include any number of organizations and companies responsible for completing the project tasks. This column is not contractual but may serve as an accountability mechanism that recognizes project-related responsibilities and workflow arrangements.

This table is presented as a template for project monitoring planning moving forward with an aspiration to formally integrate this process within Meewasin’s internal planning and project review. This tool provides room for broad application as a planning exercise for development projects, conservation intervention strategies, and large-scale monitoring initiatives. The chart documents the monitoring plan from start to finish including goals, actions, workflow, timing, responsible parties, and resources required to fulfil monitoring actions. This tool can help to plan the allocation of resources including staff time, equipment, and time estimates for the collection of variables. The planning template can also be used to identify individuals and organizations responsible for conducting monitoring work and serve as a vehicle for transparency and accountability.

6.0 Communicating Results

Successful monitoring integrates information gained through data collection and feedback stages into future decision-making (Williams 2011). Communication is used internally to inform and evaluate management and development processes and externally to curate a shared understanding among interested parties (Holness and Biggs 2011).

6.1 Data Management

Data is the first point of communication internally. Results from the analysis of data that is obtained through monitoring are communicated internally as a part of the adaptive management cycle and externally to promote best management practices (Rao et al. 2009). Field data is often shared and interpreted by a broad audience, which makes the data entry process a critical communicative tool. Data must be processed internally following the initial collection of raw data by field technicians, practitioners, and autonomous monitoring devices. Data is processed and analyzed before monitoring results are communicated to project staff, partners, stakeholders and external audiences (Rao et al. 2009). Raw monitoring data is often collected in one of two forms:

- **Qualitative Data:** Descriptive data detailing corporeal observations including audio, visual, and other sensory-based annotations. This can be delivered in the form of field notes, electronic spectral data, camera footage, or text files.
- **Quantitative Data:** Data that can be measured, manipulated, and processed in a numerical way. Monitoring data that falls into this category includes vector data, coordinates, and electronic count outputs.

Meewasin has been collecting and reporting on monitoring data since the organization's establishment in the 1970s. In the period following its initiation, the organization has experienced many changes in staff, technology, and approaches to data collection and storage. Much of the historic data captured within the early years is not currently accessible to the public nor is it easily located internally. This struggle is indicative of a need for developed standards and methods for the aggregation and inventorying of historical data. This would include translating historical data into usable formats and designing a system for historical data storage that ensures future accessibility.

Meewasin continues to face obstacles in contemporary data collection and storage. Current challenges in this area indicate the need for strong data management protocols. This includes data collection, uploading and storage, and instructions surrounding the inclusion of metadata. Meewasin pulls data from publically accessible sources and citizen science networks; this data requires special consideration of protocols surrounding data access including searches, open-source data, and external data downloading.

This document aims to advance the creation of protocols for data storage, capture, and sharing. These protocols must include special considerations for data sensitivity and interpretation, which may include access protocols and other mechanisms to ensure that sensitive data is not misinterpreted or exploited. This document also calls for gradual reevaluation of Meewasin's

current data storage systems with the intent of increasing the accessibility of historical and contemporary data, ensuring data entry and storage continuity, inclusion of comprehensive meta data, and cross-referencing mechanisms to ensure future accessibility. On a larger scale, Meewasin will aim to work with conservation stakeholders and government partners to promote centrality of monitoring data through appropriate central storage, database inventory, and search accessibility.

Summary of Goals Associated with Data Management:

- *Develop protocols for data management (capture, entry, storage, and sharing)*
- *Aggregate and inventory historical Meewasin data*
- *Protect sensitive data from exploitation and misappropriation*
- *Advance data accessibility, transferability, and centrality*

6.2 Formal Reporting Mechanisms

Meewasin communicates monitoring results internally and externally through repeated formal reporting mechanisms. Reporting is used to document monitoring methods, share results, findings, successes and failures amongst project staff, partners, stakeholders, and the external conservation community. Meewasin delivers different levels of reporting which can be understood to correspond with the monitoring levels detailed in Figure 5. The table below details some of the reporting mechanisms that Meewasin uses to communicate monitoring data both internally and externally. The examples below are categorized according to the scale at which the information is presented, function of the information (“document summary”), and the accessibility of report information (“intended audiences”). The monitoring framework project aims to advance current reporting through the addition of biennial updates on the status of the Valley-wide Resource Management Plan, annual reporting on site resource management plan progress, and the integration of monitoring within major reporting tools such as the Meewasin Board of Directors report and the State of the Valley report.

Table 6. Formal Meewasin Monitoring Reporting Tools

Reporting Tool	Scale	Document Summary	Parties Involved	Intended Audiences
<i>Donor Reporting</i>	<ul style="list-style-type: none"> • Project 	Contains details associated with donor-funded project design, resource allocation, and implementation.	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal • Donors
<i>Project Reporting</i>	<ul style="list-style-type: none"> • Target • Site • Project 	Reporting associated with specific projects including contract work, management interventions, partnership outreach initiatives, educational projects, and design implementations.	<ul style="list-style-type: none"> • Meewasin • Partners 	<ul style="list-style-type: none"> • Partners • External Public
<i>Baseline Inventory Reports</i>	<ul style="list-style-type: none"> • Project • Site 	Provides a detailed status assessment, conducted prior to site planning and development. Details baseline data, site area overview, maps, observed species	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal • Partners

		inventories, conservation targets, threat assessment, development recommendations, and future monitoring actions.		
Site Resource Management Plans	<ul style="list-style-type: none"> • Site 	Detailed plan for site management and development. Outlines site vision, ecological background, targets and threats, conservation management strategies, development strategies, monitoring plan, required resources, site interpretation, and communication strategy.	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal • External Public
Annual Site Management Plan Progress Reporting	<ul style="list-style-type: none"> • Site 	Annual summary of progress on site RMP advancement. Includes summaries of management actions completed on individual sites, monitoring work, site incidents and status changes.	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal
Annual Resource Management / Conservation Department Progress Reporting	<ul style="list-style-type: none"> • Regional • Target • Site 	Annual quick-glance reporting on resource management activities presented using infographics and brief summarization of key performance indicators, fund allocation, observed progress, and focus objectives.	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal • Meewasin Board of Directors
Biennial Valley-Wide Resource Management Plan Progress Report	<ul style="list-style-type: none"> • Regional • Target • Site 	Biennial reporting on Meewasin RMP-related advancements including key action items, target-related updates, Valley-wide system changes, assessment of threats, and summary of monitoring actions.	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal • External Public
State of the Valley Report	<ul style="list-style-type: none"> • Regional • Target 	Quinquennial reporting of organization progress and impact across the region – summarization of monitoring results over five year intervals.	<ul style="list-style-type: none"> • Meewasin 	<ul style="list-style-type: none"> • Internal • Public

6.3 Citizen Science and Outreach

Monitoring within the Meewasin Valley is fueled by the expansive network of engaged citizen scientists, local nature groups, and public database contributors who voluntarily collect observational data to expand on the collective knowledge of natural areas. “Citizen Science” refers to the citizen-led collection of scientific research and data, which is compiled and made available through publicly accessible databases. Meewasin regularly retrieves data from Citizen Science databases such as iNaturalist, eBird, Saskatchewan Bird Atlas, and iMapInvasives to supplement internally collected monitoring data. Meewasin relies on the use of Citizen Science databases and conservation community participation to inform monitoring in and around the Meewasin Valley. Meewasin harnesses the power of volunteer data collection through

“Ecoscavanger Hunts” (more commonly referred to as “bioblitzes”) which are intense periods of data collection concentrated within a small timeframe and defined area of interest. To reciprocate the knowledge gained from the Citizen Science community, Meewasin annually contributes internally captured data to a number of Citizen Science databases.

Meewasin aims to use this framework to increase public outreach opportunities related to ecological monitoring. One approach to advancing this initiative is through the concerted use of social media platforms to distribute information about pressing monitoring variables and promoting associated Citizen Science websites and apps that would serve as appropriate reporting mechanisms. This framework also recommends increasing regular staff usage of citizen science apps within general field work and public interpretation. This initiative will increase the documentation of ad hoc observations and serve as a learning and engagement tool for summer staff interns, tour groups, and school programming sessions. In addition to the previous recommendations, Meewasin aims to expand on the promotion of monitoring-related content through academic partnerships, outreach presentations, conferences, and programming. Through the indorsement of Citizen Science and public data collection networks, Meewasin hopes to broadly promote the concept of monitoring and highlight ways that individual citizens and organizations can help to advance the collection of monitoring data across the Valley region.

