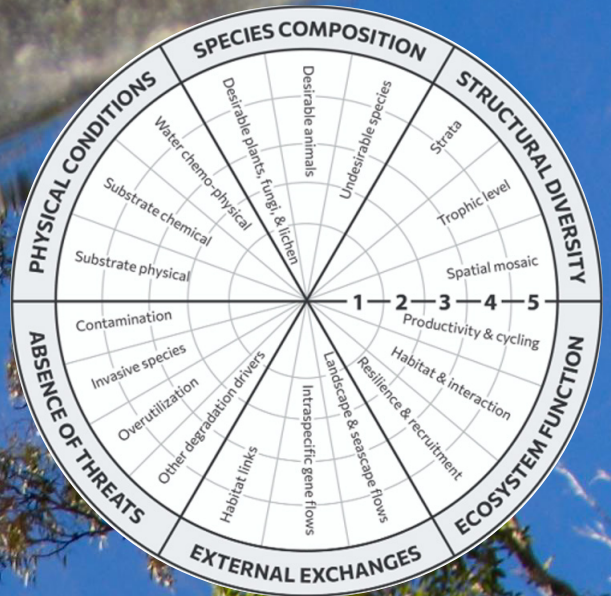




National standards *for the practice of* ecological restoration in Australia

Prepared by
Standards Reference Group,
Society for Ecological Restoration Australasia (SERA),
in consultation with key partners.

Edition 3.0
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Acknowledgement of Country

We acknowledge the traditional custodians throughout Australia and their continuing connection to, and deep knowledge of the continent's lands and waters.

We pay our respects to Elders both past and present.

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The Society for Ecological Restoration Australasia (SERA) is an independent, nonprofit ecological restoration organisation that connects the restoration community (industry, government, practitioners and scientists) across the Australasian region and is a regional chapter of the peak international body for restoration, the Society for Ecological Restoration (SER). www.ser.org

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Notes to Edition 3.0. The document is modified from (and supersedes) all previous editions. The First Edition published in Restoration Ecology (McDonald T, Jonson J and Dixon KW 2016). The main modifications since Edition 2.2 consist of further clarifications to the (now separately available) SER five-star evaluation tables, clarification of reference ecosystem terminology, further clarification of restoration approaches, contextual updates to international agreements, a new section on 'scaling up' and a range of updates to harmonise with the Third Edition of the International document published by the Society for Ecological Restoration (SER) the parent body of SERA (Gann et al. 2026).

¹ While the Standards draw on extensive expert input and a large body of knowledge available in the literature, the readability, policy style and need for independence of the Standards require that citations are minimised. A bibliography is provided.

Minister's foreword

It's a stark reality that our environment is facing many challenges in the world today, both natural and human-made.

Australia is one of 17 countries known as 'mega diverse', with many endemic flora and fauna species and natural wonders that are the envy of the world. But these species and ecosystems are under threat.

It's taking the collective efforts of governments, scientists and researchers, philanthropists, and local communities to take meaningful steps towards restoring and protecting Australia's biodiversity.

When the Albanese Government came to office in 2022, we committed to turning around the dire trajectory of nature in this country.

That same year, 196 countries adopted the Kunming-Montreal Global Biodiversity Framework. Australia was proud to join this landmark agreement, which aims to halt and reverse biodiversity loss by 2030, so that by 2050 we can be living more in harmony with nature.

Together, many of us have embarked on an ambitious agenda to tackle the drivers of biodiversity decline, and to protect and repair our precious places and the species that call it home.

I am pleased that we have made progress in recent years.

Australia's Strategy for Nature 2024–2030, agreed by Environment Ministers across Australia, sets ambitious national targets to contribute to the Global Biodiversity Framework. It focuses on the drivers of biodiversity decline and aims to protect and repair our precious places, putting nature on a path to recovery.

We're making good progress towards 30 by 30 targets, with 25 percent of Australia's landmass now protected. We've already blitzed the 30 percent global marine target (Australian marine parks now cover 52 percent of our ocean), and are now focussed on increasing high levels of protection from around 24 percent to 30 percent by 2030.

And we continue to progress our conservation and restoration targets on land through nationally agreed strategies, establishing the Nature Repair market, funding such as the \$250 million Australian Bushland Program, extending our Indigenous Protected Areas, and progressing restoration and resilience initiatives across the Great Barrier Reef's interconnected ecosystems.



The need for environmental restoration, not just protection, was also central to our landmark reforms to Australia's national environmental law, the EPBC Act, last year. Implementation of those reforms is now well underway, including a new requirement that environmental offsets must deliver a net gain for the environment, not just the previous requirement of no net loss to the environment.

In addition, State and Territory Environment Ministers, have now agreed to work together to develop a National Nature Restoration Framework. This is key to delivering on Australia's national restoration target. The Framework will support restoration practitioners to identify areas where restoration efforts should be focused, to yield the greatest benefits for biodiversity. As part of this, our Government will develop a series of maps to support the identification of areas for restoration.

But government cannot do this alone. Nature is in the best hands when governments, industry and community work together towards the same goal.

It's timely that the Society for Ecological Restoration Australasia (SERA) has produced a revised edition of the National Standards for the Practice of Ecological Restoration in Australia.

These standards are key to informing the work of governments, local community groups, landholders and natural resource management groups, in order to deliver enduring biodiversity benefits.

I congratulate SERA on these new standards, and encourage all stakeholders to work together to restore our unique and beautiful ecosystems.

We owe it to future generations to get this right.



Murray Watt

Federal Minister for the Environment and Water



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Executive summary

The contemporary call for restoration comes at a critical point in our planet's history where human influence is all pervasive. Australia's long and relatively uninterrupted evolutionary past means the continent possesses ancient soils and exceptionally diverse and unique biota—yet its terrestrial, inland waters, coastal and marine ecosystems carry a more recent legacy of extensive and continuing environmental degradation, particularly in urban, industrial and production environments. Anthropogenic climate change is exacerbating a range of pressures on ecosystems such as land clearing, overharvesting, fragmentation, contamination, inappropriate management, disease and invasive species. Degradation is so severe in most cases that it will not be overcome without highly focused and ecologically appropriate intervention including reduction of the causes of degradation and interventions to support recovery of native biodiversity.

As echoed by the UN's Decade on Ecosystem Restoration—and in the guidance for the Global Biodiversity Framework's Restoration Target 2—the practice of ecological restoration seeks to transform humanity's role from one where we are the agents of degradation to one where we act as conservators and healers of native ecosystems. It is in this context that the *National Standards for the Practice of Ecological Restoration in Australia* (the 'Standards') has been prepared by the Society for Ecological Restoration Australasia (SERA) in collaboration with its 17 current not-for-profit Partner and Advisor organisations; all of whom, like SERA, are dedicated to effective conservation management of Australia's native ecological communities.

This document identifies the need for and purpose of ecological restoration and explains its relationship with other forms of restorative activities. The Standards identify the principles underpinning restoration philosophies and methods, and outline the steps required to plan, implement, monitor and evaluate a restoration project to increase the likelihood of its success across all participating sectors. The Standards are relevant to—and can be interpreted for—a wide spectrum of projects across the entire social and environmental continuum ranging from minimally resourced community projects to large-scale, well-funded industry or government projects.

SERA and its Partners have produced these Standards for adoption by community groups, First Nations organisations, primary producers and other industries, restoration researchers and practitioners, regulators and government agencies; while recognising the different levels of knowledge, resources and operating contexts of these groups. The document can support voluntary action as well as regulatory efforts to encourage, plan, implement, monitor, report and audit ecologically appropriate environmental repair across Australia's land and water ecosystem.

Section 1 Introduction

Definitions

Ecological restoration is the process of assisting the recovery of a native ecosystem that has been degraded, damaged or destroyed.

(SER 2006)

These *National Standards for the Practice of Ecological Restoration in Australia* (the 'Standards') adopt the above definition of **ecological restoration**²—as articulated by the world's leading ecological restoration body, the Society for Ecological Restoration (SER 2004 (Gann et al. 2026)). Ecological restoration is distinguished from other **ecosystem restoration** activities that contribute to reducing harm and improving the condition of ecosystem functionality, through its aim to directly restore **self-organising** native ecosystems, including both terrestrial and aquatic. (Further clarification of the relationship between ecological restoration and other 'restorative activities is provided in Appendix 1.)

Although ecological restoration projects very often focus on vegetation in the hope that displaced fauna will re-populate the restored habitat, considering all biota is an underpinning assumption of ecological restoration and is implied by the use of the terms 'species composition' and 'biota' in this document.

The Standards recognise that the same term 'ecological restoration' is commonly used to describe not only a process (i.e. the activity undertaken) but also the outcome sought (i.e. the restored state). These Standards, however, use the term *restoration* for the *activity* undertaken and **recovery** for the *outcome* sought or achieved. Thus, the Standards define a restoration activity as any step or collection of steps within a project, that aims to progress an ecosystem as far as attainable towards full recovery, relative to an appropriate local native **reference ecosystem**—regardless of the period of time required to achieve that state. **Full recovery** is defined as the state whereby all ecosystem attributes closely resemble those of the reference model. Where only lower levels of recovery are possible despite best efforts, the recovery would be referred to as being in a state of partial recovery; although all such activities need to aspire to **substantive recovery** of native biota of the reference model to qualify as ecological restoration. (For definitions of all terms, see Glossary, Section 6.)

The fully recovered state can only be considered achieved when the ecosystem's *attributes* are on a secure trajectory (pathway) to highly resemble those of the reference model without further restoration-phase interventions being needed. After full recovery has been attained, ongoing management interventions would be viewed as a form of ecosystem maintenance.

The *activity* and the *outcome* of ecological restoration are therefore inextricably linked. If the desired recovery *outcomes* are identified from the outset then these can guide the optimal restoration *activity*. Similarly, where outcomes are uncertain, applying appropriate processes can help us to arrive at satisfactory outcomes.

² Bolding is often used within a paragraph to denote that the term is defined in the glossary.

Projects that focus solely on reinstating some form of ecosystem functionality without seeking to also substantively recover at least some self-organising proportion of the characteristic native biota of an appropriate native reference ecosystem would be best described as **rehabilitation**. Such rehabilitation, as described below and in Appendix 1, however, is nonetheless encouraged and highly valued where it: (i) benefits biodiversity and ecosystem integrity and (ii) is the highest standard that can be applied.

The ethic and global context of ecological restoration

The ethic of ecological restoration is one of conservation, repair and renewal. Society as a whole is increasingly recognising that we need to achieve a net gain in the extent and functionality of native ecosystems through supplementing conservation with environmental repair, an ethic that now underpins initiatives worldwide.

There is global recognition that **local native ecosystems** across the globe are of high intrinsic biological, societal and economic value but are diminishing in extent and condition. This is reflected in the 2022 Kunming-Montreal Global Biodiversity Framework (GBF), to which Australia is a signatory. The GBF asks of each signatory country to contribute towards the global goal to “*Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity*” ([Convention on Biological Diversity](#)).

As a response—and in recognition of the already highly active (public and private) restoration sector in Australia—Australia’s revised Strategy for Nature’s national target for restoration envisages that priority degraded areas (across terrestrial, inland water, coastal and marine ecosystems) are under effective restoration by 2030 to recover biodiversity, and improve ecosystem functions and services, ecological integrity and connectivity. Such prioritised restoration is intended to provide a critical complement to the conservation of representative ecosystem types, managing invasive species, reducing the impacts of pollutants, and adapting to climate change (Commonwealth of Australia 2024). The Strategy’s subsequent Implementation Plan therefore identifies progressive steps to guide such prioritisation to support and sustain restoration over time.

Both the GBF Target 2 website and the Guidance Notes for Target 2 of the GBF (FAO et al. 2024) clarify that ‘*ecosystem restoration*’, for the purposes of the GBF, may comprise two types of restoration: ecological restoration and rehabilitation. The goal of ecological restoration—the focus of these SERA-led Standards—is the recovery of native ecosystems to the **highest attainable extent** (i.e. either partial or full recovery—see Principle 4 and Appendices 1 and 2). Rehabilitation, on the other hand, reinstates ecosystem functions and services to result in benefits to biodiversity and ecosystem integrity but does not directly or substantively restore native ecosystems (FAO et al. 2024). Rehabilitation defined in this way is, therefore, an ecologically lower standard than ecological restoration but nonetheless may be valuable in, for example, transformed production or industrial areas if there is evidence that the project would provide some direct benefit to biodiversity or ecosystem integrity. The ethic underlying both rehabilitation and ecological restoration with respect to the GBF, however, is that both must contribute a genuine and evidence-based, net gain benefit to biodiversity, with ecological restoration always preferred where it is desirable, appropriate and practicable (FAO et al. 2024).

The ethic of engagement with **interested and affected parties**, including the principle of social inclusion—is embedded in restoration (Principle 6). This is consistent with the targets of the GBF and the UN Declaration on the Rights of Indigenous Peoples, which

underscores the intrinsic connection between Indigenous Peoples' rights to land, territory, and resources, including their conservation and protection, and the culture, wellbeing, and health of Indigenous Peoples (Gann et al. 2026). Engagement with Traditional Owners and First Nations organisations should begin early enough to influence project purpose, design, implementation and evaluation. Proponents should identify the relevant rights-holders, follow locally appropriate cultural protocols, obtain consent for the use and publication of Cultural Knowledge, recognise Indigenous Cultural and Intellectual Property, and budget for participation, advice and on-Country work. The form and depth of engagement should reflect the interests, rights and potential impacts involved; a generic consultation record is not a substitute for a locally agreed process (see also Commonwealth of Australia 2025).

Ecological restoration also seeks optimal conservation outcomes for ecosystems at increasingly larger scales. That is, it seeks to not only restore ecosystems at site level but also to pursue partnerships, including with Indigenous Peoples, to substantially expand the area and connectivity of ecosystems at landscape and waterscape level for the purposes of optimising nature conservation at scale. This ethic informs and drives a process of scaling-up restoration efforts, particularly to support the highest biodiversity needs (See Section 3—Scaling up).

Ecological restoration in Australia—the need for Standards

The practice of ecological restoration is becoming widespread in Australia and the demand for this activity is increasing across terrestrial, inland water, coastal and marine ecosystems. Many government and non-government agencies, community groups, companies and private individuals choose to engage in the repair of damage, often inherited from previous generations (**non-mandatory** restoration); while others are required to undertake restoration as part of consent conditions for current developments (**mandatory** restoration).

While successes have occurred, often the outcomes from both pursuits fall short of their objectives due to a lack of effort, resources, knowledge or skill. Substantial further progress could be made with improved focus, greater resourcing and capability building. As restoration activity expands across public, private and philanthropic sectors, there is an increasing need for transparent, scientifically rigorous and nationally consistent standards to guide project design, implementation, monitoring and evaluation.

Robust foundation documents exist that inform and guide ecological restoration, namely the SER International Primer on Ecological Restoration (SER 2004)—expanded upon in Clewell & Aronson (2013)—and the IUCN (International Union for Conservation of Nature) guidelines (Keenleyside et. al. 2012). However, this document (and its international counterpart Gann et al. 2026) are considered necessary to supplement these foundation documents. This is particularly to clarify the guiding principles and minimum standards expected if a project's *activities* are to be described as ecological restoration; and to clarify the degree to which its *outcomes* are to be evaluated as ecological recovery. Australian Standards are also needed to more specifically tailor information to the Australian context; drawing lessons from ecological restoration practice around the world but especially from Australia - a continent rich in unique species with ecosystems of extraordinary diversity and ecological complexity, and from which much pioneering restoration experience has already been developed.

What are the Standards and for whom are they designed?

The Standards list (i) six principles that underpin current best practice ecological restoration (Section 2) and (ii) key steps required to plan, implement and monitor restoration projects to increase their chance of success (Section 3). The Standards are applicable to any Australian ecosystem (whether terrestrial or aquatic), any sector (whether private or public, mandatory or non-mandatory) and for all organisms (whether plants, animals and other organisms). They can be used by any person or organisation to help develop strategic and operational plans, contracts, consent conditions and closure criteria.

Examples of restoration projects: For all readers—whether practitioners, researchers, governments or community members—this Edition of the Standards has assembled fourteen sets of examples to illustrate many of the points made in this document. Links to these are cited at appropriate locations throughout the document and can also be accessed on the [SERA website](#).

Review: The Standards will be updated periodically or on a five-year cycle as required—while the Examples will be updated more frequently, ideally on an annual basis. The Standards are designed to be generic in nature and thereby compatible with more detailed guidelines and standards that may already exist or which have been adapted (or are yet to be prepared) for a specific aspect of restoration, or geographically distinct biome.

Section 2 Six key principles of ecological restoration practice

Six 'key principles' are used here to provide a framework for conceptualising, defining and measuring ecological restoration, particularly at a time of rapid environmental change. They have been derived from a more extensive set of principles and values listed in Appendix 2.

- **Principle 1** Ecological restoration practice is based on an appropriate local native reference ecosystem.
- **Principle 2** Restoration inputs will be dictated by level of resilience and degradation.
- **Principle 3** Recovery of ecosystem attributes is facilitated by identifying clear targets, goals and objectives.
- **Principle 4** The goal of ecological restoration is full recovery, insofar as possible, even if outcomes take long timeframes or involve high inputs.
- **Principle 5** Restoration science and practice are synergistic.
- **Principle 6** Social aspects are critical to successful ecological restoration.

Principle 1 Ecological restoration practice is based on an appropriate local native reference ecosystem

A fundamental principle of ecological restoration is the identification of an appropriate **reference ecosystem** to guide project targets and provide a basis for monitoring and assessing outcomes. This represents the local native ecosystem to be restored. Once this has been identified, a **reference model** is developed from information gained from multiple actual sites (**reference sites**) and/or from ecosystem descriptions, indicators of ecosystem **attributes**, historical records, predictions, and climate projections (Table 1, Box 1). While a state-mapped vegetation classification can be highly informative, it may or may not be sufficient to identify a reference ecosystem and will not, alone, constitute a reference model.

Identifying the reference ecosystem. The site's pre-degradation ecosystems are used as starting points for identifying restoration targets—taking into account natural variation, intractable environmental changes that may have occurred at the site, and acknowledging the fact that ecosystems are naturally dynamic and adapt and evolve over time (particularly aquatic ecosystems) and that they change in response to changing environmental conditions. Therefore, we use existing and recent assemblages, coupled with sound scientific and practical knowledge of current and future environmental conditions, to help develop suitable reference models.

Where irreversible environmental changes have occurred or are predicted, such as altered topography, hydrology, or climatic conditions; a local native ecosystem more ecologically appropriate to the changed conditions may be used as a guide (see caveats in Box 2). Adopting a reference ecosystem is therefore not an attempt to immobilise an ecosystem at some point in time but to optimise potential for local species to recover and continue to evolve and reassemble over subsequent millennia.

Where local evidence is lacking (e.g. in areas where healthy examples are rare), regional information can help inform identification of likely local native ecosystems. The reference ecosystem may also include species from neighbouring localities that have recently naturally migrated e.g. due to a changing climate (See definition of 'local native ecosystem' in Glossary) and the model should also include descriptions of any natural variability and successional states that may be characteristic of the ecosystem's decline or recovery.

Developing the reference model. This involves analysis of the **composition** (species), **community structure** (complexity and configuration) and **function** (processes and dynamics) of the ecosystem to be restored on the site.

Identifying functional components to include in a reference model is important to goal setting; but returning **functions** also facilitates restoration. That is, recovery is achieved by the processes of growth, reproduction and **recruitment** of the organisms themselves over time, facilitated by the return of appropriate cycles, flows, productivity levels and specific plant and animal habitat structures, niches or interactions. Monitoring of ecosystem processes is required to identify whether acceptable trajectories of recovery are likely to result in a self-organising and functional ecosystem or whether further (or different) interventions are needed to remove barriers to recovery.

[Note that a 'reference model' informs but does not replace a set of overall targets, goals and objectives of a restoration project (See Principle 3).]

Box 1 What does the term 'reference' mean in ecological restoration?

Using existing native ecosystems as a 'reference' is a core principle for ecological restoration. It is what distinguishes ecological restoration from any other restorative activity we might undertake. A suite of terms is employed in restoration to convey the various aspects of this process³ (Table 1).

Table 1 Suite of terms that relate to the concept of using existing native ecosystems as a 'reference' for guiding restoration.

