Habitat Track

Trust for Nature's Conservation Data and Monitoring Framework

Executive Summary

Habitat Track is Trust for Nature's organisation-wide biodiversity monitoring, evaluation and evidence framework. It brings together field observations, species records and spatial data to build a consistent understanding of biodiversity values, ecological change and conservation outcomes across private land in Victoria.

The framework integrates vegetation and habitat surveys, species observations, remote sensing and spatial data to generate information on biodiversity values and ecological change across Trust for Nature's protected land network. Bringing together multiple sources of information allows biodiversity observations from individual locations to be interpreted within their broader landscape context.

Long-term biodiversity persistence depends on maintaining the condition, function and adaptive capacity of ecological systems. To assess biodiversity across the Trust for Nature estate, the framework focuses on three key components:

- **Representation** – the biodiversity values protected within the estate.
- **Integrity** – the ecological condition and functionality of those values.
- **Resilience** – the capacity of ecosystems and species to persist, recover and adapt through time.

Habitat Track uses a targeted suite of ecologically meaningful, repeatable and scalable metrics to assess biodiversity values, ecological condition and change through time. Together, these metrics provide a practical evidence base to support decisions across a large and diverse conservation network.

By generating consistent biodiversity data from protected private land, Habitat Track addresses an important gap in Victoria's biodiversity monitoring system. The framework is designed to be compatible with the Victorian Biodiversity Indicator Framework and related state datasets, allowing information generated by Trust for Nature to contribute to broader biodiversity reporting while also supporting organisational planning, stewardship and impact evaluation.

Through targeted monitoring, representative sampling and continuous spatial assessment, Habitat Track provides a foundation for tracking ecological change, understanding the contribution of private land conservation, and guiding future conservation investment.

This document establishes the conceptual framework for Habitat Track and provides the foundation for a consistent approach to biodiversity monitoring, evaluation and reporting across the Trust estate. Its purpose is to define the conservation outcomes, evidence domains and reporting metrics that guide the development of monitoring activities and biodiversity reporting. It is not intended to prescribe the detailed operational design of individual monitoring activities. Monitoring protocols, sampling strategies, survey frequencies, site selection approaches and data management procedures will be developed as supporting components of the program and refined through implementation.

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1. Introduction

Trust for Nature protects biodiversity on private land through a range of actions including conservation covenants, reserves, stewardship and Land for Wildlife. Collectively, these programs protect important biodiversity values across Victoria and support the conservation of threatened species, ecological communities and ecosystems, including many that are underrepresented within the public reserve system.

Habitat Track is Trust for Nature's biodiversity monitoring, evaluation and evidence framework. It has been developed to provide a consistent approach to understanding, measuring and demonstrating biodiversity change across protected private land in Victoria. It brings together field surveys, species monitoring, citizen science, remote sensing and spatial analysis within a single framework for generating biodiversity evidence across the Trust for Nature estate.

The framework is designed to support conservation planning, stewardship, impact evaluation and organisational reporting. By linking site-based observations with broader landscape-scale information, Habitat Track enables biodiversity evidence to be applied across multiple scales, from individual properties to ecosystems. Habitat Track provides the framework for defining conservation outcomes, measuring ecological change and translating biodiversity evidence into conservation decisions. Figure 1 provides an overview of the framework, illustrating how biodiversity evidence is generated, interpreted and applied to support conservation decision-making.