7.0 Advancing Community Partnerships

Monitoring captures information about the natural systems that we cooperatively aim to protect and the associated variables that are most important to us. Communities inform monitoring through collective beliefs and values, shared cultural histories, knowledge systems, lived experiences, and interactions with natural spaces. Within its monitoring design, Meewasin aims to advance collectively an approach to monitoring that reflects the diverse perspectives and interests of this community. This document serves as a guiding tool for Meewasin as we work to elevate our current monitoring practices and advance connections and partnerships within the surrounding community to inform discussions in relation to cooperative approaches to monitoring design.

7.1 Partner Institutions

Meewasin's enabling statute, *The Meewasin Valley Authority Act*, established a partnership between the City of Saskatoon, the Government of Saskatchewan, and the University of Saskatchewan for the joint management of the South Saskatchewan River Valley. This partnership reflects a foundational belief, and Meewasin's grounding principle, that we are able to accomplish more through working together than individually.

7.1A City of Saskatoon

Meewasin works closely with the City of Saskatoon to collaborate on intersecting work and environmental initiatives occurring within the Saskatoon region. Meewasin is involved in the management of many city-owned sites and fosters close working relationships with various City of Saskatoon departments including Naturalized Parks, Planning, Sustainability, Storm Water, Urban Forestry, and Indigenous Initiatives. To further these working relationships, the City of Saskatoon and Meewasin have renewed their respective commitments to coordinate their efforts through the establishment of a new Master Agreement. The City advances environmental leadership through the introduction of innovative approaches to management and city planning such as the *Green Infrastructure Strategy*, *Saskatoon North Partnership for Growth* (P4G), and the development of a civic Climate Action Plan. These civic strategies reflect coordinated approaches to management and planning between Meewasin and the City. For example, in 2019 Meewasin produced the *Natural Areas Inventory for the City of Saskatoon*. This report was used to inform the *Green Infrastructure Strategy*. The Valley-Wide Monitoring Framework project will provide additional opportunities to connect management, planning, and monitoring efforts occurring across the Meewasin Valley to City-led projects and initiatives. This includes areas that are captured within the Meewasin planning scope, such as the "Green Network Study Area" in the *Saskatoon North Partnership for Growth* (P4G), natural systems that can be used to advance climate modeling, and natural assets that deliver important ecosystem services that are identified in the City of Saskatoon's *Green Infrastructure Strategy*.

7.1B University of Saskatchewan

Meewasin works closely with the University of Saskatchewan to share knowledge and expertise through academic partnerships and land management. This collaborative relationship was recently reaffirmed through the signing of a Memorandum of Understanding (MoU) between the

University and Meewasin. Meewasin engages in collaborative partnerships with the University of Saskatchewan to conduct monitoring-related research, design long-term monitoring projects, and create opportunities for experiential learning and professional development. Through this partnership, Meewasin has facilitated student internships, acted as an advisor for student projects and the work of masters candidates, delivered various guest lectures and field tours, and provided natural areas for research, student training, and field lab activities. The MoU signifies an agreement to increase strategic collaboration efforts on research, education, and outreach. These are three areas that the Valley-Wide Monitoring Framework aims to advance and for which to provide additional opportunities.

7.1C Government of Saskatchewan

Meewasin exercises collaborative working relationships with both federal and provincial levels of government. Meewasin works alongside the Provincial Government of Saskatchewan in the joint management of crown lands and advancement of conservation management, education, and ecological monitoring within the province. Meewasin is a contributing member of the Saskatchewan Aquatic Invasive Species Task Force which works with the Ministry of Environment to monitor for evidence of foreign aquatic species entering Saskatchewan's watersheds, including Zebra Mussels (*Dreissena polymorpha*) and Prussian carp (*Carassius gibelio*). Meewasin regularly collaborates with agricultural professionals and range management technicians within the Saskatchewan Ministry of Agriculture to facilitate training opportunities, to provide professional development events, to capture rangeland and ecological health information, and to host demonstrations. Meewasin has also worked with the Ministry of Highways to provide additional ecological knowledge to the Saskatoon Freeway Project through the South Saskatchewan River Valley, Small Swale and Northeast Swale areas. Meewasin hopes to continue collaborating with federal and provincial levels of government on outreach education, advancing conservation practices and goals, and monitoring efforts through the Valley-Wide Monitoring Framework project. One initiative recommended through this project is the advancement of monitoring data centrality. Meewasin hopes to collaborate with provincial government data sharing partners including HabiSask, Government of Saskatchewan Heritage and Conservation Branch, and the Saskatchewan Conservation Data Centre to outline strategies and best practices for monitoring data storage, data locations, and accessibility within the province.

Meewasin is currently working alongside federal departments, provincial ministries, and major stakeholders to advance a prescribed fire partnership across the prairie provinces. The core group of collaborators for this initiative include Parks Canada, Saskatchewan Parks, Nature Conservancy of Canada, City of Saskatoon, Prince Albert Grand Council, Association of Manitoba Community Pastures and the University of Saskatchewan. The partnership aims to create standards and procedures surrounding education, training, implementation, and monitoring of prescribed fire in the grasslands and parklands of the Canadian Prairie. Meewasin is playing a leading role within this partnership initiative, in guiding the administration of funding and collaboration. This partnership exemplifies the themes and goals that the Valley-Wide Monitoring Framework aims to advance. Large-scale collaborative partnership initiatives such as these can facilitate the development of best-practice monitoring standards and protocols that benefit the respective project trajectory while simultaneously advancing the recommendations of the monitoring framework project generally.

7.1D Government of Canada

Meewasin aims to integrate and advance the environmental goals of the Federal Government through various initiatives such as managing and monitoring for species at risk (protected through the *Species at Risk Act*), maintaining migratory bird habitat (protected through the *Migratory Birds Convention Act*), and protecting natural features and ecosystem services. The Sutherland Migratory Bird Sanctuary is within Meewasin's jurisdiction in addition to many other natural areas that offer important habitat for avian breeding activity, rare plant species, and species at risk. Meewasin is working with the Federal Government to capture these important sites and areas within the Meewasin Valley in the "Canada Target 1 Challenge" conservation goals and objectives. Meewasin is also collaborating with Environment and Climate Change Canada, Government of Saskatchewan, City of Saskatoon, and various non-government environmental stakeholders to develop a framework that will protect and elevate urban green spaces through the creation of an urbanized natural park system. Through the creation of a Valley-Wide Monitoring Framework, Meewasin intends to build on the existing database of monitoring information concerning the Valley to expand knowledge and reveal additional government-related conservation targets within the area. Environment and Climate Change - Canadian Wildlife Service (CWS) is in the process of developing a systematic ecological and conservation monitoring plan to elevate accountability and successful management of protected areas. Meewasin hopes to capitalize on the mutual timing of monitoring plan development through ongoing collaboration with the CWS. Accordingly, members of the CWS were formally included in the technical advisory committee meetings for the monitoring framework project in which preliminary guidance and review was offered from a group of expert stakeholder representatives.

7.2 Engaged Citizens and Major Stakeholder Groups

Meewasin's conservation planning, development, and educational work is continually informed through the expansive local network of conservation organizations, environmental groups, academics, citizen science leaders, and scientifically engaged citizens.

7.2A Major Stakeholder Organizations

Meewasin advances conservation planning, project collaboration, professional development, and strategic task coordination through ongoing relationships with conservation and stewardship organizations such as the Nature Conservancy of Canada – Saskatchewan Region, Ducks Unlimited Canada, the Native Plant Society of Saskatchewan, the South Saskatchewan River Watershed Stewards, the Saskatoon Wildlife Federation, Global Institute for Water Security, Saskatchewan Research Council, and Wanuskewin Heritage Park. Meewasin hopes to collaborate formally with local conservation organizations to advance monitoring standards, capacity, and regional databases through the Valley-Wide Monitoring Framework. Meewasin has recently become a member of the Saskatchewan Prairie Conservation Action Plan (PCAP), which is an amalgamation of over thirty agencies and organizations working towards a common vision of prairie and species at risk conservation in Saskatchewan. Meewasin hopes that this partnership will elevate conservation management through fostering stronger monitoring relationships with producers, industry members, environmental non-government organizations, research groups, and educational institutions that are currently involved with the PCAP partnership. Meewasin intends to use the Framework project as an avenue to collaborate and build stronger relationships

with environmental organizations, such as the Canadian Parks and Wilderness Society and the Saskatchewan Environmental Society, which are focused on advancing similar initiatives and protecting mutual areas of interest.