Term	Meaning
Reference ecosystem	The ecological community identified as the one to which the restoration is directed. It is not necessarily the historical ecosystem but ideally represents the ecosystem that would inhabit the restoration site had degradation, damage or destruction not occurred, adjusted to accommodate changed or predicted environmental conditions. Where current or anticipated environmental conditions completely differ from those previously prevailing, however, an alternative ecosystem may be identified to act as the reference.
Reference model	A detailed model, developed for the identified reference ecosystem , that describes the expected reference state (in its characteristic form or forms and highest integrity condition) that the restoration site would exhibit in the absence of degradation. This model provides a benchmark to inform design of the restoration project and against which the condition of the site is measured prior to, during, and after ecological restoration . Ideally, the reference model includes information from a suitable number of extant reference sites .
Reference site	An undegraded or nearly undegraded extant site that can be used to inform the development of a reference model . In some cases, monitoring data from reference sites are used to formally compare data from the restoration site to evaluate progress of the recovery at the restoration site.
Reference state	The highest integrity form and condition of the reference model , which the ecosystem at the restoration site would exhibit in the absence of degradation.

3 Note: The use of the term 'Reference ecosystem' in this document is consistent with all past SER documents. The concept is retained in Gann et al. 2026, without using a particular term to denote it, in order to place more emphasis on reference 'model'.]

Identifying reference ecosystems and developing reference models in highly dynamic environments. Restoration in highly dynamic environments such as in-stream freshwater or marine systems is complicated not only by the dynamic nature of these environments, but also the fact that aquatic ecosystem edges are not as sharply delineated and they often have lower accessibility than ecosystems on land. Habitat cover and species composition can vary more substantially and naturally over time and can be more readily outdated in aquatic than terrestrial ecosystem; requiring more repeated surveys or temporal reference and comparison points for the identification of prior and/or reference ecosystems. Indeed, the concept of a site is difficult to define in dynamic aquatic ecosystems which are highly connected and can often contain more **spatial mosaics** of habitats than terrestrial ones. The lack of a tenure system for the ocean also means a marine site is rarely delineated in the same way as on land.

Historical and contemporary records are also much more limited in aquatic ecosystems, particularly subtidal marine ones which must be visually mapped (in person or increasingly with underwater vehicles). In this regard, reference ecosystem identification in marine environments requires consideration of a greater diversity of information. The development of generic reference models for recognised ecosystem types (such as described in Gillies et al. 2017) is therefore very helpful for marine restoration.

In addition, ambient environmental changes (such as ocean warming and acidification and reduced stream flow due to continental drying) are already resulting in changes in the ecological niches for a range of often highly mobile species, making it more difficult to identify stable ecosystem reference models in aquatic, particularly marine, environments.

See some examples of coastal and marine restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/coastal-and-marine/>

See some examples of restoration of rivers, streams and floodplain wetlands: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rivers/>

See some examples of inland wetland restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/inland-wetlands/>

Box 2 Identifying reference ecosystems in cases of irreversible past and anticipated environmental change

Many local sites, intact or degraded, are becoming increasingly threatened by human activities and some of these result in effectively irreversible impacts. Reinstating local native ecosystems in cases where irreversible environmental change has occurred requires anticipation and, if necessary, mimicry of natural adaptive processes.

1 Irreversible physical (soil, air, and water) and biological changes. In cases where truly irreversible environmental change has occurred to the site and the pre-degradation ecosystem cannot be reinstated, an appropriate solution would be to adopt, as a reference ecosystem, an alternative, locally occurring ecosystem (or at least some species thereof) that occurs naturally under the likely or changed conditions. (Examples include sites where hydrology has changed irreversibly from saline to freshwater or vice versa, sites where traditional fire regimes cannot be reinstated and the ecosystem has to shift to rainforest, or where erosion has produced a rocky platform).

Whether planned activities function as (i) ecological restoration, (ii) a complementary restorative activity or simply (iii) a **reallocation** to a human-designed ecosystem) will be highly dependent on a range of conditions. These include the local historic occurrence of such shifts due to natural dynamic processes, the strength of the case for irreversibility, and the degree to which the project is primarily focused on establishing the full complement of key ecosystem attributes as distinct from **ecosystem services** alone.

Where degradation cannot be reversed to the point where even a minimally functioning appropriate native ecosystem cannot be restored or native species cannot migrate into the area over time, the next best alternative would be rehabilitation to a condition with the highest practicable similarity to the function of a native ecosystem.

2 Irreversible (accelerated) climate change. A changing climate means that all local ecosystems are likely to be changing at faster rates than in the past; in ways that are difficult to anticipate. Some entire ecosystems will be destroyed (e.g. many marine, coastal, alpine and cool temperate communities) where no suitable migration habitats exist; while in other ecosystems, component species may have a capacity to adapt by genetic selection or migration, options that are less likely under conditions of fragmentation (Appendix 3).

Climate change is recognised as an anthropogenic degradation pressure that requires urgent and unfaltering mitigation of its causes, mitigation that needs to be embraced by the whole of society. Even with optimal mitigation, however, much of this change is irreversible and therefore becomes part of the environmental background conditions to which species need to adapt or be lost (Appendix 3).

To assist potential for adaptation, reference ecosystems and their models should be informed by research into the anticipated effects of climate change on species and ecosystems. This is to allow potential for anticipated expansions and/or transitions in species and ecosystems over time. Degree of adaptation represented in the modelling will depend on degree of change anticipated, as represented by the three following scenarios.

(i) Where only fine scale changes in temperature, pH, or moisture levels are expected to affect only some species at an individual site, adaptability can be improved by ensuring the restoration project includes a high diversity of the site's

pre-existing species (or species of an adjoining ecological community or ecotone that is most indicative of the direction of change) as some of these may be suited to the changed conditions.

(ii) In cases where the climate envelope of the species is expected to shift as a result of climate forecasts, introducing more diverse genetic material of the same species from other parts of a species' range is often recommended; at least in fragmented landscapes or aquatic environments where migration potential is lower than intact areas (Refer to Appendix 3).

iii) Where environmental change is predicted to exceed the suitability for species or ecosystems, it may be necessary to build into reference models some species from regional models of the same ecosystem or adjacent different ecosystems, or even identify an entirely different local ecosystem.

Irrespective of degree of change to the reference model or whether the change has already occurred or is anticipated, in all cases, managers need to optimise potential for adaptation by ensuring genetically diverse representatives of the target species in configurations that increase linkages and optimise gene flow. Such adaptation is optimised where all **threats** affecting ecosystems (particularly fragmentation) are minimised (Appendix 3).

In the final analysis, however, the role of restoration is to 'assist recovery' not impose a human design upon it—that is, to place ecosystems onto a **trajectory** of recovery so that they can continue to transition and their constituent species may continue to adapt and evolve. The Standards therefore recommend practitioners continue with restoration aspirations based on local reference ecosystems, unless there is strong evidence to the contrary; but be ready to adapt the specific reference models in the light of observable or likely changes occurring within or between these local ecosystems, as informed by sound science and practice.

Principle 2 Restoration inputs will be dictated by level of resilience and degradation

Restoration ultimately involves working with natural processes, irrespective of degree of damage or the sophistication of technology involved. As mentioned in the previous section, recovery is achieved by the processes of growth, reproduction and recruitment of the organisms themselves over time, facilitated by the return of appropriate cycles, flows, productivity levels and specific plant and animal habitat structures, niches or interactions. One of the most important ecological properties that influences recovery, however, is the **resilience** of species and ecosystems—and this will guide which **approach** to restoration is most appropriate at a restoration site.

All species (and ecosystems) possess a variable level of **biological resilience** that can help them recover after natural disturbances. This contributes to **ecosystem resilience**, i.e., potential for ecosystems to have some capacity to resist, recover from and reorganise in the face of human induced stresses or shocks. In such human-induced cases, however, resilience is only available to the extent those stresses are similar in type and degree to those previously experienced during the evolution of the biota contained in the ecosystem.

This means that—after removal of the degradation drivers—where the human-induced impacts are similar in type and low in degree (or where sufficient time frames and nearby populations exist for effective recolonisation), recovery may be able to occur at a restoration site without assistance. However, in sites of somewhat dissimilar or higher impact, at least some intervention (such as competition management, reinstatement of appropriate dynamics or reinstating the physical and chemical properties of the site) is likely to be needed to **initiate ecosystem recovery**.

Where impacts are substantially dissimilar or higher or sufficient recovery time or populations are not available, correspondingly higher levels of restoration inputs and interventions are likely to be needed. These may include higher levels of remediation of the physical and chemical properties of the site, supplementing populations, or returning missing species or ecological processes through **reintroduction** of plants and captive breeding and/or reintroduction of fauna. At extremely damaged sites or for highly threatened plant and animal species, intransigent barriers to recovery may occur, in which case **adaptive management** and/or active research will be needed to identify specific solutions for restoration.

Prior to prescribing whether regeneration-based or reintroduction-based approaches are needed, however, an assessment of capacity for natural recovery should be done by a person with knowledge of ecosystem resilience as well as practical methods to harness it (Box 3 and Fig. 1). This is essential to optimise success. Inappropriately applied reintroduction-based approaches on sites best suited to a regeneration-based approach can reduce recovery potential. In addition, this assessment is also important to assist in identifying which works or subsites are to be prioritised. That is, variation in the remaining resilience of sites (and the higher cost of assisting recovery where the potential is lower) highlights the strategic advantage that can be gained by investing scarce resources into areas where resilience and potential for connectivity is higher.

An important implication of working with natural processes is that they take time to unfold as responses by species occur gradually, often somewhat unpredictably, with initial treatments invariably requiring multiple **follow-up** treatments. Project planning and funding should therefore extend well beyond initial works to the period required to secure the recovery trajectory (See Section 4).

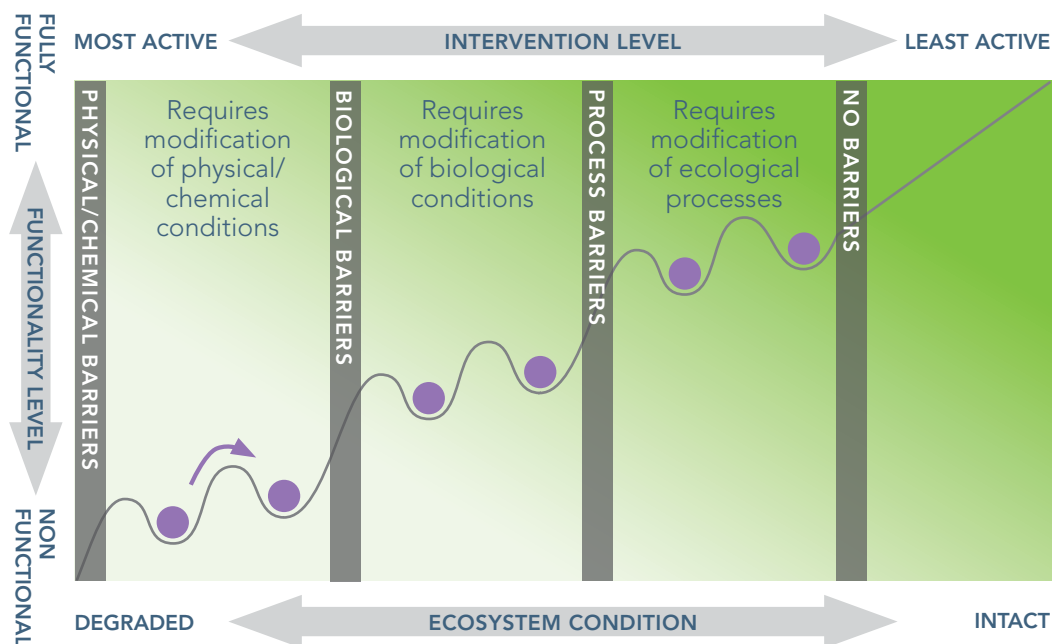


Figure 1 Conceptual model of a recovery trajectory during restoration. (Adapted from Keenleyside et al 2012, after Whisenant 1999, and Hobbs & Harris 2001). The troughs in the diagram represent basins of stability in which an ecosystem property (ball) can remain in a steady state prior to being shifted by a restoration activity past a barrier (peaks) towards a higher functioning state. Notes: (i) Cessation or mitigation of the original drivers of degradation at the site (e.g. land clearing, mining, grazing, etc.) is assumed to have already occurred as the first stage of the restoration; (ii) A site's pre-restoration condition may start at any point along the trajectory; (iii) Biological barriers can be complex (not necessarily involving lack of propagules); (iv) In some cases overcoming one barrier type (e.g. physical-chemical barriers) may be sufficient alone; and, (v) small barriers of any type may occur in any sequence along the degradation/recovery trajectory.

Box 3 Identifying the appropriate ecological restoration approach for the return of biota to a site

Correctly assessing the capacity and limits of various parts of a site to naturally regenerate, with or without assistance, aids the selection of appropriate approaches and treatments, avoiding costly errors, and increases the likelihood of attaining similarity between the restoration outcome and the appropriately developed reference model.

Regeneration potential can be hidden in dormant in-situ propagules or nearby sources. A useful initial rule of thumb is for a skilled restoration site assessor to undertake an assessment of the site and its surrounds to identify any scope for harnessing this potential through one of the regeneration approaches described in this box.

Reintroductions of species (or reinforcements of populations) will be essential, however, where potential for natural regeneration has been partially or fully depleted or genetic diversity is low. It should only be carried out, however, if and when potential for regeneration has been tested, is known, or is predicted (on the basis of evidence) to be impossible or insufficient.

Four approaches to ecological restoration

Four approaches are typically applied, informed by rigorous, practitioner informed site assessment to determine the level of in-situ biological resilience and colonisation potential remaining at a site (Figure 2, Table 2). All will require ongoing adaptive management until recovery is secured. A mosaic of approaches is common where there is a diversity of different conditions across a site. That is, some parts of a site may require one of the natural regeneration approaches, while others require a combined regeneration/reintroduction or a full reintroduction approach.

- 1 Spontaneous regeneration.** Pre-existing biota are very often able to recover unaided after cessation of a of the original causal factor of degradation (such as over-grazing, over-harvesting, over-fishing, restriction of water flows or inappropriate fire regimes). Animal species may be able to migrate back to the site if connectivity is in place, while plant species may recover through resprouting or germination from remnant soil seed banks or seeds that naturally disperse from nearby sites.
- 2 Facilitated regeneration.** Where the removal of causes of degradation is insufficient to allow spontaneous regeneration, active interventions within the site can often foster natural regeneration from in-situ propagules (e.g. soil seed banks or buds) or from recolonisation. Examples of lower-level interventions include removing competition, predation or damage from invasive species, reinstating environmental flows and fish passage (in aquatic sites), and (in terrestrial sites) applying disturbances such as fire to break seed dormancy, or installing habitat features such as hollow logs, rocks, woody debris piles and perch trees to attract fauna. Higher intervention level interventions may include remediating contamination or **substrate** chemistry, reshaping substrates, watercourses and landforms, and building habitat features such as reefs.
- 3 Combined regeneration/reintroduction.** Varying levels of resilience among individual species to the same impact type can cause some more vulnerable species to drop out of an ecosystem earlier than less vulnerable species. In such cases, after addressing the causal factors and fostering as much natural

regeneration as possible, the less resilient biota may require reintroduction. This approach can also be appropriate where existing populations of biota are low and supplementary genetic reintroductions may be needed (reinforcement); or where some patches in a site are more highly impacted than others. It is also typically used in ecosystems where there is high mobility (e.g. marine sites) or species are highly migratory (e.g. rainforest) where only a 'framework' of species can be reintroduced to kick start natural regeneration.

- 4. Full reintroduction.** Where no on-site regeneration or colonisation potential remains, not only will all causes of degradation need to be addressed and abiotic damage corrected, but also all (or virtually all) of a site's desirable biota will need to be reintroduced using current best practice methods. (This may apply to the vegetation only, leaving fauna to recolonise, or may also involve faunal reintroductions.) Works required to prepare substrates prior to reintroductions may be nil, low or high depending on the extent of damage at the site. As recovery after reconstruction commences, natural regeneration can ensure and facilitated regeneration techniques can be applied to accelerate recruitment.

See links to some examples of each of the four restoration approaches <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/four-approaches/>

See links to some examples of faunal habitat restoration or reintroduction: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/faunal-habitats/>

See links to some examples of restoration involving invasive species management: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/invasives/>

See links to some examples of soil restoration and guiding principles: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/restoring-topsoils/>

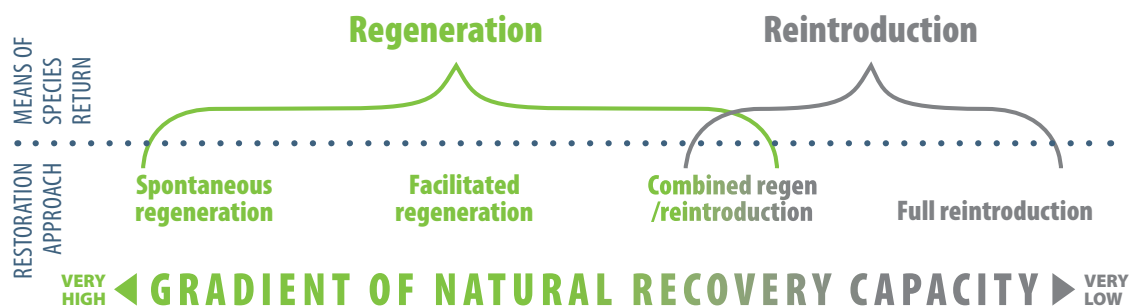


Figure 2 Schematic diagram of four restoration approaches that align with the degree of natural regeneration potential present at a degraded site at any scale from individual organism to whole of ecosystem.

Table 2 Various synonyms are used for restoration approaches (and methods) around the world, reflecting the development of similar ideas in different regions. [Note that The Standards do not encourage the use of the terms 'passive' and 'active' restoration for reasons outlined in Chazdon et al. (2021) and McDonald et al. (2023).]

Term used in this document to describe the approach	Synonyms for approach (or methods) used in Australia	Synonyms for approach (or methods) used elsewhere
Spontaneous regeneration	Natural regeneration (phasing out as it is now recognised that all regeneration is 'natural') Passive restoration	Natural regeneration Unassisted regeneration Passive restoration
Facilitated regeneration	Assisted regeneration (Phasing out to avoid confusion with ANR ⁴) Bush regeneration Rainforest regeneration	Assisted regeneration Assisted Natural Regeneration (without planting) (ANR) Farmer Managed Natural Regeneration (FMNR)
Combined regeneration /reintroduction	Revegetation Partial reconstruction Faunal reintroduction Partial active restoration	Assisted Natural Regeneration (ANR) Rewilding Framework Species Method Applied Nucleation Partial planting
Full reintroduction	Reconstruction (Phasing out to avoid implication of earthworks) Revegetation Full active restoration	Full planting Reforestation Active restoration

⁴ The methodology of Assisted Natural Regeneration (ANR), curated by the Assisted Natural Regeneration (ANR) Alliance, focuses largely on natural regeneration but can also include some enrichment planting. Hence, 'natural regeneration' was coined to meet the need to convey actively harnessing natural regeneration without reintroduction.

Box 4 Special considerations for the Full reintroduction approach

There are many long-cleared parts of landscapes where full reintroduction is essential. While the popular activity of 'tree planting' may appear a logical response and can readily meet the lower standards of 'rehabilitation', attaining the recovery of a native ecosystem model through full reintroduction is considerably more challenging. This is because ecological recovery in situations of such high degradation depends heavily on human intervention for the reinstatement of not only an ecological community's composition and structure but also, to a large degree, the reinstatement of its functionality. A key element of functionality that is not always automatic includes the capacity of organisms to breed and recruit, building populations that can perpetuate and initiate other ecosystem processes, foster diverse plant-animal interactions and, ultimately, effect the return of a self-organising and resilient ecosystem.

Some special considerations

Diversity in species mixes. Too often it is assumed that reintroducing a very small suite of species will be enough to commence recovery of an ecosystem. While reintroduction of all species may not be essential to return an ecosystem's basic functionality, representation of as many functional groups as early as possible is likely to increase functionality. Given that not all species may be available at the start of a project, it can be valuable to introduce others progressively over time. In some ecosystems, however, a wide range of species needs to be present from the start to avoid competitive exclusion of some species over others.

Habitat provision is a key early consideration, particularly to ensure key plant-animal interactions can return and help rebuild complex ecosystems. The inclusion of coarse woody debris, brush piles, small pools, artificial hollows and particularly fauna-attracting plant species can increase potential for invertebrate, bird and mammal visitation and residency.

Configuring restoration boundaries so that they reduce edge:area ratios and increase connectivity of habitats is essential to both provide sufficient habitat for some species and to reinstate potential for biota to move and share genes across the landscape, increasing potential adaptability to climate change.