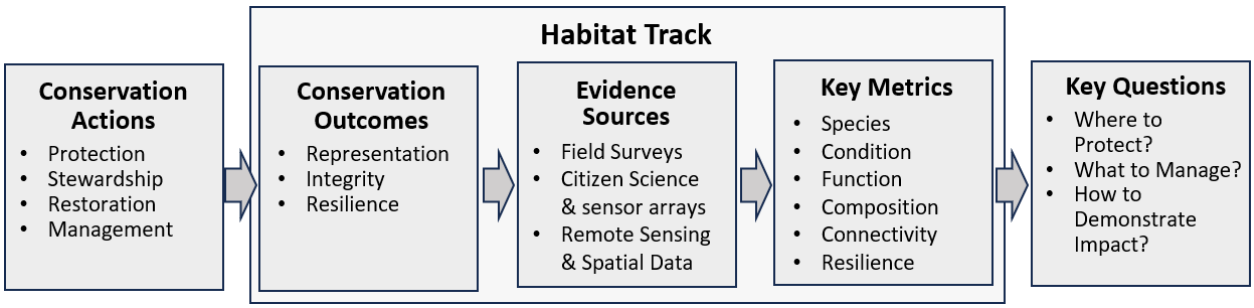

Figure 1. Overview of the Habitat Track framework

1.1 Key Conservation Questions

Habitat Track is designed to generate information that supports three core questions relevant to conservation planning, management and evaluation across areas protected by the Trust.

Where to protect?

Identifying the species, ecosystems and landscapes of highest conservation significance, and determining where protection is most likely to secure long-term biodiversity outcomes.

Which actions to invest in?

Understanding how management interventions influence ecological condition and biodiversity outcomes, and which actions deliver the greatest conservation benefit across different contexts.

How to demonstrate conservation impact?

Measuring changes in biodiversity values, ecological condition and ecosystem resilience through time to evaluate the outcomes of conservation action.

2. Conceptual Framework

2.1 Conceptual Basis

Habitat Track is built around measuring representation, integrity and resilience across the Trust's estate. These concepts provide a practical basis for assessing whether conservation actions are protecting biodiversity values, maintaining ecological function and supporting persistence through time.

The framework recognises that ecological systems are complex, dynamic and often respond to management in non-linear ways. Biodiversity outcomes emerge from the interplay between ecological condition, landscape context, disturbance regimes, species interactions and environmental change. Consequently, ecological responses can be delayed, variable between ecosystems, and influenced by factors operating across multiple spatial scales. This complexity presents challenges for monitoring approaches that assume ecological recovery will occur predictably or linearly following threat reduction. It also highlights the need to assess broader characteristics of ecological systems that influence long-term biodiversity persistence, rather than focusing solely on threats, management actions or short-term ecological responses.

Climate change further reinforces the need for this perspective. Future biodiversity outcomes will depend not only on the protection of existing biodiversity values, but also on the capacity of ecosystems and species to adapt, reorganise and persist under changing environmental conditions. As a result, conservation success is increasingly understood in terms of maintaining ecological integrity and supporting resilience, rather than preserving static ecological states.

2.2 Conservation Objectives

Habitat Track evaluates biodiversity outcomes through three complementary dimensions which provide a practical framework for understanding conservation performance at site, landscape and estate scales:

Representation

Representation describes the extent to which biodiversity values occurring across Victoria are secured within the Trust for Nature estate. This includes the diversity of species, ecological communities, habitats and ecosystems represented within the estate, as well as the protection of biodiversity values of elevated conservation significance, including threatened species, rare ecosystems, climate refugia and other disproportionately important conservation assets. Representation therefore reflects both the breadth of biodiversity values protected and the significance of those values within broader conservation contexts. Increased representation improves the likelihood that ecological diversity, evolutionary potential and ecosystem functions are maintained over the long-term.

Integrity

Integrity describes the extent to which ecological systems retain their characteristic composition, structure and ecological function. Ecological integrity reflects the degree to which native species assemblages, habitat features, ecological processes and disturbance regimes remain intact and support biodiversity. Integrity does not imply ecological stability or the maintenance of a fixed state, but rather the capacity of ecosystems to retain their characteristic functions, processes and dynamics through time. Integrity considers the overall capacity of ecosystems to function as coherent ecological systems. Within Habitat Track, integrity is inferred from metrics describing ecosystem composition, vegetation structure, habitat availability and ecological function.