7.2B Local Stakeholder Groups and Engaged Citizens

Meewasin's conservation planning, development, and educational work is continually informed by input from the expansive local network of conservation organizations, environmental groups, academics, citizen science leaders, and scientifically engaged citizens. Local environmental organizations and advocacy groups contribute a large amount of scientific data to Meewasin through publicly accessible citizen science databases, educational engagement and learning opportunities, and regular coordination of monitoring-related activities. Many groups and individuals are continuously contributing to monitoring activity within the Meewasin Valley. Meewasin regularly collaborates with the following groups for the advancement of monitoring work: the Saskatoon Nature Society and its many dedicated members, Wild About Saskatoon, Living Sky Wildlife Rehabilitation Centre, Saskatoon Wildlife Federation, Friends of the Saskatoon Afforestation Areas Inc., Swale Watchers, the Entomological Society of Saskatchewan, Trout Reach Saskatchewan, Saskatoon Trail Alliance, Saskatoon Forestry Farm Park and Zoo, SOS Trees Coalition, and many others. Meewasin hopes to use the Valley-Wide Monitoring Framework as an avenue to engage these groups in monitoring-related tasks, data collection, and project design. Meewasin also hopes to use this project as an opportunity to formally engage these groups in planning and coordination and to broaden connections within the community to include additional organizations and groups that are capturing information about natural systems and interactions within the Saskatoon region.

7.2C Expert Council and Technical Advisory

Meewasin has solicited feedback on the monitoring framework project throughout the preliminary planning and document drafting stages. During the document drafting stages, Meewasin has received input from various partner organizations, committees, local groups, academics, and professionals in formal and informal capacities. The members of Meewasin's Conservation Advisory Committee have been engaged throughout the project design stages and they have provided critically important feedback during the early stages of the project's conception and document review. In an attempt to solicit preliminary feedback on the strategy laid out in this document, Meewasin hosted a series of three technical advisory committee (TAC) meetings to discuss the approach of the project, its trajectory, and to review drafts of the Valley-Wide Monitoring Framework document. Internal staff and representatives of prominent community stakeholder groups were also engaged in these initial meetings. TAC members included representatives from the City of Saskatoon's Sustainability and Naturalized Parks departments, Environment and Climate Change Canada - Canadian Wildlife Services, Nature Conservancy of Canada - Saskatchewan, Ducks Unlimited Canada, Saskatoon Nature Society, Wild About Saskatoon, South Saskatchewan River Watershed Stewards, Wanuskewin Heritage Park, and faculty from the University of Saskatchewan. The faculties represented included the Department of Plant Sciences, School of Environment and Sustainability, Department of Geography and Planning, Department of Animal and Poultry Science, Global Institute for Water Security, and the Indigenous Land Management Institute. The series of TAC discussions focused on assessing

project components, identifying gaps and areas for further development, and preparing the document for advancement within Meewasin's internal review process. These initial meetings did not fully capture the variety of voices that are represented within this section or the future partnerships that Meewasin aims to advance through this project. However, Meewasin hopes that this document may serve in the short-term to identify strategies for Meewasin to enhance monitoring-related work and be used as a conversation piece in future discussions aimed at developing collaborative standards and community approaches to monitoring.

7.3 Advancing Diverse Partnerships

The Meewasin Valley is a regional entity that includes a diverse community and wide variety of perspectives and land-based connections. The Valley is composed of people from urban and rural settings, Indigenous peoples and settlers, newcomers, people of all ages, and a variety of other individual identity characteristics that mold and inform collective experiences of place. Meewasin aims to capture diverse community interests, values, and variables within the Valley-Wide Monitoring Framework project. In order to advance this mission, Meewasin is committed to developing more expansive community partnerships and pursuing a broader spectrum of inclusion within monitoring design, consultation, and implementation. Through this effort, Meewasin hopes to create space for diverse voices, lived experiences, and bodies of knowledge that constitute the fabric of our community and which are not currently captured within our monitoring work. This subsection acknowledges gaps in current monitoring deliverables and discusses some of the ways that Meewasin aims to broaden monitoring-related engagement within the Saskatoon region.

7.3A Advancing Treaty Relationships

The Meewasin Valley region is located on Treaty 6 Territory and the Traditional Homeland of the Métis. This area includes the histories and traditional territories of many different Indigenous communities. Indigenous oral histories and archaeological evidence indicate that this area has been a gathering place for First Nations peoples for over 6,000 years. Over a century of settler colonialism has left irrevocable impacts on Indigenous peoples and non-Indigenous peoples within the region, altering our connections to the land and each other. Meewasin is committed to reaffirming our Treaty relationships and recognizes the responsibility to consult with Indigenous communities and traditional knowledge holders as we move forward in the monitoring framework project. This document frames the discussion on ecological monitoring and natural systems within a rigid context, predominantly expressed through Eurocentric scientific language and perspectives. An unintentional consequence of the presentation within this document is the reduction of natural systems through language, to objects of commodity or specimens under study, rather than dynamic living systems that hold immeasurable status and value. Meewasin acknowledges this shortcoming and hopes to broaden and advance the representation of Indigenous perspectives, bodies of knowledge, and environmental worldviews within environmental planning and fieldwork.

Meewasin collaborates with various organizations, Indigenous groups, and Elders in the community to inform ongoing work in the Valley region and to bring Indigenous perspectives and worldviews to education, tourism, stewardship, and development initiatives. Meewasin works to

advance reconciliation through the *Truth and Reconciliation Commission of Canada: Calls to Action* in the areas of education, commemoration, and legal equity. These categories are advanced through initiatives to include Indigenous stories and narratives within educational programming and site interpretation, increase the representation of traditional languages and Indigenous histories within the Valley, reexamining the structure of Meewasin bylaws to reduce barriers to traditional land use activities such as harvesting, and including Indigenous knowledge, consultation, and teachings within staff training and fieldwork. Meewasin works to foster better collaboration and to improve Indigenous relations alongside partners such as the Saskatoon Tribal Council, the Saskatchewan Indian Institute of Technologies, the Gabriel Dumont Institute, the City of Saskatoon's Indigenous Initiatives department, the University of Saskatchewan's Indigenous Land Management Institute, as well as various internal working groups and regular discussions. Through the Valley-Wide Monitoring Framework, Meewasin aspires to build stronger and more diverse community relationships that may advance the identification of new monitoring methods, targets, and protocols that are not currently included within Meewasin's efforts.

7.3B Advancing Youth Participation

Saskatoon has witnessed a rise in principled youth-led environmental action, including regional participation in global climate strike movements and youth-centred demands for municipal climate action. Meewasin aims to represent the voices and concerns of youth within monitoring design. The framework project aims to address climate monitoring with appropriate immediacy while also creating opportunities for youth to engage in ecological monitoring and detect evidence of environmental progress through positive shifts in ecological monitoring variables. Meewasin offers educational programming for a variety of age groups at various locations across the Valley including the Northeast Swale, Beaver Creek Conservation Area, and Saskatoon Natural Grasslands. Beaver Creek Conservation Area serves as the epicenter for year-round Meewasin educational programming. These programs include school group programming, an annual series of public events, demonstrations, tours, and interpretive experiences. Meewasin's legacy of public outreach spans many decades through a myriad of public outreach events and the provision of educational interpretation for classes from the Saskatoon Public School Division and Greater Saskatoon Catholic Schools. Meewasin has catered educational opportunities to suit the curricular interests and specific needs of unique groups and alternative education programs such as the Collective Voice Program (Aden Bowman Collegiate), Outdoor School (Walter Murray Collegiate), Ecoquest (Buena Vista School), and the Ecojustice Program (St. Frances Bateman School). Meewasin hopes to expand the availability of unique engagement opportunities for alternative youth education programs and youth-led organizations. This project aims to integrate monitoring initiatives with youth programming, learning experiences for community groups and classrooms, and targeted volunteer programs that will advance the collection of Citizen Science data and provide youth with hands-on experiences engaging in resource management work and ecological monitoring.