Genetic diversity is increasingly recognised by researchers as critical to restoration success as it is necessary to attain functional populations in fragmented and highly cleared landscapes, particularly to help those populations build adaptability to climate change with shifting **climate envelopes** (Appendix 3). Collecting seed from isolated trees (that may produce hybrid seed) or from small populations (that may be inbred) may mean that a very large proportion of the trees planted from these collections have low genetic fitness or may be sterile, with very narrow adaptive capacity. This potential for low fitness is exacerbated if large numbers of individuals of the same species (that were collected from parent plants already inbred or hybrids) are planted near remnants as these can 'genetically swamp' remnant populations. Funding programs and methods developed for restoration should require projects to source seed from multiple, widely spaced parents from large populations at some distance from small vegetation fragments. Meeting this requirement would be necessary for any potential for prediction that a planted site is on a trajectory of recovery, irrespective of growth rates or structural indicators of the plants.

Principle 3 Recovery of ecosystem attributes is facilitated by identifying clear targets, goals and objectives

A restoration project will have greater transparency, efficiency, manageability and improved chances of success if the restoration targets and goals are clearly defined and translated into measurable objectives. These can then be used to monitor progress over time, applying adaptive management approaches (Box 5).

As explained in the previous Principle, reference ecosystems identify the particular terrestrial or aquatic ecosystem that informs the target of the restoration project, with the reference model describing the specific compositional, structural and functional ecosystem **attributes** requiring reinstatement before the desired outcome (the restored or substantially recovered state) can be said to have been achieved. These Standards (and the SER Standards Gann et al. 2026) list six key ecosystem attributes (rationalised from those of the SER Primer, SER (2004). These provide the structure for reference model and include: **absence of threats, physical conditions, species composition, community structure, ecosystem function, and external exchanges** (Figure 3).

Recovery is considered to have been achieved when the six ecosystem's attributes are on a secure trajectory to approximating those of the **reference state** without further repair-phase interventions being needed (other than ongoing protection and maintenance). At that stage the ecosystem would be considered 'self-organising' and increasingly resilient to natural disturbances.

Each ecosystem attribute will comprise a range of more detailed component properties, that in turn inform goals and objectives needed to achieve the target. These component properties have different expressions in different biomes and different sites, which will mean that each project will have site-specific targets, goals and objectives aligned with specific attributes. Specific (measurable) indicators are also selected and integrated into the setting of indicators to help evaluate whether these targets and goals are being met as a result of the interventions (Box 6.) However, it is common for indicators, particularly biological and functional indicators, to be specified in the identification of objectives that relate to planning, implementation and monitoring—to help evaluate whether a project is indeed on a trajectory of recovery.

The progress of recovery of these attributes can then be assessed using SER's **five-star** rating (see Principle 4 and <https://www.ser.org/page/Standards-Tools>). This assessment enables practitioners, regulators and industry to track the progress of recovery of each attribute for a project over time.

Six key attributes of a reference ecosystem



Physical conditions

The suitability of soils, water, landforms and other physical properties.



Species composition

The array and relative proportion of organisms (e.g. plants and animals).



Community structure

The physical organisation of living and non-living elements (e.g. layers and food webs).



Ecosystem function

The roles and processes arising from interactions among living and non-living elements.



External exchanges

The two-way flows between sites and their surrounding environments.



Absence of threats

Degree any factors impacting the health of the ecosystem are managed.

Figure 3 Restoration goal-setting and monitoring needs to be carried out for each of the six attributes. (Figure: Little Gecko Media, Photos: 10 Ray Thompson, 12 Mark Bachman, 15 Arid Recovery, 2, 4, 5 Virginia Bear.)

Box 5 Restoration monitoring and adaptive management

Monitoring the responses of an ecosystem to restoration actions is essential to do the following:

- **Identify whether the actions are working** as expected or need to be modified (i.e. adaptive management).
- **Provide evidence that specific goals are being achieved** and the recovery is on its planned trajectory.
- **Answer specific questions**—e.g. to evaluate particular treatments or what organisms or processes are returning to the ecosystem.

Adaptive management is implemented to allow a degree of flexibility to unexpected change, change being the natural condition of ecosystems. It involves a structured cycle of planning, action, monitoring, reflection and adjustment. Using the best available knowledge, skills and technology, practitioners implement an action, record the results and identify lessons that inform whether different interventions (or different sequences of interventions) are required to those already planned. The level of documentation should be proportional to the project's scale, risks, and resources. Importantly, adaptive management should be a standard approach regardless of funding level, project duration or whether the project is led by volunteers, community organisations, landholders, industry or government.

- 1 The most direct and critical form of monitoring **to identify whether restoration actions are working** (or need to be adapted) is routinely inspecting the site. Such monitoring is undertaken by the project supervisor to identify any need for a rapid response and to ensure appropriate treatments can be scheduled before problems become entrenched. Additional inspections are also needed after episodic events such as storms, floods, fire, severe frost and droughts.
- 2 The minimum formal monitoring required **to provide evidence that goals are being achieved** and the recovery is on its planned trajectory—is to maintain fixed photopoint monitoring record(s) of the site prior to, during and after treatment. This may be supplemented by field observations using simple indicator measures, such as species regenerating. Where feasible and useful, untreated comparison sites should be included.

Well-funded projects (or projects under regulatory controls e.g. offsets and mine site restoration (Young et al. 2022) are expected to undertake formal comprehensive monitoring for adaptive management and reporting to stakeholders. This usually involves professionals or skilled advisors and is based on a monitoring plan that identifies, among other things, monitoring design, timeframes, who is responsible, the planned analysis, and frameworks for response and communication to regulators, funding bodies or other parties.

The monitoring design of projects may involve development or adaptation of a condition assessment system or formal sampling system to track the progress of specific indicators, whether they be abiotic or biotic. In some cases, individual species or groups of species can function as surrogates for suitable abiotic conditions. For soil microorganisms, one or more quantitative determinants are used consistently throughout the life of the restoration project to ensure that the functional diversity of the microbial communities is restored in soils. (See [soil restoration examples and principles](#).)

Formal sampling of plant and animal populations can involve a range of faunal trapping and tracking methods or vegetation sampling using randomly located quadrats or transects. Design of such monitoring schemes should occur at the

planning stage of the project to ensure that the project's goals, objectives and their selected indicators are measurable and that the monitoring aligns with these goals. Care should be taken to ensure that the sampling commences prior to the commencement of restoration treatments and that the initial state is captured; where possible, control sites should be included in the design. If the necessary skills are not available in-house, advice should be sought from relevant professionals with experience in designing site-appropriate monitoring, documenting and storing data, and carrying out appropriate analysis. (Note that projects in high variability ecosystems should consider a multi-year average when determining whether a restoration site has achieved its objectives.)

- 3 Monitoring can be used to **answer specific questions** (hypotheses) about new treatments or the return of organisms or processes—but only if the data collected are well matched to the particular question and an appropriate experimental design is employed. A restoration project that is comparing or trialing techniques needs to observe the conventions of replication and include untreated controls in order to interpret the results with any certainty. Rigorous recording is also needed of specific restoration treatments and any other conditions that might affect the results. A standard practice in such a situation would be for the practitioner to partner with an ecologist or relevant scientist to ensure the experimental design receives the appropriate level of advice and assistance. Where new treatments are being considered or where the nature of the site is uncertain, treatments are first trialed in smaller areas prior to application over larger areas.

Box 6 Targets, goals and objectives—what terms should we use?

It is useful to have a hierarchy of terms such as ‘target’, ‘goals’ and ‘objectives’, to better organise planning so that proposed inputs are well matched to the desired ultimate outcomes.

While there is no universally accepted terminology and many groups will prefer to use their traditional terms, the Standards broadly adopt the terminology of the latest edition of the Open Standards for the Practice of Conservation (Conservation Measures Partnership, 2025).

It helps to think of objectives needing to be S.M.A.R.T. (i.e. specific, measurable, achievable, reasonable and time-bound). They should be directly connected to key attributes of the target ecosystem. Such objectives can be measured by the use of specific **indicators**.

Note that social goals, objectives and indicators must also be incorporated into project planning, as incorporated in the hypothetical example below. For a more in-depth coverage of social aspects of restoration in *Principle 6. Social aspects are critical to successful restoration*.

Hypothetical example

- 1 Target.** Where the aim is full recovery, the target of a restoration project should align with the specific reference community to which the project is being directed—e.g. ‘Box-Ironbark Forest’—and will include a description of the ecosystem attributes. In projects where substantial (but less than full) recovery is the aim, the target may not fully align with the reference model.
- 2 Goal/s.** The goal or goals provide a finer level of focus in the planning hierarchy compared to the target. They describe the status of the target that you are aiming to achieve and, broadly, how it will be achieved. For example, goals in this hypothetical project may be to achieve:
 - i an intact and recovering composition, structure and function of remnants A and B within 5 years, including visitation by at least two declining woodland bird species;
 - ii 20 ha of revegetated linkages between the remnants within 10 years; and,
 - iii 100% support from all stakeholders and neighbours within 5 years.
- 3 Objectives** (measured by indicators). These are the changes and intermediate outcomes needed to attain the goal/s. For example, preliminary objectives may be to achieve:
 - i less than 1% cover of exotic plant species and recruitment of at least two obligate seeding native shrub species in the remnants within 2 years;
 - ii a density of 300 stems /ha of native trees and shrubs, at least three native herb species / 10 m² and a coarse woody debris load of 10 m³/ha in the reconstructed linkages within 3 years; and,
 - iii cessation of all livestock encroachment and weed dumping within 1 year and formation of a ‘friends’ group representing neighbours within 2 years.

[For other examples of some detailed objectives and indicators, see the [Wheatbest Restoration Standards](#) and the tables associated with the five-star system of the SER Standards at <https://www.ser.org/page/Standards-Tools>.]

Principle 4 The goal of ecological restoration is full recovery, insofar as attainable, even if outcomes take long timeframes or involve high inputs

Qualification of a project as an ecological restoration activity is not determined by the duration of the project but by the goal to achieve the highest and best level of recovery attainable. It is important to bear in mind that the desired outcome may take long timeframes. This can be because sufficient time has not yet elapsed for recovery processes to run their course; sufficient restoration resources or knowledge are not yet available to overcome recovery barriers; or, mitigating the negative impacts originating from outside the site require lengthy negotiation. While success may ultimately be achieved by continuous or staged improvement over time; in many cases (e.g. non-mandatory cases), the achievement of full recovery in shorter timeframes would require substantial human and financial investment including in-depth research (e.g. many mandatory ecological restoration cases).

To help managers track progress towards project goals over time, SER offers a tool (five-levels or 'stars') for progressively assessing and ranking degree of recovery over time. Table 3 provides a summary description of the six key attributes, while Table 4 provides a summary description of zero-to-five-star conditions. The attribute and sub-attributes tables provided on the SER website downloadable from <https://www.ser.org/page/Standards-Tools>. The recovery wheel diagram—a highly useful vehicle for communicating changes over time - is provided in Fig. 4 (and a blank template in Appendix 4). It needs to be noted, however, that detailed assessment of condition for each attribute and sub-attribute is necessary if the tool is to be used with any rigor or reliability. Readers should, therefore, access the fully revised five-star system tables (that now include a zero-star category). These are described in Gann et al. 2026, with downloadable tables and wheels available at <https://www.ser.org/page/Standards-Tools>.

Five-star recovery—that is a level of recovery where the attributes of the ecosystem are on a self-organising trajectory to full recovery based on an appropriate local native reference model—is the standard to which ecological restoration projects ideally aim. However, in some cases, constraints may limit potential to less than full level of recovery. Such cases can still be referred to as ecological restoration projects as long as the aim is for substantive recovery relative to the appropriate local native reference ecosystem. However, projects that aim for less than substantive levels of recovery—or solely recovery of ecosystem functions without including the appropriate local biota—are better referred to as rehabilitation as long as they provide benefits to biodiversity and ecosystem integrity (Appendix 1).

See links to examples of full and partial recovery projects on the SERA website: <https://chapter.ser.org/australasia/restoration-standards/examples/>

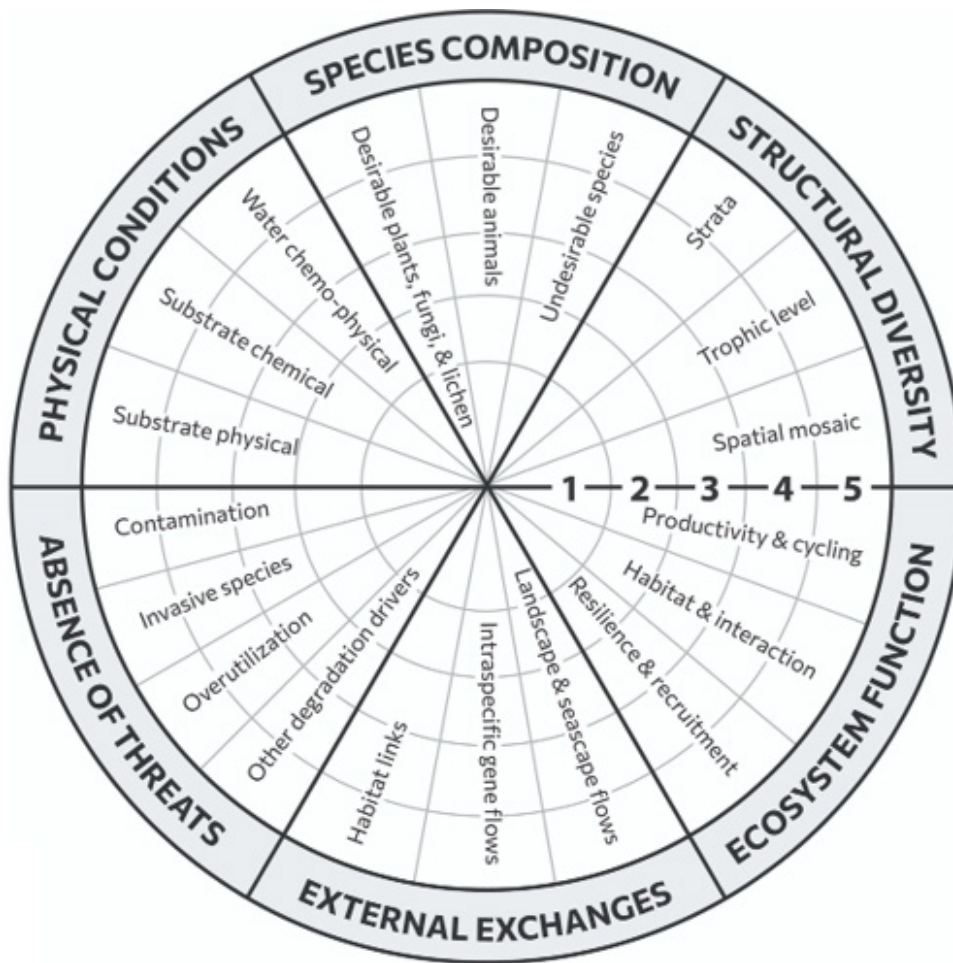
Table 3 Description of the key ecosystem attributes used to characterise the reference model, as well as to evaluate baseline condition, set project goals, and monitor degree of recovery at a restoration site (Table reproduced from Gann et al. 2026).

Attribute	Description
Absence of threats	Known threats from direct degradation drivers (e.g., overutilization, active contamination, sources of invasive species, eroding land surfaces) are virtually absent.
Physical conditions	Environmental conditions (including the physical and chemical conditions of soil, water, and topography) required to sustain the ecosystem are present.
Species composition	A very high diversity and abundance of characteristic native species and genes are present, whereas undesirable species are minimal or effectively absent.
Structural diversity	Appropriate diversity of key structural components, including demographic stages, faunal trophic levels, vegetation strata, and spatial diversity are present.
Ecosystem function	Appropriate levels of growth and productivity, nutrient cycling, decomposition, habitat, species interactions, resilience, and natural disturbance regimes are present.
External exchanges	The ecosystem is appropriately integrated into its larger landscape and seascape context through positive abiotic and biotic flows and exchanges.

Table 4 Summary of generic standards for zero-star to five-star recovery levels. Reproduced from Gann et al. 2026). Each level is cumulative. While this table provides an overall sketch of what a 'one-star' or 'three-star' condition might look like; real life sites are likely to have different star levels for different attributes at any one time. Hence, it is necessary to track and report condition for each attribute—using the attributes and sub-attributes tables (downloadable from the [SER website](#)).

Number of stars	Summary of recovery outcome
0	A high number or degree of direct degradation drivers threaten the site, representing a complete barrier to ecosystem recovery. Physical conditions are highly dissimilar to the reference model. While some ruderal or transient native biota may be present; there are no or few characteristic native biota present. Essential ecosystem processes, functions, and beneficial external exchanges typical of the reference model are missing.
★ 1	Threats from some direct drivers are absent, but others remain high in number and degree. Physical conditions show some similarity to the reference model. A low number of characteristic native biota are present. Foundational level of ecosystem processes, functions, and exchanges are present.
★ 2 ★	Significant threats from direct degradation drivers remain. The physical conditions can support some characteristic native biota, and a small subset are present and likely to be self-sustaining. Undesirable species are at intermediate levels. Low levels of ecosystem processes and functions are present. Positive exchanges with the surrounding environment have begun.
★ 3 ★	Few threats from direct degradation drivers remain but with a moderate impact. An intermediate subset of characteristic native species is established and likely to be self-sustained, supported by intermediate levels of ecosystem processes and functions. Many species and processes are now engaging in positive exchanges with the surrounding environment.
★ 4 ★	Threats from direct degradation drivers are few and have a minimal impact. Physical conditions closely resemble the reference model. A substantial subset of characteristic biota, spanning all species groups, is present, together with characteristic ecosystem structure. Key ecosystem processes and functions are established, supporting self-sustaining populations. Positive exchanges with other native ecosystems in the surrounding environment are occurring.
★ 5 ★	Threats from direct degradation drivers are virtually absent. A characteristic assemblage of biota is present, displaying structural and trophic complexity that closely mirrors the reference model. All ecosystem functions and processes, including natural disturbance regimes, are present and characteristic resilience has been restored. Cross-boundary flows are functioning appropriately. The ecosystem is self-organising and progressing towards full recovery.

2 Six key principles of ecological restoration practice



(A) Ecological Recovery Wheel



(B) Example of Using Ecological Recovery Wheel: (left to right) baseline, interim condition, and project goals

Figure 4 Progress evaluation 'recovery wheel'. This template allows managers to illustrate the degree to which their project is attaining similarity to their goals and the reference model for the six key ecosystem attributes. (Diagram reproduced from Gann et al. 2026). A blank template is available in Appendix 4 and an editable version of the ERW may be available on the [SER Standards tools page](#).

Notes for interpreting the five-star evaluation system

1 The five-star system has been designed to evaluate the progression of an ecosystem along its recovery trajectory. It is not a tool for evaluating the work of the practitioner or to record actions undertaken.

2 The five-star system represents a conceptual gradient, providing a framework that can be interpreted by managers, practitioners and regulators to suit a specific ecosystem. The sub-attribute labels in the wheel should be seen as a guide and can be amended if necessary. The indicators or metrics used to specifically describe and interpret recovery at each ranking level for a specific ecosystem need to be interpreted for each project. These should be identified at the outset of a project to provide ecologically meaningful information about project goals.

3 Evaluation can only be as rigorous (and, therefore, only as reliable) as the rigor of the monitoring that informs it. As some projects can only provide informal monitoring, evaluation needs to transparently identify the level of detail and degree of formality and reliability of the monitoring from which the conclusions have been drawn. This means that the recovery wheel or an evaluation table cannot be used as evidence of restoration success without the monitoring report on which it is based.

4 Each restoration site (or sub-site) does not necessarily start at a one-star ranking. Sites that involve remnant biota and unaltered substrates will start at a higher ranking—while sites where substrates are impaired and/or biota are absent will start at a lower ranking. Whatever the entry point of a project, the aim will be to progress the ecosystem along the trajectory of recovery towards a five-star rated recovery.

5 Although the ideal aim is to achieve a five-star rating for all attributes in a restored system, full recovery of some attributes will be difficult to achieve at larger scales.

Complete removal of external threats in a fragmented landscape or aquatic environment, for example, is usually beyond the scope of a site-specific restoration project but reduction of these threats may be possible (e.g. pollution regulation, 'no take' zoning, installation of nutrient filters, ongoing control of pest species etc.). Assessment should be undertaken of ongoing threat levels at the restoration site. If removal or reduction of external threats is not fully achievable, monitoring and reporting needs to indicate whether this is the result of external constraints and to what extent these are resolvable.