Resilience

Resilience describes the capacity of ecosystems and species to absorb disturbance, reorganise following change and support persistence through time. In ecological systems, resilience is influenced by factors such as connectivity, diversity, regeneration capacity, spatial redundancy and adaptive capacity. Resilience is particularly important under climate change because future conservation outcomes will depend not only on protecting biodiversity assets, but also on maintaining the characteristics that allow ecological systems to adapt and persist under changing conditions. Resilience is inferred from multiple indicators associated with the capacity of ecological systems to persist, recover and adapt through time.

2.3 Conservation Actions and Ecological Change

Trust for Nature's conservation activities influence biodiversity outcomes by shaping the ecological conditions, processes and landscape context that determine how species, habitats and ecosystems persist through time. Protection, stewardship, restoration and land management can reduce threats, improve habitat condition, maintain ecological processes and strengthen landscape connectivity, creating the conditions that support long-term biodiversity persistence.

The relationship between conservation actions and biodiversity outcomes is seldom direct. Ecological responses are shaped by environmental variation, disturbance regimes, landscape context and historical conditions, and may occur over long timeframes. As a result, conservation outcomes emerge from the cumulative influence of multiple interacting processes rather than any single management action.

Figure 2 summarises this conceptual model. It illustrates how conservation actions influence ecological state and processes, which in turn contribute to outcomes relating to representation, integrity and resilience. Together, these outcomes provide a framework for understanding ecological trajectories and evaluating whether conservation activities are contributing to the long-term persistence of biodiversity.

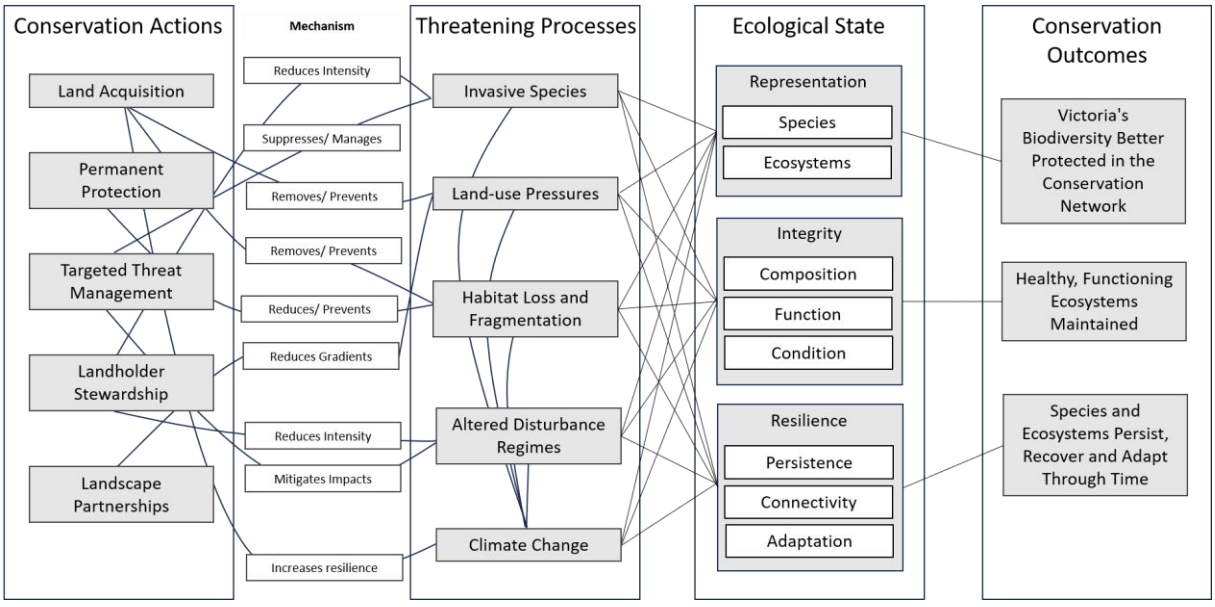

Figure 2. Conceptual diagram showing influence of collective conservation actions across threats to drive ecological state responses and conservation outcomes.