7.3C Bridging with Community Organizations

The Meewasin Valley Authority is fortunate to enjoy close engagement with a wide range of community-focused organizations that advance many of the services and guiding principles with which Meewasin is concerned. Charitable organizations and public gathering spaces are the

cornerstone of our community and Meewasin recognizes the important inclusive, people-powered, non-profit work that is occurring in the core neighbourhoods of Saskatoon. Meewasin has had opportunities to collaborate with various community organizations, groups, and associations in the past to advance environmental projects, community initiatives, and staff training. For example, Meewasin has collaborated with CHEP Good Foods Inc. and the Saskatoon Food Bank and Learning Centre to advance initiatives pertaining to community gardening projects and outreach opportunities. Meewasin recognizes the abundance of expertise, information, and transformative power that exists within the local community and aims to broaden local partnerships within the non-profit community sector in order to inform monitoring initiatives and objectives within this project. There are many organizations within Saskatoon and the surrounding area that work to build supports and provide services that are related to the types of objectives that Meewasin pursues and monitors. Through this project, Meewasin aspires to foster diverse community partnerships with organizations that are engaged in areas such as youth empowerment, fostering connections to the land, waste auditing and reducing landfill contributions, reclaiming spaces, and creating community responses to harm reduction and community monitoring. These types of partnerships are important within this framework project as they will serve to advance a more holistic and inclusive set of monitoring objectives, targets, and focus areas that will strengthen monitoring and management work across the Valley.

7.3D Broadening Connections

Meewasin recognizes the important role of local producers, ranchers, farmers, and landowners in advancing sustainable land use and conservation while providing security and sustenance for local communities and economies. Meewasin hopes to advance connections with local rancher, producer, and landowner groups and individuals who are interested in advancing conservation management and prairie preservation. Meewasin is committed to advancing inclusion in this area and aims to work alongside groups such as the Saskatchewan Prairie Conservation Action Plan, Nature Conservancy of Canada, Ranchers Stewardship Alliance, Saskatoon Wildlife Federation, and the Saskatchewan Ministry of Environment to connect with local landowners and producers and form ecological monitoring strategies and relationships.

Through the initiatives of this project, Meewasin intends to engage with individuals, organizations, institutions, and firms within the business community to broaden monitoring-related perspectives. Meewasin recognizes that the business community and its associated locational districts have a stake in the ways that natural systems are monitored, developed, and managed. Meewasin hopes to form new connections and collaborate with partners such as the Saskatoon Land Branch to broaden connections within this facet of the Saskatoon community, expand on the current parameters of knowledge acquired through ecological monitoring, and to create new volunteer and sponsorship opportunities.

8.0 Key Recommendations

This section contains a series of key recommendations which cumulatively serve as the foundation for a Meewasin Valley-Wide Monitoring Framework. Each of the recommendations identified in this section warrants further collaboration, consultation, and strategizing for successful advancement. The recommendations are intended to be advanced by Meewasin over a five-year period and are ordered below in accordance with Meewasin's multiphase project implementation strategy (discussed in Appendix A).

This document recommends the following list of initiatives for the advancement of a Valley-Wide Monitoring Framework:

1. Develop protocols for individual monitoring actions, data collection steps, and data entry methods.

This task requires the development of a template in which detailed protocols for monitoring actions and data management procedures may be documented. The template will promote task accessibility through the use of accessible language, simplistic design, and sequential steps that facilitate the completion of monitoring-related tasks with limited experience or familiarity. The completion of this recommendation will facilitate standardization and consistency across the stages of monitoring method implementation, data collection, and data storage.

2. Ensure that monitoring progress is explicitly detailed within internal reporting mechanisms.

Through this initiative, Meewasin aims to advance internal understandings of monitoring design. Including the concept of monitoring within internal reporting will serve to illustrate the broad applicability and functionality of monitoring design. This recommendation is applicable to most current internal reporting mechanisms with the addition of the following recommended progress reporting tools:

- **Biennial Valley-Wide Resource Management Plan Progress Report** – Providing an update on Meewasin RMP-related advancements including the completion status of key action items, observed shifts in target health or threat status, and any relevant advancements in the areas of ecological monitoring, development, and conservation management.
- **Annual Site Resource Management Plan Progress Reports** – Providing a short summary of site-related developments including conservation management actions,

ecological monitoring initiatives, observed changes in ecological system status and/or threat severity, site incidents and observations.

- ***Annual Resource Management Dashboard-Style Reporting*** – A quick glance internal reporting device summarizing annual resource management actions, monitoring initiatives, key performance indicators, resource distribution, and other conservation-related advancements occurring across the Valley region.

3. Improve internal communication and interdepartmental collaboration on monitoring.

This recommendation calls for concerted, interdepartmental efforts within Meewasin to coordinate on monitoring-related initiatives. This includes annual and ongoing internal communication of monitoring-related goals, seasonal workflow priorities, outreach engagement opportunities, and resources required to fulfil monitoring-related goals and initiatives. Seasonal department monitoring goals and workflow priorities should be shared prior to field season planning, budgeting, and drafting of grant proposals.

4. Annually review monitoring techniques and actions.

Within this initiative, Meewasin will annually conduct a routine evaluation of internal monitoring strategies prior to subsequent field season planning and budgeting. This process will include examining previous field season successes and failures related to monitoring and altering strategies to reflect current internal capacity, technological advancements, partnership opportunities, annual budgetary constraints and shifts in workflow priorities.

5. Include project monitoring plans within Meewasin's project application review process.

This recommendation seeks the formal integration of monitoring-related plans within Meewasin's internal planning and review process. The "Project Monitoring Planning Template", found in Appendix B (Table 5.4), will serve in the interim as a potential mechanism for documenting anticipated monitoring-related considerations within Meewasin's project application submission and review process.

6. Work with Indigenous peoples to advance the integration of traditional ecological knowledge within monitoring design and application.

This recommendation reflects a commitment to collaborate and consult with Indigenous-led organizations, knowledge keepers, and community members to broaden and advance the representation of Indigenous knowledge systems, oral histories, and worldviews within monitoring design and application. Meewasin will work in tandem with Indigenous peoples to build meaningful monitoring-related partnerships, cultivate ethical sharing environments, and seek Indigenous technical advisory input for the advancement of this project.

7. Advance external communication of monitoring results and information.

Meewasin aims to increase the transmission of monitoring-related information to public audiences through routine reporting and online content sharing platforms. Meewasin intends to increase public facing communication of monitoring-related information through the following mechanisms:

- **State of the Valley Report** – Meewasin’s *State of the Valley* report evaluates Meewasin’s impact within the Valley region, providing a five-year assessment of organizational progress which is published for public review on the Meewasin website. The *State of the Valley* report may be used as a location in which to provide a brief formal update on progress related to the Monitoring Framework project and the advancement of associated recommendations.
- **Online Content-sharing Platforms** – Meewasin will continue to utilize public-outreach and content sharing platforms such as Facebook, Twitter, and Instagram to familiarize the public with monitoring targets, management techniques, and monitoring-related discoveries.
- **Contributions to Citizen Science Networks** – Meewasin will take steps to increase internal staff contributions to Citizen Science networks and uploading of field observations to public databases. To advance this recommendation, Meewasin may require summer students and field workers to routinely use Citizen Science apps in the field. Meewasin will continue to annually upload internally collected and stored data to various public databases that Meewasin routinely accesses for information.

8. Advance the centrality, transferability, and accessibility of Meewasin data.

This recommendation aims to make monitoring data more accessible to the public. Suggestions within this recommendation include the following:

- **Protocols for Aggregating and Storing Historical Meewasin Data** – This action requires the creation of protocols detailing storage, digital interpretation, and translation of historical data that has not yet been made publicly available.
- **Protocols for Internal Data Management** – This action specifies a need for internal protocols relating to data collection, entry, storage, and sharing. The aim is to create

continuity in this area through defining a methodological process and ensuring future accessibility.

- **Implement Process for Accessing Sensitive Data** – This includes externally applied data access protocols to prevent sensitive data from being exploited, misrepresented, or used in insensitive ways. Data under consideration for these guidelines may include locations of culturally significant artefacts, information relating to traditional knowledge, personal identifications, and otherwise protected information.
- **Advance Provincial Accessibility of Monitoring Data** – This point refers to advancing data related collaborations with the Government of Saskatchewan and the Saskatchewan Conservation Data Centre to determine best practices for monitoring data capture and storage within the province to promote accessibility and centrality.