6 Evaluation using the five-star system and wheel must be site- and scale-specific.

An evaluation will provide more detail when applied at the scale of an individual project or site - and optimal accuracy is provided when evaluations are provided for the separate attributes. However, aggregation of scores for attributes, subsites and sites can be useful to summarise the degree of recovery for projects or larger programs as long as the loss of accuracy (and therefore loss of reliability) is acknowledged. Where larger scale projects retain substantial areas of permanently converted industrial activity or urban development, scores will necessarily be lower than if the scoring is confined to restored areas. Nonetheless, in such situations additional detail in supplementary reporting can capture even low-level gains at larger scales where these are important for some species or ecological processes. Similarly, in **social-ecological systems**, progress with important social outcomes of the project (such as increasing level of capacity and stewardship commitment by stakeholders) can be reported separately to capture social elements.

Some examples of restoration projects using the recovery wheel can be accessed at the [EMR project summaries website](#) and all examples linked to these Standards are listed in Appendix 5.

Principle 5 Restoration science and practice are synergistic

Sharing of knowledge. The sharing of practitioner and stakeholder knowledge and experience, particularly where arising from local sources, is important for both restoration science and practice. This knowledge comes from local community and traditional knowledge holders, on-ground land and water managers and restoration practitioners. Practitioner and local knowledge, however, can also be supported by knowledge drawn from informal and formal science, which is understood to include both western science and the science that has informed Indigenous traditional ecological knowledge. The increasing deployment of ‘citizen science’—involving members of the public in the collection of data for examination by researchers—emphasises the importance of bridges between formal and informal science.

While ‘restoration ecology’ is the term given to science that supports ecological restoration, the field of ecological restoration itself is a rapidly emerging practice that integrates adaptive management with monitoring, increasingly being informed by scientific approaches (Box 5). Formal field experiments can also be incorporated into restoration practice, generating new findings to both inform adaptive management and provide valuable insights for restoration ecology and the natural sciences in general.

Indeed, science is not the preserve of professional scientists—rather it is a logical approach to thinking based on systematic, repeatable observations and, ideally, controlled experiments to test a prediction (hypothesis). To optimise our ability to gain knowledge from restoration practice, science-practice partnerships (ideally of a long-term nature) should be encouraged. Such partnerships will help optimise potential for innovative restoration approaches to provide reproducible data and robust guidance for future activities.

What underpinning knowledge is needed in restoration practice?

Substantial background knowledge of both restoration practice and underpinning ecology is needed for professional ecological restoration planning, implementation and monitoring, requiring the planner and practitioner to draw as fully as possible from all learnings to date. Further applied and basic science is needed in a range of scenarios to support the ongoing development of the discipline of ecological restoration.

Knowledge from the sciences

It is well understood that restoration field operators need basic knowledge of biology, ecology, geology and soils, and it is well understood that it is important to embed such basic knowledge in vocational restoration curricula in Australia. Site assessors, project designers and planners, however, need a considerably wider breadth of not only restoration knowledge but also biological and ecological knowledge, particularly with respect to the particular terrestrial or aquatic ecosystems and species they are working with. Whether planning the regeneration or rebuilding of ecosystems, understanding is particularly needed about how an ecosystem is assembled, its successional patterning (if any) and what may be the critical minimum conditions needed to enable an ecosystem to continue its own recovery processes unaided (complete with recovering its characteristic resilience). As such, conservation biology and landscape ecology are highly important fields that inform restoration project planners about the biological, habitat, area and connectivity needs of animals and the relationship of area, shape and configuration of habitat patches to the viability of all organisms, but particularly threatened species. Disturbance ecology has also added depth to what is known about the role of disturbance

and rest periods in healthy ecosystems, including alternative undesirable and desirable stable states, Lessons from disturbance ecology have been particularly relevant to restoration with respect to understanding biological and ecosystem resilience. Advances in seed science and the science of captive breeding and reintroductions have also been critical to the success of restoration.

Genetic research is also of very high relevance to the reintroduction or reinforcement of populations of plants and animals affected by fragmentation; and to assessing the potential adaptability of a plant or animal population to climate change. Appendix 3 of this document provides some valuable information with respect to appropriate seed sourcing to address both fragmentation and climate change, and illustrates how the evolution of knowledge can mean that advice from science can change over time as considerably more genomic research has become more available. Improved affordability of genetic research is particularly relevant, given that there are very large numbers of species yet to be studied before researchers can determine with any certainty the degree of assistance needed (or possible) to improve the adaptability of a population to anticipated climate scenarios (Appendix 3).

Formal research can also help practitioners overcome what can seem irreversible barriers to recovery, particularly for larger scale projects where cost-effectiveness becomes paramount. These barriers might include hostile substrate conditions, problematic reproductive attributes of species and inadequate supply and quality of germplasm. In cases of mandatory restoration, transparency regarding the availability of scientific knowledge to support a restoration outcome would be expected at the proposal stage of any development that required mandatory restoration. Where reasonable or unanticipated technical challenges arise during such a mandatory restoration project, targeted research should be undertaken to identify solutions. If such research is appropriate and adequate but still fails to provide the technical solutions to meet performance criteria in relation to a restoration objective, it would be appropriate to redefine the restoration endpoint to a lower classification for that objective as soon as possible and seek alternative compensations to meet the regulatory requirements.

Knowledge from restoration practice

It is a healthy sign that at times it is difficult to tell the difference between science and practice, particularly where the former is embedded in practice. It is clear, however, that restoration practice has contributed considerable knowledge over the decades in the fields of control of invasive (and overabundant) native species, plant propagation, revegetation (using both seedlings and seed) and the translocation of native topsoils. Deep and effective inroads have also been made into community engagement and empowerment to effect the social and ecological change necessary for reversing degradation and attaining recovery in many ecosystems.

There has been strong involvement of researchers in on-site restoration of coastal and marine ecosystems (see [coastal and marine examples](#) linked to these Standards). Many of the solutions for [terrestrial restoration](#), however, have emerged more from the practitioners pursuing solutions for restoring rainforest, sclerophyll, grassland and wetland vegetation communities. Effective solutions for mass reintroductions of these ecosystems have been developed to the point that scaling up is now very possible. Substantial insights have also been gained for a wide range of ecosystems by other restoration practitioners testing the potential and limits of natural regeneration (whether spontaneous or facilitated) at a range of degradation levels.

While informed by ecology—and sufficiently rigorous to generate the general principles and approaches described in Principle 2 of these Standards—much of this practitioner-led

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work has had minimal involvement from researchers, resulting in fewer publications. This is largely because (i) writing up trials is not included in the expectations of a practitioner; and, (ii) it is difficult to justify to a client the retention of sub-optimally treated or untreated areas to use as experimental controls. Substantial opportunities therefore exist for researchers to draw on the existing and future knowledge of practitioners and to form research-practice partnerships to increase the sharing of knowledge between science and practice.

Principle 6 Social aspects are critical to successful ecological restoration

Restoration is carried out to satisfy not only conservation values but also socioeconomic values, including cultural ones. In essence, ecological restoration and all other 'restorative' activities (Fig 5 and Appendix 1,) have potential to meet a wide range of social and community development aspirations in both developed and developing countries, as is outlined in the International [SER Standards](#) (Gann et al. 2026) and guidance developed for the UN Decade on Ecosystem Restoration (FAO et al 2024).

Box 7 Restorative Continuum

Ecological benefits arise not only from ecological restoration as defined in this document but also from the full range of 'restorative' activities carried out across our terrestrial and aquatic environments along a **Restorative Continuum** (Fig.5, Gann et al, 2026). Restorative activities include ecological restoration as well as rehabilitation activities (i.e. those designed to improve ecosystem functionality without substantially restoring biodiversity) as well as activities that reduce the causes of degradation arising from society's consumption and production systems. Collectively, all the **restorative activities** along the continuum are accommodated under the UN's overarching term 'ecosystem restoration' (UNEP 2021; Nelson et al. 2024). the strategy for the UN Decade on Ecosystem Restoration.

The main take-home message of the Restorative Continuum concept is that all activities—particularly those designed to protect ecosystems and reduce impacts upon them—are critically important to the overall health and persistence of ecosystems. Success in all these activities across the globe is required to reduce local, regional, national and global extinction pressures, including climate change. Reducing such pressures is essential to the long-term success of ecological restoration.

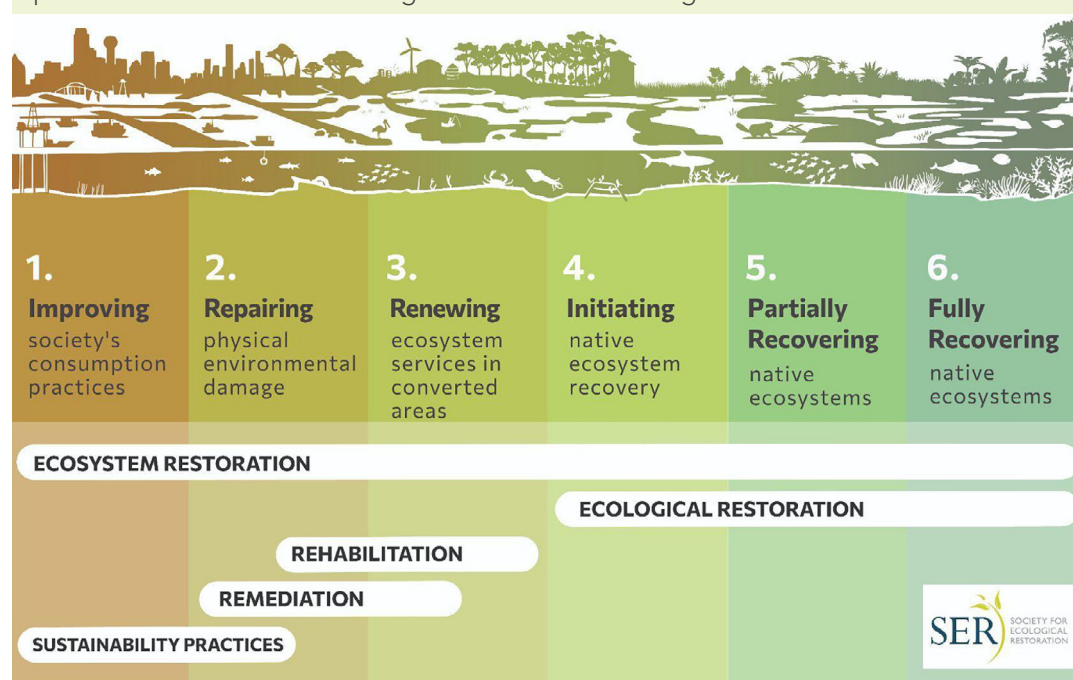


Figure 5 The Restorative Continuum includes a range of restorative activities and major restoration types (sustainability practices, remediation, rehabilitation, and ecological restoration) that, collectively, can reverse ecosystem degradation, leading to enhanced biodiversity, ecosystem functions and services, ecosystem integrity, and connectivity. (Figure reproduced from Gann et al. 2026.)

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Communities located within or near degraded ecosystems may gain health and other benefits from restoration that improves the quality of air, land, water, and habitats for native species. A '[social benefits wheel](#)' has been developed for the international SER Standards and is recommended by SERA for use in Australian projects (Gann et al. 2026). This wheel allows communication of both social and ecological benefits in restoration and enables tracking of outcomes of a project with respect to six attributes: Engagement, Benefits distribution, Knowledge and know-how enrichment, Ecosystem goods & services, Sustainable economies and Community wellbeing.

Few if any ecosystems are without human influence—whether positive or negative. Without considering social values and benefits, particularly relationships between a site and its interested and affected parties, a restoration project may not gain the social support needed for success- including adequate financing of restoration - and may fail to deliver important benefits to ecosystems and to society, particularly in the longer term.

Some human-induced disturbance regimes are intrinsic to the structure and function of a local native ecosystem (e.g. Indigenous fire management regimes that have exposed sites to fire over the long term, or protected them from fire, while others can progressively erode ecosystems or shift them to solely cultural ecosystems, with little resemblance to naturally occurring ones. This means that values and behaviours of humans will dictate the future of ecosystems. Conserving and restoring ecosystems therefore depends upon appreciation by society of the negative and positive effects of different behaviors; and involvement by all interested and affected parties in finding solutions to ensure that ecosystems, communities and society as a whole, mutually prosper.

Box 8 Indigenous Peoples and restoration

The cultures of Indigenous Peoples in Australia are the oldest continuous cultures on Earth. Indigenous Peoples are, therefore, well placed to teach other Australians a range of appropriate ways to live within and manage Australian ecosystems. As a result of this recognition, and due to their role as rights holders and knowledge holders, Indigenous groups can and do play a major role in ecological restoration and rehabilitation practice and research, including those relating to the improved management of social-ecological systems.

About 20% of Australia's land mass is recognised under Australian law as Indigenous-owned, with much land and water still under claim or viewed as never ceded. About 55% of Australia's National Reserve system is comprised of Indigenous Protected Areas (IPAs), including 113 million hectares of land and 9.3 million hectares of sea. Caring for Country is a traditional and contemporary practice both within remote Indigenous lands and lands closer to regional and urban centres. Many Indigenous Peoples are utilising their lands, social capital, and ecological knowledge to benefit their people and environment, working in collaboration with all other sectors of society.

Ecological restoration and rehabilitation activities provide a major source of employment for Indigenous Australians and help to reconnect younger generations with the cultural heritage from which they have been, and continue to be, actively dispossessed. As such, benefits can and must flow from restoration to Indigenous Peoples, a process that will benefit the whole of society as the world seeks to rebuild a more restorative relationship between our species and the rest of nature.

It is therefore essential that the targets, goals, objectives, indicators and methodologies of ecological projects involving Indigenous Peoples need to be informed by the relevant group's cultural knowledge and responsibilities for Country. This may include seasonal knowledge, cultural species, fire and water practices, culturally significant places and relationships between ecological and community wellbeing. Information should be recorded, stored and shared only under arrangements agreed with the relevant knowledge holders.

See examples of Indigenous-led restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/indigenous-led-restoration/>

The practical implications of social elements of a project for restoration include that restoration planners and project managers need to genuinely and actively engage with those who live or work within or near a site to be restored, as well as with others who have a stake in the area's goods, services or values. This needs to occur from the outset of a restoration project and continue throughout it. Not only will a restoration project be more secure if genuine dialogue occurs between managers and stakeholders, but also this dialogue—coupled with education about the ecosystem—can increase the level of practical collaboration, facilitating solutions best suited to local ecosystems and cultures.

Education and engagement are often best achieved by actively involving adequately supervised community members in paid or voluntary restoration activities—both having a positive effect in local communities. Restoration work has demonstrated potential to generate direct and indirect employment opportunities in many regions. This is particularly beneficial in rural or remote regions where other industries and gainful employment are declining or are marginal—including in remote areas owned and managed by Indigenous groups who are employed to provide ecosystem services (e.g. carbon abatement or

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habitat restoration) for which society is prepared to pay. Where projects involve community volunteers, restoration activity can serve to educate participants and create improved social outcomes, including community cohesion and individual welfare.

Social engagement, interpretation and education regarding the benefits of restoration to interested and affected parties are therefore essential components of a restoration project and need to be planned and resourced alongside the physical or biological project components. This investment is likely to be rewarded manyfold with increased awareness and understanding of problems and potential solutions by members of society who may have the strongest 'say' in the future of an area when funding programs and individual champions have come and gone.

Section 3 Scaling up restoration in Australia

Why scaling up is needed

Restoration actions in terrestrial sites are generally implemented at a site scale because this is the scale at which the individual organisms—the building blocks of ecosystems—often interact, change and recover. Because of the scale of loss and fragmentation of habitats that has already occurred in the last 250 years in Australia, however, there is a need for massive scaling up of the number and extent of restoration projects if restoration is to make a ‘dent’ on the scale of degradation. An even more important (ecological) reason for scaling up, however, is that the functionality of some individual animals, most populations and almost all ecosystem processes is influenced by larger-scale ecological processes and ecological connectivity.

That is, the science informing restoration shows that many species have minimum range sizes, particularly top predators, migratory species and species that depend on multiple habitats. The sustainability of such populations depends not only on increased habitat quality but also increases in area, habitat diversity, connectivity and the maintenance of landscape scale ecosystem processes. Area increases are also need to take into account the shape and size of the core habitat compared to areas exposed to ‘edge effects’ as the latter can render patches less suitable for many species. Increasing scale and connectivity is particularly important in the face of climate change where migration and gene flow can be essential for some species to adapt to shifting climate envelopes, given that genetic diversity is increasingly viewed as a key requirement to allow organisms to adapt in the face of changing climates (Boxes 4 and see Appendix 3).

See links to some examples of ‘scaling up’ ecological restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/scaling/>

Scaling up ecological restoration also depends on complementary activities that build community connection, cultural knowledge and broad-based social support for reducing the drivers of degradation and carrying out restoration at scale (see Principle 6—Social aspects of restoration and Appendix 1). Indeed, research points to the need for large scale **rehabilitation** programs in utilised landscapes and waterscapes to reduce catchment-wide degradation drivers. This involves practical actions to slow runoff and reduce nutrient and pollutant discharges from farmlands to, respectively, reduce erosion, siltation and improve water quality in receiving waters. Large scale actions are also needed to reinstate appropriate catchment flows and fish passage to assist in the restoration of permanent, semi-permanent, seasonal and ephemeral riparian, lakes and vegetated wetlands. In coastal and marine ecosystems, particularly in the context of sea level rise, this also includes reinstating tidal flows, connectivity between multiple coastal and marine habitats and removing artificial barriers to allow landward migration of habitats.

See links to some examples of ‘scaling up’ rehabilitation: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rehabilitation/>

The need for scaling up points to a need for restoration project planning and design (see Section 4) to identify areas that can strategically expand and reconnect native ecosystems in fragmented and degraded landscapes and waterscapes to the spatial extent practicable

—as well as reduce impacts from agricultural, industrial, and urban areas. While scaling up presents opportunities to increase productivity and the value of outcomes, it also increases the practical demands of project planning. For example, there is an increased requirement to be more strategic in the selection and prioritisation of diverse restoration approaches for various parts of the larger land or water area, which in turn requires specific site assessment and treatment prescription knowledge and skills, which are not necessarily present to the level required in the current workforce. The requirement to scale up also does not always come with a proportional growth in funding. Consideration therefore needs to be given to which practical operational compromises are acceptable at scale, and how the restoration sector can collaboratively bridge gaps between scientific theory and on-ground practice. There is also a need to consider how increased demands of scaling up the restoration workforce (and the provision of workforce training) may be met. The requirement also increases the magnitude of the important tasks of identifying and building relationships with larger numbers of partners and communicating with wider levels of interested and affected parties prior to and throughout the project or program.

Conservation planning expertise also needs to be drawn upon. While it is necessary to prioritise actions to support the recovery of threatened biodiversity including ecological communities and habitats of threatened species, it is also important to take a ‘whole of native ecosystem’ approach that will avoid fragmentation and reinstate connectivity for all species including not only those currently threatened but also those which may otherwise soon be on a trajectory of decline. Systematic conservation planning offers a well-established framework for this: setting explicit, quantitative objectives (e.g. for the extent, condition and connectivity of each ecosystem type) and identifying the set of places that together meet those objectives most cost-effectively (See Conservation Measures Partnership 2025).

Some enablers for scaling up restoration

While there are many enablers for scaling up in both terrestrial and aquatic areas, the following eight stand out as having high applicability to increasing restoration at scale.

(i) Strategic planning for upscaling restoration. Planning can help ensure restoration actions generate synergies with and co-benefits for other biodiversity targets including social outcomes. Biodiversity targets often relate to benefits to threatened species and threatened ecological communities, carbon storage and invasive species management, while social outcomes often relate to ecosystem services that benefit humans (e.g. agricultural production from pollination, improved soil condition, clean water, and coastal protection). Other social benefits include employment and cultural benefits such as renewed community relationships with places we care for. Such planning needs to be undertaken at all relevant scales to optimise potential for restoration investment to be directed to the highest priority places at a local scale as well as interconnected sites at regional, bioregional and national scales and to complement existing restoration investment. Restoration planning should also be integrated with planning for the protection and management of remaining native ecosystems, since: (i) retaining intact and lightly degraded areas is generally far more cost-effective than restoring them once highly degraded or lost; and, (ii) restoration is often most likely to succeed where it buffers, expands or reconnects these areas. Strategic planning also needs to draw on the detailed, place-based knowledge held by Traditional Owners, landholders and local communities, who are often best positioned to identify restoration opportunities, including underutilised or degraded land suited to restoration. Prioritisation should weigh the expected ecological benefit of restoration against its cost, likelihood of success and the time needed for recovery, and should account for future climates.