3. Habitat Track Data Framework

3.1 Evidence Sources

Habitat Track generates evidence through three complementary evidence sources that provide information on biodiversity values, ecological condition and ecological change across the Trust estate.

Vegetation and Habitat Surveys

Vegetation and habitat surveys provide direct observations of ecological composition, structure and regeneration that cannot currently be measured reliably through remote sensing alone. They are particularly important for assessing ecological integrity because many indicators of ecosystem function, habitat quality and ecological recovery remain observable only through on-ground assessment.

Species Observations

Species observations provide information on species occurrence, occupancy, abundance and community composition. These observations are derived from multiple sources including Trust for Nature staff inventories, citizen science records on the iNaturalist platform and automated field stations for standardised passive monitoring. Together, these datasets provide evidence of biodiversity representation, species responses and ecological change across a range of spatial and temporal scales.

Remote Sensing and Spatial Analysis

Remote sensing and spatial analysis provide information on ecosystem representation, habitat extent, connectivity, fragmentation, hydrological function and climate resilience. These datasets provide continuous coverage across the Trust estate and enable assessment of ecological processes operating beyond individual monitoring sites.

Because these datasets are not constrained by tenure boundaries, they can also be used to assess biodiversity values, habitat condition and ecological processes across the broader landscape. This provides important context for evaluating the contribution of Trust for Nature's conservation programs and identifying future conservation opportunities.

3.2 Data Quality, Confidence and Integration

Biodiversity datasets vary in spatial coverage, temporal extent, sampling design and uncertainty. Habitat Track applies quality assurance procedures across all monitoring domains and will communicate confidence, assumptions and limitations where relevant. Biodiversity observations can also be influenced by factors such as detectability, observer effort and survey timing. These influences will be minimised through standardised monitoring methods and, where appropriate, analytical approaches that account for variation in observation processes.

Ecological systems are inherently variable, and uncertainty cannot be eliminated from biodiversity monitoring. Habitat Track therefore does not rely on individual observations, indicators or datasets in isolation. Confidence is derived from repeated observations through time, replication across sites, assessment across multiple spatial scales and agreement among independent sources of information. Where different evidence sources support similar conclusions, confidence in inferred outcomes increases. Where evidence differs, this may indicate uncertainty, ecological complexity or priorities for further investigation.

Habitat Track is intended to operate within Victoria's broader biodiversity information system rather than as a stand-alone monitoring program. Integrating Trust for Nature data with state-wide monitoring programs, remote sensing products, environmental datasets and other biodiversity information provides critical context for interpreting ecological change. This broader evidence base strengthens inference by helping distinguish local management responses from wider drivers such as climate variability, disturbance events and landscape-scale ecological change.

3.3 Monitoring Design Principles

Habitat Track has been designed to provide information that is representative, scalable and practical across a large and diverse estate. Rather than attempting to monitor every property, the framework combines representative field sampling, strategic site selection and continuous spatial assessment to understand ecological patterns, trends and outcomes across the Trust estate.

Monitoring activities may occur across covenants, reserves and other protected properties, with sampling designs tailored to the conservation values, management objectives and reporting requirements of each program. Field-based monitoring focuses on representative samples of ecosystems, management contexts and conservation values, while citizen science observations, automated field stations and spatial datasets provide broader spatial and temporal coverage.

3.4 Reporting Metrics

Representation, integrity and resilience are assessed using indicators that describe biodiversity values, ecological condition, ecological processes and ecological change. Together, these indicators provide a broader and more informative assessment of conservation outcomes than any single measure alone.