9. Develop a public volunteer program for ecological monitoring.

This recommendation advances annual monitoring goals and objectives through the development of a Meewasin volunteer program to increase capacity in monitoring implementation and data collection. This initiative would include the additional components:

- **Site Steward Roles** – Creating more knowledge of Meewasin site issues through the delegation of site stewardship roles. This is a way of formally recognizing and including people who regularly visit and report site issues to Meewasin.
- **Tiered Volunteer Training Program** – Development of volunteer orientation and field training for Meewasin volunteers. This program would include basic Meewasin orientation and beginner development training, intermediate volunteer training and field development, and master-level volunteer training and education.

10. Advance inclusivity within monitoring implementation and planning.

This point references the goal of fostering inclusive community partnerships to advance the identification of monitoring targets, objectives, and approaches that will serve and reflect the diverse interests of communities within the Valley. Within this effort, Meewasin aims to create space for diverse voices, lived experiences and bodies of knowledge that are not currently captured within Meewasin's monitoring work.

11. Strengthen monitoring-related partnerships within the Saskatoon region and the broader prairie conservation sphere.

The aim of this recommendation is to advance a cooperative and collaborative approach to monitoring through local and regional partnerships. This includes the perspectives and expertise of various public institutions, local and regional conservation groups, non-

government organizations, and the expansive network of engaged citizen scientists collecting and sharing monitoring-related information within the Valley.

12. Develop collaborative minimum standards for monitoring across the Valley region.

This recommendation involves the collaborative development of basic monitoring standards with input from community groups and organizations, public institutions, and conservation agencies that will commit to the process of implementing the collective standards. The aim of this recommendation is to define and implement a series of bare minimum standards for monitoring, which Meewasin will commit to upholding and employing internally.

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10.0 Definitions

Adaptive Management – a cyclical approach to project implementation that involves the integration of project design, management actions, and monitoring to promote action-based learning and flexibility within decision-making.

Autonomous Recording Unit (ARU) – self-contained, passive recording devices designed to capture data pertaining to bioacoustics.

Bioacoustics – a scientific branch of study concerned with the production, transmission, and reception of animal sounds.

Bioblitz – an intense period of biological surveying by groups of scientists, naturalists, and volunteers. Data is uploaded to Citizen Science platforms such as the Saskatchewan Conservation Data Centre and iNaturalist. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Biodiversity – the richness and variety of living organisms and habitats within an ecosystem. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Conservation – the sustainable use, protection, and management of natural areas and assets to prevent decline or loss. Conservation does not attempt to preserve natural areas and assets in a particular ecological state. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Conservation Target – an element of biodiversity, which can be a species, habitat, or ecological system that the project has chosen to focus on. (Source: Conservation Measures Partnership 2013)

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

Data – a collection of facts or information. Data falls within two broad categories:

Qualitative Data: descriptive information that is generally non-numeric in nature and collected through methods of observation.

Quantitative Data: numerical information that can be measured, manipulated, and processed in a mathematical way.

Ecological Integrity – the ability of a natural area to maintain rich ecological processes, such as habitats, nutrient cycling, water purification, climate regulation, and carbon sequestration. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Invasive Species – a species that is non-native to the ecosystem of an area and whose presence causes or is likely to cause harm to economic, environmental, or human health. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Hydro-riparian Areas – rivers and creeks (flowing water bodies) from the stream bed up to the top of the bank including riparian vegetation. (Source: Meewasin Valley-Wide Resource Management Plan)

Meewasin Valley (also “the Valley” and/or jurisdiction) – refers to lands described as the “Meewasin Valley” and falling under the authority of Meewasin pursuant to *The Meewasin Valley Authority Act*.

Miradi – adaptive management software for conservation projects.

Monitoring – the process of gathering information on different elements within a system of interest for the purpose of assessing the system status and mapping status changes over time.

Monitoring Methods – detailed processes that include protocols describing how monitoring actions are to be carried out.

Monitoring Objective – refers to benchmark quantitative outcomes derived from a management action or project implementation.

Monitoring Indicator - a variable or parameter that is measured over time to determine whether the status of a target or project is progressing towards set objectives.

Native species – species of flora and fauna that occur naturally in a particular ecosystem, region, or habitat.

Native Grassland – areas dominated by native grasses. Native grasslands support rare species of plants and birds and ecosystem functions and provide important connectivity to wide-ranging mammals and migrating birds. There are less than 20% of grasslands left in Saskatchewan. (Source: *Meewasin Valley-Wide Resource Management Plan*)

Open Standards – a model for conservation planning that brings common concepts, approaches, and terminology to project design, management, and monitoring in order to help practitioners improve the practice of conservation. (Source: Conservation Measures Partnership, 2013)

Planning Scope – Meewasin’s jurisdiction (within the City of Saskatoon and the R.M. of Corman Park) with a 15 kilometer buffer applied. (Source: *Meewasin Valley-Wide Resource Management Plan*)

Post-glacial Channel Scar (Swale) – a remnant of glaciation consisting of glacial features such as ridges, glacial till, and a series of wetlands (and a high water table) resulting from the glacial meltwater channelizing to form an ancient river. (Source: *Meewasin Valley-Wide Resource Management Plan*)

RMP – abbreviated Resource Management Plan, a plan to inform and guide conservation activities across the Meewasin Valley.

Meewasin RMP – abbreviated *Meewasin Valley-Wide Resource Management Plan*.

Rare species – a species that is uncommon, scarce, or infrequently encountered. Meewasin uses this term to broadly reference species that fall within various provincial and national rarity ranking systems such as that of COSEWIC, the Nature Conservancy of Canada, and the Saskatchewan Conservation Data Centre.

Resource Management – is the management of land, water, air, and species to achieve scenarios that are the most beneficial for the ecology of the region. (Source: *Meewasin Valley-Wide Resource Management Plan*)

Riparian – the transitional zone between terrestrial and aquatic areas of a wetland or watercourse. Riparian vegetation and soil are strongly influenced by the presence of water. (Source: City of Saskatoon Green Infrastructure Strategy)

SARA – *Species at Risk Act*

Spatial Data – any data related to or containing information about a specific location.

Species at Risk – refers to provincially threatened and endangered species listed under the *Species at Risk Act*.

Stewardship – a responsible way to interact with, use, manage, restore, and protect natural and cultural resources. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Sustainability – development that is responsive to operational requirements and environmental needs, while balancing long-term financial, environmental, cultural, and social needs. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Swale – see definition for Post-glacial Channel Scar.

Threats – phenomenon that may pose a danger to the integrity and abundance of identified conservation targets and affect the ecological integrity of an area.

Traditional Land Uses – acknowledges the historic, cultural, spiritual, and physical connection of Indigenous peoples to the land and all the gifts it provides. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Traditional Ecological Knowledge - cumulative body of knowledge, practice and belief evolving by adaptive processes and handed down through generations by cultural transmission, regarding the relationship of living beings (including humans) with one another and with their environment. (Source: National Aboriginal Forestry Association, 2006)

Urban Wildlife Information Network – abbreviated UWIN. A national data sharing network of urban wildlife behavior, coordinated by Lincoln Park Zoo's Urban Wildlife Institute. (Source: Lincoln Park Zoo, 2020)

Wetlands – land having water at, near, or above the land surface; land saturated with water long enough to promote aquatic processes as indicated by saturated or hydric soils, aquatic vegetation, and various kinds of biological activity adapted to a wet environment. Wetlands can

hold water temporarily or permanently, with water levels fluctuating over the course of a single year and over many years with climatic cycles. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Wetland Complex – A combination of individual wetlands and surrounding areas that have complementary functions and greater significance when viewed together rather than individually. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Wildlife Habitat – natural environments that support the basic requirements for food, water, reproduction, and protection of species. Certain wildlife habitats may be important at particular times of the year. Wildlife habitats include habitat for insects, birds, amphibians, reptiles, and mammals. (Source: City of Saskatoon *Green Infrastructure Strategy*)

Appendix A: Implementation Strategy

Multiphase Implementation Strategy

The following graphic depicts a multiphase implementation strategy for the series of recommendations listed in section 8.0 of this document. Within this implementation strategy, the recommendations have been divided between three numbered temporal phases and a fourth overarching multiphase category. Recommendations have been distributed within this schematic in accordance with the general organizational capacity, availability of resources, and workflow demands experienced by Meewasin at the time of drafting this report. The order and distribution of recommendations within this strategy may be subject to change with shifts in organizational priorities, resource availability, external partnerships, and community involvement.