(ii) Testing and scaling up successful restoration models. Many restoration approaches and methods have been developed and tested for the successful restoration of a range of terrestrial and aquatic ecosystems, usually combining insights from both restoration science and practice, but particularly lessons from restoration practice. Substantial innovation has occurred in Australia, notably through restoration NGOs specialising in one or other aspect of restoration whether it be Indigenous-led restoration, broadscale revegetation of sclerophyll, rainforest or grassland ecosystems, harnessing natural regeneration, rehydrating wetlands, coastal and marine restoration, creating landscape level linkages, faunal reintroductions, threatened and invasive species management, private land restoration or landholder engagement. Partnerships between practitioners, researchers and policy makers can substantially support the scaling up restoration - as can publication of the results in open access journals, reports, websites, educational videos, conference presentations and newsletters—particularly where there is open discourse that encourages inputs from practitioners.

(iii) Capacity building. National accredited vocational training qualifications have long been in place for practitioners of restoration across Australia, particularly Australian Qualifications Framework (AQF) levels 1-5 in Conservation and Ecosystem Management (CEM). If delivered by increased numbers of restoration-experienced teachers, such training would provide potential for scaling up capacity building among practitioners employed in the restoration industry, and is particularly important for restoration site assessors, field supervisors and field mentors. Where sufficiently well-trained and supervised teams can be mentored and upskilled, improvements in productivity may allow greater areas to be treated for the dollars invested. Capacity building is also needed for ecologists involved in restoration planning as training in the 'how to' of restoration is rarely offered at degree level. Potential exists for 'skills sets' of units drawn from CEM qualifications to be offered to university graduates who require add-on training in restoration site assessment and treatment prescription, although substantial practical experience in restoration is required for this role. Because of the current shortfall in graduates having restoration experience, involving restoration practitioners in planning is also essential to increase the numbers of people able to read land and sea country developing appropriate restoration plans suited to implementation at a range of scales.

(iv) Large-scale native seed supply and production. Scaling up restoration to link existing native vegetation across vast, long cleared areas requires massive quantities of seed. This requires scaling up of the native seed industry sector in Australia—including the establishment of seed banks and dedicated [seed production areas](#) in all regions where restoration activities are most urgently required (Appendix 3). **Seed production areas** need to be based on germplasm collected originally from genetically strong naturally occurring populations, subject to strict governance and guidelines, and seed multiplication to the level required will take many years to achieve. The Australian Native Seed Survey Report (Hancock et al. 2020) and Andres et al. (2023) have outlined the recent status of the seed industry and highlight the challenges ahead with the enormous scale of seed production we need to achieve if we are to undertake restoration at scale. Standards and accreditation of seed collectors and ensuring fit-for-purpose regulation are important components in meeting the need for large scale seed supply and production.

(v) Upscaling restoration project data collection. There are very large numbers of dispersed restoration sites under effective restoration in Australia, initiated through multiple Commonwealth and state programs, councils, Traditional Owners, NRM organisations, NGOs, community groups and private landholders. Registering current and historic restoration activity not only allows restoration efforts to be quantified and better studied to improve practices, but it can encourage a more extensive uptake of restoration by communities, restoration organisations and agencies. While restoration is—and must be—locally distributed and data entry must suit the needs of dispersed restoration actors,

examples exist of Australian platforms for collective registration of terrestrial and aquatic restoration projects. There is considerable potential for interlinking multiple databases for aggregating data nationally to increase Australia's potential for effective restoration and strategic planning at scale. Consistent spatial data on ecosystem extent, condition and restoration outcomes would also allow restoration priorities to be identified and progress to be tracked against national and international targets (e.g. Target 2 of the Kunming-Montreal Global Biodiversity Framework) and future international agreements.

(vii) Securing financing mechanisms for scaling up restoration. A range of restoration funding mechanisms exists in Australia including the more traditional public, philanthropic and private land manager investment. Increasingly, these are being complemented by the development of schemes to encourage voluntary restoration investment, particularly by business. The Australian Carbon Credit Unit scheme attracts individuals and companies to fund carbon-storing projects as offsets for their own greenhouse gas emissions and the Nature Repair Act 2023 signals a growing role for ecological restoration in delivering measurable biodiversity outcomes through market-based mechanisms. Additional incentives for restoration investment come from corporate sustainability frameworks such as the Taskforce on Nature-related Financial Disclosures (TNFD) and the Science Based Targets Network (SBTN), which are driving increased business reporting on environmental impacts. For these mechanisms to deliver genuine outcomes and avoid rewarding low-integrity outcomes or creation of new degradation (Gann et al. 2026), however, financial arrangements need to be standards-based, with a range of standards schemes, guidelines and methods available or under development. Aligning investment with spatial priorities identified through strategic planning would also help direct funding to where it will deliver the greatest biodiversity return, rather than only to where projects are easiest to establish.

(vii) Scaling up public awareness. Expanding the sharing of stories and information that communicate the need, value and benefits of restoration to all Australians is important to underpin ongoing reduction in degradation and to scale up public support for restoration solutions. Media releases and promotional videos prepared by restoration organisations and agencies—particularly where they communicate the social benefits of restoration to target audiences—are an essential tool for the amplification of restoration messages to the public. Whether the media releases are supplied to conventional media or social media platforms (or whether their reach is small or large), they fill a need by communities and individuals for 'good news' stories in a communication environment where bad news too often prevails. Maintaining a connection between the good news and genuine, factual information about the problems that the restoration is seeking to address, however, is an important key to ensuring that the communication is indeed increasing the scale and depth of public awareness to the extent that this may also increase public support for restoration initiatives.

Section 4 Standards for ecological restoration activities—planning, implementation, monitoring and evaluation

Restoration projects need to adopt appropriate processes of planning, implementation, monitoring and evaluation to improve the chances of achieving the desired restoration outcomes.

The following activities and their performance levels are those required for professional level ecological restoration planning, implementation, monitoring and evaluation; although non-professional restoration practitioners are encouraged to adopt this guide, where practicable, to optimise success. The size and complexity of the work carried out (as well as qualifications and experience of staff) should correspond to the size, complexity, degree of damage, regulatory status and budgets of the project.

Where a restoration project is non-mandatory, the emphasis should be on highest practicable outcomes, with delivery encouraged on a continuous improvement basis. Where the Standards are incorporated into a legal instrument, funding agreement or contract, the relevant requirements, evidence thresholds, responsibilities, review processes and consequences of non-performance should be stated in that instrument. Conformance should not be implied solely because a project refers to these Standards.

As complementary interpretations, guidelines or specific industry sector standards become available these will be linked to updates of this Standards document.

1 PLANNING AND DESIGN

- 1.1 **Stakeholder engagement.** After the appropriate permissions and agreements have been made with the site owners and managers (and tenure verified), engagement with interested and affected parties is essential to the sustained success of any project. Meaningful engagement must be undertaken at the planning stage of a restoration project, with all key such parties (including the land or water manager, industry interests, neighbours and Indigenous rights and knowledge holders, who often lead restoration projects). Plans for public areas or mandatory restoration include a strategy for stakeholder engagement throughout and upon completion of the project.

(See tool: [The Open Standards for the Practices of Conservation](#))

Planning should also include arrangements for continued engagement with interested and affected parties. Responsibility for this, indicative costs and the process for transferring long-term stewardship should be agreed before implementation begins.

- 1.2 **External context assessment.** Plans are informed by regional conservation goals and priorities, often identified in national or regional strategies, and:
- 1.2.1 contain a diagram or map of the project in relation to its surrounding landscape or aquatic elements;
 - 1.2.2 identify ways to align habitats at the restoration site to improve external ecological connectivity with the surrounding landscape or aquatic environment to optimise colonisation and gene flow potential between sites; and,
 - 1.2.3 specify mechanisms for the project to interface optimally with nearby native ecosystems or land or water use areas.
- 1.3 **Ecosystem baseline inventory.** (i.e. starting state site assessment⁵) Plans identify the site's current ecosystem and its condition—including:
- 1.3.1 a list of all native and non-native species evidently persisting on the site, particularly noting any threatened species or communities;
 - 1.3.2 description of the current compositional, structural and functional attributes at the site;
 - 1.3.3 status of current abiotic conditions—including the dimensions, configuration and physical and chemical condition of streams, waterbodies, land surfaces, water column or any other material elements relative to prior conditions;
 - 1.3.4 relative capacity of the biota on site or external to the site to commence and continue recovery with or without assistance (i.e. degree of remaining biological resilience);
- the assessment of biological resilience must be prepared by a person with experience in assessing potential for (and harnessing) natural regeneration—this includes undertaking an inventory of:
- native and non-native species presumed absent and those potentially persisting as propagules or occurring within colonisation distance; and,
 - any areas of higher and/or lower condition, including priority resilient areas and any distinct spatial zones requiring different treatments.

⁵ Noting that for commercial developments, the starting state is often preceded by a different pre-disturbance state that was not the reference state.

1.3.5 Type and degree of threats that have caused degradation, damage or destruction on the site and ways to eliminate, mitigate or (in some cases) adapt to them; depending on degree of reversibility. This includes assessment of:

- historical, existing and anticipated impacts within and external to the site—e.g. over-utilisation, sedimentation, fragmentation, pest plants and animals, hydrological impacts, pollution impacts, altered disturbance regimes and other threats—and ways to manage, remove or adapt to them;
- description of the need for supplementing genetic diversity for species reduced to non-viable population sizes due to fragmentation [to a standard described in Offord & Meagher 2009 (for flora) and IUCN/SSC 2013 (for fauna)]; and,
- existing and anticipated effects of climate change (temperature, rainfall, sea level, marine acidity etc.) on species and genotypes with respect to likely future viability. (For useful tools see: Appendix 3).

1.4 **Reference ecosystem identification and subsequent reference model development.** Plans identify (to the level needed to assist project design) the appropriate local native reference ecosystem(s) and then develop a reference model based on actual reference sites or compiled from historical or predictive records. (Generic information on benchmark characteristics and functions for the ecosystems may be available in state-based guidelines. These should be used to assist, not replace, reference ecosystem identification.) The reference model will then represent the composition and any notable structure or functions (reflecting the six ecosystem attributes) including:

- 1.4.1 substrate characteristics (biotic or abiotic, aquatic or terrestrial, soil or substrate);
- 1.4.2 the reference model's functional attributes including nutrient cycles, characteristic disturbance and flow regimes, animal-plant-microbe interactions, ecosystem exchanges and any disturbance-dependence of component species;
- 1.4.3 the major characteristic species (representing all plant growth forms and functional groups of microorganisms and any fauna);
- 1.4.4 any ecological mosaics or ecotones, requiring the use of multiple reference models on a site. (In cases where intact ecosystems are being disturbed and then restored, the pre-existing intact ecosystems must be mapped in detail prior to site disturbance); and,
- 1.4.5 assessment of habitat and host needs of important biota (including any minimum range areas for fauna and their responses to both degradation pressures and restoration interventions).

1.5 **Targets, goals and objectives.** To produce well-targeted works and measure whether success has been achieved (see also Monitoring, below), plans identify a clearly stated:

- 1.5.1 restoration **target**—i.e. usually the reference ecosystem (including the model describing the key ecosystem attributes) as well as any social target;
- 1.5.2 restoration **goal(s)**—i.e. the condition or state of that ecosystem and attributes that you are aiming to achieve—as well as any social goals; and,

- 1.5.3 restoration **objective(s)**—i.e. changes and immediate outcomes needed to achieve the target and goals relative to any distinct spatial zones within the site or social elements;

such objectives are stated in terms of measurable and quantifiable indicators to identify whether or not the project is reaching its objectives within identified timeframes.

- 1.6 **Restoration site assessment and treatment prescription.** Strategic planning (that identifies which restoration approaches are best applied in particular areas of a site) precedes action planning (which details these at a finer scale and provides treatment prescriptions).

Site assessment and treatment prescription in both levels of planning draw on the resilience assessment undertaken at the 'ecosystem baseline inventory' phase. Treatment prescriptions that describe what, where and by whom treatments will be undertaken and their order or priority, must be prepared by a restoration practitioner with experience in the particular approach to be applied.

The degree treatment prescriptions are tightly specified will differ according to the scale of the works and predictability of outcomes. Where knowledge or experience is lacking, increased adaptive management or targeted research that informs what an appropriate prescription is, will be necessary.

With content appropriate to whether the plan is a strategic plan or action plan, the plans should, collectively, include the following elements:

- 1.6.1 ensuring that the project timeframes are sufficient to include all the necessary follow up treatments required to place the ecosystem on a secure trajectory. This should also include contingency arrangements to accommodate unexpected conditions such as drought, flood or fire;
- 1.6.2 descriptions of actions to be undertaken for elimination or reduction/mitigation of **causal** problems;
- 1.6.3 identification of (and brief rationale for) (i) specific restoration **approaches** (ii); descriptions of specific treatments for each zone; and (iii) **prioritisation** of actions.

Depending on the condition of the site, this includes identification of the following.

- Amendments to the shape, configuration, chemistry or other physical condition of abiotic elements to render them amenable to the recovery of target biota and ecosystem structure and function.
- Effective and ecologically appropriate strategies and techniques for the control of undesirable species to protect desirable species, their habitats and the sensitivities of the site.
- Ecologically appropriate methods for triggering regeneration or achieving reintroduction of any missing species.
- Specifications for appropriate species selection and genetic sourcing of biota to be reintroduced. In the case of fauna, a strategy for sourcing and re-introduction should comply with IUCN/SSC (2013) and any guidelines or regulations of the relevant state or territory. IUCN guidelines for captive breeding (McGowan et al. 2016). In the case of plant species, a strategy for sustainable seed supply and a timetable for collection and supply of seed or plants should be prepared that complies with guidelines in 'Plant germplasm conservation in Australia' (Offord &

Meagher 2009) and Module 5 of the [Florabank guidelines](#) and codes of practice. (Also refer to Appendix 3 of this document for important clarifications of current advice.) Useful standards for seed-related practice can be found in SER's [International Standards for Native Seeds in Ecological Restoration](#) (Pedrini and Dixon 2020) and Revegetation Industry Association of Western Australia's (RIAWA) [Seed Industry Standards](#) (RIAWA 2025).

- Identification of ecologically appropriate contingency strategies (such as leaving gaps for later in-fill plantings, soil amendments or faunal reintroductions in subsequent seasons) if the ideal species or genetic stock is not immediately available.

1.7 **Assessing security of site tenure and of post treatment maintenance scheduling.** Some indication of potential for long-term conservation management of the site is required before undertaking a restoration plan. Plans identify:

- 1.7.1 security of tenure of the site to enable long term restoration commitment and allow appropriate ongoing access and management; and,
- 1.7.2 potential for adequate arrangements for ongoing prevention of impacts and maintenance on the site after completion of the project to ensure that the site does not regress into a degraded state.

1.8 **Analysing logistics.** Some indication of potential for resourcing the project and of likely risks is required before undertaking a restoration plan. Plans address practical constraints and opportunities including:

- 1.8.1 identifying funding, labour (including appropriate skill level) and other resourcing arrangements that will enable appropriate treatments (including follow up treatments) until the site reaches a stabilised condition;
- 1.8.2 undertaking a full risk assessment and identifying a risk management strategy for the project, particularly including contingency arrangements for unexpected changes in environmental conditions or resourcing;
- 1.8.3 a rationale for the duration of the project and means to maintain commitment to its aim, objectives and targets over that period; and,
- 1.8.4 permissions, permits and legal constraints applying to the site and the project.

1.9 **Review process scheduling.** Plans include a schedule and timeframe for:

- 1.9.1 review by independent peer reviewers and interested and affected parties as required; and,
- 1.9.2 review of the plan in the light of new knowledge, changing environmental conditions and lessons learned from the project.

2 IMPLEMENTATION

During the implementation phase, restoration projects are managed in such a way that that the following are secured.

2.1 **No further and lasting damage is caused by the restoration works** to any natural resources or elements of the species or ecosystems that are being conserved, including physical damage (e.g. clearing, burying topsoil, trampling, loss of hollows through inappropriate fire), chemical pollution (e.g. over-fertilising, pesticide spills) or biological contamination (e.g. introduction of invasive species, e.g. see ['Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi*'](#);

- 2.2 **Treatments are interpreted and carried out responsibly, effectively and efficiently** by suitably qualified, skilled and experienced people or under the supervision of a suitably qualified, skilled and experienced person. “Suitably qualified in this Standard should be at least Conservation and Ecosystem Management certificate III or diploma; while ‘suitably experienced’ should be a satisfactory period of field experience in addition to education;
- 2.3 **All treatments are undertaken with appropriate timing and in a manner that is responsive to natural processes and fosters and protects natural recovery.** Primary treatments including substrate and hydrological amendments, pest species control, application of recovery triggers and biotic reintroductions are adequately followed up by secondary treatments as required. Appropriate monitoring and aftercare are provided for any reintroduced fauna or flora;
- 2.4 **Corrective changes of direction in response to unexpected ecosystem responses** are facilitated in a timely manner and are ecologically informed and documented;
- 2.5 **All projects exercise full compliance with occupational work, health and safety legislation** and all other legislation including that relating to soil, air, water, oceans, heritage, species and ecosystem conservation (including that all permits required are in place); and,
- 2.6 **All project operatives communicate regularly with key interested and affected parties** (or as required by funding bodies) to keep them apprised of progress.

3 MONITORING, DOCUMENTATION, EVALUATION AND REPORTING

Ecological restoration projects adopt the principle of observing, recording and monitoring treatments and responses to the treatments to inform changes and different approaches for future work. They regularly assess and analyse progress to adapt treatments (adaptive management) as required. Partnerships with research bodies are sought in cases where innovative treatments or treatments applied at a large scale are being trialed and is it necessary to ensure all necessary research permits and ethical considerations are in place.

- 3.1 **Monitoring** to evaluate progressive restoration outcomes begins at the planning stage with the development of a monitoring plan to identify success or otherwise of the treatments (See also Boxes 5 and 6).
- 3.1.1 Monitoring is geared to specific targets and measurable goals and objectives identified at the start of the project and include:
- collection of data prior to works and at appropriate intervals (e.g. at higher frequency early in the recovery phase) to identify whether objectives, goals and targets are being attained; and,
 - collecting data on work sessions, specific treatments and approximate costs.
- 3.1.2 A minimum standard of monitoring for small, volunteer projects is the use of fixed photopoints, along with species lists and condition descriptions. (Note that photographic and formal quantitative ‘before and after’ monitoring is ideally undertaken not only at the restored site but also at untreated areas and any actual reference site.)
- 3.1.3 Projects also monitor the performance of the recovery using pre-identified indicators consistent with the objectives. In professional or larger projects this is ideally carried out through formal quantitative sampling methods supported by a condition assessment (taking account of any regionally appropriate benchmarking system).

- 3.1.4 Sampling units must be an appropriate size for the attributes measured and should be replicated sufficiently within comparable areas of the site.
- 3.2 **Adequate records of treatments (inputs) and all monitoring are maintained** to enable future evaluation.
 - 3.2.1 Consideration should be given to lodging data with open access databases such as any specific BioCollect database established for restoration project registration (e.g. the [Habitat Restoration HUB](#)), a similar BioCollect portal or [Australian Coastal Restoration Network projects database](#).
 - 3.2.2 Secure records of the provenance (i.e. geographic source) of any re-introduced plants, animals and other organisms are held by the project managers. These records should include location (preferably GPS-derived) and description of donor and receiving sites, reference to collection protocols, date of acquisition, identification procedures and collector/breeder's name.
- 3.3 **Documentation of all works and evaluation** of the outcomes is carried out, with progress assessed against the targets, goals and objectives of the project—particularly including the project's reference model).
 - 3.3.1 Evaluation can use any system that adequately assesses results from the monitoring. (It is recommended that consideration be given, however, to informally or formally using SER's five-star system.)
 - 3.3.2 Results are used to inform ongoing management.
- 3.4 **Reporting** involves preparation and dissemination of progress reports to key interested and affected parties and broader interest groups (newsletters and journals) to convey outputs and outcomes as they become available.
 - 3.4.1 Reporting can use any system that conveys the information in an accurate and accessible way, customised to the audience. (It is recommended that consideration be given, however, to using [SER's recovery wheel](#) to visually communicate progress.)
 - 3.4.2 Reporting must clarify the level and details of monitoring upon which any evaluation of success or otherwise has been based.

4 POST-IMPLEMENTATION MAINTENANCE

- 4.1 **The management body is responsible for ongoing maintenance to prevent deleterious impacts and carries out any required monitoring of the site after completion of the project to ensure that the site does not regress into a degraded state.** Comparison with an appropriate reference ecosystem will be ongoing.

5 REVIEW OF USE OF THE STANDARDS

- 5.1 **The use of the Standards by an organisation should be reviewed at regular intervals** using feedback from interested and affected parties. The review should examine whether requirements are understandable, proportionate and achievable; whether they improve ecological outcomes; and, whether any groups face unintended barriers. Clarifications, templates and technical guidance may be updated by the organisation.