Habitat Track uses metrics derived from vegetation and habitat surveys, species observations and spatial datasets. Together, these metrics provide complementary evidence of representation, integrity and resilience across the Trust estate. Metrics are selected using five criteria:

- relevance to Trust for Nature's conservation objectives
- ecological significance and sensitivity to change
- repeatability and consistency through time
- practicality and cost-effectiveness of collection
- capacity to support decision-making and evaluation

The framework deliberately prioritises a limited number of metrics that are ecologically informative, interpretable and scalable. This reflects the view that conservation monitoring is most effective when focused on measures that directly support conservation decisions rather than attempting to quantify every aspect of ecological change.

The reporting framework combines indicators describing ecological state, ecological change and broader landscape context. State indicators describe the current condition or biodiversity values of protected areas, change indicators describe ecological trajectories through time, and contextual indicators describe the landscape characteristics and environmental conditions that influence future outcomes. Together, these indicators provide complementary perspectives on conservation outcomes and support interpretation of ecological patterns, trends and responses across the Trust estate.

Table 1. Summary of Habitat Track reporting metrics

Metric	Conservation Outcome	What it Measures
Vegetation and Habitat Surveys		
VCI Score	Integrity	Overall vegetation condition score based on VCI method
Floristic Richness Score	Integrity	% of native plant diversity present relative to benchmark
Vegetation Structure Score	Integrity	% of structural complexity present relative to benchmark
Threatened Plant Species Metric	Representation	Weighted score for presence of listed flora
Habitat Metric	Integrity	Weighted score for habitat feature availability
Functional Richness	Integrity	% of expected functional groups present
Floristic turnover metric	Resilience	Change in species composition between survey periods
Recruitment Metric	Resilience	Frequency of successful recruitment across growth forms
Weed Pressure Metric	Integrity	% cover of weeds
Grazing Pressure Metric	Integrity	Herbivory Severity Score
Species Observations		
Fauna Richness Score	Integrity	% of observed species diversity relative to expected
Threatened Fauna Species Metric	Representation	Weighted score for conservation-significant fauna
Indicator Species Occupancy	Integrity	Observed frequency of habitat specialist species
Functional Richness	Integrity	% observed occurrence of known functional groups
Fauna turnover metric	Resilience	Change in species composition between survey periods
Introduced Pest Occupancy	Integrity	Frequency of pest species occurrence
Total Species Inventory	Representation	% of all known species relative to expected across estate
Remote Sensing and Spatial Analysis		
Habitat Representation	Representation	Proportion of ecosystems and habitats protected
Habitat Value Metric	Representation	Importance of estate relative to remaining extent
Species Habitat Representation	Representation	% of available weighted habitat secured for focal species
Habitat Condition Change	Integrity	% of sites improving in HCAS Condition
Integral Index of Connectivity	Resilience	Trends in IIC score from new acquisitions
Patch Size Distribution	Resilience	Trends in PSD score from new acquisitions
Climate Refuge Area	Resilience	% of available CRA secured from new acquisitions
Wetland Inundation Frequency	Resilience	Trends in WIF for priority wetlands over 5 years
Floodplain Connectivity	Resilience	Trends in HC for priority wetlands over 5 years
Tolerable Fire Interval distribution	Resilience	Trends in TFI distribution across TFN estate.

3.5 Monitoring Systems and Methods

The following outlines the methodologies used across each evidence source to generate the reporting metrics.

Vegetation and Habitat Surveys - Vegetation Condition Index

To assess vegetation condition, Habitat Track will use the Vegetation Condition Index (VCI), a vegetation assessment framework developed by the Arthur Rylah Institute for ecological monitoring and reporting in Victoria. The VCI measures the extent to which observed vegetation resembles benchmark vegetation for a location, using quantitative measures of native species richness and vegetation structure relative to spatially explicit benchmarks. The approach provides a repeatable and sensitive measure of ecological condition that supports comparison across ecosystems and through time.