Figure 8. Multiphase Implementation Strategy

Ongoing / Multiphase Initiatives

The “Ongoing / Multiphase Initiatives” section is an overarching category containing initiatives that will be continuously revisited throughout the three implementation phases within the strategy. The recommendations that fall within this category require additional reflection, repeated visitation, and various levels of collaboration in order to achieve desired progress.

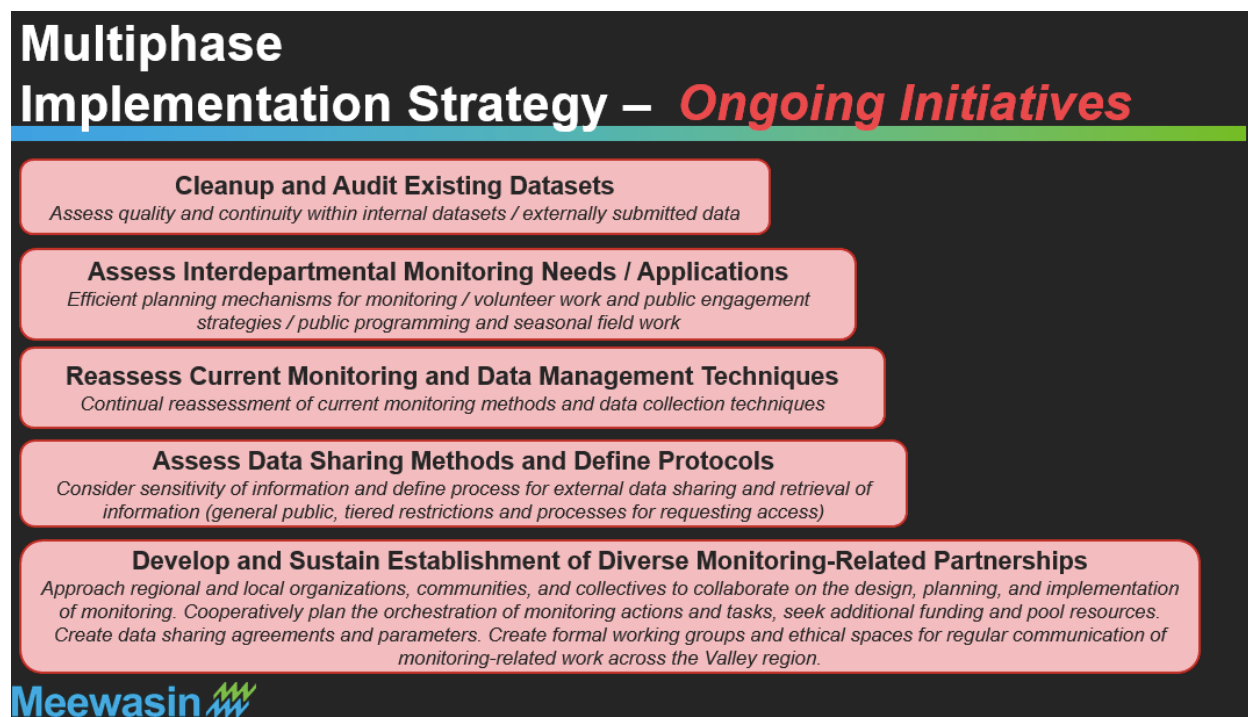


Figure 9. Ongoing Deliverables in Multiphase Implementation Strategy

Numbered Deliverable Phases

Phases one through three represent temporal windows, associated with the completion of recommendations within each phase category. Time periods associated with these phases are comparably nonuniform, each representing an expected successful phase delivery window of 1 to 3 years, subject to workflow demands, resource availability, and capacity. Within this strategy, a set of leading assessment questions have been identified for each phase to guide progression and serve as a point of reference for retrospective progress assessment following the completion of each phase.

Multiphase Implementation Strategy – Phase One Initiatives

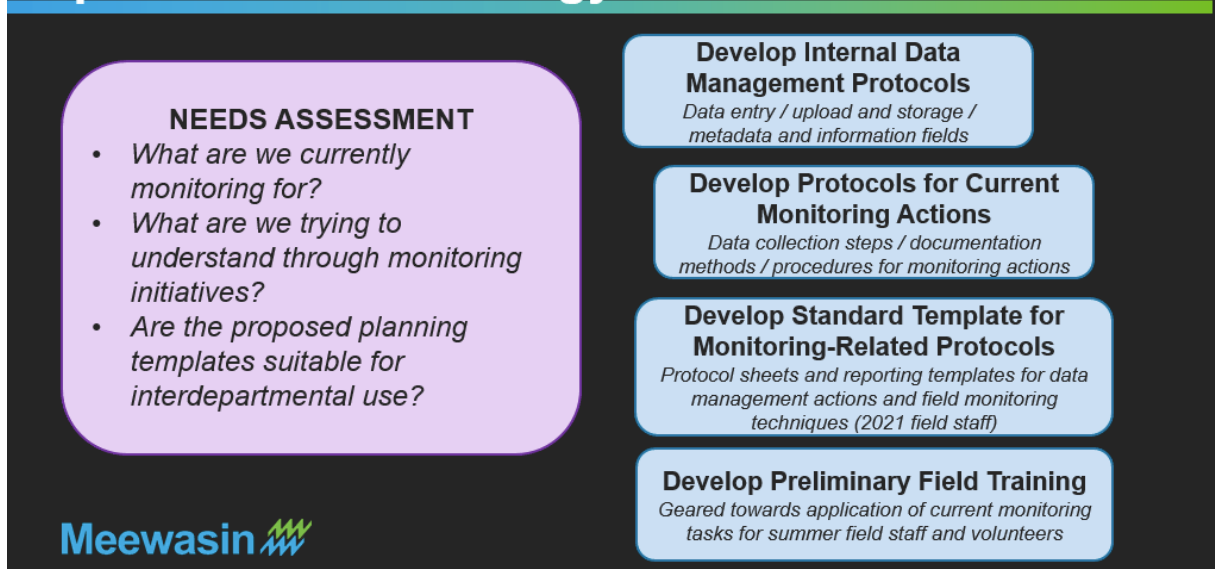


Figure 10. Phase One Deliverables in Multiphase Implementation Strategy

Multiphase Implementation Strategy – Phase Two Initiatives

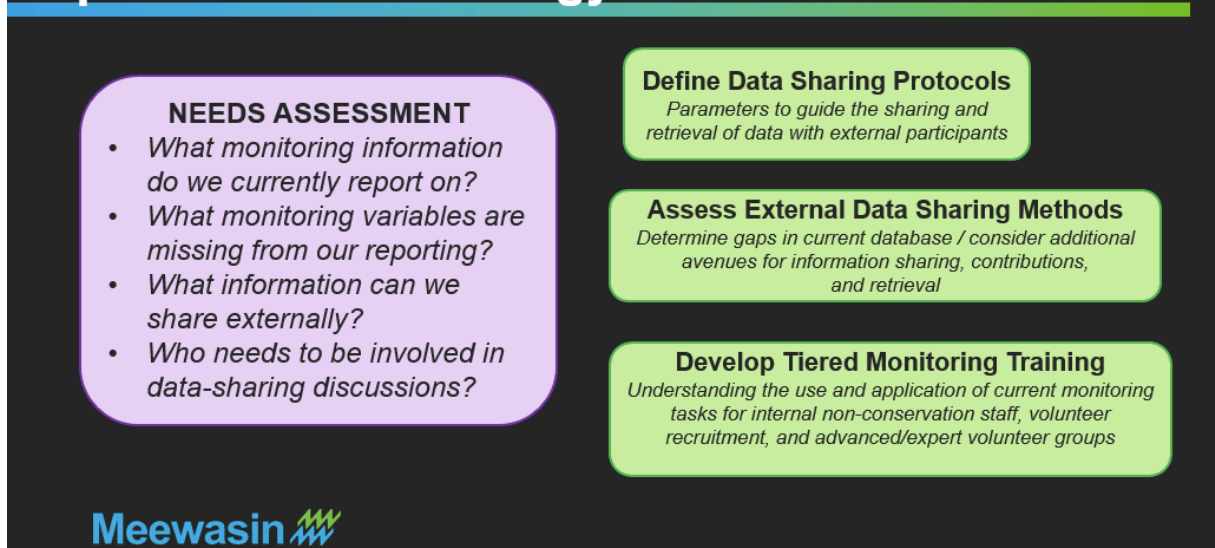


Figure 11. Phase Two Deliverables in Multiphase Implementation Strategy

Multiphase Implementation Strategy – *Phase Three Initiatives*

NEEDS ASSESSMENT

- Are we capturing the needs and interests of the external community?
- What information is currently being monitored within the region and by whom?
- Which perspectives and voices are excluded from this process?
- What are the minimum standards for quality?
- How can we coordinate regional efforts and information sharing?