Section 5 Glossary of terms

An effort has been made to ensure generic terms defined here are consistent with those of the SER Standards (Gann et al. 2026) while others are defined in a way that pertains more specifically to Australian contexts, conditions and species.

Abiotic: non-living materials and conditions within a given ecosystem, including soil, rock, dead wood, litter or aqueous substrate, the atmosphere, weather and climate, topographic relief and aspect, the nutrient regime, hydrological regime, fire regime and salinity regime.

Adaptive management: a sophisticated form of 'trial and error'. Using the best currently available knowledge, skills and technology an action is implemented and outcomes observed and recorded including success, failures and potential for improvement. These learnings form the basis of the next round of decision making and trialing in a process of continuous improvement.

Approach: (to return of biota) the particular restoration strategy adopted for returning biota to a site or subsite, matched to the degree to which the capacity for natural regeneration of biota on that site or subsite is intact, has been reduced, or is entirely absent. Approaches named in these standards include **spontaneous natural regeneration, facilitated natural regeneration, combined regeneration/reintroduction or full reintroduction**.

Attributes, of an ecosystem: the biotic and abiotic properties and functions of an ecosystem (in this document referred to as including absence of threats, physical conditions, species composition, community structure, ecosystem function and external exchanges).

Barriers: (to recovery) factors impeding recovery of an ecosystem attribute.

Biological resilience: The processes, largely derived from evolutionary adaptations that enable components across bio-logical levels to resist or recover from perturbations (sensu Thorogood et al. 2023). This is expressed at the individual organism level as resistance adaptations (such as thick bark, hard coatings of seeds or eggs that protect buds, embryos and other reproductive parts) and recovery adaptations (such as responsiveness to cues for hatching, germination, resprouting, enhanced flowering, and adaptations that enhance propagule dispersal, e.g. winged or floating seeds, fleshy fruits, floating fragments).

Biotic, biota: the living components of an ecosystem, including living animals and plants, fungi, bacteria and other forms of life (microscopic to large).

Carbon sequestration: the capture and long-term storage of atmospheric carbon dioxide (typically in biomass by way of photosynthesis and tree growth) to reduce the impacts of climate change.

Climate envelope: the climatic range in which a species currently exists. With climate change, such envelopes are predicted to shift towards the poles or higher elevations. However, as precipitation is likely to change in less predictable ways, the displacement of climate envelopes will be complex and difficult to predict.

Combined regeneration/reintroduction: an approach to restoration that includes a degree of reintroduction of biota alongside natural regeneration and/or facilitated regeneration interventions, falling short of full reconstruction. Examples of this approach include the globally promoted Assisted Natural Regeneration (ANR) methodology that includes some degree of reintroduction alongside facilitated regeneration and the practice of Rewilding that includes both regeneration and reintroduction approaches.

Community structure: the physical organisation of biotic and abiotic elements in a community. This refers to the degree of layering and spatial patchiness in an ecosystem; whether of substrates (e.g. rocks, coral or shell reefs, woody debris) or organisms (e.g. trees, shrubs, ground layer vegetation)—as well as trophic complexity (i.e. food webs). This enables the development of complexity of habitats and functions.

Composition: (of an ecosystem) the array and relative proportion of organisms within an ecosystem.

Construction: creating an ecosystem, through a full reintroduction approach, where it did not occur previously—as distinct from ‘reconstruction’. A typical example is the creation of a wetland where it did not previously occur.

Cultural ecosystem: an ecosystem shaped to at least some extent by human utilisation, to provide food, fibre, medicines and/or culturally important artefacts.

Cycling: ecological cycles include the movement of resources such as water, carbon, nitrogen, and other elements that are fundamental to all other ecosystem functions.

Damage: (to ecosystem) a substantial level of impact, generally from a single disturbance event such as a bulldozing event.

Degradation: (of an ecosystem) a persistent decline in the structure, function and composition of an ecosystem compared to its former state, generally from frequent or persistent impacts.

Destruction: (of an ecosystem) complete removal or depletion of an ecosystem.

Ecological maintenance: ongoing activities (such as applying appropriate fire or hydrological regimes) intended to counteract processes of ecological degradation to sustain the attributes of an undegraded ecosystem or a restored ecosystem. The maintenance phase is distinguished from the restoration phase, where repeat treatments are usually termed **Follow up**. Higher ongoing ecological maintenance is likely to be required at restored sites where higher levels of threats continue, compared to sites where threats have been controlled. Both maintenance and restoration are included in the broad term ‘ecosystem management’.

Ecological restoration: The process of assisting the recovery of a native ecosystem that has been degraded, damaged, or destroyed. It differs from other ecosystem restoration activities along the Restorative Continuum in that it aims to recover a native ecosystem to the state it would exhibit in the absence of degradation, while accounting for environmental change. (Note: Single species restoration can be considered complementary and an important component of ecological restoration.)

Ecosystem: small or large-scale assemblage of biotic and abiotic components in oceans, rivers and on land in which the components interact to form complex food webs, nutrient cycles and energy flows. The term ‘ecosystem’ is used in the Standards to describe an ecological community of any size or scale.

Ecosystem attributes: (see **Attributes**).

Ecosystem restoration: The full spectrum of practices and activities along the **Restorative Continuum**, depending on local conditions and societal choice. These activities contribute collectively to halting and reversing degradation, resulting in improved biodiversity, ecosystem integrity, and ecosystem functions and services.

Ecosystem resilience: The capacity of an ecosystem to resist, recover, or reorganise in response to disturbance or other environmental stressors. Native ecosystems vary in their ability to resist or recover from disturbance, largely dependent on variations in their component organisms' **biological resilience**. When an ecosystem's resistance and recovery are exceeded, ecosystems naturally reorganize into new states. The inherent resilient capacity of ecosystems is ultimately the foundation of ecological restoration. See also **social-ecological resilience**.

Ecosystem services: the benefits to humans that are provided by ecosystems. They include the production of clean soil, water and air, the moderation of climate and disease, nutrient cycling and pollination, the provisioning of a range of goods useful to humans and potential for the satisfaction of aesthetic, recreation and other human values. Restoration targets may specifically refer to the reinstatement of particular ecosystem services.

External exchanges: the two-way flows that occur between elements in the landscape or aquatic environment including flows of energy, water, fire, genetic material, animals and seeds. Exchanges are facilitated by habitat linkages.

Facilitated natural regeneration: (Syn. facilitated natural regeneration) the approach and practice of fostering natural regeneration (in situ) and recolonisation after actively removing ecological impediments (e.g. invasive species, fish barriers, overabundant native species) and reinstating appropriate abiotic and biotic states (e.g. environmental flows, fire regimes). While generally this approach is typical of sites of low to intermediate degradation, even some very highly degraded sites have proven capable of natural recovery given appropriate treatment (including high levels of substrate engineering) and sufficient time frames. (Note: Assisted natural regeneration no longer recommended as a synonym. See Assisted Natural Regeneration which is a system of restoration focusing on regeneration approaches, but which can also include some reintroduction.

Farmer Managed Natural Regeneration: a land restoration technique used in developing countries that focuses on facilitating recovery of native species from suppressed rootstocks and seed.

Five-star (5-star) recovery: a semi-quantitative rating system based on biotic and abiotic factors that provides comparative assessment of the degree to which the **attributes** of an ecosystem are recovering after treatment. (Note, it is not a rating of the restoration works but of the recovery outcomes.)

Follow up: The repeated re-treatments required during the restoration phase to progressively improve natural regeneration. These are distinct from **maintenance** that is carried out after the restoration or recovery phase. The simple watering and weeding of plantings is usually referred to as 'maintenance' although another useful term is 'aftercare'.

Full reintroduction: a restoration approach where the appropriate biota need to be entirely or almost entirely reintroduced as they cannot regenerate or recolonise within feasible timeframes, even after expert facilitated regeneration interventions. Site earthworks may or may not be needed. An example of reconstruction is the mass revegetation of trees, shrubs and groundcovers on previously cropped agricultural lands (including mature successional phase species) or the complete rebuilding of a coral reef (including mature successional phase species).

Framework species method (FSM): a technique for restoring forest ecosystems, particularly rainforests, by installing a 'starter' subset of species selected for their ability to attract dispersal of more species into the site. Similar approaches may be used in other ecosystems—e.g. marine—where colonisation rates can be high and a suite of fewer species can act as a framework to support the gradual accumulation of other species.

Full recovery: the state whereby all ecosystem attributes closely resemble those of the reference model. Further necessary intervention at that point would be classified as maintenance rather than restoration.

Functions, of an ecosystem: the collective term for the roles and processes that arise from interactions among living and non-living components of ecosystems. Examples include nutrient cycling and sequestration (through biomass accumulation, food production, herbivory, predation and decomposition), water filtration and cycling, soil formation, succession, disturbance regimes (fire, flooding and drying), water filtration and storage, provision of habitat, predation, dispersal, pollination, reproduction, disturbance and resilience.

Gene flows: transmissions of seed or pollen between individual organisms that maintains the genetic diversity of a species' population. In nature, gene flow can be limited by dispersal distances of vectors and by topographic barriers such as mountains and rivers. In fragmented habitats it can be limited by the separation of remnants caused by clearing.

Germplasm: the various regenerative materials (e.g. seeds, vegetative materials) that provide a source of genetic material for future populations.

Highest attainable extent: the desired aspiration of ecological restoration which refers to whether the goals can be achieved within available means, time or current conditions.

Inbreeding depression: The reduced biological fitness in a given population as a result of inbreeding (i.e. breeding of closely related individuals).

Indicators: (of recovery) characteristics of an ecosystem that a manager identifies as being suitable for measuring the progress of restoration goals or objectives at a particular site (e.g. increasing numbers or cover of native species decline of non-native species).

Initiate native ecosystem recovery: The point along the Restorative Continuum where recovery is at a low level and has potential for improvement but meets the minimum criteria for ecologically **substantive recovery** and thus ecological restoration. This level of recovery can also be considered as a subcategory of partial recovery.

Interested and affected parties: Any individual, group, or institution that has a vested interest in or can influence a project and/or that potentially will be affected by the project and has something to gain or lose if conditions change or stay the same. Interested parties are all those who need to be considered in achieving project goals and whose participation and support are crucial to its success. Previous synonym: stakeholders.

Landscape flows: external exchanges that occur at a level larger than the site and include flows of energy, water, fire, genetic material, animals and seeds. Exchanges are facilitated by habitat linkages. The term 'landscape' and 'landscape flows' can also be applied to marine and freshwater 'seascape'.

Local native ecosystem: a self-organising biological system comprising species or subspecies (excluding invasive non-native species) that are either known to have evolved locally or have recently migrated from neighbouring localities due to changing climates. Where local evidence is lacking, regional or historical information can help inform the most probable local native ecosystems. While many ecosystems we consider natural have been modified in extent and configuration (e.g. through burning by Indigenous Peoples).

Management (of an ecosystem): a broad categorisation that can include maintenance and repair of ecosystems (including ecosystem restoration).

Mandatory restoration: reparatory actions required (mandated) by government, court of law or statutory authority. May include compensatory restoration including biodiversity offsets (i.e. restoration as compensation for damage to nature by plans or projects). Mandatory restoration may also include net gain restoration uncoupled from new or ongoing degradation.

Natural regeneration: recovery or recruitment of organisms from in-situ propagules or propagules that have colonised a site. Natural regeneration from these propagules may (i) occur spontaneously after the removal of barriers alone, (ii) be facilitated by additional active interventions, and (iii) may occur in the longer term as a result of reproduction by individual organisms reintroduced by humans.

Net gain: (project level) A positive improvement from restoration's contributions to biodiversity, ecosystem integrity and human wellbeing, using the degraded state as a baseline, and measured at appropriate temporal and spatial scales. Measurement of net gain should include intended as well as unintended consequences of restoration activities, within and outside the restoration site. Because net gain at the project level, by definition, is measured against the degraded baseline, it only applies to ecosystems that have been degraded (i.e. it is not appropriate to measure net gain of non-degraded ecosystems).

Net gain: (system level) The net positive result from restoration at broad temporal and spatial scales, as compared to the pre-restoration baseline at the same scales, after all gains and losses have been accounted for as measured by improvements to biodiversity, ecosystem integrity, and human wellbeing. Often referred to as 'nature positive'.

Non-mandatory restoration: voluntary rather than required (mandated) by a government, regulatory authority or court of law.

Outbreeding depression: When offspring from crosses between individuals from different populations (from a remnant parent and an introduced parent) have lower fitness than progeny from crosses between individuals from the same population.

Over-utilisation: any form of harvesting or exploitation of an ecosystem beyond its capacity to regenerate those resources (including over-fishing, over-clearing, over-grazing, over-burning etc).

Partner: Any individual, group, or institution including governments and donors whose active participation and support are essential for the successful implementation of a project or program. **See also interested and affected parties.**

Primary treatment: the first treatment of any part of a site (e.g. removal of standing weed biomass), after which there will be subsequent follow-up treatments, collectively referred to as 'secondary treatments'. ('Primary' here does not imply importance.)

Productivity: the rate of generation of biomass in an ecosystem, contributed to by the growth and reproduction of plants and animals.

Provenance: source (location) from which seed or other germplasm is derived.

Reallocation: transformation to another land use other than conservation.

Reconstruction: synonym sometimes used for **full reintroduction**, where all biota are reintroduced. Some see it as also implying physical rebuilding of the substrate.

Recovery: the process return of an ecosystem's self-organising attributes through reassembly of its abiotic components and reassembly, growth and reproduction of its organisms, with or without human assistance. Degrees of recovery (partial or full) can be assessed against the levels of composition, structure and function identified for the reference model.

Recruitment: production of a subsequent generation of organisms. This is measured not by numbers of new organisms alone (e.g. germinants of plants or birth of animal young) but by the number that establish to adulthood in the population.

Reference ecosystem: the recognisable ecological community identified as the one to which the restoration will be directed. While it is not necessarily the historical ecosystem, it ideally represents the ecosystem that would inhabit the restoration site had degradation, damage or destruction not occurred, adjusted to accommodate changed or predicted environmental conditions. Where current or predicted environmental conditions completely differ from those previously occurring, however, an alternative ecosystem may be identified to act as the reference.

Reference model: A detailed model, developed from the identified reference ecosystem, that describes the expected state (in its characteristic form or forms and highest integrity condition with respect to flora, fauna and other biota, abiotic elements, functions, processes, and successional states) that the restored ecosystem would exhibit at full recovery. It provides a benchmark to inform design of the restoration project and against which the condition of the site is measured prior to, during, and after **ecological restoration**. Ideally, the reference model includes information from a suitable number of extant **reference sites**.

Reference site: An undegraded or nearly undegraded extant site that can be used to inform the development of a reference model. In some cases, monitoring data from reference sites are used to formally compare data from the restoration site to evaluate progress of the recovery at the restoration site.

Reference state: The highest integrity form and condition of the reference model that the ecosystem at the restoration site would exhibit in the absence of degradation.

Regeneration: (see **Natural regeneration**).

Rehabilitation: reinstates attributes of some physical properties (e.g. soils and water) and a level of ecosystem functioning on degraded or converted sites, along with a renewed or improved and ongoing provision of high quality and diverse ecosystem goods and services. Native biodiversity and ecosystem integrity are supported but actions do not achieve substantive recovery of a native ecosystem. An example would be a non-native carbon planting, a riparian nutrient filter or use of non- native invertebrates to decompose waste.

Reinforcement: increasing a genetically limited plant or animal population, whether of a threatened or common species, to increase its potential for long term conservation at a site.

Reintroduction: an **approach** to the returning of missing species to an ecosystem through human agency, whether by direct seeding, planting, translocation or release.

Resilience: see **ecosystem resilience**, **biological resilience** and **social-ecological resilience**.

Restoration: see also **ecological restoration**. The term 'restoration' is in common usage and can be used singly and in combination with other words to convey an intent to return something to a prior condition (e.g. restoring a species, a population or a particular ecosystem function such as carbon sequestration). Single species restoration can be considered complementary to ecological restoration. When talking about 'ecosystem restoration' the term 'restoration' alone can be used to refer to both ecological restoration and rehabilitation.

Restoration project: A planned, monitored and implemented effort to achieve recovery of an ecosystem, as distinct from a 'restoration program' that usually includes more than one project. This can sometimes be referred to as a restoration 'site'. The term 'project' is not used in this document to refer to a specific limited set of works confined to a contract or funding round but is used to describe a holistic set of works in defined area over time to attain ecosystem recovery.

Restorative Continuum: a conceptual framework that links the full spectrum of environmental improvement activities carried out across our terrestrial and aquatic environments (from reducing societal causal factors of degradation, through improving ecosystem functionality (in amenity and production environments) to ecological restoration.

Revegetation: establishment, by any means, of plants on sites (including terrestrial, freshwater and marine areas) that may or may not involve local or native species.

Rewilding: a methodology geared to increasing biodiversity and restoring ecosystem integrity by focusing on assisting natural processes supported by planned reintroduction or reinforcement of animal or plant species (especially keystone species or apex predators) into habitats from which they have disappeared or been depleted.

Rightsholder: An individual or group who has legal or customary title, tenure, or use of lands and waters or natural resources within an area. All rightsholders are also **interested and affected parties** in a project, but not all interested and affected parties are rightsholders.

Secondary treatment: repeated follow-up treatments, e.g. to control invasive species, required during the restoration phase after primary treatment has triggered an ecological response.

Seed production area (SPA): a site used for the production of bulk quantities of high-quality seed of known origin, quality, free of any undesirable hybridity and with appropriate genetic diversity for supplying replanting or direct seeding onto restoration and rehabilitation sites.

Self-organising (full): a state whereby all the necessary elements are present and the ecosystem's attributes can continue to develop towards the reference state without outside assistance. Self-organisation develops gradually over time and is evidenced by factors such as growth, reproduction, ratios between producers, herbivores, and predators and niche differentiation. In restoration the degree self-organising capacity is partial or full is measured relative to characteristics described in the reference model.

Site: discrete area/property/location. Can occur at different scales including patch and larger scales landscapes or aquatic environments).

Social-ecological systems: Complex, integrated, and linked systems of people and nature, at varying spatial scales. This term, commonly used in connection with social-ecological resilience, emphasizes that humans are a part of nature and part of ecosystems.

Spatial mosaic: patchiness in assemblages of species often reflecting spatial patterning (in vertical and/or horizontal plane) due to differences in substrate, topography, hydrology disturbance regimes.

Spatial patterning: (see **Spatial mosaic**).

Spontaneous regeneration: a form of natural regeneration or recruitment of species that occurs without human assistance other than the removal of the original degradation driver. Also used to describe the restoration **approach** that allows this form of natural regeneration to occur.

Stakeholders: see **interested and affected parties**.

Stratum, strata: layer or layers in an ecosystem; often referring to vertical layering such as trees, shrubs and herbaceous layers.

Structure: (of an ecosystem) the physical organisation of an ecological system both within communities and at a larger scale (e.g. density, stratification, and distribution of species-populations, habitat size and complexity, canopy structure, pattern of habitat patches).

Substantive recovery: The state where recovery is at least at a low level (e.g. star level one for all six attributes) and has potential for improvement to higher levels. This level of recovery can also be considered as a subcategory of partial recovery.

Substrate: the soil, sand, rock, debris or water medium where ecosystems develop.

Succession: patterns of change and replacement occurring within and between ecosystems over time in response to disturbance and the provision of a period of rest after disturbance. Some Australian ecosystems (including higher diversity heath communities) respond to disturbance with all species regenerating together from the outset, whereas others can reassemble gradually over time.

Threat: a factor potentially or already causing degradation, damage or destruction.

Threshold: (ecological) a point at which a small change in environmental conditions causes a shift in an ecosystem property to a different ecological state. Once a threshold is crossed, an ecosystem may not easily return to its previous state.

Trajectory: (ecological) a pathway of recovery or development over time, which can be defined and monitored using sequential measurements of biotic and abiotic ecological parameters.

Transformed: shifted to a different ecosystem. In this Standard, specifically referring to a production ecosystem or urban ecosystem.

Translocation: the movement of organisms from one part of the landscape or aquatic environment to another, sometimes including translocation of topsoils containing live seed and other organisms.

Treatment: interventions or actions undertaken to achieve recovery, such as substrate amendment, invasives control, biomass reduction, habitat conditioning, reintroductions.

Trophic levels: Hierarchical categorization of organisms within ecosystems depending on their position in the food chain or food web. Levels include producers, consumers, predators, and decomposers, which represent the transfer of energy and nutrients through ecosystems.

Undesirable species: Includes nonnative species (except in some cases where they may provide irreplaceable or temporary support for native biodiversity and ecosystem recovery), as well as native species that may be overabundant or otherwise considered to be out of place.