Habitat Track adopts VCI as its primary measure of vegetation condition and supplements it with measures of habitat structure, recruitment and threatening processes to support broader assessment of ecological integrity and resilience. Species responses and landscape-scale processes are assessed through complementary monitoring approaches.

Species Observations

iNaturalist

Habitat Track uses iNaturalist as its primary citizen science platform for recording plants, animals and fungi across the Trust estate. These observations contribute to biodiversity inventories and improve understanding of species occurrence, distribution and representation.

As citizen science data can be influenced by observer effort and detectability, observations will be interpreted alongside other monitoring datasets and used as complementary evidence rather than direct measures of population change or ecological condition.

Citizen science observations also provide opportunities to improve understanding of biodiversity values beyond the Trust estate. Observations contributed by covenantors, Land for Wildlife members and other land managers can help document species occurrence, improve biodiversity inventories and increase understanding of the contribution of private land to biodiversity conservation across Victoria.

Staff Biodiversity Inventories

Trust for Nature staff routinely record flora and fauna observations during covenant assessments, stewardship visits and targeted surveys. These records contribute to property biodiversity inventories, document species occurrence across the Trust estate and help identify threatened or otherwise significant species. Records incorporated into Habitat Track will include species identification, observer, observation date, spatial location and supporting photographs or media. While survey effort varies between programs, these data contribute primarily to understanding biodiversity representation and species occurrence.

Field Stations

Field stations provide a standardised approach for generating species observations across the Trust estate. During the initial implementation phase, Habitat Track will deploy approximately 100 monitoring kits across selected properties. Each kit will comprise two unbaited black flash camera traps (Reconyx HF4K) and one dual-band acoustic and ultrasonic passive acoustic monitor (Wildlife Acoustics Mini Bat 2).

Monitoring kits will be deployed during spring, with each property monitored for a three-month period. Equipment locations will be rotated monthly, resulting in three monitoring locations per property during each deployment cycle. The first year of implementation is intended primarily as a rollout and

establishment phase, allowing deployment protocols, analytical workflows and operational logistics to be tested and refined before longer-term monitoring schedules are established.

Field stations provide information on fauna occurrence, occupancy, relative abundance and community composition, particularly for species that are difficult to detect using searches or point-based survey approaches. Paired unbaited camera traps will target native terrestrial mammals and invasive pest species. One camera in each pair will target small- to medium-sized mammals and the other will target medium- to large-sized mammals, increasing the likelihood of detecting the full mammal assemblage at a site. Passive acoustic recorders will target vocalising birds, bats and amphibians; some mammals may also be detected incidentally.

Spatial and Remote Sensing Datasets

Habitat Track integrates a range of spatial datasets to assess biodiversity values, ecological condition and landscape-scale ecological processes. Core datasets include:

- Trust for Nature proprietary spatial layers, including covenant, reserve and conservation asset datasets
- DEECA biodiversity datasets, including Nature Kit products, Strategic Management Prospects (SMP) layers including species distribution models, composite habitat values layers, fire history, management priorities and other spatial planning products.
- CSIRO environmental, climate and ecological datasets including the Habitat Condition Assessment System (HCAS).
- Published and commissioned datasets relating to connectivity, climate refugia, habitat extent, ecosystem mapping and species distributions.

These datasets provide continuous spatial coverage across the Trust estate and enable assessment of ecological processes operating at scales that cannot be effectively monitored through field-based approaches alone. They form the foundation for representation, connectivity, habitat extent, climate resilience and landscape condition analyses conducted through Habitat Track.

Beyond supporting reporting across the Trust estate, spatial datasets can also be used to assess biodiversity values and conservation opportunities across private land more broadly. These analyses provide a landscape context for Trust for Nature's activities and support strategic planning for protection, stewardship, restoration and conservation initiatives.

The specific analytical methods, model inputs and dataset versions used to derive spatial indicators will be documented through supporting technical specifications and updated as datasets and methodologies evolve.