Explore Formal External Data Sharing Tools

Streamlined ways to retrieve and receive updates on monitoring data collection

Determine Minimum Standards for Regional Monitoring Tasks

Work quality standards, data management and information sharing standards

Additional Initiatives To Be Determined

Through monitoring partnerships

Meewasin 

Figure 12. Phase Three Deliverables in Multiphase Implementation Strategy

Appendix B: Tables

Project Monitoring Planning Template

The table below, detailed in section 5.4, is the proposed template for project monitoring planning to be included in Meewasin's future internal planning and project review processes. This tool can be applied broadly as a planning exercise for development projects, conservation intervention strategies, educational outreach events, and large-scale monitoring initiatives.

Table 5: Project Monitoring Planning Template (Section 5.4, p. 30)

Conceptual Component	Monitoring Objective	Indicators	Monitoring Methods	Resources Required	Timing	Repeatability	Measures of Success Implementation (MOS-I)	Measures of Success Effectiveness (MOS-E)	Lead Organizations
Conservation Targets									
Conservation Threats									
Actions (Intervention/ Development/ Outreach Activities)									

Inventory of Meewasin Monitoring Aspirations

The table below (discussed in section 4.3) is an inventory of aspirational monitoring practices, partnerships, and data collection methods that are not currently utilized by Meewasin. This table serves as a working inventory for the ongoing documentation of prospective and aspirational monitoring-related initiatives and partnerships that may be pursued by Meewasin and potential associated parties in the future. This inventory functions to inform the process of evaluating current monitoring methods (as discussed in section 4.2) and inform future field season planning by presenting potential avenues through which to expand and improve upon current applications of monitoring.

Clarifying Note: the information listed in Table 7 serves to exemplify a range of aspirational monitoring-related possibilities for Meewasin. The various organizations, monitoring methods, and other associated logistics identified within this table had not been formally pursued by Meewasin at the time of drafting this report.

Table 7. Inventory of Meewasin Monitoring Aspirations

Category of Understanding	Proposed Monitoring Method	Monitoring Mechanism	Monitoring Indicators	Project Timeline	Application Scales	Additional Resource Requirements	Potential Associated Parties
Environmental Condition Monitoring	Soil Monitoring (Chemical and Physical)	Physical and Chemical testing - various field and lab analysis	Classification, observations, variable levels (i.e., salinity, composition, pollutants / heavy metal traces, density, etc.)	Short to Long-term	Conservation Target, Project, Site	Field testing and sampling equipment, soil probe, auger	Meewasin, USask – Department of Soil Sciences
		Soil Biota lab sample analysis	Presence of microorganisms (fungi, bacteria) and soil fauna (micro and macroscopic)	Short-term	Project, Site	Funding for lab analysis, TBD ¹⁹	Meewasin, USask – Department of Soil Sciences, Microbiology

¹⁹ To be determined

	Monitoring for Greenhouse Gas Modeling	Field sampling and lab analysis	Carbon sequestration potential, Citizen Science, TBD	Short to Long-term	Conservation Target, Project, Site	Funding for lab work, TBD	Meewasin, CoS, USask, Citizen Science
	Advanced Water Quality Monitoring	Field testing and sampling, lab processing	Various variable levels (i.e., salinity, dissolved oxygen, acute toxicity, etc.)	Short-term	Conservation Target, Project, Site	Field testing equipment, funding for lab analysis	Meewasin, USask, GIWS ²⁰ , SRC
	Storm Water Monitoring (storm and catchment ponds)	Field testing and sampling, lab analysis	Various variable levels, micro plastics, survey for invertebrates and fish species	Short to Long-term	Conservation Target, Project, Site	Funding for lab analysis, TBD	Meewasin, CoS, USask, SSRWSI
	City Snow Dump Monitoring	Field test and lab sample analysis	Snow volume, contaminants, impacts to surrounding environment	Short-term	Project, Site	Funding for lab analysis, TBD	Meewasin, CoS, USask, Water Security Agency, ECCC ²¹
	Thermal Pollution	River water temperatures, TBD	TBD	Short-term	Regional, Project	TBD	Meewasin, CoS, SSRWS, USask, TBD
	Baseline Inventories	Compilation of current site inventories	Data trend analysis, information gaps, current inventories	Short to Long-term	Site		Meewasin, USask, SNS, WAS, Citizen Science ²²

²⁰ Global Institute for Water Security

²¹ Government of Canada Department of Environment and Climate Change Canada

²² Citizen Science noted as potential partner for initiatives that pertain to publically organized database research and monitoring efforts

Wildlife Behaviour Monitoring	Bird Monitoring	MAPS Program	Population estimates through bird banding	Long-term	National, Provincial, Regional, Site	Bird banding certification and staff training, banding netting	Meewasin, SNS, LSWR ²³
		Tree Swallow/ Bluebird Nesting Box Monitoring	Presence, identification	Short to Long-term	Site	Nesting boxes, wildlife cameras	Meewasin, SNS, LSWR
		Purple Martin Monitoring	Presence, abundance	Short to Long-term	Project, Site	Wildlife cameras	Meewasin, SNS
		Owls and other Birds of Prey Surveying	Identification, presence, location	Short-term	Project, Site	GPS unit, binoculars	Meewasin, SNS
		Tree Cavity Surveying	Presence, location, observations	Short-term	Project, Site	GPS unit, binoculars	Meewasin, SNS
		Stick Nest Surveying	Presence, location, observations	Short-term	Project, Site	GPS unit, binoculars	Meewasin, SNS
	Autonomous Recording Devices	Passive capture of wildlife movement, behavior, presence, and vocalizations	Visual and aural detection and identification	Short-term	Project, Site	ARU, drone, wildlife cameras	Meewasin, USask
	Amphibian Surveying	Frog and Salamander Surveys	Presence, identification, location	Short-term	Project, Site	GPS unit	Meewasin, USask, SNS, CWS ²⁴
	Insect Monitoring	Gibson's Giant Tiger Sand Beetle (<i>Cicindela formosa gibsoni</i>)	Identification, presence, location	Short-term	Project, Site	GPS unit	Meewasin, SNS, NCC – SK ²⁵ , CWS
		Dragonfly and Butterfly Surveys	Identification, presence, location	Short-term	Project, Site	GPS unit	Meewasin, SNS, NCC – SK
		Site Insect Inventorizing	Identification, presence,	Short to Long-term	Site	GPS unit	Meewasin, SNS, USask

²³ Living Sky Wildlife Rehabilitation Centre

²⁴ Canadian Wildlife Service

²⁵ Nature Conservancy of Canada – Saskatchewan branch

			location, abundance				
	Winter Wildlife Track Monitoring	Post-snowfall track surveys	Presence, identification, observations	Short-term	Project, Site	Snowshoes, GPS unit	Meewasin, USask – Biology Department
	Rodent Monitoring	Live trap capture	Presence, identification, observations	Short-term	Project, Site	Live traps	Meewasin, SNS, WAS, USask – Biology Department
	Cavity Nest Monitoring	Urban forest and riparian forest surveys	Presence, location	Short-term	Project, Site	GPS unit	Meewasin, SNS, SOS Trees ²⁶ , LSWR, WAS
Vegetation Composition Monitoring	SAR Plant Species Surveying	Plains Rough Fescue (<i>Festuca hallii</i>)	Presence, location, identification, extent, community mapping	Short-term	Project, Site	GPS unit	Meewasin, SNS, NPSS, CWS
		Rare Sedge Species (<i>Carex spp.</i>)	Presence, location, identification, extent, community mapping	Short-term	Project, Site	GPS unit	Meewasin, SNS, NPSS, CWS
	Wetland Vegetation Surveys	Classification and riparian health assessment	Stewart & Kantrud Classification, vegetation health assessment, plant identification and mapping	Short-term	Project, Site	GPS unit	Meewasin, USask, CoS, NPSS
	Riparian / Urban Forest	Field monitoring and assessment	Stand density, tree health	Short-term	Project, Site	Clinometer, tree core,	Meewasin, CoS – Urban