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Appendix 1 Relationship of ecological restoration to other restorative activities

As terrestrial and aquatic ecosystem degradation continues to expand across the globe, many countries and communities have been adopting policies and measures designed to conserve biodiversity and improve the way societies integrate with the rest of nature in a healing and sustainable way. This work is done by all communities including [Indigenous communities](#).

Ecological restoration is but one of the measures undertaken to help conserve biodiversity and improve the ways societies integrate with the rest of nature. A primary activity undertaken globally is formal protection—i.e. increasing the number and size of protected areas to conserve intact or near-intact ecosystems. Other measures include **reducing impacts** from agriculture, fisheries, forestry and extractive industries, as well **Improved land and water management** within these industry zones and in urban zones outside reserves.

Ecological restoration is the appropriate means of repairing damage in natural areas wherever it is attainable and desirable, irrespective of the zone in which they occur. For this to avoid net loss, however, this needs to be accompanied by avoidance of degradation, damage and destruction of intact ecosystems in the first instance—and, where possible, formal protection. There should be complete avoidance of negative impacts upon rare or irreplaceable ecosystems or ecosystem elements that take a long time to develop (such as old growth). Any offsetting for unavoidable damage in natural areas should aspire to a restoration standard of full recovery.

In production and urban areas, many areas have undergone extreme and extensive past modification and the lands and waters within them may be of high economic or cultural value. This can make ecological restoration undesirable or unattainable in such cases. In such areas, the next practicable 'highest and best' level of repair should be aspired to.

Improved environmental management activities in already transformed production and urban areas are needed to reduce impacts not only upon the immediately affected areas and regions, but also more globally. Such improvements are critical to the success of all ecological restoration as even intact, remote ecosystems are affected by how we live and work in more populated cities and production areas. That is, substantial improvements in the ecological sustainability of urban and production zones are needed to reduce society's impacts on biodiversity, soils, water, air quality and climate—thereby reducing downstream effects and securing conditions for longer term rehabilitation and ecological restoration.

It can be helpful to align all of these broad pursuits on a spectrum of broader environmental protection, reduced impact and repair (Figure 5). The point along that spectrum where the label 'ecological restoration' is applied is the point where an appropriate local native ecosystem is adopted as a model and the goal is substantive recovery of local native biodiversity in the long-term. Fig. 6—which portrays these activities in the form of a restorative 'pyramid'—illustrates how sound reduction of impacts and rehabilitation provide a supportive foundation for ecological restoration.

Cross-disciplinary skills in project design and implementation (including but not restricted to the fields of landscape architecture, engineering, agronomy and horticulture) are highly valued in the improved management of ecosystems, whether the goal is ecological restoration, rehabilitation or reduction of impacts. They can all play an important role in the Restorative Continuum (Gann et al. 2026).

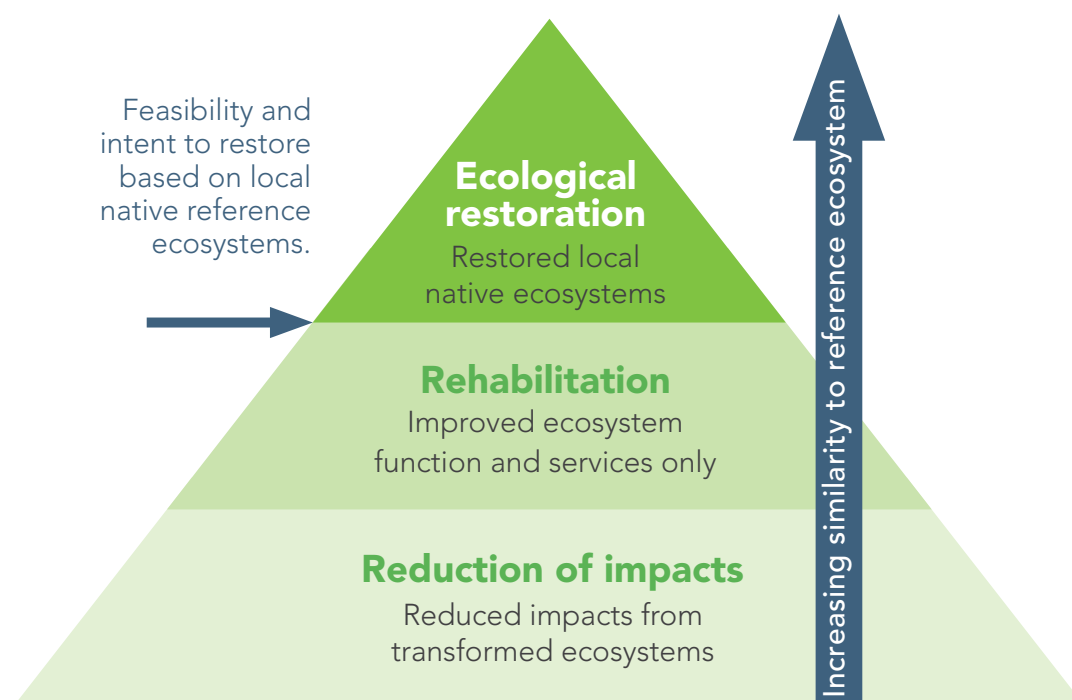


Figure 6 Broader context. Ecological restoration can be seen as sitting at the top of a pyramid of activities, where it is dependent upon the capacity of society to attain improvements in the lower levels of the pyramid—i.e. reduce deleterious impacts upon ecosystems and to rehabilitate and sustainably manage utilisation of nature. That is, the long-term success or failure of ecological restoration will be greatly influenced by the degree of success or failure of rehabilitation and reduction of impacts.

See links to some examples of improved sustainability practices: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/improving-sustainability-practices/>

See links to some examples of rehabilitation: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rehabilitation/>

Access the full set of the examples associated with the Standards here: <https://chapter.ser.org/australasia/restoration-standards/examples/>

1 Rehabilitation

“Rehabilitation reinstates attributes of some physical properties (e.g. soils and water) and a level of ecosystem functioning on degraded or converted sites, along with a renewed or improved and ongoing provision of high quality and diverse ecosystem goods and services. Native biodiversity and ecosystem integrity are supported but actions do not achieve substantive recovery of a native ecosystem.” (Definition of rehabilitation negotiated internationally—see Gann et al. (2026))

Land and water managers seeking to restore ecosystem services should consider using locally native species, with diverse genetic makeup, where these species can provide the ecosystem services sought. This is because such species may also provide biodiversity benefits and may have the added advantage of self-perpetuation and resilience to local shocks such as drought and wildfire.

If rehabilitation in a transformed area uses non-native species (or the local native species do not result in substantive recovery), however, rehabilitation activities can still potentially expand and buffer available habitats for native species including some threatened species. At larger scales, rehabilitation that provides such buffering and connectivity can also play an ecologically highly significant role in improving the adaptability of ecosystems and individual species to rapid environmental change, particularly in the transitional zones between natural areas and altered/degraded areas. As such, rehabilitation can be highly complementary to ecological restoration.

Current best practice in rehabilitation (in a similar way to ecological restoration) has largely arisen from professional or voluntary efforts made within a range of industry, government and community sectors, the mining industry, forestry, agriculture, fisheries, utilities corridors, urban bushland and urban parks and gardens sectors.

The Standards seek to encourage all industry, government and community sectors to continue to adopt the practice of ecological restoration wherever appropriate; and where not appropriate, to undertake rehabilitation of ecosystem function to the highest possible functionality recovery level (refer to five-star system of recovery for functional elements).

Further detail on current engagement of a range of industries in rehabilitation is outlined below, with comments included on the degree to which ecological restoration is also practiced (or could be increasingly practiced) in the particular industry sector.

See links to some examples of rehabilitation: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rehabilitation/>

Appropriate standards for both ecological restoration and rehabilitation in various management sectors in Australia

Mining

A regulator (government) consent authority will determine the level of repair and restitution required under law for a project—i.e. whether proponents will be required to undertake restoration (whether full or some lower level of recovery) or the lower standard of rehabilitation, as appropriate. The decision is usually based on a number of factors, particularly the condition of the site prior to the commencement of ground-disturbing activities. That is, some mines are asked to achieve what would be defined here as ecological restoration, with many adopting and aspiring to this goal voluntarily. Other mines (e.g. mines on already modified land) are asked to achieve what would be defined

here as a rehabilitation standard to bring the condition of the site to at least a useful condition or an agreed land use (e.g. pastures for livestock) through consultation with stakeholders such as local communities.

Ready-made, off-the-shelf post-mining restoration or rehabilitation solutions are rarely available, and companies will need to invest significantly in R&D if they are to achieve biodiverse, cost-effective and sustainable outcomes on remade substrates and landscapes. Critically, programs that have been successful in the mining industry are those that have been planned well in advance of the disturbance activities and where restoration or rehabilitation is integrated into the whole-of-mine planning process. This includes linking engineering and production with environmental programs to ensure restoration or rehabilitation are an integral part of the business of mining, from concept to closure. Regulatory authorities should seek evidence of the following prior to ground disturbance.

- Many mining companies are integrating the appropriate standard of ecological restoration or rehabilitation across their business (consistent with the Mining Standards Young et al. (2022))
- For ecological restoration, a full risk assessment is provided of the capacity of the company to deliver timely restoration that includes understanding landform, soil creation (where topsoil is limited), topsoil protection (to enhance biological and seed preservation), propagation needs, recalcitrant biota, seed supply and storage requirements, seed dormancy alleviation and 'germination on demand', precision seeding, hydrological support for establishment plants, weed and feral animal controls, nutritional and pollination needs of plants, establishment of faunal habitat and reintroduction of fauna. (Cost alone would not be an acceptable excuse for avoiding reinstating representative biota or achieving other restoration objectives.)
- Corporate approvals and processes are in place to ensure that where restoration or rehabilitation knowledge is lacking, appropriate targeted investment in R&D occurs well ahead of ground disturbance. The five-star rating system of the Standards provides an internal and external measure of restoration success for the mining industry and regulators. [Note: in Australia, generous tax concessions are provided to mining companies engaging with research bodies in mining restoration research, plus the Australian Research Council provides funding for industry to undertake such research through the various Centre and Linkage Grant schemes.]
- Safeguards are in place to ensure that economic down-turns or defaults by development companies do not result in a failure to restore a site to the agreed closure standard.

See links to some successful examples of a full reintroduction approach—rebuilding from 'scratch'—among the four restoration approaches: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/four-approaches/>

Precis. Where mining is undertaken in natural areas, the highest standard of ecological restoration is expected by society as exemplified in the regulatory process. This means that a five-star recovery should be the goal of any restoration project involving a natural area. In semi-natural sites with important or high biodiversity values, there is an expectation that post-mining repatriation achieves habitat recovery to the highest attainable extent, progressing the site to at least a three-star recovery condition. Where mining occurs on converted landscapes, there is an expectation that mine site rehabilitation achieves a safe, stable and ecologically sustainable utilitarian condition which provides ecosystem services and lowers rather than raises impacts on natural systems (i.e. rehabilitation as defined in this document).

Reforestation for timber production or carbon storage

Reforestation for timber production and especially carbon farming can provide substantial co-benefits for the conservation of biodiversity if ecological restoration models are adopted to the greatest extent attainable; thus, achieving ecosystems capable of long-term sustainability. Diverse local ecosystems have also been shown to provide high carbon stores. Maintenance of high genetic diversity, as opposed to excessive selection of preferred forms, will help to maintain adaptability of forest areas to climate change.

Precis. Silviculture, carbon farming or agroforestry projects should be encouraged to at least use local native species and adopt local native reference ecosystems to the extent attainable. Such projects, where adjacent to natural habitats, should be encouraged to adopt a five-star recovery goal, using the locally occurring ecosystem as a reference ecosystem. Where this is not possible, as high a recovery ranking as attainable should be the goal. If lower goals are applied for good reason, the revegetation should be undertaken in a manner that enhances ecosystem services (rehabilitation) and has no deleterious effect on the adjacent natural areas and does not preempt potential for further recovery if it is possible in the future.

Agricultural lands

Agricultural lands occupy large areas of Australia with many farms and rangelands containing substantial native habitats. Over recent decades, many landholders have been conducting ecological restoration and/or rehabilitation on farmlands and in rangelands, particularly through Landcare and often with co-investment from governments through regional natural resource management (NRM) organisations. The goal of much of this work is to provide extensions or linkages to other native habitats or carbon sequestration.

Precis. While many projects in agricultural lands can be best described as rehabilitation, some projects are committed to ecological restoration. Of those, some have already achieved four-star or five-star recovery on a range of attributes. Many others, particularly larger projects or those with higher levels of degradation, however, have only achieved two or three-star recovery and may or may not be able to progress further (at least for parts of their sites) due to resource constraints and the irreversibility of some causal factors including competing production needs and therefore ongoing fragmentation. Degree of recovery depends on whether or not the land or water manager (with or without support from an agency/organisation) can make the necessary commitment to contribute land for linkages in the medium to long-term.

Whether aiming for restoration or rehabilitation, landholders, Landcare groups, regional NRM organisations and funding bodies are encouraged to use these ecological restoration Standards to progressively improve outcomes at all sites to the greatest extent attainable, particularly through improved knowledge dissemination and prioritisation of more resilient and strategically important areas.

See links to some examples of restoration in agricultural landscapes: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/production/>

See links to some examples of Rehabilitation: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rehabilitation/>

Aquatic ecosystem management

Restoration and rehabilitation of freshwater, estuarine and marine habitats is underway in Australia, yet much larger areas of restoration are needed to even begin to address the very high levels of aquatic ecosystem destruction that has occurred nationally. Ecological restoration, and in some cases rehabilitation, protects aquatic species, habitats and carbon stores (e.g. within rivers, lakes wetlands, kelp forests, seagrass meadows, mudflats, saltmarsh and mangroves); improves fish breeding for conservation, commercial and recreational fisheries; and provides cultural and recreational values that highlight compatibility between these interests.

Aquatic ecosystem restoration and rehabilitation have specific needs including the need to reduce impacts from terrestrial zones to the extent possible. A dialogue between terrestrial and aquatic professionals will ensure that the broader based restoration principles from the terrestrial environment can be adapted to planning and implementing marine, freshwater and estuary restoration programs.

Precis. *Many but not all aquatic ecosystems are naturally highly dynamic and interconnected and hence many aquatic species and ecosystems can have very high migratory resilience. This can potentially enable full or at least partial recovery (ecological restoration) if facilitated regeneration is combined with reintroduction of some species that have been locally extirpated or have limited dispersal capacity. However, the dynamic conditions of particularly coastal ecosystems (e.g. daily tidal flows and repeated wave action) increase the complexity and difficulty of restoration in aquatic areas. In some areas located in zones of high industry and public recreational activity, only recovery of some ecosystem function (i.e. rehabilitation) may be possible due to the limitations of managing degradation pressures.*

See links to some examples of coastal and marine restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/coastal-and-marine/>

See links to some examples of rivers, streams and floodplain wetlands restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rivers/>

See links to some examples of inland wetland restoration: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/inland-wetlands/>

Utilities and infrastructure

Ecosystem protection and remediation after the construction of infrastructure such as highways and dams has provided opportunities for both ecological restoration and rehabilitation. Some restoration is attained through programs designed to 'offset' the loss of biodiversity caused by the development. Some five-star restoration has been achieved in water catchment areas and adjacent to utilities, while at other sites only rehabilitation is possible.

Precis. *Five-star restoration is sought wherever possible in or adjacent to natural areas; with the fragmentation impacts of linear utilities corridors on fauna mitigated by installation of adequate, dedicated fauna crossings. In permanently modified areas, a three-star recovery should be sought where possible. Where no substantial recovery level can be attained, at least rehabilitation of ecosystem function such as provision of habitat connectivity should be sought.*

Urban green space

Urban landscapes including public parks can contain important natural and semi-natural areas and provide opportunities for ecological restoration, particularly for improving native plant and animal habitat connectivity at the urban/natural area interface. Local and state governments, statutory bodies and NGOs—and many thousands of community Bushcare and Coastcare volunteers across Australia—are involved in controlling the causes of degradation and actively applying ecological restoration to these areas, supported by rehabilitation of adjacent lands and waterways.

Urban parks, streetscapes and private gardens (including those involving non-native plants) can also provide important supplementary habitat and resources for native fauna and can be modified to incorporate local native plant species to reinforce the genetic diversity of nearby remnant bushland fragments. (Such reinforcement would require advice from ecologists or restoration professionals.) In urban areas, however, it is important that such work is done while maintaining design values and amenity—as design qualities of a site may be a deciding factor in enhancing support from individuals and communities for improvements at both the local site and in relation to broader issues of environmental concern.

Precis. *Many urban bushland projects are committed to restoration and commonly achieve at least four-star or higher outcomes. Where this is not possible (but where parks and gardens can include native plantings that reinforce conservation genetics and provide faunal habitats) rehabilitation consisting of professionally advised genetic supplementation and the enhancement of habitat, connectivity is encouraged.*

2 Reduction of impacts

Reduction of impacts in utilised areas of the environment is needed to the highest attainable extent, particularly in transformed zones, to maintain potential for conservation of biodiversity while pursuing both production and lifestyles that are ecologically sustainable (see also the Restorative Continuum concept in Principle 6 of this document and Gann et al. 2026).

Society needs production, business and residential areas. However, a global groundswell of community support shows an increasing willingness to reduce impacts of this permanently converted zone upon the environment. The Standards seek to promote, within this movement, an increase in appreciation that biodiversity conservation and restoration - even if in areas distant from where the majority of the population lives and works - is an important and substantial endpoint of these efforts. Particularly important to the conservation of biodiversity is reduction of the impact of industry and lifestyles by reducing carbon emissions and storing carbon.

Ecologically sustainable production

Substantial and increasing efforts have been made over recent decades by agencies, industry groups and producers to reduce the impact of agriculture, horticulture, aquaculture and fisheries upon the quality of Australia's biodiversity, land, water and air. These efforts are partly due to consumer trends and recognition that ongoing impact is both ecologically and economically unsustainable in the long term.

The most valuable contributions to nature conservation have come from minimising natural area over-harvesting, clearing, fragmentation, reducing the impacts of pest plants and animals, reducing erosion, sedimentation and nutrient enrichment of waterways,

minimising methane emissions in agriculture and sequestering carbon through revegetation and improved soil management.

Resistance still exists to limiting industries and growth, however. This risks increased quantity of consumption undermining the ecological gains that have been achieved by the efforts of many to improve the quality of consumption"

Ecologically sustainable lifestyles

The lifestyle and purchasing choices made by all Australians dictate the degree to which our industries can be sustainable and engage in reduction of impacts and rehabilitation. That is, the higher the consumer demand for ecological sustainability the higher the likelihood that industry sectors can viably adopt reduction of impacts and rehabilitation strategies. Consumers can directly assist the conservation of natural areas by adopting renewable energy solutions for transport and powering the home, purchasing goods whose production has a lower ecological impact, and reducing waste.

Domestic lifestyles in cities, suburbs and rural towns can also have a direct negative or positive impact upon native ecosystems through ways we manage, among other things, our nutrient runoff, disposal of garden debris, pets and invasive exotic plants and animals (particularly including cats). Positive engagement by city dwellers with natural areas—whether for recreation or to engage in restoration in their local bushland or waterways—can not only complement restoration but also create a stronger appreciation of nature within society.

See some examples of projects improving sustainability practices including consumption and production: <https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/improving-sustainability-practices/>.

Appendix 2 Further principles and values underpinning ecological restoration

First order

Ecological restoration

- **Supports and is modelled on native ecosystems and does not cause further harm.** Australia contains large tracts of relatively intact land and water ecosystems, which represent an invaluable natural heritage. Appreciation of the long history of evolution of organisms interacting with their natural environments underlies the ethic of ecological restoration within the Australian context.
- **Is aspirational.** The ethic of ecological restoration is to seek the highest and best conservation outcomes for all ecosystems but particularly is predicated on nature positive principles where restoration drives net gain benefits for biodiversity conservation rather than merely no net loss. Even if it takes long timeframes, full ecological restoration should be the goal wherever it may be ultimately attainable and desirable. Where full ecological restoration is clearly not attainable or desirable, continuous improvement in the condition of ecosystems and substantial expansion of the area available to nature conservation is encouraged.
- **Is universally applicable and practiced locally with positive regional and global implications.** It is inclusive of aquatic and terrestrial ecosystems, with local actions having regional and global benefits for nature and people.
- **Reflects human values but also recognises nature's intrinsic values.** Ecological restoration is undertaken for many reasons including maintaining the economic, ecological, cultural and spiritual values of nature. Our values also drive us to seek to repair and manage ecosystems for their intrinsic value, rather than for the benefit of humans alone. In practising ecological restoration, we seek a more ethical and satisfying relationship between humans and the rest of nature.
- **Is improved by rigorous, relevant and applicable knowledge drawn from a dynamic interaction between science and practice.** All forms of knowledge, including knowledge gained from science, nature-based cultures and restoration practice are important for designing, implementing and monitoring restoration projects and programs. Results of practice can be used to refine science; and science used to refine practice. Primary investment in practice-applicable research and development increases the chance of restoration success and underpins regulatory confidence that a desired restoration outcome can be achieved.
- **Is not a substitute for sustainably managing and protecting ecosystems in the first instance.** While high-quality ecological restoration can be guaranteed to improve the condition of a degraded ecosystem and there are many reports of partial recovery, there have been no reports of a reconstructed ecosystem attaining ecological equivalence to the composition, structure and function of an undegraded reference state. Functional natural ecosystems are not transportable or easily rebuilt once destroyed. For this reason, the international SER Standards state that one of their underpinning assumptions is that 'the potential for ecological restoration should never be invoked as a justification for destroying, damaging, or unsustainably using existing native ecosystems'.