Ongoing Development

Habitat Track will continue to evolve as implementation progresses, with monitoring methods, analytical products and reporting approaches refined in response to emerging knowledge, technologies and organisational needs.

4. Integration into Trust for Nature Systems

Following initial implementation, Habitat Track will provide the foundation for a new State-wide Conservation Plan, enabling conservation priorities to be identified using a robust and consistent evidence base. This will strengthen the organisation's ability to target protection, stewardship and restoration efforts towards the species, ecosystems and landscapes where the greatest conservation gains can be achieved. By providing accessible, repeatable and comparable information across the Trust estate, the framework will also support stronger strategic decision-making and enable executive and Board oversight of our conservation objectives.

The framework will also create a pathway for integrating biodiversity performance metrics into Trust for Nature's annual reporting and broader organisational performance assessment. Over time, this will strengthen the organisation's ability to demonstrate conservation impact, track progress against strategic objectives, and communicate its contribution to biodiversity outcomes across Victoria.

Habitat Track also provides a platform for generating biodiversity knowledge across Victoria's private land estate. Through spatial analyses, citizen science participation and species observations contributed by landholders and conservation partners, the framework can help improve understanding of biodiversity values beyond Trust for Nature properties. While reporting and evaluation remain focused on Trust for Nature’s conservation objectives, these broader data streams support strategic planning and contribute to a greater state-wide conservation perspective.

Habitat Track will progressively develop an integrated data-management framework that supports the secure storage, management and analysis of biodiversity observations, monitoring data, spatial datasets and reporting products. Where possible, monitoring data will be linked with Trust for Nature business systems, spatial platforms, citizen science platforms and other relevant biodiversity datasets to support efficient data capture, analysis and reporting. Automated analytical workflows and machine learning techniques may be applied to assist with species identification, image and acoustic processing, quality assurance and data interpretation, improving the efficiency and scalability of the program while maintaining appropriate standards of transparency, validation and scientific rigour.

This document does not seek to define all analytical methods, reporting approaches or conservation performance measures. These components will be documented separately. A Conservation Outcomes Framework will define the conservation outcomes the organisation is seeking to achieve and how success will be assessed. An Analytical Framework will define how indicators are calculated, how confidence and uncertainty are evaluated, how multiple evidence sources are integrated, and how ecological change is interpreted and reported. Habitat Track should therefore be read as the conceptual foundation for the program rather than a complete description of all monitoring, analysis and reporting processes.

Appendix 1. Alignment with the Victorian Biodiversity Indicator Framework

The Victorian Biodiversity Indicator Framework (BIF) is DEECA's state-wide framework for monitoring and reporting biodiversity outcomes across Victoria. It provides a consistent structure for assessing biodiversity condition, trends, management effectiveness and long-term outcomes.

Habitat Track has been developed to support Trust for Nature's biodiversity monitoring, evaluation and reporting needs while remaining compatible with relevant elements of the BIF. While the two frameworks operate at different scales, they share a common focus on measuring biodiversity outcomes using complementary datasets across multiple spatial scales.

This compatibility enables information generated through Habitat Track to contribute to broader biodiversity evidence and reporting in Victoria, while also supporting Trust for Nature's planning, stewardship, impact evaluation and organisational reporting requirements.

BIF Theme	Habitat Track Contribution
State of Biodiversity	Vegetation condition monitoring, flora and fauna records, threatened species monitoring, ecosystem representation
Expected Survival	Habitat extent, landscape connectivity, climate resilience, wetland and floodplain function
Biodiversity Management	Weed, pest, grazing and fire regime monitoring
Management Effectiveness	Ecological response monitoring linked to protection, stewardship and management actions

Habitat Track is particularly valuable because it generates biodiversity evidence from Victoria's protected private land estate, complementing broader state-wide monitoring and improving understanding of conservation outcomes on private land.