²⁶ SOS Trees Coalition

	Health Assessments		inventory, stand age, diameter breast height, average height			measurement tape, GPS unit	Forestry, SOS Trees, USask – RRM ²⁷ Program
	Vegetation Community Mapping	Field surveying, aerial imagery	Land Use / Land Classification analysis, identification, location, aerial imagery interpretation	Short-term	Regional, Conservation Target, Project, Site	Drone, GPS unit, GIS, aerial imagery access	Meewasin, NPSS, USask – Plant Sciences Program / RRM Program,
	Drone Monitoring and Aerial Imagery	Air photo interpretation, drone mapping	Land Use / Land Classification analysis, identification, location	Short-term	Regional, Conservation Target, Project, Site	Drone (permit / licensing), aerial imagery	Meewasin, CoS, USask,
Invasive Species Monitoring	Invasive Species Management Effectiveness Monitoring	Assessing management method success – drone, density surveying, data trend analysis	Data analysis, aerial imagery interpretation, presence / absence, density, diversity	Short to Long-term	Regional, Project, Site	Drone (permit / licensing), aerial imagery, GPS unit, GIS	Meewasin, CoS, USask, RM Corman Park
	Invasive Insect Monitoring in Urban Forests	Assessing forest stand health and surveying for presence of invasive insect species	Forest health, inventory of tree conditions, evidence and presence of invasive pests	Short-term	Project, Site	TBD	Meewasin, CoS – Urban Forestry / Entomology, USask – Entomology, SNS
Human-Site Interaction Monitoring	Depreciative and Illicit Behaviour Monitoring	Incident tracking, damage and strain to public sites, frequency and concentration	Data trend analysis, presence and abundance	Short to Long-term	Regional, Project, Site	Surveillance equipment, funding for education /	Meewasin, USask, Swale Watchers,

²⁷ Renewable Resource Management Program (University of Saskatchewan, College of Agriculture)

						awareness, TBD	WAS, CoS, TBD
	Non-compliance Enforcement Effectiveness Monitoring	Enforcement responsiveness, TBD	Comparative data analysis, issues tracking, TBD	Short to Long-term	Regional, Project, Site	TBD	Meewasin, USask, UofR, CoS, SPS ²⁸ , RCMP ²⁹ , RM Corman Park; Conservation Officers
	Site Usage and Off-trail Travel Impacts	Assessment of environmental impacts relating to official trail and amenity use and off-trail / established unofficial trail network	Soil compaction, erosion and slumping, hydrological alteration and trenching, wildlife habitat and vegetation community	Short-term	Project, Site	TBD	Meewasin, STA ³⁰ , CoS
	Indicators of Human Health	Monitoring variables connected to prosperity and wellness within the Valley region	Requires community engagement to determine	Short to long-term	Project, Site, Regional	TBD	Meewasin, CoS, TBD
	Domestic Dog Impact Monitoring	Environmental assessment of dog-related site impacts	Soil nutrient levels, water quality, waste and litter, TBD	Short-term	Project, Site	TBD	Meewasin, CoS, LSWR
	Wildlife Friendly Fence Monitoring	Wildlife friendly design effectiveness	Wildlife tracks around fence line, evidence of wildlife injury / death, fence	Short-term	Project, Site	TBD	Meewasin, CoS, USask, WAS, SNS, Swale Watchers, NCC, DUC ³¹

²⁸ Saskatoon Police Services

²⁹ Royal Canadian Mounted Police – both Warman and Saskatoon detachments fall within the Meewasin Valley

³⁰ Saskatoon Trail Alliance

³¹ Ducks Unlimited Canada

			line hair samples, TBD				
	Traffic and Speed Limit Monitoring	Impacts from vehicle traffic on and adjacent to sites	Wildlife mortalities, observed wildlife movement and behavior disturbances, water quality and soil variables	Short-term	Project, Site	Funding for lab analysis, aerial surveillance, roadway signage and educational materials, TBD	Meewasin, CoS, USask, Swale Watchers, WAS
Partnership-Powered Monitoring Initiatives	Earthworm Monitoring	Ad hoc observations, "WormWatch" Citizen Science network	Presence and location	Short-term	National, Site	Tools for field documentation / data upload	Meewasin, Citizen Science
	Tick Monitoring	eTick	Presence, location, identification	Short-term	National, Regional	Tick keys, specimen collection containers, documentation / data upload tools	Meewasin, Citizen Science, USask – Parasitology / Biology Department
	Backyard Bird Monitoring	Project FeederWatch	Presence, identification, location	Long-term	National, Regional	Funding for educational / promotional communications	Meewasin, Citizen Science, SNS, WAS, LSWR
	Plant Flowering Date Monitoring	PlantWatch Program	Identification, recorded flowering date, location	Long-term	National, Regional	Funding for educational / promotional communications	Meewasin, Citizen Science, SNS
	Expansion and Longevity of Urban Wildlife Information Network (UWIN)	Wildlife cameras and data analysis	Presence, absence, behavioural observations and locations, habitat movement and connectivity assessments	Long-term	All	Wildlife cameras, GIS, data processing funding / technology	Meewasin, USask, WAS, SFF, UWIN, SNS, Citizen Science

	Landscape and Habitat Connectivity	Wildlife cameras, aerial / remote imagery, data analysis, TBD	Land Use / Land Classification analysis	Long-term	Regional	Wildlife cameras, GIS, data processing funding / technology	Meewasin, USask, WAS, UWIN, CoS
	Monitoring Species of Abundance	Distribution and abundance of culturally significant species across the Valley region	Location and abundance, other variables require community consultation	Short to Long-term	Project, Site, Target, Regional	Citizen Science, TBD	Meewasin, Wanuskewin, CoS, TBD
	Increasing ARU Data Processing	Kaleidoscope, Zooniverse, TBD	Identification / interpretation of ARU data (bioacoustics recordings, imagery)	Short to Long-term	All	Data processing funding / technology, TBD	Meewasin, USask, Citizen Science, SNS, WAS
	Monitoring in Accordance with Traditional Ecological Knowledge	TBD	TBD	TBD	TBD	TBD	Meewasin, TBD
	Interpretation of Monitoring Data through Traditional Ecological Knowledge	TBD	TBD	TBD	TBD	TBD	Meewasin, TBD

Appendix C: Photos

Photo Series 1: Ecological Monitoring Techniques



Photo 1a: Meewasin permanent monitoring plot equipped with a SQM-L Dark Sky Meter and Wildlife Camera (Location: Northeast Swale).



Photo 1b: Installation of pitfall and sticky insect monitoring traps (Location: Small Swale).



Photo 1c: Monitoring for micro plastic contamination with Dr. Markus Brinkmann and the South Saskatchewan River Watershed Stewards (Locations: Northeast Swale, Beaver Creek Conservation Area).



Photo 1d: Grazing exclusion cage and vegetation transect clipping process used to monitor intensity of targeted conservation grazing (Location: Northeast Swale).



Photo 1e: Capturing bird calls and other wildlife vocalizations using audio recording devices.

Left Image: Handheld Zoom H4nPro audio recording device (Location: Northeast Swale).

Right Image: Wildlife Acoustics SM3 Song Meter autonomous recording device (Location: Maple Grove).



Photo 1f: Collecting grab samples for water quality testing (Location: Small Swale).

Photo Series 2: Community Engagement and Citizen Science



Photo 2a: 2020 Saskatoon berry planting event with the “misaskwatomina Project” led by Kevin Wesaquate (Location: Victoria Park).



Photo 2b: Meewasin 2017 Bioblitz event (Location: Northeast Swale).



Photo 2c: Meewasin 2019 Winter Ecoscavanger Hunt event with the Saskatoon Nature Society (Location: Beaver Creek Conservation Area).



Photo 2d: 2019 Crocus Hike with the Saskatoon Nature Society (Location: Cranberry Flats).



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Meewasin Valley Authority

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Treaty 6 Territory and Homeland of the Métis

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