Second order

Successful ecological restoration depends upon the following

Ecological

- **Addressing causes at multiple scales to the extent possible.** Degradation will continue to undermine restoration inputs unless the causes of degradation are addressed or mitigated. The range of anthropogenic threats include, e.g., over-utilisation, clearing, erosion and sedimentation, pollution, altered disturbance regimes, reduction and fragmentation of habitats and invasive species. All these threats are capable of causing ecosystem decline in their own right, and can be exacerbated when combined, particularly over long-time frames. All these factors - including habitat loss and fragmentation, in particular, exacerbate the threats to biodiversity from climate change.
- **Recognising that restoration initiates a process of natural recovery.** Reassembling species and habitat features on a site invariably provides just the starting point for ecological recovery; the longer-term process is performed by the organisms themselves. The speed of this process can sometimes be increased with greater levels of resourcing.
- **Recognising that undesirable species can also be highly resilient to the disturbances that accompany restoration,** with sometimes unpredictable results as competition and predator-prey relationships change. Invasive species, for example, can intensify or be replaced with other invasives (e.g. feral cat abundance increasing after fox control and vine domination following exotic canopy removal) without comprehensive, consistent, repeated and ecologically informed treatment to attain containment or control.
- **Taking account of the landscape/aquatic context and prioritising resilient areas.** Sites must be assessed in their broader context to adequately assess complex threats and opportunities. Greatest ecological and economic efficiency arises from improving and coalescing larger and better condition patches and progressively doing this at increasingly larger scales. Position in the landscape/aquatic environment and degree of degradation will influence the scale of investment required.
- **Applying approaches best suited to the degree of impairment.** Many areas may still have some capacity to naturally regenerate, at least given appropriate interventions; while highly damaged areas may need rebuilding 'from scratch'. It is critical to consider the inherent resilience of a site and (unless it is already highly evident) trial interventions that trigger and harness this resilience prior to assuming any reintroductions or reinforcements are needed (Box 4).
- **Addressing all biotic components.** Terrestrial restoration commonly starts with re-establishing plant communities but must integrate all important groups of biota including plants (particularly those that are habitat-forming), animals and other biota at all levels from micro—to macro-organisms. This is particularly important considering the role of plant-animal interactions and faunal trophic complexity that is required to achieve the reinstatement of functions such as nutrient cycling, living soils, pollination and dispersal. Collaboration between fauna and plant specialists is required to identify appropriate scales for on-ground works and to ensure the appropriate approaches and treatments are applied to achieve recovery.
- **Addressing genetic issues.** Where habitats and populations have been fragmented and reduced below a threshold/minimum size, the genetic diversity of plant and animal species may be compromised and inbreeding depression may occur unless more diverse genetic material is reintroduced from larger populations, gene flow reinstated and /or habitats expanded or connected (Appendix 3).

Logistical

Knowing your ecosystems and avoiding past mistakes. Success can increase with increased working knowledge of (i) the target ecosystem's biota and abiotic conditions and how they establish, function, interact and reproduce under various conditions including anticipated climate change; and (ii) responses of these species to specific restoration interventions tried elsewhere.

Gaining the support of stakeholders. Successful restoration projects have strong engagement with stakeholders including local communities, particularly if they are involved from the planning stage. Prior to expending limited restoration resources, potential benefits of the restored ecosystem to the whole of society must be explicitly examined and recognised and it must be previously agreed that the restored ecosystem will be the preferred long-term use. This outcome is more secure when there are appreciable benefits or incentives available to all interested and affected parties ; and where these parties are themselves engaged in the restoration effort.

Taking an adaptive (management) approach. Ecosystems are often highly dynamic, particularly at the early stages of recovery(and particularly aquatic ecosystems). Furthermore, each site is different. This not only means that specific solutions will be necessary for specific ecosystems and sites; but also, that solutions may need to be arrived at after trial and error. It is therefore useful to plan and undertake restoration in a series of focused and monitored steps, guided by initial prescriptions that are capable of adaptation as the project develops.

Identifying clear and measurable targets, goals and objectives. In order to measure progress, it is necessary to identify at the outset how you will assess whether you have achieved your restoration outcomes. This will not only ensure a project collects the right information, but it can also better attune the planning process to devise strategies and actions more likely to end in success (Box 6).

Arranging adequate resourcing. Budgeting strategies need to be identified at the outset of a project and budgets secured. When larger budgets exist (e.g. as part of mitigation associated with a development) restoration activities can be carried out over shorter time frames. Smaller budgets applied over long timeframes, however, can be highly effective if works are strategically designed and are limited to areas that can be adequately followed-up within available budgets before expanding into new areas. Such a gradual process can also better accommodate changes in ecosystems that occur over time. Well-supported community volunteers can also improve the feasibility of longer term and gradual recovery.

Ensuring adequate long-term management arrangements. Secured tenure, property owner commitment and long-term management will be required for most restored ecosystems, particularly where the causes of degradation cannot be fully addressed. Continued restoration interventions aid and support this process as interactions between species and their environment change over time. It can be helpful for plans to identify likely changes in species, structure and function over the short-, medium- and longer-term duration of the recovery process.

Appendix 3 Genetics, fragmentation and climate change—implications for restoration of local native vegetation communities

Consideration of genetics in restoration over the last few decades suggests that it is valuable to recognise two primary complications with respect to restoration of Australia's ecosystems: **fragmentation** and **climate change**. This recognition helps us better understand the genetic risks posed by fragmentation (i.e. reduces potential for gene flow at landscape scale) at the very time when gene flow is critical to providing the genetic diversity needed for evolutionary adaptation in response to climate change. (For more detailed information see Appendix 1 of Gann et al. 2026.).

Confining seed collection to a 'local **provenance**' area to ensure prior local adaptation is maintained (i.e. avoid **outbreeding depression**) was recommended by researchers some decades ago. Since then, it has been widely adopted by plant-based restoration practitioners. However, geneticists are now clarifying that collecting very close to the restoration site can have highly undesirable consequences. Firstly, geneticists agree that local adaptation is not as common as many believe and that **inbreeding depression** caused by reduced genetic diversity (often found in small remnants) is a far higher risk than outbreeding depression. Second, conservation geneticists are increasingly finding that a 'local' genotype may occur over a wide **natural genetic neighbourhood** (i.e. from 10s to 100s of km) depending on the species and its biology (Fahey et al. 2025).

Genetic issues related to fragmentation

In a largely cleared landscape, small fragments are at risk of elevated inbreeding when populations of a species drop to low numbers. Revegetation that physically expands and reconnects remnant patches is a key action, but inbred seed collected from a fragment may be less fit and fail to reinstate functional and adaptable plant populations. In general, it is therefore best to collect seed from larger stands with higher numbers of the target species. This means that in fragmented landscapes where larger vegetation stands are not available, collecting seed from much wider distances and multiple sources will be necessary to capture sufficient genetic diversity to rebuild functional and resilient communities. Sourcing seed material from a wider area also improves seed availability (a significant limitation in current practices) and prevents compounding the genetic health issues caused by loss of habitat and connectivity. Where possible, seed should be multiplied in genetically guided regional seed production areas, to avoid overharvesting from small remnants.

[See links to some examples of seed production areas.](#)

Genetic issues related to climate change

Examination of Australian ecosystems shows that many native species have endured ancestral extremes of climate well beyond predicted climate change scenarios (Hopper 2009). However, *accelerated* climate change is a serious emerging problem. As a result of shifting climate envelopes (Box 9), some terrestrial species will be impaired by climate

drying, increased temperatures and fire frequency, fire intensity and increasing insect herbivory exacerbated by climate change. Cold-adapted species will be lost at colder, higher elevations where there is nowhere higher for them to migrate as climate warms. Many marine species will be impaired by increasing ocean temperatures and acidity, while marine, freshwater and terrestrial habitats will be lost in some locations due to sea level rise unless they can colonise or be relocated to other areas. Indeed, even conservative global warming scenarios suggest that a wide range of local environments, to which species may have adapted, will change dramatically.

Potential survival responses

Although we cannot precisely predict the type and scale of risks that ecosystems face due to anticipated climate change (because only a small proportion of species has been individually studied to date), we know that some species may become locally extinct (at least from their current locations) unless they can adapt or migrate.

Adaptation through plasticity

Some species may have sufficient inherent ‘adaptive plasticity’ to persist at current locations as climates change, as has been demonstrated from translocation experiments and detailed pollen analysis of past environments. That is, an *individual* plant (and their progeny) may be able to adjust its response to new selective filters by mechanisms such as reducing its leaf size, increasing leaf thickness or altering flowering and emergence times. But in many cases, persistence may depend on a species’ capacity for selection through evolutionary adaptation, which in turn depends on population size, adaptive capacity of the trait and the diversity of the genes available.

Genetic adaptation and migration

Species that have large, connected populations, a wide climatic range, naturally high dispersal characteristics and whose populations have many genes in common are likely to have a higher chance of genetically adapting to the new environments as well as migrating to new areas as their climate envelope moves (Box 9). Conversely, species with low pollen and seed dispersal characteristics, that occur naturally in ‘islands’ or ‘outliers’ or that have been isolated through land clearing or river regulation, for example, may be less able to adapt or migrate in response to climate change.

Box 9 Climate envelopes

The climate range in which a species currently exists can be referred to as its ‘climate envelope’.

During climate change this climate envelope is likely to uncouple from the current location in which the species exists and, where conditions become hotter, move further poleward or higher elevations. This means that the species may be lost from the more equatorial extreme of the range and need more help to adapt as it, or its genotypes, move poleward or to higher elevations.

However, as precipitation is also likely to change in less predictable ways, the displacement of climate envelopes will certainly be more complex and potentially difficult to predict precisely.

Implications for restoration

The severity of the effects of fragmentation and climate change are increased by the coincidence and combined effects of both factors. This increases the imperative for restoration to focus on both (i) restoring connectivity to counter fragmentation and improve the migratory potential of species and their genes and (ii) ensuring that the propagule sourcing for revegetation (which reinstates that connectivity) focuses on high genetic diversity to optimise adaptability.

An overview of implications for propagule sourcing can be found in Module 5 of the [Florabank Guidelines](#) (Harrison et al. 2021).

Where connectivity cannot be reinstated and landscapes or waterscapes remain largely fragmented, reinforcing populations with more genetically diverse will help to reduce risk of inbreeding and assist genetic adaptation. In addition, while the local gene pool still has potential to play a major role in adaptation, it may be prudent to consider including at least a small amount of germplasm of the same species from a 'future climate' area—that is, a region with a climate similar to that which is predicted for the area being restored (Broadhurst et al. 2008, Prober et al. 2015).

Tools for assessing climate-readiness in relation to genetics

Some tools are available to help restoration planners undertake what could be called 'climate readiness' analysis at the planning stage. This guidance is also highly valuable to ensuring genetic diversity for fragmented landscapes.

Firstly, restoration practitioners are encouraged to seek out predictions of locations where ecosystems are likely to be affected by climate change. Secondly, practitioners are encouraged to liaise with researchers to gain a better understanding of predicted responses of species to both fragmentation and climate change and to identify the relative risks of a range of options relating to the deliberate movement of genetic material in restoration projects. Genetic analysis can be undertaken by a range of research institutions and is becoming increasingly affordable and accessible for restoration organisations and agencies. This cost reduction is increasing numbers of species being studied while rapid improvements in the effectiveness and efficiency of genetic testing tools are also occurring.

Web-based tools are also readily accessible for identifying whether the species currently occurring in the vicinity of your site will still be suited to climates predicted to occur at your site in the future. These include the following.

- The [Restore & Renew web-based tool](#) that provides empirical natural genetic neighbourhood information and climatic evidence to support low-risk decision-making on where to source material for establishing diverse and climate-ready populations in moderate and severe climate scenarios. Guidance is provided across a continuously growing number of species along the Australian eastern coast (currently well over 100 species) with emerging datasets relevant to other Australian states (as of February 2026).
- The Atlas of Living Australia website (www.ala.org.au) that can help practitioners identify the natural geographic range of a species and whether it may have potential to tolerate the conditions predicted to occur under climate change scenarios which themselves are mapped on the website www.climatechangeinaustralia.gov.au. An explanation of how these tools can be combined is found in Booth et al. (2012).
- CSIRO's Climate Change Directory (Prober et al. 2026) provides an entry point to selected climate change information, planning guides, datasets and decision-support tools relevant to Nature Repair Market projects.

Take home messages

Practitioners designing planting lists need to bear in mind that it is impossible to be certain of the changes that will occur. Different species will respond to climate change in different ways and there is no easy way to predict this, although more genomic studies on individual species are a key to greater certainty. Furthermore, temperature and rainfall are not the only important predictors. A range of physical (e.g. soils, fire incidence) and biological factors (e.g. dispersal, herbivory, disease) —which themselves may or may not be affected by a changing climate—can also have important roles in influencing the distribution of a species.

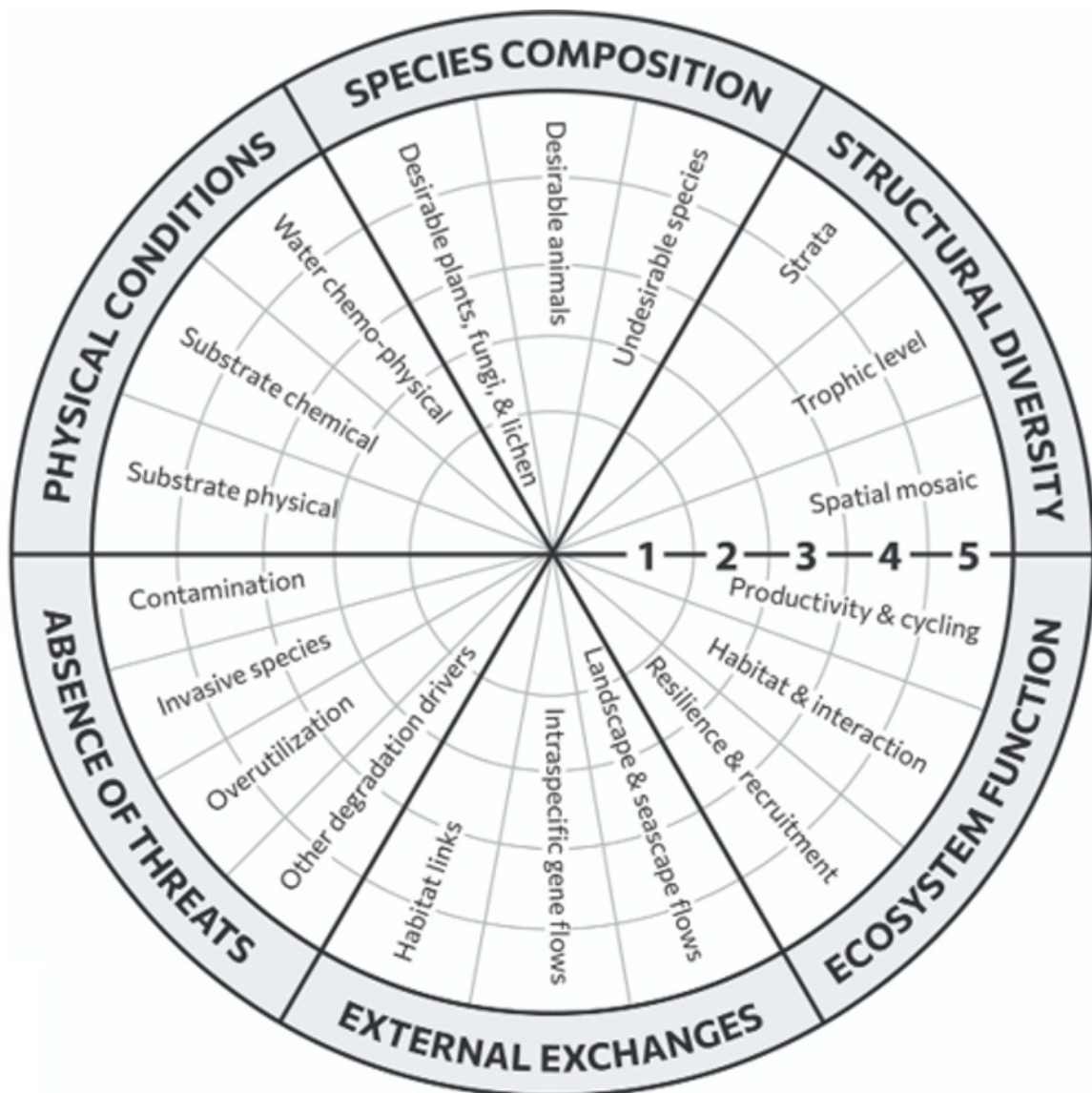
While some caution will always be required, a balanced approach in fragmented areas would see the restoration plan specify actions to increase connectivity. Where this involves reintroduction, propagules should be sourced from multiple, widely spaced parents from larger populations, even if they have to be sourced from sites more distant from the restoration site. Where advised and fully documented, it may be beneficial to trial the inclusion of some germplasm from ‘future climate’ locations to improve climate-readiness. Such a combined approach is likely to improve opportunities for natural adaptation should it be required. When such trials include long- term monitoring (i.e. at least a decade) they can also enable the resulting lessons to be captured for both restoration and climate science (Pedrini and Dixon 2020).

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Appendix 4 Blank progress assessment templates (for practitioner use)

The latest versions of the evaluation form and recovery wheel are available on the SER website: <https://www.ser.org/page/Standards-Tools>



Evaluation of ecosystem recovery

Site

Reference ecosystem

Assessor Date

Attribute category	Recovery level (1-5)	Evidence for recovery level
Attribute 1 Absence of threats		
Over-utilization		
Invasive species		
Contamination		
Other degradation drivers		
Attribute 2 Physical conditions		
Substrate physical conditions		
Substrate chemical conditions		
Water chemo-physical conditions		
Attribute 3 Species composition		
Desirable plants, fungi & lichens etc.		
Desirable animals		
No undesirable species		
Attribute 4 Community structure		
Strata		
Trophic levels		
Spatial mosaic		
Attribute 5 Ecosystem function		
Productivity, cycling etc		
Habitat & plant-animal interactions		
Resilience & recruitment		
Attribute 6 External exchanges		
Landscape & and seascape flows		
Intraspecific gene flows		
Habitat links		

Appendix 5 Index to links to some examples of restoration projects

Fourteen sets of examples of successful restoration case studies are linked to Edition 3 of the *National Standards for the Practice of Ecological Restoration in Australia*.

The full set is available through the [SERA website](https://chapter.ser.org) and but the individual pages' URLs are provided in Table 5 below.

Table 5 Links to all webpages that have been set up to reflect a range of themes.

The set will be reviewed periodically.

Topic / webpage	URL
Coastal and Marine Restoration	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/coastal-and-marine/
Faunal Habitat Restoration and Reintroductions	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/faunal-habitats/
Four Approaches to Restoration	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/four-approaches/
Improving Sustainability Practices	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/improving-sustainability-practices/
Indigenous-led Restoration	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/indigenous-led-restoration/
Inland wetlands	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/inland-wetlands/
Invasives management	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/invasives/
Rehabilitation	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rehabilitation/
Restoration in agricultural landscapes	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/production/
Restoring topsoils	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/restoring-topsoils/
Rivers, Streams, and Floodplain Wetlands	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/rivers/
Scaling Up Restoration	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/scaling/
Seed Production Areas	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/spa/
Terrestrial Ecological Restoration Projects	https://chapter.ser.org/australasia/restoration-standards/examples-and-case-studies-supporting-the-australian-standards/terrestrial/

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Greening Australia (GA)
Kelp Forest Alliance (KFA)
Landcare Australia(LA)
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